Message

I am pleased to know that the International Conference on Traditional Dairy Foods is being jointly organized by Dairy Technology Society of India and National Dairy Research Institute from November 14 to 17, 2007 at Karnal.

Traditional dairy foods have always played a pivotal role in preservation of milk and promotion of its consumption among people. The event will provide a forum to dairy and food scientists, academicians, industrialists, policy makers, farmers and students from all over the world to deliberate on theoretical and practical issues and novel technological aspects such as mechanized manufacture, marketing needs and emerging concepts of traditional dairy foods.

My best wishes for the success of the Conference.

(A.R.Kidwai)
MESSAGE

It is a pleasure to know that an International Conference on Traditional Dairy Foods is being organized jointly by National Dairy Research Institute and Dairy Technology Society of India during November 14-17, 2007 at Karnal, India.

Milk and traditional milk products such as butter and 'khoa' based sweetmeats are being prepared in Indian households since times immemorial. They constitute an important item in our social and religious functions. These traditional dairy foods are being prepared manually and often in unhygienic conditions. In view of the increasing demands, changing consumer preferences, concerns of food safety and quality, etc., there is certainly a need to develop appropriate machinery for the large scale hygienic preparation of high quality milk foods.

It is hoped that the learned participants will deliberate on developing novel technologies and come out with practical recommendation to promote traditional milk food industry.

I wish the Conference a grand success.

Dated the 11th October, 2007
New Delhi (MANGALA RAI)
MESSAGE

With diminishing geographical and cross-cultural barriers many traditional dairy products are becoming immensely popular throughout the country and other parts of the world as well. The market potential and current growth rate of dairy products particularly traditional ones is unparalleled. It is envisaged that development of suitable technological package for the organised production of these products would offer significant value addition and product diversification for Indian Dairy Industry.

Holding of an International Conference on Traditional Dairy Foods at this point of time is praiseworthy and I compliment the organizers for the same.

I also hope that a clear cut processing, value addition and marketing agenda for traditional dairy products shall emerge out from the deliberations in the conference.

I wish the conference all the success.

Place: New Delhi
Dated: 31st October, 2007

(K.M. Bujarbaruah)
Message for Souvenir

The major strength of traditional dairy products is their mass appeal. Significant achievements have been made in commercial production of these dairy delicacies. Popularization of ethnic dairy foods has virtually diminished the geographical barriers around the globe. The estimates clearly indicate that a great potential lies for production and trade of these products. However, mechanization, automation, adoption of quality management systems like GMP and GHP, are the major challenges that require immediate attention. Small opportunities are often the beginning of great enterprise.

I am pleased to know that Dairy Technology Society of India has taken the initiative to organize the “International Conference on Traditional Dairy Foods” during November 14-17, 2007 at National Dairy Research Institute, Karnal. I firmly believe that the conference will provide a platform for researchers, academicians, technologists, industrialists, policy-makers and marketing personnel’s as well as people involved in manufacture and trade of these traditional products to discuss various issues confronting them and then evolve strategies that will enable harnessing the full potential of these very valuable group of food commodities.

I wish the Conference a great success.

(Sushil Kumar)
International Conference on Traditional Dairy Foods

November 14-17, 2007

NDRI, KARNAL (INDIA)
Preface

Food habits of people of different countries, of different regions within countries and even of different religious groups within regions have evolved over thousands of years and they differ remarkably from one another. It is in this context that traditional foods have a unique place in diets of the consumer today, presenting a great deal of variety. Traditional foods have long been associated with different demographic groups, being an integral part of their ethos. It is amply evident that traditional foods of a particular country or region may not entirely suit people in other countries or regions. However, today there are not too many geographic areas where foods of different countries or regions are not to be found on the same platter. The wide adaptation ability of the human system is the probably the basis of this changing pattern, though there are not too many scientific studies conducted in this area.

The above scenario notwithstanding, large portions of populations of most countries and regions have their diets predominantly based on traditional foods. Demographic changes, the top-most among them being large scale immigration, have been instrumental in bringing traditional ethnic flavours into mainstream food processing. Finding ways to reproduce ‘authentic’ flavour and texture while translating these to more mass-produced items, is a considerable challenge. Hence, if traditional foods are proposed to be marketed on commercial scales, it becomes imperative that suitable technologies be developed for their production and packaging. Technology of traditional foods is also relevant to institutional food systems, catering services and cross-continental marketing necessitated by presence of large ethnic groups in foreign countries e.g. Indian populations settled in countries like USA, UK, Canada, Australia, Middle East etc.

With regard to the dairy products market in India, Western products consumed in the country are ‘modern’ or ‘non-traditional’. However, in the West, Europe in particular, the same products, especially cheese and fermented milks are traditional products, although many newer forms of these products have also become popular. ‘New products’ in the West viz., milk powder, concentrated milks, present-day ice cream and other desserts are the result of technological innovations. These products have, to a great extent, become ‘conventional’ and will predictably take the ‘traditional’ mantle in due course of time. Indian indigenous products are little known in other countries.

What is particular about traditional products, irrespective of whether it is Indian Burfi or Western cheese, is not only their unique sensory attribute but also the traditional technology that has been associated with them. While the ‘sensory’ character continues to linger in the minds of the people, the old technology fast becomes unattractive in the modern manufacturing and marketing context. This is where continued interest in research on the traditional products is generally focussed. Understanding the fundamental nature of these products in terms of chemical, microbiological and physical properties including texture and structure have been considered to be the key to any technological advancement that can be made in production of the traditional products. In this regard, certain newer concepts such as water activity, glass transition and crystallization are attracting increasing attention of researchers, with some notable progress having been made in this area in Indian traditional dairy products.

Traditional Dairy Products like other traditional foods need attention with regard to technology development. While a few traditional dairy foods such as cheese, and a wide variety at that, have evolved to such an extent that most cheese is produced employing modern technology. Butter, yoghurt, quark (or, quarg) and buttermilk are other such products of Western origin, for which traditional technologies have
largely been replaced by modern manufacturing practices. Nevertheless, there are certain pockets in some of the European countries where the traditional practices thrive and are indeed, promoted for more than one reasons. These may be the desire to preserve the cultural heritage, to avoid ‘interference’ of modern technologies in the traditional technologies which otherwise would give rise to product alteration, and to ensure ‘genuineness’ of the products. In fact, such specially prepared products marketed through individual vendors/shop-keepers fetch premium price for their ‘superior’ quality. Thus, several cheese varieties of Italy, France and Germany, certain cultured milk products of Eastern Europe are marketed through such parallel channels and are believed to be the ‘most genuine’ products unlike the ones manufactured in large, commercial plants and marketed over wide distances.

The present Conference programme has been so designed that practically all the aspects relevant to traditional dairy foods as they interest the consumer and the manufacturer are addressed. Some of the newer technological concepts to be dealt with during the conference are meant to present their potential in advancing the process of modernization of manufacture of the traditional dairy foods. They are also expected to guide research in certain basic aspects of these products so that they can be better understood from the points of view of their production and marketing.

One of the technical sessions of the Conference has rightly been dedicated to buffalo milk, not only because the latter constitutes the largest portion of milk produced in India and has a huge share in production of Indian traditional dairy products, but also on account of its nutritional virtues and healthfulness. Functional foods are today probably the most talked-about food group that has gained great prominence in recent times, thanks to the growing health concerns on the part of consumers. While many of the traditional dairy foods have inherent health factors built in them, there is at the same time a great potential to make other traditional products ‘functional’ by suitably incorporating into them certain well-established nutraceutical principles. Theses foods, therefore, have been given their rightful place in the technical programme of this Conference.

This is certainly not the first meeting of its kind at the national level but perhaps the first major international event on the subject being organized in India ever since the National Commission on Agriculture in 1976 strongly recommended the case of traditional dairy products for large-scale production by the organized sector of the dairy industry. The outcome of the Conference deliberations will hopefully pave the way for rapid progress in production of the value-added dairy foods along the modern lines for the benefit of the consumers and the producers alike.

(A. A. Patel)
Secretary General, ICTDF 2007
& Head, Dairy Technology
NDRI, Karnal
INTERNATIONAL CONFERENCE ON TRADITIONAL DAIRY FOODS

Dairy Technology Society of India

&

National Dairy Research Institute

Karnal (Haryana) - 132 001 India

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# International Conference on Traditional Dairy Foods

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Indian Traditional Dairy Products: An Overview

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ABSTRACT

The increased availability of milk during the flush season coupled with inadequate facilities to keep liquid milk fresh during transit from rural production areas to urban market has led to the conversion of milk into traditional milk products. These products are integral part of Indian heritage and have great social, religious, cultural, medicinal and economic importance and have been developed over a long period with the culinary skills of homemakers and halwais. In addition to preservation of milk solids for longer time at room temperature, manufacture of traditional dairy products add value to milk and also provide considerable employment opportunity. The important Indian traditional dairy products that have commercial significance are ghee, khoa, paneer, chhana, dahi, kulfi, shrikhand and several milk confections prepared from khoa and chhana such as burfi, peda, gulabjamun, milk cake, kalakand, rasogolla, sandesh, etc. In addition, there are many region-specific traditional products like rabri, basundi, kunda, kheer, payasam, etc. Each of these products has its unique flavour, texture and appearance. In the present paper, an attempt has been made to discuss various aspects of these products including recent developments in traditional dairy products.

1. INTRODUCTION

The Operation Flood programme, one of the world’s largest and most successful integrated dairy development programs initiated in 1970, has led India to emerge as the largest milk producer in the world. It is estimated that milk production in India reached a record level of 96 MT in 2006 accounting for more than 14% of the world’s total production of which buffalo milk constitutes nearly 55% (FAO, 2007). Historically, surplus milk in the rural areas where it is produced has been converted into a variety of traditional products primarily as a means of preservation. The increased availability of milk during the flush season coupled with lack of facilities to keep liquid milk fresh during transit from rural production areas to urban market makes conversion of milk into traditional products particularly attractive. These products include curd, ghee, khoa, paneer, chhana, dahi, kulfi, shrikhand and a variety of milk sweets, some of which are now increasingly produced even by the organized sector milk plants. Traditional dairy products and sweets are an integral part of Indian heritage. These products have great social, religious, cultural, medicinal and economic importance and have been developed over a long period with the culinary skills of homemakers and halwais. In addition to preservation of milk solids for longer time at room temperature, manufacture of traditional dairy products add value to milk and also provide considerable employment opportunity. It is estimated that about 50% of total milk produced in India is converted into traditional milk products. Traditional dairy products not only have established market in India but also great export potential because of strong presence of Indian diaspora in many parts of the world (Rao and Raju, 2003). In the present paper, various facets of Indian traditional dairy products are discussed with particular attention to their type, production practices, properties and shelf life.
2. CLASSIFICATION OF INDIAN TRADITIONAL DAIRY PRODUCTS

A variety of traditional milk products are manufactured in India with most of them being region specific. The classification of traditional dairy products based on the principle of manufacture is given in Table 1.

Table 1. Classification and uses of traditional milk products of India

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Principle of Manufacture</th>
<th>Products</th>
<th>Uses</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Heat desiccation</td>
<td>Khoa</td>
<td>Khoa based sweets (Burfi, Peda, Gulabjamun, Kalakand, Milk Cake, Kunda etc.)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Rabri</td>
<td>Direct consumption</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Basundi</td>
<td>Direct consumption</td>
</tr>
<tr>
<td>2</td>
<td>Heat and acid coagulation</td>
<td>Chhana</td>
<td>Chhana based sweets (Rasogolla, Sandesh, Rasamalai, Chhana murki, Cham-cham, etc.)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Panneer</td>
<td>Culinary dishes, Direct consumption</td>
</tr>
<tr>
<td>3</td>
<td>Fermentation</td>
<td>Dahi</td>
<td>Culinary dishes, Direct consumption</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Chakka</td>
<td>Shrikhand, Shrikhand vadi</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Misti dahi</td>
<td>Direct consumption</td>
</tr>
<tr>
<td>4</td>
<td>Fat concentration</td>
<td>Makkhan</td>
<td>Direct consumption, Ghee making</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ghee</td>
<td>Culinary purpose, Direct consumption</td>
</tr>
<tr>
<td>5</td>
<td>Frozen</td>
<td>Kulfi / Kulfa</td>
<td>Direct consumption</td>
</tr>
<tr>
<td>6</td>
<td>Addition of cereals and desiccation</td>
<td>KheerPayasam</td>
<td>Direct consumption</td>
</tr>
</tbody>
</table>

The market demand, quality of milk, economics of operation and shelf life determines the type of products to be manufactured and marketed. Both cow and buffalo milks are used for the manufacture of these products. Most of the traditional dairy products have higher yield and better quality when they are made from buffalo milk. On the other hand, few of these products are of superior quality when they are made from cow milk. The difference in cow and buffalo milk with relation to the quality of these products is due to the differences in the qualitative and quantitative aspects of various milk constituents, which in turn lead to the difference in the physical and functional properties of the two milks. The gross composition of some important Indian traditional dairy products is given in Table 2.
Table 2. Gross composition (%) of important Indian traditional dairy products

<table>
<thead>
<tr>
<th>Product</th>
<th>Type of Milk</th>
<th>Moisture</th>
<th>Fat</th>
<th>Protein</th>
<th>Lactose</th>
<th>Sucrose</th>
<th>Ash</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Khoa</td>
<td>Cow</td>
<td>30.4</td>
<td>22.2</td>
<td>18.8</td>
<td>24.9</td>
<td>-</td>
<td>3.7</td>
<td>Srinivasan and Anantakrishnan (1964)</td>
</tr>
<tr>
<td></td>
<td>Buffalo</td>
<td>32.0</td>
<td>24.2</td>
<td>18.3</td>
<td>22.0</td>
<td>-</td>
<td>3.5</td>
<td>Srinivasan and Anantakrishnan (1964)</td>
</tr>
<tr>
<td>Rabri</td>
<td>Buffalo</td>
<td>49.8</td>
<td>15.5</td>
<td>9.5</td>
<td>11.3</td>
<td>12.0</td>
<td>2.0</td>
<td>Gayen and Pal (1991b)</td>
</tr>
<tr>
<td>Basundi</td>
<td>Buffalo</td>
<td>52.6</td>
<td>11.6</td>
<td>9.9</td>
<td>11.5</td>
<td>12.7</td>
<td>1.7</td>
<td>Patel (1999)</td>
</tr>
<tr>
<td>Peda</td>
<td>Buffalo</td>
<td>10.3</td>
<td>20.1</td>
<td>19.0</td>
<td>18.3</td>
<td>30.0</td>
<td>2.2</td>
<td>Reddy (1985)</td>
</tr>
<tr>
<td>Burfi</td>
<td>Buffalo</td>
<td>15.7</td>
<td>20.5</td>
<td>14.9</td>
<td>15.8</td>
<td>30.4</td>
<td>2.8</td>
<td>Reddy (1985)</td>
</tr>
<tr>
<td>Milk cake</td>
<td>Buffalo</td>
<td>16.8</td>
<td>21.3</td>
<td>11.4</td>
<td>7.7</td>
<td>40.5</td>
<td>2.3</td>
<td>Patil (2002)</td>
</tr>
<tr>
<td>Chhana</td>
<td>Cow</td>
<td>56.5</td>
<td>22.4</td>
<td>16.5</td>
<td>3.1</td>
<td>-</td>
<td>1.5</td>
<td>Boghra (1988)</td>
</tr>
<tr>
<td></td>
<td>Buffalo</td>
<td>53.8</td>
<td>24.5</td>
<td>17.1</td>
<td>2.6</td>
<td>-</td>
<td>2.0</td>
<td>Boghra (1988)</td>
</tr>
<tr>
<td>Paneer</td>
<td>Cow</td>
<td>56.0</td>
<td>22.0</td>
<td>18.5</td>
<td>2.1</td>
<td>-</td>
<td>1.4</td>
<td>Sachdeva et al. (1991)</td>
</tr>
<tr>
<td></td>
<td>Buffalo</td>
<td>52.3</td>
<td>28.8</td>
<td>18.3</td>
<td>3.5</td>
<td>-</td>
<td>2.0</td>
<td>Pal and Garg (1989)</td>
</tr>
<tr>
<td>Rasogulla</td>
<td>Cow</td>
<td>50.1</td>
<td>7.3</td>
<td>8.7</td>
<td>N</td>
<td>30.5</td>
<td>1.1</td>
<td>Arora et al. (1996)</td>
</tr>
<tr>
<td></td>
<td>Buffalo</td>
<td>53.1</td>
<td>4.1</td>
<td>6.6</td>
<td>N</td>
<td>36.2</td>
<td>0.4</td>
<td>Verma (1989)</td>
</tr>
<tr>
<td>Sandesh</td>
<td>Cow</td>
<td>25.5</td>
<td>19.9</td>
<td>18.5</td>
<td>-</td>
<td>34.5*</td>
<td>1.7</td>
<td>Sen and Rajorhia (1990)</td>
</tr>
<tr>
<td></td>
<td>Buffalo</td>
<td>27.1</td>
<td>18.5</td>
<td>19.8</td>
<td>-</td>
<td>33.8*</td>
<td>1.9</td>
<td>Sen and Rajorhia (1991)</td>
</tr>
<tr>
<td>Dahi</td>
<td>Cow</td>
<td>86.5</td>
<td>4.0</td>
<td>3.3</td>
<td>4.2</td>
<td>-</td>
<td>0.6</td>
<td>Singh (2007)</td>
</tr>
<tr>
<td></td>
<td>Buffalo</td>
<td>83.5</td>
<td>7.0</td>
<td>3.8</td>
<td>4.9</td>
<td>-</td>
<td>0.7</td>
<td>Singh (2007)</td>
</tr>
<tr>
<td>Shrikhand</td>
<td>Buffalo</td>
<td>40.8</td>
<td>5.1</td>
<td>5.7</td>
<td>2.2</td>
<td>45.4</td>
<td>0.5</td>
<td>Pal (2006)</td>
</tr>
</tbody>
</table>

* includes lactose; N = figures not available

3. COMPOSITIONAL DIFFERENCES BETWEEN COW AND BUFFALO MILKS

Owing to the inherent qualitative and quantitative characteristics of cow and buffalo milks, each type of milk is eminently suitable for certain types of region specific indigenous milk products. Sindhu and Singhal (1988) extensively reviewed the differences in the composition of cow and buffalo milk. A summary of the gross chemical composition of buffalo milk in comparison to the milks of Indian and western cows is given in Table 3.
Table 3. Concentration of some major constituents in buffalo and cow milks

<table>
<thead>
<tr>
<th>Constituents</th>
<th>Buffalo Milk (India)</th>
<th>Cow Milk (India)</th>
<th>Cow Milk (Western countries)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>83.63</td>
<td>86.37</td>
<td>87.20</td>
</tr>
<tr>
<td>Solids-not-fat</td>
<td>9.81</td>
<td>8.95</td>
<td>9.10</td>
</tr>
<tr>
<td>Fat</td>
<td>6.56</td>
<td>4.68</td>
<td>3.70</td>
</tr>
<tr>
<td>Protein</td>
<td>3.88</td>
<td>3.36</td>
<td>3.50</td>
</tr>
<tr>
<td>Lactose</td>
<td>5.23</td>
<td>4.91</td>
<td>4.90</td>
</tr>
<tr>
<td>Total Ash</td>
<td>0.76</td>
<td>0.68</td>
<td>0.70</td>
</tr>
<tr>
<td>Calcium</td>
<td>0.18</td>
<td>0.12</td>
<td>0.12</td>
</tr>
<tr>
<td>Magnesium</td>
<td>0.02</td>
<td>0.01</td>
<td>0.01</td>
</tr>
<tr>
<td>Sodium</td>
<td>0.05</td>
<td>0.05</td>
<td>0.05</td>
</tr>
<tr>
<td>Potassium</td>
<td>0.11</td>
<td>0.15</td>
<td>0.15</td>
</tr>
<tr>
<td>Phosphorus</td>
<td>0.10</td>
<td>0.10</td>
<td>0.10</td>
</tr>
<tr>
<td>Citrate</td>
<td>0.18</td>
<td>0.18</td>
<td>0.18</td>
</tr>
<tr>
<td>Chloride</td>
<td>0.07</td>
<td>0.10</td>
<td>0.10</td>
</tr>
<tr>
<td>Ca / P ratio</td>
<td>1.8</td>
<td>1.2</td>
<td>1.2</td>
</tr>
</tbody>
</table>

Source: De (1980); Sindhu (1998); Fox and McSweeney (1998)

Buffalo milk has higher amount of total proteins, caseins and whey proteins than cow milk. In buffalo milk, almost all the casein is present in the micellar form whereas in cow milk only 90-95% is in micellar form and the rest is present in serum. In general buffalo casein contains higher proportions of calcium and magnesium but lower proportions of sialic acid and hexose. The lactoferrin content of buffalo milk is 32 mg/100 ml compared to only 15 mg/100 ml of cow milk (Bhatia and Valsa, 1994). No genetic polymorphism is exhibited either by the caseins or whey proteins in buffalo milk indicating that buffalo milk proteins are simple molecules compared to cow milk proteins.

Buffalo milk fat contains higher proportions of high melting triglycerides (9-12%) than cow milk (5-6%) and as a result it is more solid in nature. Similarly the proportion of butyric acid containing triglycerides is 50% in buffalo milk compared to only 37% in cow milk (Ramamurthy, 1976). As a consequence of higher proportions of butyric acid containing triglycerides the emulsifying capacity of buffalo milk fat is superior to cow milk fat. Buffalo milk fat is poor in free fatty acids (0.22%) than cow milk fat (0.33%). Size of fat globules is bigger (4.15-4.60 mm) in buffalo milk compared to cow milk (3.36-4.15 mm). Buffalo milk fat contains a significantly lower concentration of total and free cholesterol (275 and 212 mg/100 g respectively) than in cow milk fat (330 and 280 mg/100 g respectively) (Bindal and Jain, 1973).

Buffalo milk contains a higher amount of divalent cations (calcium and magnesium) but a lower amount of monovalent cations (sodium, potassium and chloride) than cow milk. The content of colloidal calcium and magnesium in buffalo milk is 160 mg and 9 mg respectively per 100 ml of buffalo milk compared to only 80 mg and 3 mg per 100 ml respectively of cow milk. The calcium to phosphate (Ca/P) ratio in buffalo milk is 1.8 while it is 1.2 in cow milk (Sindhu, 1995). However, the concentration of polyvalent anions (phosphate and citrate) in buffalo milk is similar to that of cow milk.
In general, the vitamin A content in buffalo milk is higher (about 340 IU/kg) than in cow milk (230 IU/kg). However, due to the absence of carotenoids and high fat content, its total vitamin A potency per unit weight of fat is lower than in cow milk fat. Due to higher fat content, buffalo milk contains higher tocopherol (334.2 mg/kg) content than cow milk (312.2 mg/kg). Buffalo milk is rich in taurine (6 mol/L), an end product of the metabolism of sulfur-containing amino acids, compared to cow milk (4 mol/L). Lipase and alkaline phosphatase activity is less in buffalo milk (Kumar and Bhatia, 1994).

In India, milk from both bufaloes and cows (Desi, cross breed and exotic) is commercially important. The quality, technological developments and shelf life of some of the prominent Indian traditional dairy products are described here below:

4. HEAT DESICCATED PRODUCTS

4.1 KHOA

Among the heat desiccated milk products, khoa – an intermediate concentrate that is base material for a wider range of sweetmeats such as burfi, peda, gulabjamun, milk-cake, kalakand and kunda has great significance in India. According to one estimate about 5.5% of total milk production is converted into khoa (Banerjee, 1997) and on the basis of present milk production of about 96 million tones per annum, this is equivalent to about 14.7 million kg of khoa per day. Khoa is prepared by continuous boiling of milk until desired concentration (65 to 72% TS) and texture is achieved. According to Prevention of Food Adulteration (PFA) (1955) rules, khoa sold by whatever variety or name such as Pindi, Danedar, Dhap, Mawa, or Kava means the product obtained from cow or buffalo (or goat or sheep) milk or milk solids or a combination thereof by rapid desiccation and having not less than 30 per cent milk fat on dry weight basis. The Bureau of Indian Standards has given the requirements for three types of khoa, viz. Pindi, Danedar and Dhap in terms of total solids, fat, ash, acidity, coliforms and yeast and mold counts (IS: 4883, 1980). To achieve the PFA standard a minimum fat level of 5.5 in buffalo milk is essential. The quality of khoa is better when made from buffalo milk because khoa from cow milk is inferior due to its moist surface, salty taste and sticky and sandy texture which is not considered suitable for the preparation of sweetmeats. Also, buffalo milk results in higher yield of khoa. The higher emulsifying capacity of buffalo milk fat due to the presence of larger proportion of butyric acid-containing triglycerides and release of more free fat compared to cow milk may be responsible for smooth and mellowy texture of its khoa (Sindhu, 1996). Khoa is manufactured primarily by halwais in jacketed kettles, which inherently suffers from several disadvantages particularly the poor and inconsistent quality of the product. It has a limited shelf life of about 5 days at 30°C.

4.1.1 Scaling up of the technology of khoa making

Many attempts have been made on up-gradation of the technology of khoa and most of these are directed towards mechanization of the process and developing continuous khoa making plants (Aneja et al., 2002). A mechanized conical process vat for preparation of khoa was developed by Agrawala et al. (1987). This equipment consists of a stainless steel conical vat with a cone angle of 60° and steam-jacket partitioned into 4-segments for efficient use of thermal energy and less heat loss. This is however, a batch type equipment suitable for making limited quantities of the product.

An inclined scraped surface heat exchanger (ISSHE) for continuous manufacture of khoa has been developed at Anand (Gujarat) by the National Dairy Development Board (NDDB) (Punjrath et al., 1990). In this machine, concentrated milk of 42 to 45% total solids is used as feed. The inclination of ISSHE permits the formation of a pool of boiling milk critical to formation of khoa. Dodeja et al. (1992) developed a thin film scraped surface
heat exchanger (TSSHE) system at NDRI for the continuous manufacture of khoa. In this unit, two SSHEs are arranged in a cascade fashion. Milk is concentrated into first SSHE to about 40-45% TS and finally to khoa in the second SSHE. Unlike in ISSHE, the feed for this unit is buffalo milk and thus rendering it suitable for organized small and large dairies and entrepreneurs. The capacity of both these units is about 50 kg khoa per hour and many organized dairies have adopted these continuous khoa making plants.

Christie and Shah (1992) designed and developed a three-stage unit for continuous khoa manufacture. The machine has three jacketed cylinders placed in a cascade arrangement. This facilitates easy transfer of milk from one cylinder to other which works as heat exchanger. The heat exchangers are installed with a mechanism of providing inclination. The slope allows the movement of the contents in longitudinal direction. The unit is provided with variable pulley drive so that speed adjustment is possible. The unit is highly bulky requiring too much flooring area.

4.1.2 Alternative approaches in khoa making

In addition to above mentioned mechanized systems, many other alternative approaches have also been attempted to upgrade the technology of khoa-making. Singh and Rajorhia (1989) studied the possibility of adopting a roller dryer for khoa production. The process was highly energy-intensive and khoa obtained by this method was flaky, dry and completely lacking desired consistency. Reverse osmosis (RO) technique was applied in the manufacture of khoa from cow milk (Pal and Cheryan, 1987) and buffalo milk (Kumar and Pal, 1994a). It involves pre-concentration of milk (2.5-fold for cow milk and 1.5-fold for buffalo milk) using RO process followed by desiccation in a steam-jacketed open pan for the manufacture of khoa. The quality of khoa made by the membrane process was found to be identical to the conventionally prepared product. According to the workers, such process would offer attractive energy saving in the initial concentration of milk. It is also possible to replace jacketed pan with SSHE to make the process continuous. Attempts were also made by different workers to incorporate whey solids in the form of whey protein concentrate (WPC) and reported that increased addition of WPC in the milk resulted in large granulation in khoa and increased yield (Patel et al., 1993; Dewani and Jayaprakasha, 2002).

4.2 KHOA-BASED CONFECTIONS

4.2.1 Burfi

Burfi is the most popular milk-based confection essentially made from khoa. Sugar and other ingredients are added in different proportions to khoa according to the demand of consumers. Several varieties of burfi are sold in the market depending on the additives present, viz., plain mawa, pista, nut, chocolate, coconut and rava burfi. Good quality burfi is characterized by moderately sweet taste, soft and slightly greasy body and smooth texture with very fine grains which is attained from buffalo milk khoa. Colour, unless it is chocolate burfi, should be white or slightly yellowish. Traditionally burfi is prepared by adding sugar to hot khoa and vigorous blending in a shallow kettle till a homogenous, smooth and fine grains mass is achieved. In hot condition it is spread in shallow trays for setting. Kumar and Dodeja (2003) developed a continuous method of making burfi using three-stage TSSHE. It consists of a continuous khoa-making system (2-stage SSHE) and a burfi-making unit. Sugar was fed into the burfi-making unit using a sugar dosing mechanism developed for the purpose. Palit and Pal (2005) adopted TSSHE and Stephan processing kettle for the large scale production of burfi. They standardized buffalo milk to SNF and fat ratio of 1.5:1 and prepared khoa on a continuous khoa making machine (TSSHE). Khoa having 38-40% moisture was transferred to a Stephan process kettle which was reduced to about 30-32% under vacuum. This was followed by sugar addition @ 30% and kneading and working at 60°C. Burfi, thus
obtained was hot filled into polystyrene tubs and kept at room temperature for setting. Thereafter it was vacuum packaged. A shelf life of about 60 days at 30°C has been reported by the workers.

**Burfi** contains high amounts of fat (19.52%) and sugar (29.4%) which are major constraints to relish for obese, diabetic and people prone to heart diseases. With a view to overcome these constraints, Prabha (2006) developed a technology for the production of dietetic **burfi** using alternative ingredients, viz. whey protein concentrate (WPC), sorbitol, maltodextrin and sucralose and optimized the ingredients using Response Surface Methodology (RSM). The product was found to be highly acceptable by the consumers.

### 4.2.2 Peda

**Peda**, another khoa-based sweet, is granular in texture having dry body because of comparatively lower moisture content. Although the method of manufacture of **peda** vary from region to region, it is identical to that of **burfi** preparation wherein a mixture of **khoa** and sugar is heated at low-fire till desired texture is attained. Several types of **pedas**, viz. plain, kesar and brown are available in the market. Plain **peda** is made into round balls of about 20–25 g size, normally by rolling between the palms (Pal, 2000). The product may also be formed into different shapes and sizes using different dies/moulds. **Peda** is usually packed in paper board / boxes having a parchment paper liner or grease-proof paper liner (Reddy, 1985). Dewani and Jayaprakasha (2002) reported that replacement of milk solids-not-fat (MSNF) up to 40% with WPC improved all the sensory attributes of plain **peda**. An industrial method of converting **khoa** into kesar **peda** had been developed at NDB, Anand (Banerjee, 1997). Dewani and Jayaprakasha (2004) also applied RO process for pre-concentration of milk as an intermediate step in the production of plain **peda**. It was reported that such product was nutritionally better than the conventionally made **peda**.

Brown **peda**, another type of **peda** that is characterized by caramelized color and highly cooked flavor, is popular in many parts of the country. Some of the popular brands are Mathura **peda**, Dharwad **peda** and Mishra **peda**. As per an estimate the annual production of Dharwad **peda** varies from 3-6 tonnes per day (Kulkarni and Unnikrishnan, 2006). In almost all of these types, **khoa** is first cooked to brown colour in ghee and then **peda** is prepared from it by blending sugar and other additives. The analysis of the market samples from different parts of the country revealed significant variation in the quality of brown **peda** (Londhe, 2006). Among the various samples analyzed, Mathura **peda** was reported to be superior in quality than other types. Londhe (2006) also standardized the method of manufacture of brown **peda** and attempted to enhance its shelf life by using different packaging techniques.

### 4.2.3 Gulabjamun

**Gulabjamun**, is also a khoa-based sweet characterized by brown colour, smooth and spherical shape, soft and slightly spongy body free from both lumps and hard central core, uniform granular texture, mildly cooked and oily flavour, free from doughy feel and fully succulent with sugar syrup. The gross chemical composition of **gulabjamun** vary widely depending on numerous factors, such as composition and quality of **khoa**, proportion of ingredients, sugar syrup concentration etc. The traditional method of **gulabjamun** making from dhap **khoa** has been standardized by Ghosh et al. (1986). It involves proper blending of **khoa**, refined wheat flour, baking powder and water (optional) to make homogenous and smooth dough. The small balls formed from the dough are deep dried in ghee to golden brown colour and subsequently transferred to 60% sugar syrup maintained at about 60°C. It takes about 2 hours for the balls to completely absorb the sugar syrup. Dewani and Jayaprakasha (2002) reported that replacement of MSNF up to 30% with WPC resulted in increased overall acceptability scores of **gulabjamun**. A mechanized semi-continuous system has been developed for the manufacture of **gulabjamun** from **khoa** at commercial scale (Banerjee, 1997).
Deep-fat frying is a key operation in *gulabjamun* preparation. This process induces typical brown colour and texture required to produce good quality product. Recently, Kumar et al. (2006) studied the kinetics of colour and texture changes that take place during deep-fat frying of *gulabjamun* and reported that the browning-induced changes in colour parameter $L^*$ (lightness or brightness) followed zero-order reaction, while the ratio of $b^*$ (yellowness) and $a^*$ (redness) values followed first-order kinetics. Further reported that the increase in the texture parameters hardness and firmness followed zero-order reaction kinetics whereas stiffness rise followed a first-order reaction.

With the growing awareness of impact of sugar on health, sugar-free dairy products are demanded by consumers and *gulabjamun* is no exception. With a view to address this problem, Chetana et al. (2004) developed a technology for the production of sugar-free *gulabjamun* by optimizing various processing parameters. It was reported that soaking of fried *gulabjamun* balls in sorbitol syrup of 54°Brix strength added with aspartame @ 0.25% maintained at 65°C for 3 h produced good quality product.

4.2.4 Kunda

*Kunda* is defined as a desiccated product prepared by the continuous heating of milk or high moisture *khoa* with sugar. It is characterized by semi-brown to brown colour, soft body and grainy texture, and characteristic sweet, nutty and pleasant flavour. The *khoa* generally used for *kunda* making has high moisture content. If the *khoa* used has low moisture, then about 10% milk is added. After the addition of calculated amount of sugar (25–30%), *khoa* is subjected to slow desiccation on direct fire. At the end, a brown mass with granular texture is obtained which has about 25% moisture (Kulkarni et al., 2001). The shelf life of *kunda* is reported to be about 15–28 days at 30°C (Rao et al., 2000). Attempts were made to enhance the shelf life of *kunda* by Navajeevan and Rao (2005) using retort pouch processing technology. However, it was reported that the shelf life of retort processed *kunda* was limited by chemical changes during storage and was only 2 weeks at 37°C and 1 week at 55°C.

4.3 Rabri

Rabri is a partially concentrated and sweetened milk product containing several layers of clotted cream (*malai*). It is quite popular in northern and eastern parts of the country. Traditionally, it is prepared by milk at a very small scale by simmering whole milk for a prolonged period and adding sugar after achieving the desired concentration. Rabri is generally manufactured by *halwais* and stored in open and shallow type of container, which result in wide variations in composition and enormous contamination from surroundings. (Gayen and Pal, 1991a). A standard method of manufacture of rabri was developed by Gayen and Pal (1991b). It involves standardization of buffalo milk to 6% fat, its simmering in a steam jacketed kettle at 90°C, repeated removal of clotted cream (*Malai*) on the colder part of the kettle or to a separate container, concentration of milk to three fold after removing about 100 gm clotted cream from 1 kg milk and adding sugar @ 6% of initial milk to the concentrated milk. The clotted cream is finally added to the concentrated sweetened milk and the product is stored at refrigeration temperature.

Efforts were also been made to develop a commercial method for manufacture of rabri employing SSHE for concentration of buffalo milk, and addition of shredded *chhana/paneer* in place of clotted cream to provide the desirable texture to the final product (Gayen and Pal, 1991b). Recently, Pal et al. (2005) successfully developed a technology for the large scale production of rabri using thin film scraped surface heat exchanger (TSSHE).
4.4. Basundi

Basundi is a partially desiccated sweetened milk product popular mostly in western and southern parts of India. It is different from rabri in several respects. Basundi is less thickened and normally does not contain flaky/layered texture as in case of rabri. Basundi is similar to sweetened condensed milk with the exception that it has pleasant heated flavor and slightly brown color (Pal, 1998). Traditionally basundi is prepared from buffalo milk which is concentrated to about 2-fold by slow boiling in an open kettle. The film of heated coagulated milk constituents formed on the milk/air inter-phase is intermittently stirred back into the milk to provide typical soft textured flakes which remain uniformly suspended in thickened milk. Sugar @ 6–7% of milk added at the last stage of concentration followed by optional addition of flavors and nuts. The product is cooled and served chilled.

The method of manufacture of basundi on commercial scale was developed recently by Patel and Upadhyay (2003a & b; 2004a). The method involves selection of buffalo milk having good heat stability, standardization of milk to a fat/SNF ratio of 0.5 and preheating to 90°C for 10 min. The milk is partially concentrated in a batch-type steam jacketed stainless steel open, wide-mouth pan. The cane sugar is added at this stage at a rate of 5% (w/w) of original milk. The final concentration of 2.5 times the original is attained. Basundi so prepared is hot (e” 55°C) filled in glass bottles and then cooled to about 10°C and subjected to refrigerated (7+2°C) storage till consumed. Such product had a shelf life of up to 25 days (Patel et al., 2005). Further, when post production heat treatment was given in hot water bath (90°C for 10 min) or by autoclaving at 105°C for 10 min, the shelf life was reported to be up to 40 days at refrigerated temperature (7+2°C) (Patel and Upadhyay, 2004b).

Recently, Patel et al. (2006) developed a mechanized system for continuous basundi production (CBM). The design of CBM Machine, based on the principle of thin film scraped surface heat exchanger, is energy efficient and the quality of the product is better compared to traditional product. It is claimed that such process used for basundi making helps to attain a product of assured uniform quality under hygienic conditions.

5. HEAT-AND-ACID COAGULATED PRODUCTS

5.1 CHHANA

Chhana, an important heat and acid coagulated product, serves as a base material for a large variety of Indian sweetmeats such as rasogolla, sandesh, chum-chum, chhana murki, chhana podo and rasonalai. Cow milk is better suited to produce chhana as it yields soft and smooth texture with velvety body, desirable for making chhana based sweetmeats particularly rasogolla. Chhana produced from buffalo milk is reported to be hard and greasy because of inherent differences in qualitative and quantitative aspects of buffalo milk. However, attempts have been made by several workers to overcome these defects. Some of the suggested measures include addition of sodium citrates, dilution of buffalo milk with 20-30% water, coagulation at low temperature and homogenization (Rajorhia and Sen, 1988).

Recently, Kumar (2006) reported that admixture of sweet cream butter milk (SCBM) and buffalo milk in the proportion of 60:100, on total solids basis, adjusting fat and SNF ratio to 1.2:1 and coagulating at a pH of 5.2 and 75°C produced highly acceptable chhana. With a view to obtain higher yield and total solids recovery in chhana, Kumar et al. (2005) successfully applied ultrafiltration (UF) and diafiltration (DF) techniques in chhana making. The process involves preparation of UF-DF retentate from a blend of SCBM and buffalo milk (40:100), addition of 0.5% dipotassium hydrogen phosphate as stabilizer after ultrafiltration, addition of 10% citric acid as coagulant to UF-DF retentate at room temperature and heating to 80°C at pH 5.4 for coagulation.
Attempts were made by different workers to mechanize the chhana-making process. Aneja (1998) reported a prototype for continuous chhana-making, capable of producing 40 kg/hr of chhana. Recently, workers at Indian Institute of Technology, Kharagpur developed a continuous chhana-making unit of 60 L/h of milk capacity (Sahu and Das, 2007). The unit has a duplex plunger pump and a helical coil heat exchanger for dosing of milk and acid and heating the milk prior to acid coagulation respectively. It also consists of a vertical column that gives residence time for the separation of milk solids to chhana. In this unit, the chhana-whey mixture, after being discharged from the top of the column, is moved over an inclined strainer through which the whey is removed.

5.2 PANEER

5.2.1 Conventional paneer

Paneer, a highly popular product throughout the country, has many uses starting from its consumption in raw form to preparation of several varieties of culinary dishes and snacks. Good quality paneer is characterized by a white color, sweetish, mildly acidic, nutty flavor, spongy body and close knit texture. Buffalo milk paneer has all these attributes, hence preferred over cow milk paneer which is of inferior quality due to its very compact and fragile body and its pieces lose their identity in cooking (Sachdeva et al., 1985). Use of buffalo milk also provides higher yield of paneer. Higher concentration of casein in the micelle state with bigger size, harder milk fat due to larger proportion of high melting triglycerides in it and higher content of total and colloidal calcium have been attributed for harder and chewy chhana from buffalo milk that is less suitable for making good quality of rasogolla (Sindhu and Singhal, 1988). According to the Prevention of Food Adulteration Act (1954), paneer shall contain not more than 70% moisture and the fat content should not be less than 50% of dry matter.

The technology of manufacturing paneer from buffalo milk has been standardized so as to obtain the most acceptable and safe product with maximum recovery of solids (Sachdeva and Singh, 1988). Subsequently, process of preparing paneer of acceptable quality from cow milk has also been developed (Sachdeva et al., 1991). Irrespective of the type, milk should be standardized to a fat and SNF ratio of 1:1.65 so that the final product conforms to PFA requirements. Good quality paneer is obtained by heating milk to about 90°C, acidifying the hot milk by adding citric acid solution followed by removal of whey and pressing of the curd before cooling the pressed mass in chilled water. Chemical and physical changes in casein and whey proteins, brought about by the combined influence of heat and acid treatment, form the basis of paneer making. Conventionally, citric acid is used for coagulating hot milk for paneer making but certain non-conventional, low-cost coagulants have been suggested for manufacture of paneer without any loss of its yield and quality (Sachdeva and Singh, 1987). Normally, paneer blocks of required size/weight are packaged in polyethylene pouches, heat sealed and stored under refrigeration conditions. Alternatively, they are vacuum packaged in laminated or co-extruded films.

5.2.2 Paneer variants

Suitable technologies have been developed for the manufacture of acceptable-quality paneer from reconstituted whole milk powder (Singh and Kanawjia, 1992) and recombined milk (Singh and Kanawjia, 1991). Roy and Singh (1999) reported that an acceptable quality filled milk paneer could be prepared using buffalo skim milk and groundnut oil or partially hydrogenated vegetable oil (vanaspati). Venkateshwarlu et al. (2003) standardized the process for manufacturing paneer from skim milk incorporated with coconut milk of 25% fat.

Sachdeva et al. (1993) adopted UF technique in paneer making. It involves standardization and heating of milk followed by UF whereby much of lactose, water and some minerals are removed.
along with this permeate. UF of milk and removal of permeate is equivalent to removal of whey by coagulation in conventional method. The retentate (concentrated mass), which has about 40% total solids, is cold acidified to get the desired pH. Till this point, the product is flowable and can be easily dispensed into containers with automatic dispensing machines. The filled containers are then subjected to texturization by microwave heating in a microwave oven. The resulting product has typical characteristics of normal paneer and an extended shelf life under refrigeration.

A paneer-like product was developed by Rao and Mathur (1991) adapting in-package process. The process involves use of standardized buffalo milk (2% fat and 9.2% SNF) and concentrating to 27% total solids by UF followed by filling the concentrated milk in retortable pouches and subjecting to texturization process at 118°C for 5 min. It was reported by the workers that the total solids recovery (95%) was more in in-packaged paneer than the conventional product. The shelf life of in-packaged paneer was reported to be 3 months at 35°C.

5.2.3 Mechanization of paneer making

Batch production at a small scale employing the traditional process often results in an inconsistent product. A continuous paneer-making system was developed at NDRI, Karnal by Agrawala et al. (2001). In this system, the unit operations involved in paneer making have been mechanized. The continuous paneer-making machine is designed to manufacture 80 kg paneer per hour by employing twin-flanged apron conveyor cum filtering system for obtaining the desired moisture content and texture attributes.

5.2.4 Shelf life of paneer

The shelf life of paneer is reported to be only 6 days under refrigeration though its freshness is lost within 3 days (Bhattacharya et al., 1971). At room temperature paneer does not keep good for more than one day. The spoilage in paneer primarily occurs due to the surface growth of microorganisms. Hence, attempts have been made to curb the surface growth of microorganisms and there by increase the shelf life of paneer. Dipping of paneer in 5% brine solution increased the shelf life from 7 days to 20 days at 6-8°C (Sachdeva, 1983). Singh et al., (1989) reported a shelf life of 36 days at room temperature when sorbic acid at a rate of 0.15% was added to milk and the product was wrapped in sorbic acid-coated paper. Sachdeva and Singh (1990) reported that a shelf life of 32 days under refrigeration could be achieved when paneer was treated with a combination of delvocid and hydrogen peroxide. Sachdeva et al. (1991) reported that paneer packaged in laminated pouches had a shelf life of about 30 days at refrigerated storage (6+1°C). Paneer packaged in high barrier film (EVA/EVA/PVDC/EVA) under vacuum and heat treated at 90°C for one min is reported to have a shelf life of 90 days under refrigeration (Punjrath et al., 1997).

5.3 CHHANA BASED CONFECTIONS

5.3.1 Rasogolla

Rasogolla, a chhana-based delicacy, is stored and served in sugar syrup. For the production of rasogolla, chhana is thoroughly kneaded and made into small balls, which are subsequently boiled in clarified sugar syrup followed by slow cooling in comparatively low concentration sugar syrup. Snow-white in colour, rasogolla possesses a spongy and chewy body and smooth texture. It is best prepared from soft and freshly made cow milk chhana. Buffalo milk usually yields hard chhana that lacks sponginess, as well as desired body and texture. Verma and Rajorhia (1995) made successful attempts in developing rasogolla from buffalo milk. The method consists of standardizing buffalo milk to 5.0% fat (and 9.8% SNF) and heating to boil followed by addition of 0.05% sodium alginate (w/w) with constant stirring so as to dissolve it completely
and subsequently cooling to 40°C. Coagulation of milk was achieved by adding 1.0% citric acid solution (40°C) at pH 5.1. Chhana was obtained, after the coagulum was filtered, pressed and added with arrowroot, semolina and baking powder. The mixture, after thorough kneading to a smooth paste and rolled into uniform balls was cooked vigorously in boiling sugar syrup. Cooked rasogolla balls were then transferred into warm sugar syrup for soaking and allowed to cool to room temperature. To enhance the shelf life, provide convenience and make suitable for export, rasogolla is often canned.

Rasogolla contains about 32–55% sugar which is of major concern to the calorie conscious and diabetic people. Hence, successful attempts were made by Jayaprakash (2003) to develop a low-calorie or diabetic rasogolla using a high intensity sweetener and a bulking agent. Of the several types of rasogolla sold in the market, viz. ordinary (non-spongy), spongy, diabetic and canned, canned rasogolla has good keeping quality than other types. Chormale et al. (2004) attempted to further improve the keeping quality subjecting rasogolla to osmotic dehydration and reported that the osmotic dehydrated rasogolla with a sugar to rasogolla ratio of 1:1 at 40°C was found desirable with respect to sensory quality and chemical composition.

Different workers made successful attempts to mechanize the production process of rasogolla. Choudhury et al. (2002) developed a prototype mechanized unit for kneading of chhana and chhana ball-forming in a continuous manner. It was reported that such unit can handle 15–20 kg of chhana per hour and convert it continuously into chhana balls (approximately 6 g) as the final product. Recently, Karunanithy et al. (2007a, b & c) also tried to mechanize these unit operations in rasogolla making for its continuous production. The authors claimed that the resulting product from the developed continuous rasogolla making machine was comparable in quality with the control and market products.

5.3.2 Sandesh

Sandesh, another popular chhana-based sweet, can be classified broadly into three types, viz. karapak (low moisture), narampak (medium moisture) and kachhagolla (high moisture). Among these narampak is the most popular variety. Sandesh is preferably prepared from chhana obtained from cow milk because it yields soft body and texture with fine and uniform grains (Sen and Rajorhia, 1990). Buffalo milk chhana on the other hand leads to a product with a hard body and coarse texture, both undesirable characteristics. However, successful attempts were made in developing a method for the production of narampak sandesh using buffalo milk by Sen and Rajorhia (1991). It involved standardization of buffalo milk to 4.0% fat, heating to boil, dilution with water (30%, the volume of milk) followed by coagulation of diluted milk to obtain chhana, which was converted into smooth paste and divided into two equal lots. Ground sugar at the rate of 30% of the total weight of chhana was mixed with one lot of the chhana and mixture slowly cooked at 75°C with continuous stirring and scraping. When patting stage had reached the second lot of chhana also mixed to it. Heating and scraping was continued till a final temperature of 60°C reached. The mix was then cooled to 37°C and moulded in desired shape and size and packaged in suitable packages.

Kumar and Das (2003) optimized the processing parameters viz. mixing, kneading and cooking of chhana and sugar mixture for the mechanized production of sandesh from cow milk. But, it was observed that the desired homogeneity after the initial mixing was lacking in the product. With a view to overcome this, Kumar and Das (2007) subsequently developed a single-screw vented extruder for cooking of chhana and sugar mixture that can be integrated with the mechanized method for the continuous production of sandesh from cow milk. With necessary modifications, this technology may also be adapted to continuous production of sandesh from buffalo milk.
5.3.3 Chhana Podo

Chhana podo is unique as it is the only milk based indigenous dairy product prepared by baking chhana. It is characterized by a brown crust with a white or light brown inner body. It has a typical cooked flavour and rich taste. The product is sweetish due to the addition of sugar. It has a moderately spongy cake-like texture and soft body. Estimated annual production of chhana podo is approximately 1000 tonnes (Ghosh et al. 2002). The method of production of chhana podo was standardized by Ghosh et al. (1998). It involved kneading of chhana with sugar and refined wheat flour (madia) / semolina (suji), spreading of kneaded chhana mix on a flat, dry, clean pan smeared with ghee and baking in an oven at 200°C for 65 min to obtain a puffed, brown spongy textured product. Kumar et al., (2002) optimized the commercial method of chhana podo and reported that the most acceptable product can be made from milk with 4.5% fat, suit 5%, sugar 35%, and water 30% (of china) and baking at 200 + 5°C for 50 min. The shelf life of chhana pod is only 3 days at 30°C while it is 35 days when vacuum packaged and stored at 6+1°C (Kumar et al., 2002).

6. FERMENTED PRODUCTS

6.1 DAHI

Dahi (curd) is a well known fermented milk product consumed throughout India, either as a part of the daily diet along with the meal or as a refreshing beverage or it may be converted into ratio (seasoned with onion, spices, etc.). According to the PFA (1955) rules, dahi shall contain the same percentage of fat and solids-not-fat as the milk from which it is prepared. Starter cultures such as Streptococcus lactis, S. diacetylactis, S. cremoris in single or in combination with or without Leuconostoc species along with Lactobacillus acidophilus, L. bulgaricus, and S. thermophilus may be used for dahi preparation (IS:9617, 1980). Dahi is largely made at home using traditional kitchen recipes or in small scale at confectionary (halwais) shops involving milk of buffalos, cows and goats. However, buffalo milk is best suited for dahi having better sensory quality, particularly body and texture because of its inherent properties. At the consumer’s household or halwais’ level, milk is boiled, cooled to room temperature, inoculated with 0.5 to 1.0% starter (previous day’s dahi or butter milk) and then incubated undisturbed for setting for about overnight. In cold weather, the dahi setting vessel is usually wrapped up with woolen cloth to maintain appropriate temperature.

Many organized dairies are now preparing dahi adopting the standardized method (Singh, 2007). In this method, fresh, good quality milk is pre-heated and subjected to filtration and clarification. The milk is standardized to 4 to 5% fat and 10 to 12% SNF, homogenized and heat treated followed by cooling to incubation temperature and inoculated with specific dahi starter culture. It is then filled in suitable containers (plastic cups) of the appropriate size and incubated at 40–42°C for 3–4 hours. When a firm curd is formed and the acidity reaches to about 0.7%, dahi cups are transferred to cold room maintained at about 4–5°C and stored at that temperature till consumption. Kumar and Pal (1994b) studied the suitability of reverse osmosis (RO) concentrates for the manufacture of dahi and reported that the quality of dahi made from 1.5-fold RO concentrates was highly satisfactory. Further it was reported that the use of highly concentrated RO milk (more than 1.5-fold) for dahi-making failed to bring the pH down the desirable level and yielded a product that was extremely thick, lumpy and that lacked a clean pleasant flavour.

Being a widely consumed dairy product, dahi was chosen as a vehicle by some workers to incorporate different nutraceuticals and combat chronic and non-communicable diseases in India. Fortification with minerals (Singh et al., 2005; Ranjan et al., 2006), incorporation of dietary fiber in the form of fruits (Pandya, 2002) and incorporation of probiotic organisms (Yadav et al., 2005) are some of the applications reported. Studies conducted on calcium fortification of cow and buffalo milks for dahi making revealed that among
the three salts studied viz. calcium chloride, calcium lactate and calcium gluconate, the quality of dahi made from cow milk enriched with calcium gluconate (Singh et al., 2005) and buffalo milk enriched with calcium gluconate and calcium lactate (Ranjan et al., 2006) were comparable with the dahi made from the non-calcium fortified milk.

6.2 MISTI DAHI

Misti dahi, also called as mishti doi or lal dahi or payodhi is a sweetened variety of dahi popular in Eastern India (De, 1980). It is characterized by a creamish to light brown color, firm consistency, smooth texture and pleasant aroma. Traditionally, misti dahi is prepared from cow or buffalo or mixed milk. It is first boiled with a required amount of sugar and partially concentrated over a low heat during which milk develops a distinctive light cream to light brown caramel color and flavor. This is then cooled to ambient temperature and cultured with sour milk or previous day’s dahi (culture). It is then poured into consumer- or bulk-size earthen vessels and left undisturbed overnight for fermentation. When a firm body curd has set, it is shifted to a cooler place or preferably refrigerated. Till recently, misti dahi preparation was mainly confined to domestic or cottage scale operations. However, the technology for the manufacture of misti dahi in an organized manner was developed by Ghosh and Rajorhia (1990). The process involves standardization of buffalo milk (5% fat and 13% SNF) followed by homogenization at 5.49 MPa pressure at 65°C, sweetening with cane sugar (14%) and heating mix to 85°C for 10 min. Then cooling the mix to incubation temperature and inoculating with suitable starter culture and incubating the mix to obtain a firm curd. The firm curd is transferred to cold storage (4°C) and served chilled. Now, the organized dairies for example, Mother Dairy, Delhi is manufacturing and marketing misti dahi at large scale.

6.3 SHRIKHAND

Shrikhand is an indigenous fermented and sweetened milk product having a typical pleasant sweet-sour taste. It is prepared by blending chakka, a semi-solid mass obtained after draining whey from dahi, with sugar, cream and other ingredients like fruit pulp, nut, flavor, spices and color to achieve the finished product of desired composition, consistency and sensory attributes. Shrikhand has a typical semi-solid consistency with a characteristic smoothness, firmness and pliability that makes it suitable for consumption directly after meal or with poori (made of a dough of whole-meal wheat, rolled out and deep-fried) or bread. Although largely produced on small scale adopting age-old traditional methods, shrikhand is now commercially manufactured in organized dairy sector to cater to the growing demand.

The traditional method of making shrikhand involves the preparation of curd or dahi by culturing milk (preferably buffalo milk) with a natural starter (curd of the previous batch). After a firm curd is formed, it is transferred in a muslin cloth and hung for 12–18 h to remove free whey. The chakka obtained is mixed with required amount of sugar, color, flavoring materials and spices and blended to smooth and homogenous consistency (Upadhyay and Dave, 1977). Shrikhand is stored and served in chilled form. The batch-to-batch large variation in the quality and poor shelf life of shrikhand are the serious drawbacks of the traditional method. Generally the recovery of solids in chakka is also low. With a view to overcome the limitations of the traditional method, Aneja et al. (1977) developed an industrial process for the manufacture of shrikhand. Normally skim milk is used for making dahi for the manufacture of shrikhand in this method. By using skim milk, not only fat losses are eliminated, but also faster moisture expulsion and less moisture retention in the curd are achieved (Patel, 1982).

The use of the right type of culture is an essential pre-requisite for the manufacture of shrikhand. Among different starter cultures recommended by various workers, LF–40, a culture containing Lactococcus lactis
subsp. *lactis* and *Lactococcus lactis* var. *diacetylactis*, has received wide acceptance by many *shrikhand* manufacturers. The LF-40 culture @ 1–1.5% is added to milk and the milk is incubated at 30°C for 10–12 h in order to get 0.9% of titratable acidity in the curd. *Dahi*, so obtained is centrifuged in a basket centrifuge to get *chakka*. Measured quantities of *chakka*, sugar, cream and additives are mixed in a planetary mixer to get *shrikhand* (Patel and Chakraborty, 1985). With a view to extend the shelf life of *shrikhand*, many dairies normally practice thermization. *Shrikhand*, being a semi-solid product, is packed in heat-sealable polystyrene containers of various sizes ranging from 100 g to 1.0 kg and stored at refrigerated temperature.

Sharma and Reuter (1992) attempted to adopt UF technology for making *chakka*, the base material for *shrikhand*. The objective was to recover all the whey proteins and increase the yield of the final product while automating the process. The process involved heating skim milk in a double jacketed vat with slow agitation up to a temperature of 95°C for 5 min and then cooling it to 21–22°C. This was followed by inoculating with mixed starter culture (*Lactococcus lactis, Lactococcus lactis* var. *diacetylactis* and *Lactococcus cremoris*) at a rate of 0.1 – 0.15%. It was incubated at 21–22°C for 16–18 h so as to get curd with pH of 4.6–4.5 and with a pleasant diacetyl aroma. The coagulum obtained was agitated slowly and subjected to ultrafiltration. Whey was removed in the form of permeate. The *chakka* thus obtained was mixed with 70% fat cream and sugar so as to manufacture *shrikhand* that contained 6% fat, 41% sugar and 40% moisture. The mixture was then kneaded in a planetary mixer at 25–26°C in order to get a smooth paste-like semi-solid consistency with no feeling of sugar grains. It was reported that there was practically no difference between traditional and UF-*shrikhand*. Recently, Md-Ansari *et al.* (2006) also developed *shrikhand* using UF pre-concentrated skim milk.

Several attempts have been made to incorporate different additives into *shrikhand* to address the growing interest in the diversification of food products to attract a wider range of consumers. The pulp of fruits such as apple, mango, papaya, banana, guava and sapota (Bardale *et al.*, 1986; Dadarwal *et al.*, 2005), cocoa powder with and without papaya pulp (Vagdalkar *et al.*, 2002) and incorporation of probiotic organisms (Geetha *et al.*, 2003) have been tried in *shrikhand*. However, in case of post-fermentation addition of pulps, it is essential from the food safety angle, that the fruit pulp intended for addition must be subjected to heat treatment equivalent to pasteurization.

### 6.4 LASSI

*Lassi* is made by blending *dahi* with water, sugar or salt and spices until frothy. The consistency of *lassi* depends on the ratio of *dahi* to water. Thick *lassi* is made with four parts *dahi* to one part water and/or crushed ice. It can be flavored in various ways with salt, mint, cumin, sugar, fruit or fruit juice and even spicy additions such as ground chilies, fresh ginger or garlic. The ingredients are all placed in a blender and processed until the mixture is light and frothy. Sometimes a little milk is used to reduce the acid tinge and is topped with a thin layer of *malai* or clotted cream. *Lassi* is chilled and served as a refreshing beverage during extreme summers (Sabikhi, 2006). While sweetened *lassi* is popular mainly in North India, its salted version is widely relished in the southern parts of the country. Various varieties of salted *lassi* include buttermilk, chhach and mattha. Ancient Indian literature reports that regular use of buttermilk has therapeutic advantages, being beneficial in haemorrhoids (piles), swelling and duodenal disorders. Buttermilk warmed with curry and/or coriander leaves, turmeric, ginger and salt, is a therapy for obesity and indigestion as per the Indian medicinal science of *Ayurveda* (Sabikhi and Mathur, 2004).

The keeping quality of *lassi* is extended considerably under refrigeration. Although, further extension of shelf life of *lassi* is achieved by ultra high temperature (UHT) processing of product after fermentation...
and packaging it aseptically, the sensory quality is adversely affected due to wheying off. To overcome this problem, Aneja et al. (1989) developed a method for manufacture of long-life lassi that does not settle down over extended storage in aseptic packs. Now, UHT-processed lassi and spiced buttermilk are commercially manufactured and marketed by different dairies in India.

Kumar (2000) developed lassi for calorie-conscious and diabetic people using an artificial sweetener and reported that aspartame at a rate of 0.08% on curd basis was the most acceptable level to prepare low-calorie lassi. Recently, Khurana (2006) developed suitable technologies for the manufacture of mango, banana and pineapple lassi along with their low-calorie counterparts using artificial sweeteners.

7. CEREAL BASED DAIRY PRODUCTS

7.1 KHEER

Kheer is a heat-desiccated, cereal-based sweetened and concentrated milk confection. Kheer prepared from buffalo milk is whiter and thick bodied and is, therefore, preferred over that obtained from cow milk. In addition to milk, kheer also contains substantial amount of non-dairy ingredients such as rice, sugar, semolina, cardamom, almonds, pistachio, etc. It is characterized by sweet, nutty and pleasant flavour (Aneja et al., 2002). De et al., (1976) standardized the method of manufacture of kheer. The suitability of several types of rice viz. basmati, parmal and parboiled for kheer making were studied by Jha (2000) who reported that basmati brokens were most suitable for kheer making. Kheer has a limited shelf-life of about one day at ambient temperature. Hence, a process has been developed with an objective to enhance its shelf-life by adopting in-package cooking and sterilization of kheer in retort pouches (Jha et al., 2000).

7.2 PAYASAM

Payasam, a milk-based delicacy popular in the southern parts of India, forms an integral part of the cultural ethos of South India. There are several varieties of payasam with distinct characteristics that may be attributed to the area of their origin and traditional methods of preparation. These include vermicelli payasam, khus-khus or gasa-gase (poppy seed) payasam, palada payasam etc. The popularity of different varieties also differs from state to state (Unnikrishnan et al., 2000). Based on the use of ingredients other than milk and sugar, payasam is classified as pulse-based, cereal-based, tuber product-based, fruit-based and seed-based. In general, payasam is thinner in consistency than kheer, although its varieties range from free-flowing to solid. The colour of payasam varies from white, light cream, cream and light brown to brown. However, it is distinctly brown when jaggery is used as the sweetening ingredient. The methods of manufacture of different varieties of payasam and their dry mixes have been standardized (Venkateshwarlu and Dave, 2003; Nath et al., 2004).

8. FROZEN DAIRY PRODUCTS

8.1 KULFI

Kulfi is a popular frozen dessert of Indian origin produced by freezing a mix obtained from concentrated milk (khoa-like) and sugar. Kulfi differs from ice cream that it contains practically no air. Although manufactured traditionally by halwais at small-scale, of late large kulfi is produced and marketed by large dairies employing modern methods. Salooja and Balachandran (1982) standardized the method of production of kulfi and reported that use of milk with 26 percent TMS gives kulfi with better body, texture and overall acceptability. Kulfi contains 13–20% sugar which is an obstacle to relish for diabetic people. To overcome this, efforts were made to develop a technology for the production of kulfi using artificial sweeteners and bulking agents (Pandit, 2004).
9. FAT-RICH DAIRY PRODUCTS

Buffalo milk is also best suited for the preparation of fat-rich dairy products viz. malai (clotted cream), makkhan (Desi butter) and ghee (clarified butter) compared to cow milk due to its higher fat content, bigger size of the globule and higher proportion of solid fat leading to the higher yield, lesser loss of fat in butter milk or skim milk, easy preparation of cream or butter and better granulation (Sindhu, 1996).

9.1 MALAI

Malai or clotted cream is a fat-rich portion of milk formed at the interface of undisturbed hot milk (90-95°C) and air due to interaction between denatured proteins and lipids. It is a form of white clotted cream and an intermediate product in the indigenous method of ghee-making. The gross composition of malai prepared by conventional method using buffalo milk with 6% fat was reported to be 54.08% total solids, 32.5% fat, 14.7% protein, 5.59% lactose and 1.27% ash (Pal et al., 2005).

9.2 MAKKHAN

Makkhan is the traditional unsalted butter made by hand-churning the whole milk dahi. It is white with a slight green tint and is preferred to creamy yellow product from cow milk. It has a distinctive, pleasant aromatic flavour derived from fermented dahi, from which it is made. There is no addition of salt or colouring matter, as in western style cultured butter (Aneja et al., 2002).

9.3 GHEE

Ghee is heat-clarified butterfat derived solely from milk or curd or from desi butter (cooking butter) or from cream to which no colouring matter or preservative has been added. In India, ghee is considered as an excellent cooking or frying medium. In addition, ghee is used for numerous religious rites by Hindus and it has also many medicinal uses (Rajorhia, 2003). It is usually prepared from cow’s milk, buffalo’s milk or mixed milks. Ghee made from cow milk fat has a distinct golden yellow colour, attributable to carotene. On the other hand ghee from buffalo milk is noted for its white colour with a greenish tinge, attributed to bilirubin and biliverdin. On an average cow or buffalo ghee contains 99.0-99.5% fat and less than 0.5% moisture. Traditionally, ghee is produced by first converting milk into dahi, churning dahi to produce makkhan, and subjecting makkhan to heat clarification to yield the final product. Ghee production forms the largest segment of the milk consumption and utilization pattern in India (Aneja et al., 2002). Hence for obvious reasons, many efforts have been made by various workers to mechanize the process of ghee production.

Punjrath (1974) developed a prototype continuous ghee making plant of 100 kg/h capacity on the principle of flash evaporation using butter as base material. In another process Abichandani et al., (1995) a thin film scraped surface heat exchanger (TFSSHE) attached with a butter melter for continuous manufacture of ghee. The organoleptic and chemical quality of ghee prepared by this continuous mechanized method did not differ from that prepared by batch process. Recently, Patel et al. (2006) developed an industrial method of ghee making with an aim to reduce fat and SNF losses by inclusion of serum separator and a spiro-heater. It was claimed by the authors that the new method offers more commercial benefits than the existing methods.

10. TEXTURE AND MICROSTRUCTURE OF TRADITIONAL DAIRY PRODUCTS

The unique feature of Indian traditional dairy products is that they are obtained by a wide variety of methods (Table 1) involving a range of unit operations. Obviously, this leads to a great range of product
structures and textures. The chemical components of traditional dairy products including various additives and the processing conditions to which they have been subjected, determine the texture and microstructure of the products. Microstructure in turn, controls some of the physical properties such as viscosity, firmness, susceptibility to syneresis and elasticity of these products (Prasad, 1998). Electron microscopy has been employed in a numerous studies by various workers to elucidate the microstructure of Indian traditional dairy products such as khoa (Patil et al., 1992; Adhikari et al., 1994), gulabjamun (Adhikari et al., 1994), paneer (Kalab et al., 1988), chhana (Adhikari et al., 1992, 1993), rasogolla (Adhikari et al., 1992, 1993; Verma and Rajorhia, 1995), misti dahi (Gupta et al., 2000) etc. In some of these studies attempts have been made to relate the textural properties of the product to its structure.

With the growing demand, there is a need for manufacture of traditional dairy products in modern dairy plants, without any compromise on the eating quality of the product. Retaining the product’s complex texture, while following modified or new processes, is a real challenge to the manufacturer. Hence, characterization of a product’s texture is valuable not only in process development studies but also in monitoring of textural quality in routine production. A quantitative and reasonably reproducible approach is developing a texture profile by using a trained sensory panel. Sensory texture profiles of most of the Indian traditional dairy products have been well characterized. While texture refers to sensory perception of the force-deformation relationship in a product, instrumental measurements provide objective information about the subjective properties. Thus, instrumental data have been related to sensory data with a view to making instrumental assessment on several traditional dairy products (Patel, 2006).

Texture profile analysis (TPA) refers to identification and quantification of various constituent perceptions of texture which give the overall texture impression, i.e. the individual texture attributes such as hardness, gumminess, chewiness, etc. In TPA, the sample is usually subjected to large deformation (in the destructive range) primarily to simulate the chewing action (Bourne, 1978). In the recent times, with the advent of modern texture analyzers facilitated with software, most instrumental measurements on traditional dairy products have been made using the TPA approach. Products such as khoa (Patil et al., 1990; Gupta et al., 1993), burfi (Patil et al., 1991), peda (Londhe, 2006), kalakand (Patel et al., 1992), gulabjamun (Kumar et al., 2006), paneer (Gupta et al., 1993), chhana (Desai et al., 1991; Gupta et al., 1993), rasogolla (Desai et al., 1993; Gupta et al., 1993), etc. have been characterized by instrumental TPA. Research conducted at this institute and elsewhere has led to generation of data on fundamental rheological properties of certain products especially paneer employing small deformation tests e.g. stress relaxation (Awadhwal and Singh, 1985; Kashipati, 1991; Rao, 1993). The viscoelastic properties of other products such as kalakand and chhana-murki have also been studied (Patil and Patel, unpublished data).

11. CONCLUSION

Traditional dairy products, apart from being an integral part of Indian heritage, have great social, religious, cultural, medicinal and economic importance. In addition to preservation of milk solids for a longer time at room temperature, manufacture of traditional dairy products add value to milk and also provide tremendous employment opportunity. Owing to the inherent qualitative and quantitative differences, most of these products, particularly ghee, khoa, paneer and dahi have higher yield and better quality when they are made from buffalo milk. On the other hand, some of these products such as chhana and rasogolla are of superior quality when they are made from cow milk. Most of these traditional dairy products are well characterized and the method of manufacture has been standardized using mechanized or semi-mechanized systems.
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This summer TA Instruments is proud to introduce a NEW generation of Q Series™ Differential Scanning Calorimeters. By incorporating over 50 customer-inspired hardware and software improvements, the NEW Q2000, Q200, Q20, and Auto Q20 (AQ20) deliver unparalleled DSC performance. Our NEW Tzero Sample Press & Pans are easy to use, and dramatically improve DSC measurements. NEW Platinum™ software enhances laboratory productivity, validates DSC performance, and ensures accurate and precise measurements, every time.
ORAL PRESENTATIONS
(OP 01 – OP 42)
OP-1

Traditional know how of raw milk cheeses - problems in legal and economic aspects

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Cheese typicity is strongly associated with environmental conditions, way of animal management and producer’s know-how. Saint-Nectaire which benefits from the Protected Designation of Origin label, is a semi-hard raw bovine milk cheese traditionally manufactured in more than 250 farmhouse workshops. Its hand-made production must respect strict charters but must also fit international food safety standards. In spite of good willingness and frequent controls, products contamination constitutes a permanent threat for producers who tend to be overzealous but meet difficulties to maintain traditional practices.

The aim of our study was to evaluate the cost of sanitation in these traditional workshops and the consequences of abusive utilization of biocide molecules. Our results revealed that cost of sanitation represents more than 8% of cheese price. Concerning disinfectant, more than 150 different commercial brand disinfectants have been counted mainly based on four biocide molecules. Emergence of micro organism’s resistance to these molecules has been demonstrated.

OP-2

Bioactivity of functional food ingredients

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As living standards rise, people are more concerned with the health benefits of foods. Functional foods which are enhanced with bioactive components are, therefore, receiving increasing attention worldwide. Considerable potential exists to add bioactive ingredients to traditional dairy foods to increase their functionality and health enhancing properties. Our research uses cell culture model systems to examine the bioactivity of a range of phytochemicals. As an example, we present some of our recent findings on phytosterols. With increasing intake of phytosterol enriched products, concern has been expressed that absorption of other fat soluble dietary constituents may be compromised. Additionally, the potential toxicity of phytosterol oxidation products has not been addressed. We present data demonstrating that phytosterols do not interfere with the absorption of xanthophyll carotenoids and essential fatty acids. We report that phytosterol oxidation products are less toxic than cholesterol oxidation products.

OP-3

Studies on the development of a new milk-cereal based nutritional supplement (Nutrifil) and its efficacy in the nutritional support and rehabilitation of children and adults

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A low cost, high nutritional value milk-cereal based dry blend (Nutrifil) was developed using fat-filled milk powder, pre-cooked wheat, sucrose, and a vitamin/mineral premix. Nutrifil was found to be
Oral Presentations

convenient and easy to prepare, and highly acceptable in terms of taste and texture to both children and adults. The performance of Nutrifil in promoting optimal nutritional status in malnourished individuals was tested through clinically controlled feeding trials, four of which are presented here. Two studies were carried out in Uganda on HIV-infected adults and two in Romania on institutionalised neurologically disabled children. The studies in Uganda revealed that a daily 4.2 MJ supplementation with Nutrifil over a period of eight weeks, taken with their normal diet, promoted significant weight gain and improved the immune status of HIV-infected adults in both hospitalised and non-hospitalised patients. In the Romanian studies Nutrifil was given at various levels of supplement up to 3.15 MJ per day, in addition to the normal diet, to children with neurological disabilities, depending on the level of malnutrition, for periods of up to eight months. In both studies significant increases in weight and height velocity in the children were reported, and those with the worst malnutrition (60-79 % weight-for-height %), in particular, notably improved. At a cost as low as €0.50 per 4.2 MJ of the supplement Nutrifil was thus found to be a versatile cost effective food supplement for these situations.

OP-4

Fractionation of dairy proteins using high-pressure and supercritical carbon dioxide

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In our laboratory, high pressure carbon dioxide (CO₂) has been used to produce casein in a continuous process and supercritical CO₂ has been used to produce enriched fractions of the whey proteins through manipulation of pressure, temperature and protein concentration, all of which affect solution pH. When CO₂ is dissolved into milk, it hydrolyzes to form carbonic acid. Processes based on CO₂ may be more economical than other methods because relatively concentrated feed streams or milk, instead of dilute feed streams, may be processed; and, are environmentally friendly because the CO₂ may be recovered after separation has been achieved. Use of CO₂ to precipitate casein from milk resulted in a protein comprised of large aggregates and decreased solubility compared to calcium caseinate but with similar secondary characteristics. Preliminary studies indicate that electrostatic interactions may be responsible for the differences in properties between CO₂-casein and acid casein, and sodium and calcium caseinates.

OP-5

Water transfer during rehydration of micellar casein powders

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Rehydration is an essential quality attribute of a dairy powder because most powders are dissolved before use. However, there can be problems associated with different stages of the rehydration process: i.e. wettability, sinkability, dispersibility, solubility. Many sensors and analytical methods such as the insolubility index, NMR spectroscopy, turbidity, viscosity and particle size distribution can be used to study water transfer in dairy protein concentrates during rehydration. Micellar casein (MC) powder, obtained by tangential membrane microfiltration of milk followed by spray drying, is an interesting dairy
powder due to its high level of protein content and is a valuable model of milk micelles. However, enrichment of milk in micellar casein decreases water transfer during rehydration of MC powder. The low water transfer during MC powder rehydration is time consuming. Some studies have shown that insolubility is related to a decrease in water transfer needed for rehydration and not thermal denaturation. Other studies have also shown that the decrease in water transfer might be related to the micellar structure. In the present study, the destructuration of micellar structure induced by addition of phosphate or citrate solution to MC increased water transfer during rehydration. Water transfer in the dairy protein concentrate during rehydration was shown to be the function of the aqueous environment, the nature of mineral salts, the structure of dairy proteins, the size of the powder particle and the rehydration conditions.

**OP-6**

**Food stability beyond water activity and glass transition: Macro and micro region concept in the state diagram**

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Water activity concept proposed that a food product is the most stable at its monolayer moisture content. In order to avoid limitations of water activity, glass transition concept was proposed in the literature. Based on the glass-transition concept, a food is the most stable at and below its glass transition. In recent days it is also evident that glass transition concept is not valid for stability determination of many quality attributes under different conditions. The glass transition concept was used to develop state diagram by drawing another stability map using freezing curve and glass line. Recently, other components are being included in the state diagram. It is being emphasized in the literature to combine water activity and glass transition concepts. An attempt is made to combine these two concepts in the state diagram and to propose macro and micro-region concept for determining the stability of foods.

**OP-7**

**Kishk - A dried cereal/fermented milk traditional product**

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Many societies have traditionally preserved surplus milk as dried fermented products sometimes incorporating other ingredients. One such traditional product is Kishk – a dried cereal/fermented milk product widely consumed for centuries in the Middle East, Western Asia and the Himalayan region. The ratio of cereal to fermented milk in Kishk typically ranges between 1:2 and 1:4. Kishk is normally free of pathogens such as coliforms but typically contains yeasts and moulds reflecting the hygienic conditions of the manufacturing environment. Sporeforming organisms are normally present in significant amounts. Kishk is a very nutritious product as the nutrient profiles of the cereal and milk constituents complement one another.
OP-8

Traditional Indian cultured milks and fermented dairy products

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Fermented dairy products constitute one of the most important functional food and is a vital component of the human diet in India as in many other regions of the world. Dahi (curd), mishti doi, probiotic dahi, yoghurt, shrikhand, lassi and cultured butter milk figure prominently in people’s diet in different parts of India and world. Cow and buffalo milk is generally used for dairy purpose, but occasionally from other mammals such as goats, sheep, yaks and horses are also used in some parts of world. Besides imparting nutrition and novelty, these products have probiotic effects as it contain sufficient levels of certain live and active cultures, which can help to improve bacterial microflora of the intestinal tract, it also help to preserve the precious nutrients of milk. The word Dahi comes from Sanskrit word “Dadhi”; there are numerous references to dahi in the ancient Vedas. Milk was fermented with green leaves, palasha bark and putica creeper. Dahi (dadhi) was eaten with barley or rice. Churning of Dahi to make butter at home and utilize the refreshing buttermilk with leftover grains of butter in it as a refreshing drink has been practiced for several centuries. Cultured dairy products find a very prominent position in the Indian culture, food habit and religious ethos. Fermented dairy products are traditionally prepared at small scale in each household as unorganized sector, now the commercial production of some of these products has become a big activity industry. Around 9% of the total milk produced in India is converted into fermented milk products and this sector is showing an annual growth rate of more than 20% per annum.

OP-9

Application of membrane processes for upgradation of Indian traditional milk products

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The main pressure driven membrane systems in ascending order of pore size are: reverse osmosis (RO), nanofiltration (NF), ultrafiltration (UF) and microfiltration (MF). In a broader sense, RO is essentially a dewatering technique, NF a demineralization process, UF a method for fractionation and MF a clarification process. Membrane processes are increasingly being used in the dairy industry because of several inherent advantages. These are continuous molecular separation processes that do not involve either a phase change or inter-phase mass transfer. RO is the most energy efficient dewatering process. Fluid milks can be partially concentrated economically using RO, particularly for the preparation of Indian traditional concentrated dairy products like khoa, chakka, shrikhand, rabri, basundi and kheer. The economical levels of RO concentration for whole milk is up to 30% TS and for skim milk, 22% TS. Inherent problems of salty taste and sandy texture in cow milk khoa could be overcome by nanofiltration of cow milk to 1.5 fold concentration before khoa manufacture. Dahi prepared from nanofiltered cow milk was also found to be superior to that of normal cow milk dahi. UF/MF processes have been used for the manufacture of chakka, srikhand, chhana and chhana based sweets, rasogolla mix powder and long-life paneer. UF technology has also been applied to upgrade manufacture of khoa from cow and buffalo milks by incorporating whey protein concentrates. The quality of Indian traditional dairy products can be further improved by removing up to 99.9% microorganisms, particularly spores from the milk by MF process. Energy
requirements of membranes processes are very low compared with traditional evaporation process. Further, membrane processes can be carried out at ambient temperature. Thus, thermal degradation problems common to evaporation process can be avoided resulting in better nutritional and functional properties of milk constituents. Easy, simple and economical operation, improved recovery of constituents and better yield of products are other advantages for which membrane processes are valued.

**OP-10**

**The quality and chemical composition of traditional Egyptian cheeses- a review**

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Traditional Egyptian cheeses are consumed not only in Egypt but also in the Arab world in general. Domiati, Karieh, Ras, Processed cheeses are the most popular and traditional cheese types in Egypt. They have received much attention and many research studies by Egyptian scientists. This review describes the chemical composition and the quality of these cheeses.

**OP-11**

**Process modifications for the manufacture of Indian traditional dairy products from buffalo milk**

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Traditional dairy products are an integral part of Indian heritage and culture. These products have been developed over a long period with the culinary skills of housewives and halwais and possess great social, religious, cultural, medicinal and economic importance. In addition to preservation of milk solids for longer time at room temperature, manufacture of traditional dairy products add value to milk and also provide tremendous employment opportunity. In India milk from both buffaloes and cows is commercially important. Depending on its inherent qualitative and quantitative characteristics, each type of milk is eminently suitable for certain types of region specific indigenous milk products. Buffalo milk because of high total solids and fat is suitable for certain products such as ghee, paneer, khoa, dahi, etc. while cow milk is suitable for chhana and chhana-based sweets. Process modifications have been to make good quality khoa and paneer from cow milk. Likewise technological modifications in buffalo milk for manufacture of good quality chhana for rasogolla and sandesh making have also been made. The possibilities of making some region specific products like rabri, basundi and some other milk confections on commercial scale with extended shelf life have also been explored. With the growing interest in health foods, attempts are made to develop technologies for milk confections with enhanced health attributes. These process modifications and developments in manufacture of traditional dairy products using buffalo and cow milks are discussed in this presentation.
OP-12

Milk-derived bioactive proteins and peptides- promising ingredients for functional foods

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Functional foods have emerged as a new approach to improve human nutrition and well-being. This development has been facilitated by increasing scientific knowledge about the effects of diet and specific dietary components on human health. Accordingly, opportunities have arisen to formulate food products which deliver specific health benefits, in addition to their basic nutritional value. Such tailor-made products optimally target particular consumer groups at risk of chronic diseases, e.g. cardiovascular and metabolically induced diseases. In essence, the introduction of functional foods has shifted the nutrition sciences from identifying and correcting nutritional deficiencies to designing foods that promote optimal health and reduce the risk of disease. The dairy industry has pioneered in the development of functional foods. This status is supported by the fact that milk and colostrum are considered at present the most important source of natural bioactive components that can be exploited for development of health-promoting foods. The traditional dairy streams (milk, colostrum, whey) contain a multitude of bioactive components which can be fractionated and isolated in purified form and used as functional ingredients both in dairy and non-dairy formulations and even pharmaceuticals. In this respect, many specific milk proteins and their peptide derivatives have proven the most promising ones. Clinical evidence for the efficacy of these bioactives is now accumulating, for example in prevention of certain gastrointestinal infections, reduction of blood pressure and control of body weight. In particular, the functional diversity demonstrated by milk peptides has prompted recently a lot of active research and commercial interest. A few functional food products based on milk peptides have already been launched on global markets. Furthermore, bioactive peptides have been identified in various traditional fermented dairy products. These results should encourage future research to focus on maximizing the health-promoting potential provided by such products.

OP-13

Cheeses from buffalo milk

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Cheese, the nature’s wonder food and the classical product of biotechnology, is a highly nutritious food with good keeping quality, enriched pre-digested protein with fat, calcium, phosphorus, riboflavin and other vitamins, available in a concentrated form. It has been reported to have therapeutic, anticholesterolemic, anticarcinogenic and anticariogenic properties beyond their basic nutritive value. Scenario of cheese production in India is quite bright because of the facts that cheese has all the beneficial attributes of an ideal dairy product and the emergence of new global economic reforms based on globalization and liberalization in the marketing arena that has unfastened the door to the Indian dairy industry to penetrate the international cheese market.
Cow milk is considered to be an ideal raw material for manufacture of various ripened varieties of cheese. In India it is buffalo milk, which shares more than 54 per cent to the total milk production. Buffalo milk due to its intrinsic basic differences in its physico-chemical make-up has posed certain problems in manufacture of hard and semi-hard varieties of cheese. The major problems encountered in the manufacturing of such hard cheeses from buffalo milk have been the slow development of acidity, faster renneting time, lower retention of moisture, hard rubbery and dry body, slower proteolysis and lipolysis and lack of characteristic flavour. A great deal of research work has been done at National Dairy Research Institute and elsewhere to manufacture good quality of hard and semi-hard varieties of cheese. It has been suggested that heating the milk at relatively higher temperature, addition of sodium chloride to milk, higher starter culture inoculum, supplementing the starter with Lactobacillus casei/Lactobacillus helveticus, low setting temperature, and low cooking temperature have made it possible to manufacture good quality cheese. Process has also been developed to enhance flavor development by addition of lipase and protease enzymes, using partially lactose hydrolyzed milk, blending of buffalo milk with goat milk and using microencapsulated enzymic preparations such as FlavorAge, Accelase, NaturAge, etc. Technologies have been appropriately standardized for manufacture of various types of cheeses such as Cheddar, Swiss type, Gouda, Mozzarella and Cottage cheese. Process for low fat Gouda and Cheddar cheese as well developed employing certain manufacturing modifications and using modified starters and exogenous enzymes to meet the requirements of health loving clientele. Attempts are being made to develop fresh Quarg and Feta type cheeses from buffalo milk to cater the need of national and international markets.

OP-14

Ready mixes of traditional Indian dairy foods

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Traditional dairy foods are part of Indian ethos and culture. There are a wide variety of traditional dairy foods prepared across the country by adopting processes like condensation, fermentation, clarification, desiccation either singly or in combination. Some of the common dairy foods produced in the country are Pedhas, Halwas, Payasams, Kheers, Burfis, Chhana based sweets, Kadhi etc. Some of these products are produced during special events like marriages, birthdays and other auspicious occasions.

The production of many of the traditional foods is cumbersome and time consuming. Attempts have been made to produce and present these products in the form of ready-to-eat and ready-to-use convenience foods. The ready mixes category falls into the category of ready-to-use form and several traditional foods are available in this form and offers convenience of use to the end user. Some of the popular products in this market of estimated size of 200 million US $ (Rs. 800 crores) are the Jamun mix, Badam mix, Kheer mix, Basundi mixes, Dalia dessert mixes etc.

The convenience mixes can be prepared by dry blending, tray drying, vacuum tray drying, roller & spray drying, osmotic dehydration and crystallization drying process. Some of the products developed by the above processes like Payasm mix, dehydrated Kadhi, Jowar – Milk based porridge mixes, Dalia dessert mixes Kheer mix etc. are discussed in the presentation “Ready Mixes of Traditional Indian Dairy Foods”.
Bio-preservation of traditional Indian dairy foods

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Preserving food to extend its shelf-life, whilst ensuring its safety and quality, is a central preoccupation of the food industry. As a result, there has been a steady stream of new ‘minimal’ preservation techniques. The development of the hurdle concept has led to renewed interest in the use of more traditional preservation methods and the ways they can be combined with newer technologies.

Although bacteriocins may be found in many Gram-positive and Gram-negative bacteria, those produced by lactic acid bacteria (LAB) have received particular attention in recent years. Several LAB bacteriocins offer potential applications in food preservation, and the use of bacteriocins in the food industry can help reduce the addition of chemical preservatives as well as the intensity of heat treatments, resulting in foods which are more naturally preserved and richer in organoleptic and nutritional properties.

Also, the use of these bacteria and their metabolites is generally accepted by consumers as something “natural” and “health-promoting”. Consequently, there has been renewed interest in so-called “green technologies” including novel approaches for minimal processing and the exploitation of bacteriocins for bio-preservation.

Bacteriocins can be added to foods in the form of concentrated preparations as food preservatives, shelf-life extenders, additives or ingredients, or they can be produced in situ by bacteriocinogenic starters, adjunct or protective cultures. Immobilized bacteriocins can also find application for development of bioactive food packaging. In recent years, application of bacteriocins as part of hurdle technology has gained great attention.

The most well-known bacteriocin is nisin, the lantibiotic which has found application as a shelf-life extender in a broad range of products worldwide, ranging from processed and cottage cheese to dairy desserts and liquid egg. The success of nisin has prompted many research groups to search for novel bacteriocin producing strains over the last 20 years. This has resulted in a growing range of potential biopreservatives which may be used successfully to protect food from spoilage and safety problems. Another commercially exploited bacteriocin pediocin PA-1, produced by *Pediococcus acidilactici* is marketed as ALTA. Lacticin 3147 produced by *Lactococcus lactis* DPC3147 has been tested as biopreservative in various dairy and food products. Microgard™ products are bacteriocin like inhibitory substances produced by fermenting Grade A Skim milk with *Propionibacterium* species. These have been approved by FDA and widely used as biopreservative. Recently we have produced a highly potent bacteriocin Pediocin 34 from *Pediococcus pentosaceus* 34 isolated from Cheddar cheese. Pediocin 34 based biopreservative has been shown to significantly enhance the shelf life of some of the indigenous dairy products. It may serve to enhance the shelf life of several foods in combination with other hurdles.
OP-16

Equipments for traditional Indian dairy foods – NDRI experience

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The specific processing requirements for equipment development for traditional Indian milk products are diversified. Concerted efforts have been made at this institute to design equipments for different categories of users and a number of presentable prototypes have been developed. The requisite engineering design inputs could be delineated as preheating, concentration, scrapping of equipment surface, mixing and blending of ingredients and milk-metal-air contact for producing characteristic mild cooked flavour in indigenous dairy products. Sometimes several of the above operations are to be carried out simultaneously in the same processing vessel.

Institute has contributed significantly in generation and accumulation of complete profile of engineering design data on several traditional dairy products for R&D applications. Traditional dairy products in our country are made manually, handling up to 4-5 litres of milk at the domestic level and up to 20 litres of milk at halwai level, where the products are freshly made and consumed mostly within a day. In order to overcome the shortcomings associated with manufacture of traditional dairy products at this level, equipments have been developed for some such products for small-scale applications, such as, paneer making gadget, cream separator attachment for mixies, a curd beater and mechanized khoa pan for rural applications. The category of process equipments catering to the need of entrepreneur supplying products to a group of local halwais or the dairy plants producing indigenous milk products need to handle milk up to 50 litres per hr in a batch type operation or from 200 to 500 litres per hr in a continuous mode of operation. Some such equipment developed at our institute are batch type designs of multi-process vat for viscous dairy products and scraped surface heat exchanger for khoa and equipment designed for continuous processing paneer / chhana, khoa, ghee and chhana ball forming and cooking of rasogolla.

Texture formation in traditional dairy products is one important characteristic for process mechanization as product with a pasty consistency and poor grainy texture has low acceptability. Innovative gaps also exist on development of appropriate packaging machinery and packaging materials for traditional milk products, for integration with the mechanized processing line and also on development of shelf life prediction software based on product, package and environment interaction with regard to above products.

OP-17

Advances of computer vision technology in food quality evaluation

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Computer vision based on image processing/analysis techniques have been increasingly employed in the food industry for quality inspection, classification and evaluation, with great advantages in its objectiveness, efficiency and reliability. The food industry now ranks among the top ten industries using computer vision technology. Especially computer vision has recently been investigated as a tool to evaluate the functional properties of cheddar and mozzarella cheeses, topping percentage and distribution of pizzas and quality attributes such as shrinkage, pores size and distribution, texture and colour of cooked meats,
which has significantly expanded its possible application in the food industry. This paper reviews the most recent progress in the application of computer vision in the food industry for quality evaluation including meat, poultry, seafood, fruit and vegetables, grains and other foods.

**OP-18**

**Flavor considerations in traditionally consumed cheese products in Brazil**

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In the Northeast region of Brazil, two cheeses, commonly known in Portuguese language as Queijo Coalho and Queijo Pré-cozido (their equivalent in English language being “Curd cheese” and “Precooked cheese”) are the main cheese products which are highly appreciated. Even today, most of the production of these cheeses is still done by small-scale farmers wherein processing control measures are not stringent, consequently leading to a wide variation in the quality of these products. This presentation will focus on the production and quality aspects of various cheeses traditionally consumed in Brazil. Minas Frescal cheese is another cheese which is very popular and enjoys the prestige of large consumption by Brazilians. This cheese is soft (50-70%, w/w), white, slightly salted and possesses slight lactic acid taste. Most of these products have short shelf life. Recently low-fat content products have also appeared in market and these are gaining importance. Besides the sensorial attributes of most of the traditional cheese products, this work will also highlight the differences in aroma quality and volatiles composition of curd and precooked cheeses. The volatile compounds of these cheeses were also analyzed by using a simultaneous distillation and extraction technique utilizing Likens and Nickerson’s apparatus. Thirty gram of cheese was homogenized and extraction was carried out at 55°C for 120 min by using a mixture of pentane-ethyl ether (2:1) solvent. The extracts were concentrated and analyzed for the identification of volatile compounds using a system of high resolution gas chromatograph coupled with mass spectrometer. A large variation in volatile profile of the two cheeses was observed and curd cheese was preferred in aroma and flavour attributes as compared to that of the precooked cheese.

**OP-19**

**Traditional Indian dairy products: Prospects for industrialization**

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Manufacture of traditional milk products is the most prolific segment of the Indian Dairy Industry. Preparation and marketing of these products has been mainly confined to the unorganized sector and represents the most promising venue for industrialization in view of the value addition during the conversion process.

Dairy Sector as well as the international trade of dairy commodities has been undergoing major transformations worldwide. Vibrant economies of the new entrants on the global scenario – such as India, China, Argentina, Ireland etc have influenced considerably the world trade of dairy products. EU has been realigning the internal quota systems in a dynamic manner for greater share of the Global trade. Further growth of the Nation’s Dairy Industry would have to cope with the rapid transformations that
are taking place in the world economies under the WTO regimen. Lucrative markets for traditional dairy products also exist overseas, where ethnic populations of Indian subcontinent have settled down. The Indian dairy industry faces the twin challenges of meeting a strong domestic demand and tapping the more profitable export markets. Major challenge lie in the development of technologies and equipments for the industrial production of traditional dairy products conforming to quality standards. With the growing awareness towards health and nutrition, appropriate packaging and nutritional labeling have assumed greater significance. Quality parameters for the International trade for dairy products are regulated by the WTO guidelines. Newer and stricter sanitary and phytosanitary standards are being developed and implemented for regulating quality parameter for the export of dairy products. Concerns for the product quality and safety coupled with the environmental issues will significantly affect the way milk is produced, processed, packaged and marketed. It calls for adopting GMP, ISO Quality Management Systems, HACCP and conformation to the Codex standards. Future development plans must pay necessary attention to the energy utilized for milk production, handling and processing in context with the global warming. Considerable scientific, technological and financial inputs need to be planned strategically planned if the available opportunities are to be favorably consolidated.

Various economic and market driven forces will determine the changes that are needed for restructuring the unorganized sector of the dairy industry engaged in the preparation and marketing of ethnic dairy products. Booming domestic economies, enhanced purchasing power, need for convenience etc. will determine the technological changes and extent of industrialization of this sector. This event organized by the National Dairy Research Institute forum is very timely and will help to bring into focus various developmental issues for restructuring this hitherto unorganized sector.

**OP-20**

**Use of dairy products as vectors for promotion of health: selected examples**

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Milk and dairy products have for ages been recognized for their nutritional importance — owing to high and balanced contents of protein, fat, sugar, vitamins and minerals. More recently, a growing interest in health and well-being of the consumer, and consequently an increasing demand for safe and environment-friendly premium products, have urged the dairy industry, on the one hand, and the dairy research, on the other, to better understand and eventually respond to such trends — in order to satisfy consumer’s objectives, as well as contribute to a sustainable economy. Integrated research programs are thus required to meet those challenges — among which incorporation of probiotic strains, upgrading of whey via physical or biological routes, and use of plant enzymes as rennets are strategic examples (that are to be further discussed in this presentation).

Ongoing studies pertaining to the incorporation of probiotic strains, from the Bifidobacterium and Lactobacillus genera, in dairy matrices have provided insight into their potential as starters for the manufacture of cheese, or as biological additives for the manufacture of whey cheese — the latter offering the further advantage of food by-product upgrading. Technological performance of strains, effect on novel product development and viability thereof in dairy products during manufacture and storage, as well as stability during (simulated) exposure to gastrointestinal conditions, are among the properties that have been studied and will be presented herein.
Efforts toward reduction of the biological oxygen demand of whey include thermal precipitation of proteins — as in whey cheese manufacture, which may in turn incorporate probiotic strains or slow acid-producing starters, combined with whey protein hydrolysates aimed at enhancing flavour and texture. Results to be discussed have led to production of improved food matrices, following optimized processing and formulation.

Plant rennets — in particular cardosins extracted from thistle flower (Cynara cardunculus L.), have also been a focus of global research efforts; their performance on both caseins (from bovine, ovine and caprine sources) and whey proteins have accordingly been under scrutiny. Assessment of alternative techniques for purification of cardosins, of their proteolytic activity on isolated caseins, α-lactalbumin and â-lactoglobulin, and of generation of bioactive peptides released from such proteins (in cheese-like systems, or in whey protein concentrates) will be considered.

**OP-21**

**Functionality of milk powders in relation to heat stability**

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Milk powders are widely used in recombined milk products and processed foods. The functionality of powders in these applications can be highly variable and occasionally unpredictable, and the solutions to functionality problems tend to be largely empirical in nature. In order to manufacture milk powders that will function consistently, it is important to have a good understanding of the component interactions that occur within the milk during processing and in the resulting powders. The heat stability of milk powder is important in applications such as recombined UHT milks, recombined evaporated milk, soups and sauces. The heat stability of milk powder is affected by the composition of the original milk from which the powder is made, processing conditions, additives and the composition of the food system in which the powder is used. This paper provides an overview of the influence of processing factors on milk component interactions during the manufacture of milk powders. The roles of these component interactions in functionality, particularly heat stability, are discussed in detail.

**OP-22**

**Traditional fermented milk (Laban rayeb) and yoghurt (Zabadi) of Egypt**

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Laban Rayeb is a uniquely Egyptian countryside product. Laban Rayeb is fermented milk similar to yogurt made from raw milk. It’s not subjected to any heat treatment. Acidification spontaneously develops in 24hrs from natural flora of milk. Because of the auto-digestion of lactose by its endogenous bacteria; the lactose in fermented dairy products is better absorbed than other sources of lactose in lactase-deficient subjects. Possible variation between Laban Rayeb and yoghurt compared with milk were investigated. Breath hydrogen measurements were used to determine whether lactase-deficient subjects absorbed lactose in Laban Rayeb better than lactose in yogurt or in milk. Symptoms were scored by questionnaire every 30 minutes for 8 hrs.
Ingestion of 18g of lactose in Laban Rayeb resulted in only about one third as much hydrogen excretion as a similar load of lactose in milk, indicating a much better absorption of lactose in case of Laban Rayeb. Ingestion of Laban Rayeb also resulted in fewer reports of diarrhea or flatulence than did a similar quantity of lactose ingested in yoghurt or milk. The enhanced absorption of lactose in Laban Rayeb or yogurt appeared to result from the intraintestinal digestion of lactose by lactase released from the Laban Rayeb or yogurt organisms. This auto-digesting feature makes Laban Rayeb and yogurt a well-tolerated source of milk for lactase-deficient persons.

The area under the discontinuous curve of breath-H$_2$ concentration decreased relative to lactose results after ingestion of Laban Rayeb but not after yogurt. No correlation of symptoms with the degree of carbohydrate mal-absorption was demonstrated. We conclude that the lactase activity of cultures varies between Laban Rayeb and yoghurt recorded the degree of lactose intolerance varies by individual as Laban Rayeb is able to reproduce the impressive improvement in symptoms after ingestion.

**OP-23**

**Assuring safety and quality of milk and dairy foods**

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The traditional dairy products provide an excellent opportunity for “value-added” dairy foods and represent an untapped potential for growth in domestic as well as international market. Despite their increasing popularity, economic significance and potential economic significance, traditional dairy foods are largely produced by small-scale processors employing age-old methods of processing, handling, storage and distribution, which limit the quality and shelf life of the products. Milk and dairy foods are good growth medium for many microorganisms. The quality and safety of milk and dairy products largely depend on controlling entry and growth of microorganisms from cow to consumer.

The main objective of this presentation is to review the role of microorganisms in safety and quality of milk and dairy products and discuss strategies for controlling the threat of pathogens and spoilage organisms including microbial risk assessment and the Hazard Analysis and Critical Control Points (HACCP) program.

**OP-24**

**Supercritical fluid extraction in dairy processing**

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The increasingly stringent environmental regulations have pointed out the need for the development of environmentally benign technologies for the processing of food products. Supercritical fluid extraction (SFE) using carbon dioxide (CO$_2$) as a solvent has provided an excellent alternative to the use of chemical solvents. A supercritical fluid is any substance at a temperature and pressure above its thermodynamic critical point. It has the unique ability to diffuse through solids like a gas, and dissolve materials like a liquid. CO$_2$ is a common solvent due primarily to its low critical parameters, low cost, non-toxicity, chemical
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inertness, and non-flammability. Dairy products, such as whole milk, butter and cheese have traditionally been the main products of milk processing. The increased production in skim milk and changes in consumer demand have resulted in a large surplus of a milk fat. Milk fat is a good source of essential fatty acids and possesses a uniquely pleasing flavor not found in other fats. On the other hand, its high proportions of saturated fatty acids and cholesterol content have resulted in creating a shift away from its direct consumption and its utilization as an ingredient. Based on its ability to enhance solvating power by varying density, supercritical fluid processing offers a feasible approach to customized fractionation of milk fat by the phenomena of selective distillation and extraction simultaneously. Another unique feature of processing milk fat with supercritical CO$_2$ is the concentration of milk fat flavors (a-lactones) by more than five times the amount in the milk fat. SFE has also been applied in several other areas of dairy processing such as removal of cholesterol, determination of vitamins and veterinary drugs in dairy products, etc. The manuscript covers the principles for the analytical SFE of lipids, instrumentation and applications of SFE to dairy industry.

**OP-25**

**Whey proteins for innovative uses: Encapsulation and controlled delivery of bioactives**

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Whey proteins (WPs) are used in various food applications; however, they also lend themselves for novel applications such as hydrogels and nanoparticle systems for encapsulation and controlled delivery of bioactive compounds. Hydrogels made from whey protein concentrate (WPC) are pH-sensitive with a minimum swelling ratio near the isoelectric point (pl) of WPs (~5.1). These hydrogels are suitable for controlled drug release. The swelling and release behavior of the WPC hydrogels can be controlled by coating them with layers of calcium alginate. Beta-lactoglobulin (BLG), the primary WP, can be used to prepare nanoparticles of about 60 nm average diameter using desolvation method. The stability of the particles was investigated by degradation experiments at neutral and acidic conditions with and without proteolytic enzymes.

**OP-26**

**Nutraceutical properties of dairy ghee**

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The results of three investigations to study the effects of dietary intervention of dairy ghee vis-à-vis soybean oil on gastrointestinal (GI) and mammary carcinogenesis and arteriosclerosis in rats have been reported. In GI carcinogenesis studies, animals on soybean oil diet had higher tumor incidence, tumor multiplicity and tumor volume compared with the animals fed on cow or buffalo ghee. The accumulation of thiobarbituric acid substances (TARS) in liver and colorectal tissue on soybean oil was significantly higher than on dairy ghee; while accumulation of CLA on ghee diets was 5- 7.5 fold of that on soybean oil. In mammary carcinogenesis study, dairy ghee opposed to soybean oil significantly diminished DMBA induced mortality. In studies investigating the effects on arteriosclerosis, mean cholesterol level was
significantly less on ghee diets than on soybean oil. Further, the rise in plasma cholesterol on soybean oil was due, largely to increase in VLDL + LDL-cholesterol, whereas on ghee diets, HDL-cholesterol contributed to major part of increase in plasma cholesterol. Atherogenic index decreased significantly on ghee diets and increased on soybean oil. Cow ghee opposed to buffalo ghee was more effectual in improving lipid profile and resulted in decreased deposition of cholesterol and triglycerides in aorta. Superoxide dismutase activity in RBC, liver and colorectal tissue was significantly higher in ghee groups opposed to soybean oil group. Lysosomal enzymes secreted by peritoneal macrophages and macrophage phagocytic activities were significantly higher on ghee diets than on soybean oil. Hence, dairy ghee attenuates gastrointestinal and mammary carcinogenesis and diminishes dietary hypercholesterolemia; the accumulation of conjugated linoleic acid in tissues and/or the stimulation of immune system and antioxidative status might be the contributing factor.

**OP-27**

**Mechanized manufacture of traditional dairy products**

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In India large quantity of milk is consumed as traditional dairy products. The market of traditional dairy product is very large but it is manufactured in small quantities by the individual manufacturers. Limitations exist of large scale production of traditional dairy products. Mechanized manufacture of traditional dairy product can help in large production. Mechanized manufacture as well as packaging facilities will improve the quality of product and self life of products. A global market economy has facilitated technology to produce the indigenous dairy products. Machines which are used for manufacturing western food products can be successfully adapted with some modification for large production of traditional dairy products.

Our Sugam unit has successfully used the quarg separator for manufacturing the maska for shrikhand production and developed as semi-solid packaging machine for better packing. Scrapped surface heat exchanger machines were developed for continuous khoa (condensed solid milk) production along with meat ball portioning machine and doughnut fryer used for Gulab jamun production. Mechanized production will also help in consistent good quality product and also help in developing many value added products.

**OP-28**

**Functional probiotic dairy foods shall lead the market**

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Vedic sanskriti had recognized the role of diet in health and nutrition and now after several thousand years, this is the era when we prove the linkages among health, nutrition and diet with science based investigations. The mind set is changing from ‘breakdown maintenance’ to ‘preventive maintenance’ of health by going towards functional foods. Probiotics, prebiotics, synbiotics, functional foods, neutraceuticals, medifoods, organic foods, bioactive foods, dietetic foods, health foods, etc are the charged words being used in present day research and food markets to offer foods which provide something more.
than the basic nutrition. The concept of synbiotics emerged in mid ‘90s. It is gaining more interest because it improves the viability of probiotics and delivers specific health benefits.

The market of functional foods and probiotics is governed by several factors especially the cultural base, geographical situation, demography, economy, level of education in the society, government interests and so on. Japan is the leader in the market, followed by Europe and USA. Introductions of products containing probiotics are on the rise, with many new product introductions occurring in yogurt, smoothies, spreads, cream cheeses, cereals and shelf stable dressings. Milk and dairy products have been considered products with high nutritional value because of its high quality proteins and large varieties of bioavailable nutrients. Dairy products therefore offer an excellent matrix for functional foods. It is estimated to account for 60% of the total functional food sales in Europe. Global functional food market has been estimated in the region of USD 48 billion and is increasing at an astonishing rate, which is likely to triple in next five years.

The health claims of probiotic dairy foods can be put under three categories; (i) Satisfactory evidence available - improving protein digestibility, positive influence on gut flora and control of diarrhea, constipation, colitis, reduction of duration of antibiotic associated diarrhea, control of lactose intolerance (ii) Further evidences needed – hypcholesteroloemic effects, antitumor/anticancer activities, immunostimulating effects, inflammatory bowl diseases control (iii) Emerging frontiers – control of AIDS, treatment of food allergy, oral applications, antimutagenic activities.

Probiotic based functional food products are just entering in Indian market and very soon the market will be flooded with such products from local as well as multinational companies. Lot of research work is done at SMC College of Dairy Science, Anand; NDRI, Karnal and some other institutions in India. Liquid acidophilus milk, acidophilus lassi, spray dried acidophilus banana powder, acidophilus malt powder, wheat and rice blended preparations, symbiotic dahi, etc have been developed from Anand while probiotic cheese, acido whey, probiotic dahi, etc have been developed from Karnal. Looking to the potential demand of the probiotic dairy foods, lot of work will be required in research, education, marketing strategies and regulatory aspects.

**OP-29**

**Croatian traditional cheeses**

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Croatia is small but very rich country with numerous varieties of traditional cheese. As the country is located in the south-east of Europe it posses Mediterranean, mountain and continental climate that influence on specificity of traditional cheese production. Traditional cheese production has been carried out since several hundred years. Mostly, the cheeses were produced on family farm small scale dairy plant processing on farm produced milk. On farm cheese production in Croatia is very important due to environmental protection (avoiding fire incidence on Adriatic coast area), rural development and increasing on farm income. By cheese production, the problem of milk collecting organization is solved especially on dislocated mountain areas as well as on many Adriatic islands. Numerous tourists every season come for vacation and consume a lot of Croatian traditional food among them cheeses take special position. Therefore, in the past ten years several projects conduced with general aim to develop technology, characterization
and marketing of traditional cheeses. The present paper discusses Croatian traditional cheeses, their importance and the recent investigations conducted on Croatian traditional cheeses. Characterization parameters of cheese, considering chemical and physical composition, biochemical changes, dominant micro flora which dominates in technological production procedure and determines traditional flavour of mature cheese are described.

**OP-30**

**Cost effective stainless solutions for dairy industry**

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Dairy Industry deals with Milk and Milk Products. Since these are Food Products, Health and Hygiene form an integral part of the material used in Milk / Milk Processing industry. Since Stainless Steels have very good corrosion resistance, these have been mandatory for use in dairy Industry. Earlier conventional 300 series Cr-Ni grades of austenitic stainless steels like 304 and 316 were used as food contact material in dairy Industry.

With passage of time, technological advancements in stainless steel manufacturing facilities led to development of alternate grades of austenitic stainless steels. These grades have similar technical characteristics as of Cr-Ni grades and are more widely known as Cr-Mn grades. The user can now select from a wider range of austenitic stainless steels - Cr-Ni or Cr-Mn - that are suitable for different applications in the dairy industry. These Cr-Mn Stainless Steels have shown comparable corrosion resistance, formability and weldability to 304, in addition to higher strength. International standards for food contact material are also governed by chemical composition of the material being used and not limited by the specific grades or family of grades. This paper deals with an in-depth study of applications in dairy industry and suitability of various Cr-Mn grades of stainless steels for these applications in the dairy industry.

**OP-31**

**Traditional milk marketing system – an Indian experience**

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This paper covers the findings, actions and the recommendations of a multi-stakeholder, multi-partner ‘Action Research (AR) to understand the dynamics of the Traditional Milk Sector (TMS) and actions to improve the sector’ taken up in Khammam and Vijayawada districts of Andhra Pradesh. This highlights the strengths of TMS and the dependence of producers, market intermediaries and consumers on it. It also highlights the major weaknesses like dilution of milk at vendor level, addition of neutralisers during summer, mixing of unchilled evening milk with morning milk, poor handling and hygiene, heavy bacterial load, low scale of vendor operations and resultant lower price to producers and poor quality milk to consumers. The absence of infrastructure for processing, storage and packing and stakeholder organizations/platforms are contributing factors.
Data derived from secondary sources indicates that at the national level, a vast majority of producers, consumers and market intermediaries are contributing to TMS and are dependant on it. About 77 percent of the total milk marketed passes through this channel. Though TMS has vast size, spread, reach and potential for impacting millions of poor in India, it remains vastly discriminated and neglected.

Together with producers, vendors, consumers and Govt. departments, the AR took up organisation of stakeholder associations and their training, interface meetings, establishment of fat testing facility, coordination of productivity enhancement activities etc. These have started positively impacting the quality and price of milk, scale of operations and the readiness of vendors to conform to legal standards for milk. These also demonstrate the reasons, need and the direction of reforms and the required policy changes.

**OP-32**

Chemistry of buffalo milk vis a vis cow milk

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Buffalo milk is ranked second in the world after cow milk, being more than 12% of the world’s milk production. In India, consumers prefer fluid buffalo milk over cow milk. Buffalo milk is reputed for its richness and creaminess. As compared to cow milk, buffalo milk has higher proportion of fat, protein and mineral. Buffalo casein micelles are distinctly larger than cow casein micelles. Opacity of buffalo casein micelles is higher than that of cow casein micelles. Solvation of buffalo casein micelles is lower than cow casein micelles. Buffalo milk is also thermally less stable in comparison to cow milk. Major buffalo milk proteins (âs1-casein, âs2-casein, â-casein, 8-casein, â-lactalbumin, â-lactoglobulin) are cloned and sequenced. The number of amino acids in these proteins is identical between buffalo and cow proteins. The size of buffalo milk fat globules varies from 4.15 – 4.6 im, which is significantly larger that the value of 3.36 – 4.15 im observed for cow milk fat globule. Buffalo milk fat contains higher proportion of C_{4:0}, C_{6:0}, C_{12:0} and C_{18:0}, fatty acids than in cow milk fat. The proportion of C_{6:0}, C_{8:0}, C_{10:0}, C_{12:0}, C_{14:0}, C_{14:1} fatty acids in buffalo milk are lower than in cow milk fat. The average cholesterol level of buffalo milk is 20 mg/100 ml milk. This value is significantly higher than those reported for cow milk (16 mg/100 ml). Buffalo milk contains higher concentration of divalent cations of calcium and magnesium; however the concentration of monovalent cations and anions such as sodium, potassium and chloride are lower than in cow milk. The pH of fresh buffalo milk varies between 6.63-6.80, which is apparently higher than 6.5-6.7 reported for cow milk. Buffalo milk has more buffering capacity and therefore the pH of buffalo milk decreases more slowly than the pH of cow milk during acidification.

**OP-33**

Overview of themophilic cultures brand for the fresh fermented market

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The Indian market for fermented dairy products is undergoing a process of transition which is evident by new launches of Dahi, Lassi & fruit Yoghurt. Cultures are widely use in the dairy industry to preserve microbiological qualities as well as develop organoleptic features such as texture, colour and taste. In
addition, human clinical studies have demonstrated the health benefits of specific probiotic strains that are today widely used and recognized to enhance digestive health and immune system modulation. Much of the dairy industry today has adopted Direct Vat Inoculation (DVI) as the preferred method due to the convenience, security and consistency this solution offers. Danisco is a market leader in DVI technology and offers a wide and comprehensive range of DVI products.

In this presentation we shall focus on the broad assortment of thermophilic fermented fresh products on the worldwide market and the various processes of production observed (set, stirred, drinkable). We will present our lactic acid cultures brand YO-MIX™ and their functionalities e.g., acidification speed, texture, post-acidification control, production of flavour, etc. Danisco YO-MIX™ cultures have unique patented strains with an outstanding capacity to produce ExoPolySaccharides (EPS) during fermentation to secure a particularly high level of creaminess and viscosity compared to other yogurt cultures on the market. Success of dairy product manufacturer is dependent on their ability to launch innovative, new products that respond to the constantly changing market. Danisco with the selection of cultures is able to respond at the various manufactures needs and also demonstrate the influence of starters on the finished products qualities.

**OP-34**

**Cost optimization and shelf-life improvement using innovative emulsifier & stabilizer blends**

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In recent years Ice-cream & frozen desserts market in India is witnessing an unprecedented growth which was never seen earlier. Thanks to the innovation in functional Ingredients, technology, distribution & communication which has lead to the new product development and launches in the market. In this paper we have focused on two of the most important issues concerning Ice-cream & frozen desserts industry that is cost optimization and shelf-life.

The significant increase in SMP prices has affected the ice cream & frozen desserts industry adversely. The competition on the ice cream market makes it difficult to transfer the rising powder prices direct to the consumer in one step.

In this paper we have examined at different possibilities for cost optimizing, both by replacement of MSNF and also other possibilities e.g., using innovative functional ingredients which do not affect the quality but give us a substantial cost saving.

Further, increasing consumer demand for high quality ice cream forces the manufacturer to look at all possible parameters to ensure that quality of ice-cream manufactured at Plant is the same when it is eaten by the consumer. In this paper we shall also examine different ways to reduce quality drop during the shelf life of ice cream. In both the trials we have used unique functional system CREMODAN® Ice-pro System developed by Danisco for which a patent application has been filed.
OP-35
Use of soy in traditional dairy sweets
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Soybean is one of the nature’s magnificent nutritional gifts. It is one of the very few plants those provide a high quality protein with minimum saturated fat. Soybeans contain all the three macronutrients required for good nutrition, as well as fiber, vitamins and minerals. Soybean protein provides all the essential amino acids in the amounts needed for human health. The 1990’s FAO/WHO protein evaluation committee put soy protein at par with egg and milk protein and ahead of beef protein. Soymilk can be perfectly replaced either partially or fully for any of the dairy milk products. Soymilk products are high protein, low fat alternates to dairy products with no cholesterol. Traditional sweets specially Rasogolla and Kalakand, are the indigenous milk products prepared out of Chhana obtained from a blend of the soymilk and cow milk by acid/heat coagulation. Process of making these sweets is similar to its dairy milk version. Incorporation of soymilk and dairy milk enhances the biological value of the final product. The leading Chhana based sweet makers are experimenting with soymilk to offer a variety of nutritious and less expensive Indian sweets. Include soymilk and its products in various delicious recipes in your daily diet and enjoy the proven health benefits of soy. All soy dairy alternatives should be handled with the same care as any perishable dairy product.

OP-36
Traditional Sicilian cheeses
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There are more than 400 different types of traditional cheeses in all over Italy, and 33 of them, representing 78% of the total production, have been granted by the EU the Protected Designation of Origin, P.D.O. Sicily has 2 P.D.O. cheeses (Ragusano and Pecorino Siciliano). Another 2 ones have already been approved (Piacentinu Ennese and Vastedda della Valle del Belice) and are waiting for the formal recognition of P.D.O. Besides P.D.O. cheeses, at least another ten traditional cheeses (provola dei nebrodi, maiorchino, canestrato, palermitano etc) are produced in Sicily. In all of these handmade products, the importance of cheese-maker (often woman) is crucial.

The most important biodiversity factors influencing the bio-organoeleptic qualities are the animal species and breeds, the pasture, the use of raw milk and the natural rennet, as well as cheese-making tools and natural aging locations. An important element of specificity is the natural microbial flora of raw milk, which is fortified and enriched by the microbial niche found in cheese-making tools -often made of wood, cupper or cane- and from the “natural cave” where aging occurs. The traditional cheese making process is also able to guarantee the “food safety” of those products. We will also present an overview of the different traditional methods of cheese safety in various Emerging Countries, that risk to loose their cheese-identity under the “false” pressure of HACCP imposed by globalization.
OP-37
Conceptualizing process modules for traditional dairy products
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Traditional Dairy Products like Paneer, Curd, Lassi, Butter milk, sweetmeats like Khoa, Gulabjamun, Srikhand, Mishtidoi etc offer substantial value addition and hence present enormous growth prospects. There is little participation from the organized sector in manufacturing and marketing of these products within India and abroad. Except for a few organized traditional dairy product manufacturing installations, the processing even in established dairies is crude and more with halwai like approach.

An organized effort is required to stream line the manufacturing processes on industrial scale to ensure hygiene, purity and quality of these products. This sector can compete with market established dairy products if a concentrated marketing effort is made which presently is found lacking. The equipment to manufacture these traditional products also presents a very large export potential. Technologies and necessary equipment for industrial scale production are already available and the need is to apply the acquired experience and integrate it together to conceptualize viable process plant modules.

An effort has been made in this paper to conceptualize a process module to manufacture various traditional milk products which can be improved upon with the technology input from research institutions and process houses who are already manufacturing these products. This could greatly benefit a wide spectrum of manufacturers of these products including potential investors who are showing lot of interest in such ventures.

OP-38
Potential of probiotics based on their bioactive metabolites
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It is certainly true to say that nowadays the benefits of consuming dairy products which are produced through fermentation with lactic acid bacteria (LAB) are well appreciated. Indeed, LAB plays an important role in the production of fermented foods such as those produced by the dairy and wine industries. These microorganisms usually produce lactic acid as a main end product of the fermentation process, although they may also produce other organic acids, such as acetic and formic acids. The health benefits associated with fermented foods can be attributed directly to the interaction of the ingested live microorganisms with the host (probiotic effect) or indirectly as a result of ingestion of microbial bioactive compounds, such as vitamins, organic acids/fatty acids, exopolysaccharides and bioactive peptides produced during the fermentation process (biogenic effect).
OP-39

Future developments in dairy functional foods

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In this paper, the authors look at world market and trends in functional foods and try to identify where the next developments will take place in such foods, especially those based on either dairy products or incorporating active ingredients extracted from milk. From ten food groups and target populations, four are identified as ones that will most likely see increased success.

In addition to such identification, the authors also look in a more general way at where the European food industry, especially its well developed dairy industry, will develop over the coming 20 years, in particular those developments essential to functional foods developments. In common with other food sectors, consumer oriented developments will take place with increased emphasis on consumer health in addition to conventional nutrition and, here, functionality scores highly in the public perception. However, novel technologies will be essential for successful incorporation of bioactive ingredients and their delivery to targeted areas of the body. Nanotechnology developments rank high in any such list with nanoparticles and nanotubes coated with the bioactive compound being incorporated into food products as a delivery tool. However, without careful research and transmission of the ideas involved to the consumer, this science is at risk of being lost to the food and dairy industries.

OP-40

Foods with added plant sterols and stanols - case Benecol

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The prevalence of cardiovascular disease is increasing worldwide. An estimated 16 million people die from various forms of cardiovascular diseases annually. In addition to medical therapies, dietary tools to control the risk factors of such diseases are actively being developed. Plant sterols and stanols which are present in the everyday diet in small amounts effectively reduce the absorption of cholesterol from the digestive tract and as a consequence, lower serum cholesterol. Benecol foods contain stanol ester and are targeted at those who want to lower their serum cholesterol levels by dietary means. Benecol foods are sold in 20 countries globally. Cholesterol lowering effect of Benecol have been established clinically in normo- and hypercholesterolemic individuals, in women, men and children, in patients with coronary heart disease, in patients with non-insulin dependent diabetes, in conjunction with cholesterol-lowering statin therapy and in different food matrices. Several international bodies including the European Union Scientific Committee on Foods and International Atherosclerosis Society have included the use of foods with added stanol or sterol ester in their recommendations for cholesterol-lowering dietary therapies.
OP-41

Opportunities for technology driven market growth of traditional indian dairy foods

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There is tremendous opportunity for introducing traditional Indian dairy food if only proper technology is introduced. Hatsun Agro Product Limited has introduced Curd Rice (KRD RYS) for the first time with a shelf life of 6 to 7 days. Curd rice is predominantly taken in South India after lunch or dinner as a last item. After the food, they believe that curd rice is giving proper digestion and good for health. Curd rice of Hatsun (KRD RYS) is processed in the centralized kitchen, hygienically packed, sealed and transported by the refrigeration system and we made it available in different parts of the State. There is tremendous scope for producing traditional Indian sweets and also if there is a technology for producing Channa for making sweets in the Eastern part of the Country, the potential is very good.

OP-42

Financial institutions - role in dairy development for global markets

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India is the largest producer of milk in the world and the dairy sector contributes significantly to the agricultural GDP in the country. However, the processing and value addition to the milk is very low and our share in global trade of milk & milk products is also negligible. The investment in infrastructure and the human skill development is the need of the hour to cope with the challenges posed by the post liberalization and globalization environment for which credit is one of the prime requirements. The financial institutions along with the Government play a crucial role in ensuring the credit delivery for a wide range of activities from production to consumption viz., setting up dairy farms, development of feed & fodder, establishment of processing units, cold chain, storage & marketing infrastructure. The FIs also provide the credit for other integrated and important components of the activity such as training and quality certification systems thereby making the units ready to meet the standards for the global market wherein the quality is the mantra.

NABARD considers the food processing as a thrust area and supports this vibrant sector by means of refinancing & co financing various dairy projects and also implementing Centrally Sponsored Schemes for the development of the sector through the financial institutions. NABARD also provides continuous support for research and development, innovation etc. through specific funds created for the purpose.

In order to attract the private participation in the sector, many schemes are also being implemented by the Government wherein the financial incentives are being provided in the form of interest free loan, interest subsidy, capital subsidy etc. to the prospective entrepreneurs for setting up the dairy units. Considering the potential and growth of the dairy industry in India especially in this era of globalization, the banks are expected to play a major role in the coordinated development of the sector.
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(DPNH 01 – DPNH 18)
DPNH-1

Ksheerapakam-traditional Ayurvedic preparations of dairy based nutraceuticals

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Ayurveda is one of the oldest knowledge systems in the area of healthcare. Ayurveda has been a dynamic
system of knowledge serving the Indian sub- continent. Many Ayurvedic compositions are popular as
food supplements and health foods in India and abroad. But the main drawback of such preparations is
the perishable nature of the product. Many such preparations are extracted from herbs, by using milk as
the medium of extraction. These types of products such as ‘Pal Kashayams’ were very popular in Kerala,
as rejuvenating tonic for pregnant ladies.

But since the product is highly perishable, the users are advised to prepare the ‘Kashayam’ on a daily
basis. As the method of preparation is tedious and time consuming, these types of products are becoming
unpopular. Even many other Ayurvedic preparations such as memory boosters and cardiac tonics are
also becoming obsolete, because of the same reason. If these products can be made available in a non-
perishable and ready to use form, consumer acceptance can be expected. It will definitely be a boon to the
upcoming rural ayurvedic industry of Kerala, as these products will be a new entrance in the commercial
market of nutraceuticals. Ksheerapakam is one of the most important and unique preparations found in
Ayurvedic system. No reference is available regarding such preparations in modern Pharmaceutics. Since
the product is highly perishable, the users are advised to prepare the ‘Kashayam’ on a daily basis. As the
method of preparation is tedious and time consuming, these types of products are becoming unpopular.
Even many other Ayurvedic preparations such as memory boosters and cardiac tonics are also becoming
obsolete, because of the same reason. If these products can be made available in a non- perishable and
ready to use form, consumer acceptance can be expected. Trials were conducted for the preparation of the
dosage forms by subjecting the Kashayam for spray drying. The experimental studies carried out represent
a unique feature in developing new products based on milk.

DPNH-2

Viability of probiotic bifidobacteria in traditional buffalo curd in Sri Lanka

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Buffalo curd is a popular and nutritious food for over 1 billion people in South Asia where it is known as
meekiri (Sri Lanka) and dahi (India, Pakistan). It is defined as the product obtained by the coagulation
of milk of water buffaloes (Bubalus bubalis L.) through the agency of Streptococcus lactis (now Lactococcus
lactis ssp. lactis), Streptococcus diacetylactis (now Lactococcus lactis ssp. lactis biovar diacetylactis), Streptococcus
cremoris (now Lactococcus lactis ssp. cremoris) singly or in combination with Leuconostoc spp. (Sri Lanka
Standard 824, 1988). Probiotics can be defined as living microorganisms which, upon consumption in
large enough amounts, exert health benefits beyond inherent basic nutrition (Guarner & Schaafsma, 1998).
Bifidobacterium is one such genus that has been reported to have health benefits such as prevention of
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diarrhoeal diseases, prevention of growth of pathogens and protection from some forms of cancer (Shah, 2001; Isolauri, 2004). Although many studies reported on the feasibility of producing a probiotic product with goat’s milk and ewe’s milk, hitherto the feasibility of producing a probiotic product with buffalo curd has not been adequately researched. There is a huge potential for improvement of the quality of buffalo curd through the addition of probiotics. Therefore, studies were undertaken to evaluate the feasibility of incorporating Bifidobacterium longum NCTC11818 in traditional Sri Lankan buffalo curd to produce a probiotic product. Viability of bifidobacteria during fermentation of buffalo curd at tropical ambient temperature (29 ± 2°C), at two storage temperatures (29 ± 2°C and 4±2°C) and in three packaging materials (traditional clay pots, plastic cups, glass bottles) was investigated. Bifidobacteria survived for 3 days above the required population level of 10^6 CFU/g in buffalo curd in clay pots at 29 ± 2°C. They did not persist at acceptable levels over the 4-day shelf life due to the combined effects of temperature, acidity and redox potential. Chill storage slows post-fermentation acidification and prolongs bifidobacterial viability while packaging materials, which present a greater barrier to oxygen had a similar effect. The results indicate that bifidobacteria can be successfully incorporated into buffalo curd to give a product, which has improved acceptability. Probiotic buffalo curd had significantly higher (P<0.05) sensory scores for properties such as taste and mouth-feel resulting in a significantly higher (P<0.001) overall acceptability.

DPNH-3

Chemopreventive effect of acidophilus casei dahi on 1, 2-dimethyl hydrazine induced genotoxicity and preneoplastic lesions during colon carcinogenesis in rats

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Colon cancer is a major cause of death from cancer in western world. Diet is reported to account for about one-third of all cancer deaths in developed nations. There is an interest in the potential protective role of fermented milk containing probiotic cultures against colon cancer. In our lab a probiotic dahi was prepared by inoculating Lactobacillus acidophilus NCDC 14, Lactobacillus casei NCDC 19 and dahi culture Lactococcus lactis biovar diacetylactis NCDC-60. The dahi was of good flavour, body and texture having pH 4.6, titrable acidity 1.08, viscosity 0.270 Pa.s, fat 3% and 10^8 cfu of above mentioned probiotic microorganisms. The antihypertensive, antidiabetic, antithrombogenic and immunomodulatory effects of the probiotic dahi had already been tested in rats. The present study was designed to determine the effect of probiotic dahi on 1, 2 dimethyl dihydrazine (DMH) induced colon carcinogenesis in wistar rats. Four experimental groups were used: 1) non-treatment control; 2) DMH control; 3) dahi-DMH-dahi group: dahi administered before and after DMH; 4) dahi-DMH: dahi given only 4 weeks before DMH. At 10 weeks of age, all animals received subcutaneous injection of DMH dissolved in normal saline at a dose rate of 20mg/kg body weight, once weekly for 15 weeks. The animals were sacrificed one week after the last injection, and the aberrant crypt foci (ACF, preneoplastic lesion for colon cancer) formation were visualized under light microscopy. Probiotic dahi significantly prevented the development of ACF (69%), decreasing the total number of AC and inhibiting cyst formation. Comet assay in lymphocytes was done to asses the DNA damage. A significant decrease in DNA damage (48%) was observed in dahi fed group as compare to DMH control group (94%).The feeding of probiotic dahi to rats significantly enhanced the activity of glutathione-S-transferase (GST), superoxide dismutase (SOD) and catalase (CAT) in the liver and colon cells. We speculate that the acidophilus casei dahi...
exerts chemoprevention against cancer development at extra hepatic sites by modulating hepatic biotransformation enzymes and antioxidant status. Furthermore, the findings also suggest that acidophilus casei dahi inhibit ACF formation, an early preneoplastic marker of malignant potential in the process of colon carcinogenesis.

**DPNH-4**

**Inhibition of 1, 2 – dimethylhydrazine (DMH) induced colon carcinogenesis in rats by supplementation of acidophilus-casei dahi (probiotics dahi) and wheat bran**

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Epidemiological studies suggest an inverse relationship between the intake of dietary fibers, particularly fibers from cereal grains and colon cancer risk. Wheat bran was shown to provide protection against colorectal cancer in human intervention and animals studies. Other studies suggest that the consumption of fermented milk products and lactic acid bacteria, that are used to ferment the dairy products, decrease the incidence of colon carcinogenesis. Keeping this in view acidophilus casei dahi was prepared by the addition of *Lactobacillus acidophilus*, *Lactobacillus casei* and dahi culture *Lactococcus lactis* biovar. *diacetylactis*.

In the present study, an *in vivo* trial was conducted to see the anti carcinogenic effects of acidophilus-casei dahi as well as synergistic effect of supplementation of wheat bran along with dahi, during the early stages of colon carcinogenesis. The rats were divided into four groups- 1) DMH control group 2) Wheat bran group 3) Dahi group 4) Wheat bran-Dahi group. At ten weeks of age all animals received subcutaneous injection of DMH at a dose rate of 20mg/kg body weight. The animals were sacrificed one week after the last injection. The anti oxidative and detoxification parameters were studied in rat liver, intestine and colon. A significant increase in anti oxidative as well as detoxification status was observed in wheat bran-dahi fed group. Comet assay in rat lymphocytes and colon tissue was done to assess the DNA damage. A significant increase in DNA damage was observed in DMH control group. The activity of α-glucosidase and α-glucuronidase in faeces was also estimated and a significant increase was observed in DMH control group as comparison to Dahi and Wheat bran fed group. The wheat bran-dahi groups show more anti carcinogenesis than other groups (dahi group and wheat bran group). Hence, it may conclude that the supplementation of wheat bran along with acidophilus-casei dahi provide protection against colon carcinogenesis.

**DPNH-5**

**Improving health attributes of cottage cheese with hypocholesterolemic effect of some selected lactobacilli**

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Presently much interest has been generated worldwide to evaluate the hypocholesterolemic effect of various lactic acid bacteria (LAB), especially for reduction of the risks of atherosclerotic cardio vascular diseases (CVD). While the cheese industries throughout the world are trying to derive benefit from a marketing
advantage, such as added-value probiotic-containing cheese, which would afford a competitive edge over the existing products. The development of probiotic Cottage cheese with the hypocholesterolemic effect of probiotic LAB would thus lead to a major economic advantage. The present study was, therefore, undertaken to amalgamate some health benefits of probiotic culture to the cottage cheese with the special emphasis given on the hypocholesterolemic effect of probiotics to reduce the risks of atherosclerotic CVDs. The study established that L. acidophilus NCDC-14 has in vitro ability to eliminate cholesterol and deconjugate taurocholate from the synthetic media and produce antagonism towards some common pathogens. The organism was also proved successful in vitro to endure the gastrointestinal tract transient and adhere to the intestinal mucosae. Animal feeding trial using rat model also confirmed that L. acidophilus NCDC-14 successfully colonizes in the rats’ intestine and attaches in vivo to colonic mucosae. The findings also established that supplementation of direct acidified cottage cheese, ad libitum once a day besides feeding cholesterol enriched diet for 28 days, incorporated with $10^7$-$10^8$ cells of L. acidophilus NCDC-14 per g produced a total reduction in plasma cholesterol and plasma LDL cholesterol levels by 28.60 and $\sim$24.50 per cent, respectively with a corresponding elevation in plasma HDL cholesterol level by $\sim$37.20 per cent as well as an equivalent decline in cardiovascular risk factor by $\sim$64 per cent. Further clinical studies are a prerequisite for proving efficacy of this particular strain because of the limitations with extrapolating data obtained from in vitro and animal studies. Ideally, clinical studies should be conducted double blind in a cross-over fashion.

DPNH-6

Preparation of soya milk and ewe’s milk blend and its effect of feeding on the growth performance of suckling mecheri lambs

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One week old Mecheri lambs having an average body weight of 2.2 kg were selected and divided into three groups, control fed exclusively with ewe’s milk, treatment 2, fed with 50 per cent of soya milk and 50 per cent of ewe’s milk and treatment 3, fed with 75 per cent soya milk and 25 per cent ewe’s milk. The control group milk contained (%): 6.33 ± 0.04 fat and 4.00 ± 0.05 protein, 3.90 ± 0.02 carbohydrates and 14.97 ± 0.02 total solids. The fat percentage in the soya milk and ewe’s milk blend of both the treatments T2 and T3 were standardized to six per cent by adding butter oil. The 50% soya milk and 50% ewe’s milk blend (T2) (in percentage) had 6.00±0.04 fat, 4.65±0.01 protein, 3.33±0.03 carbohydrate and 14.71±0.01 total solids and the 75% soya milk and 25% ewe’s milk blend (T3) (in percentage) had 6.00±0.03 fat, 4.98±0.01, protein, 3.05±0.01carbohydrate and 14.76±0.01 total solids. All the lambs were fed with 10 per cent of their body weight. The control group had a mean body weight (Kg) of 3.43±0.06, 6.34 ± 0.06 and 8.57 ± 0.17 at 30, 60 and 90 days of age respectively. The T2 group had a body weight (Kg) of 3.69 ± 0.10, 6.34 ± 0.06 and 9.99 ± 0.12 at 30, 60 and 90 days of age respectively. The T3 group had a body weight (Kg) of 3.74 ± 0.11, 6.89 ± 0.09 and 10.33±0.16 at 30, 60 and 90 days of age respectively. The growth performance of the treatment groups T2 and T3 were significantly higher than the control animals ($P<0.01$). The higher weight gain observed in the T3 as compared to T2, might be due to higher protein and total solids content of the respective soya milk and ewe’s milk blends fed. This investigation reveals that the feeding of soya milk and ewe’s milk blend will be beneficial for feeding orphan lambs.
DPNH-7

Survival of isolated *Saccharomyces* spp. in simulated gastrointestinal environment and its selection for the formulation of acidophilus yeast milk

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The microorganisms selected as probiotic culture must confront a variety of simultaneous or sequential adverse conditions exits in gastrointestinal (GI) tract. Probiotic yeast has the capability to survive and remain active in the digestive tract by being resistant to the defence mechanism of the host. In the present study, *Saccharomyces* spp were isolated from different dairy products (Kefir, Dahi and cream) and fruits (Grapes and Lychee). Biochemically characterized 50 *Saccharomyces* isolates were screened for their viability in simulated gastrointestinal environment for the formulation of acidophilus yeast milk. Selected isolates were tested for their viability by their exposure to simulated gastric juice (pH 2.0; residence time 2h), and then yeast cells were centrifuged at 10,000xg for 1 min and resuspended in simulated small intestine juice (pH 8.0; 3mg/ml oxgall; residence time 4h). Samples were taken at every hour, till 6 h of incubation and pour plating was done on glucose yeast extract agar medium. Plates were incubated at 37°C for 48h. Among all isolates, strain 8S4 (isolated from kefir grains) and SBS (pharmaceutical preparation SBkid) showed excellent viability in *in vitro* simulated gastric and intestinal environment. These isolates can even survive after 3hrs at 3% oxgall concentration. Among 50 isolates, two isolates have been selected for further studies with regards to development of an acidophilus- yeast fermented milk product.

DPNH-8

Lactose intolerance as affected by rural Egyptian traditional habits of consuming milk

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Milk with crushed traditional flattens bread or milk with whole wheat grains (Be-Lila) is considered as a main breakfast dishes for the most fellahen. It is to the Egyptian tradition. About 78% of the Egyptian population demonstrated lactose mal-absorption. From abdominal symptoms survey, it was observed that fellahen with positive lactose intolerance was not suffering from abdominal symptoms. Opposite to urban population, the general awareness of the laxative effect of milk led urban population to reject to drink milk or a reduction in the ingested volume to avoid symptoms. Therefore, the effects of rural Egyptian traditional habits of consuming milk on lactose intolerance and their consequence symptoms were investigated. Possible differences were studied. Results revealed that, the ingestion of milk with bread or wheat grains improved the symptoms of lactose intolerance. Fiber delayed stomach emptying and released lactose avoiding reaching small intestine in high level and consequently prevented appearance of symptoms. The cumulative breath H2 and the area under the discontinuous curve of breath-H2 concentration decreased relative to lactose resulted after ingestion of milk with bread or Be-Lila as compared with ingestion of milk alone. It can be concluded that, because of the milk mixed with bread or wheat grains with high fiber content, the lactose in traditional rural milk dish is better absorbed than other sources of lactose in lactase-deficient subjects. Such finding give a new solution or new tool to overcome lactose intolerance without any additional milk treatment or taking tablets which put the milk drinker under the stress of being ill leading to lose the enjoyment of drinking the milk.
DPNH-9

Effect of enzymatic hydrolysis on antioxidant activity of casein

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Milk is a very complex food whose consumption confers a number of nutritional benefits and antioxidative defence against oxidative stress. Milk proteins are versatile ingredients that have functional and nutritional properties. Whole casein and its fractions (a, b, k) both from buffalo and cow milk, were evaluated for their radical scavenging activity against 2, 2’ azinobis - 3-ethyl benzthiazoline - 6-sulphonic acid (ABTS+) radical using Trolox, a water soluble vitamin E analogue as reference antioxidant. Further, these samples of casein and their fractions were subjected to hydrolysis using such as pepsin at pH 2.5 and corolase at pH 7.5, at E: S ratio 1:25 for 24 hours and evaluated for their antioxidant activity. Trolox equivalent antioxidant capacity (TEAC) value of 1.01 mmol/mg for buffalo whole casein increased to 2.796 mol/mg for peptic hydrolysate and 3.316 mmol/mg in corolase PP digest hydrolysate while for identical concentration the increase for cow casein was from 0.803 mmol/mg to 2.278 mmol/mg for pepsin digest and 3.056 mmol/mg in corolase PP digest. Among casein fractions, the antioxidant activity of a-casein was observed to be highest both for buffalo and cow casein corresponding to 41% and 33% reduction of ABTS radical at 1 mg/ml concentration, however, on hydrolysis with pepsin it resulted in 56% and 46% reduction of radical at 0.5 mg/ml concentration of digest, respectively. Thus it could be inferred that although whole casein and its fractions differed significantly (p<0.05) in terms of radical quenching affinity both in case of buffalo and cow casein, there was no significant difference in the antioxidant value on hydrolysis with different proteases.

DPNH-10

Therapeutic advantage of probiotic fermented indigenous food mixture

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Importance of probiotics in indigenously developed fermented foods to control gastro-intestinal disturbances is being practiced since prehistoric times. In the present study, an attempt has been made to use live cells of probiotics i.e. *Lactobacillus acidophilus* for fermenting the food mixture containing rice, soyabean, skimmed milk powder and tomato pulp (2:1:1:1 w/w) in order to check the microbial imbalance in the gastro-intestinal tract which otherwise may lead to diarrhoea and further to death because of dehydration. Rats having *Escherichia coli* induced diarrhoea were fed with the developed autoclaved and fermented food mixture for a week and their faeces were analysed for moisture, nitrogen, ash and counts of lactobacilli and coliforms. The faecal moisture, nitrogen and ash content in normal mice varied from 12.85 to 12.99, 1.15 to 1.18 and 11.93 to 11.98 percent respectively. Faecal lactobacilli and coliform counts of normal mice ranged between 9.09 to 9.17 and 5.42 to 5.66 log viable cells/g, respectively. After induction of diarrhoea in *E. coli* fed mice, a significant reduction in faecal lactobacilli with a corresponding increase in faecal excretion of coliforms, moisture, nitrogen and ash was noticed. In mice fed on unfermented food mixtures, there was no significant variation in faecal coliforms while faecal lactobacilli were observed to be further reduced significantly till 3 days of feeding and remained almost the same during 3rd day to 7th day of the feeding trial. In experimental group fed with fermented food mixtures
for 7 days, a significant increase occurred in the faecal lactobacilli counts whereas faecal coliform counts along with other nutrients decreased significantly, thus ultimately arresting diarrhoea in mice. Conclusively, fermentation of the food blend containing rice, soyabean, SMP and tomato pulp with a probiotic provided not only a good profile of easily digestible nutrients but also live cells of *L. acidophilus* having nutritional as well as therapeutic advantage in the gastro-intestinal disturbances.

**DPNH-11**

**Thermo-tolerance induction in lactobacilli cultures employing non- lethal heat shock**

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For development of functional component in a dairy-based food product, the probiotic lactobacilli must be able to withstand the high temperatures usually attained during manufacturing and processing. Hence, an attempt was made to induce the thermo-tolerance in lactobacilli using non-lethal high temperature treatment. Lactobacilli cultures viz. *Lactobacillus acidophilus* NCDC 13, *L. acidophilus* NCDC 14, *L. casei* NCDC 19 and *L. casei* NCDC 298 were grown in MRS broth for overnight at 37°C. These cultures were inoculated (1%) in reconstituted skim milk (13%) and incubated at 37°C for nearly 5 hour in order to get early log phase cells for further treatment. The heat induction was given by raising the temperature of the young culture from 37°C to 52°C quickly by keeping the tubes in water-bath at 70°C and held at 52°C for 15 minutes with constant agitation. The thermo-tolerance induction was examined by exposing the heat induced cultures to a lethal temperature i.e. 60°C for 5 minutes followed by plating to enumerate the survival pattern, keeping one set as control with no prior induction. The culture NCDC 13 survived to the extent of 8.32 log cfu/ ml after induction, which is much higher when compared with control (6.83 log cfu/ ml) corresponding to their initial counts 11.44 log cfu/ ml and 10.85 log cfu/ ml, respectively. On the similar lines NCDC 14, 19 and 298 were found to survive better after heat induction in comparison to their respective controls. The results indicated that the survival of cultures usually increases significantly after a mild heat treatment that could be used as a pre-treatment before incorporating the probiotic cultures in a dairy product at a high processing and manufacturing temperatures.

**DPNH-12**

**Probiotic characterization of lactococci for use as dietary adjunct for manufacture of fermented dairy foods**

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Role of lactic acid bacteria (LAB) in food manufacture, preservation, agricultural fermentation, pharmaceuticals, human health and nutrition is well documented. These are natural inhabitant of gastrointestinal (GI) tract of human and other warm blooded animals. Use of these organisms as probiotics in dairy foods has gained momentum recently. Therefore, an attempt was made to select lactococci, which can survive simulated GI environment viz. pH and bile salts as well as adhesion to hexadecane in terms of cell surface hydrophobicity. Three standard strains of *Lactococcus lactis* were studied for their survival at different pH and ox-bile concentrations. *Lc lactis ssp lactis biovar diacetylactis* NCDC 061 was found to grow to an extent of 15.67, 15.42, 10.81, 9.81 and 8.76 log cfu/ml at 0.0, 0.5, 1.0, 1.5 and 2.0 percent ox-bile
concentrations, respectively. This organism, also survived to the tune of 7.07, 8.15, 8.60, 8.86 and 11.20 log cfu/ml at pH levels of 1.0, 2.0, 3.0, 4.0 and 6.8, respectively. Almost, a similar trend was observed in case of *Lc lactis ssp cremoris* NCDC 282, wherein total viable count (TVC) varied from 14.53, 10.86, 9.66, 8.59 and 7.13 log cfu/ml at the above ox-bile concentrations. TVC of *Lc lactis lactis biovar diacetylactis* NCDC 060 declined from 11.42 to 6.28, 7.11, 8.25 and 9.36 log cfu/ ml at pH levels of 6.8, 1.0, 2.0, 3.0 and 4.0, respectively. However, *Lc lactis ssp lactis biovar diacetylactis* NCDC 060 could not survive at high concentration of 1.5 percent ox-bile. Strain NCDC 061 possessed maximum cell surface hydrophobicity followed by 060 and 282, in the order of 83.62, 41.56 and 25.88 percent, respectively. The above observations demonstrate the tolerance of *Lc lactis ssp lactis biovar diacetylactis* NCDC 061 and *Lc lactis ssp cremoris* NCDC 282 to the GI environment and good adhesion ability. Hence, these starters could be exploited as dietary adjunct for the manufacture of probiotic fermented foods.

**DPNH-13**

**Antioxidative and antihypertensive activity of trypsin hydrolysed whey protein concentrate**

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Whey proteins are considered as powerhouse of bioactive peptides, Hence, their hydrolysate by trypsin were prepared to optimize the process for maximum antioxidant activity. For this study, five independent variables viz, preheat treatment, pH, E/S ratio, temperature and time of hydrolysis were standardized by applying Response Surface Methodology (RSM). The antioxidant activity of the whey protein hydrolysate was determined by ABTS (2, 2’ azinobis 3- ethyl benzothiazoline- 6-sulphonic acid) radical assay method. The primary optimization process was done with different permutation and combinations in full mode as designed by RSM and the response antioxidant activity was expressed in terms of trolox equivalent antioxidant capacity (TEAC) values (ìM of Trolox equivalence/ mg of the protein). The effect of preheating, time period and temperature of hydrolysis were optimized. For final optimization process, 15 samples were analyzed and the conditions for maximum antioxidant activity were standardized at preheating temperature (88° C), pH 7.3, E/S ratio (0.05), temperature (36.5° C) and period of hydrolysis (8 hr ) corresponding with DH 11.8 per cent resulting in TEAC values of 20.28 ± 0.08 (ìM / mg). The model was found to be significant with R² value of 0.997244 and lack of fit test- as non significant, indicating that the optimized conditions were best suited. The observed antihypertensive activity was 229.96 ìg / ml (IC₅₀).

**DPNH-14**

**Production and characterization of angiotensin-converting enzyme inhibitory peptide from milk fermented with Lactobacillus helveticus and Saccharomyces cerevisiae**

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Angiotensin Converting Enzyme (ACE, EC 3.4.15.1) has a key role in blood pressure regulation through control of renin-angiotensin system. The enzyme can raise blood pressure by converting angiotensin I to
the potent vasoconstrictor angiotensin II and also inactivates the antihypertensive vasodilator bradykinin. Therefore ACE inhibition mainly results in hypotensive effect. In this study, our purpose was to obtain potent ACE inhibitors from milk protein. Two strains of Lactobacillus helveticus and four strains of Saccharomyces cerevisiae were collected from National Collection of Dairy Cultures, NDRI, Karnal. Skim milk was fermented with each strain of L. helveticus and S. cerevisiae (1:1) at 37°C for 24h in different combinations. Milk hydrolysates from eight combinations of these two genera were evaluated for ACE-inhibition in vitro. The hydrolysate depicting highest ACE-inhibition (70%) was selected for further purification. A first enrichment of ACE inhibitory peptides was obtained by ultrafiltration through 10, 5 and 3 kDa molecular mass cut-off membrane. The permeate was further fractionated by gel filtration and reverse phase HPLC. The HPLC profile indicated that ACE inhibitory activity is due to short and hydrophobic peptides. The fraction which showed the highest ACE inhibitory index was then analysed by mass spectrometer to determine molecular weight. The purified peptide was found to be a tri-peptide with IC50 (The 50% inhibitory concentration of peptide) value of 18.6µg/mL. ACE inhibitory activity remained stable after treatment with gastric enzymes in vitro which indicated that this peptide could resist in vivo gastrointestinal digestion after oral administration. Hence these ACE inhibitory peptides, as part of functional foods, can play significant role in prevention and treatment of hypertension.

DPNH-15

Microencapsulated probiotics: Novel ingredient for value addition of non-fermented dairy products

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Probiotics improve the dynamics of intestinal microbial balance favourably upon sufficient live ingestion. Micro-encapsulation significantly improves the stability and viability of probiotics in food and during passage through gastrointestinal track. Probiotic lactobacillus (L. casei NCDC 298) was encapsulated in alginate matrix. The alginate matrix was incorporated with resistant maize starch and resulted capsules were coated with hydrophobic material, stearic acid. The encapsulated L. casei NCDC 298 was incorporated to milk chocolate, a non-fermented dairy product (~10⁸ cfu/g), along with prebiotic (Inulin). The efficacy of encapsulated probiotics in milk chocolate environment as well as in delivery of live probiotics in modulation of intestinal micro-environment in mice was evaluated. The survival of the L. casei NCDC 298 was found to improve at low pH, high bile salt concentration and during heat treatments when cells were encapsulated in alginate. The matrix concentration had a positive effect on survival without affecting release of entrapped cells in simulated colonic pH solution. Maximum survival of cells was recorded in 4% alginate, which was further enhanced upon incorporation of 2% resistant maize-starch followed by coating with stearic acid. The lactobacilli count declined below the acceptable level (≤10⁷ cfu/g; recommended by IDF) upon 30 days of storage under ambient conditions, whereas, under refrigerated conditions, viable count was unchanged in milk chocolate upto 60 days. Sensory panelists preferred chocolate with encapsulated lactobacilli. Milk chocolate with encapsulated cells increased the faecal lactobacilli, decreased coliforms and carcinogenic beta-glucuronidase enzyme in mice when fed. Further, encapsulated probiotics can be tried for value addition of other non-fermented dairy products including indigenous dairy products.
DPNH-16

Rice bran as a source of dietary fibre in bread

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Rice bran, a by product of the rice milling industry constitutes 8.8-11.5% by weight of brown rice and consists of outer bran layers of the kernel and part of the germ. It is rich in proteins, fat, starch, free sugars, B-complex vitamins, minerals and dietary fibre. Since rice bran protein is of relatively high nutritional value, it is incorporated in bread, muffins, breakfast and snack foods and biscuits. Defatting of rice bran also enhances the shelf stability. In the recent years, there has been an increasing trend to prepare bread with wheat flour to which rice bran concentrate is added. The bread prepared is comparable in its sensory attributes to the bread prepared only with refined wheat flour. The problems such as constipation, colon cancer, diverticulosis could be reduced to some extent by increasing the fibre content of the bread by addition of rice bran protein concentrate. Thus, rice bran has a tremendous potential for utilization as food by virtue of its nutritive value.

DPNH-17

Influence of conjugated linoleic acid enriched ghee feeding on 7, 12 dimethyl benz (a) anthrazene induced mammary gland carcinogenesis in female wistar rats

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An experiment was conducted to investigate anticarcinogenic potency of Conjugated Linoleic Acid (CLA) in rats. 21 day female wistar rats were taken for study and animals are divided into two groups of 30 animals each. Group I, animals were fed with soybean oil (20%) based diet whereas group II animals fed with Ghee (20%) which is having the CLA 19.36 mg/g of fat. Feeding of test diets were started on the day of weaning. Animals of both the groups were given 7, 12 Dimethyl benz(a)anthrazene (DMBA) @ 5 mg per animal as single dose by oral intubation. Feeding of test diets were continued 32 weeks after DMBA administration. Animals were weekly palpated for its mammary tumour development and data were recorded. At the end of 32 weeks, animals of both the groups were sacrificed, tumour data were recorded and histopathological of tumour was done. The tumour incidence in group I was 83.33% whereas in group II, 46.07%. The type of tumour occurrence based on histopathological were fibroma, adenoma, fibroadenoma in both the groups where as in group one animals were showed malignant type of tumour i.e. adenosarcoma. The incidence of fibroma, adenoma, fibroadenoma and adenosarcoma in group I were 36.00%,24.00%,28.00% and 12.00% and in group II 57.14%,14.29%, 28.57% and 0.00% respectively. Hence it was concluded that, feeding of CLA not only inhibited benign type tumour but malignant tumour as well.
Bile salt hydrolase activity of some potential indigenous probiotic lactobacilli of human origin

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In recent years interest has increased to use bile salt hydrolysis to influence the cholesterol metabolism of humans. Bile salt hydrolase (BBH) activity by a probiotic bacterium could maximize its prospects of survival in hostile environment of GI tract and hence can be used as one of the potential markers for screening of probiotic strains. To select some potential BSH producing lactobacilli isolates, twenty cultures of numerous Lactobacillus spp. were assayed for BSH activities against glycocholic acid (GCA), taurocholic acid (TCA) and taurodeoxycholic acid (TDCA). Fifteen of these strains had been isolated from the human feces, 03 from buffalo milk, and 02 from other sources. A modified spectrophotometric assay was developed and compared with the standard BSH assay for the rapid quantification of bile salt hydrolase activity of these lactobacilli strains. BSH activity, as quantified by the amount of taurine or glycine liberated from conjugated bile salts, indicated that substrate specificity was more towards glycine-conjugated bile compared to taurine-conjugated bile. TDCA hydrolase activity of some potential BSH producing lactobacilli strains was also assessed by a direct plate assay involving MRS agar plates supplemented with 0.5% TDCA (MRS-TDCA), bile salt hydrolysis was manifested by the formation of precipitate halos around colonies or the formation of opaque granular white colonies. Eight isolates were found to be positive for GCA hydrolase, TDCA hydrolase and TCA hydrolase activities. Nine strains were positive for GCA hydrolase activity but did not show TCA hydrolase and TDCA hydrolase activity. Interestingly three strains were found to be positive for TCA hydrolase and TDCA hydrolase activity but gave negative result for GCA hydrolase activity. Out of twenty lactobacilli isolates, five most potential BSH producing indigenous probiotic Lactobacillus isolates were selected for further studies. L. plantarum 10, L. plantarum 11 and L. plantarum 91 showed maximum BSH activity towards conjugated bile salts such as sodium glycocholate, sodium taurocholate and sodium taurodeoxycholate and may be the promising probiotics to exert beneficial bile salt hydrolase activity.
PROMOTING THE IMAGE AND VALUE OF DAIRY FOODS

(PIVD 01 - PIVD 23)
PIVD-1

Food and spiritualism

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Food should be pleasing to the eyes, the nose, the tongue, but above all, it should nourish body and soul. Food is sacred. It is a gift of nature, and we should take it in its natural form or as close to that as possible. Playing politics with food or profiteering from food is an insult to our common sense. Indian science classifies food into three types: satvik, rajsik, and tamsik. Satvik food is associated with true food. It is simple, natural, seasonal, and local. Fruit, vegetables, grains, pulses, nuts, and herbs come in this category. Relishing the natural taste, the original flavor of food with the least interference and processing has been considered the highest form of cuisine by Indian nutritionists and Ayurvedic doctors. Those who eat satvik food need no other medicine. This is the diet of gods and angels, sages and sadhus, mothers and babies. Natural spring water; fresh and untreated milk and yogurt; pure boiled rice; potatoes baked in their skins; beans and peas; salads of all kinds; thyme, rosemary, sago, cardamom, cumin, turmeric, basil, coriander, chives, and other herbs; and mangoes, apples, bananas, and every local fruit are satvik foods. It is not just what you eat but how you eat it. Preparing with care, sharing and celebrating, being unhurried and relaxed in a convivial ambience contribute to making food satvik. Preparing and eating satvik food is a spiritual practice. Rajsik food is associated with Raja the king. It is spicy, stimulating, exciting, lavish, and elaborate. It is complicated, preserved, and processed. Onions, garlic, chili, spices, pickles, mature cheeses, salt, sugar, canned food, alcoholic drinks, tea, coffee, chocolate, ice cream, foreign food, and frozen food out of season come in this category. Rajsik food has been promoted by soldiers, merchants, and people who prefer taste above nutrition, pleasure above satisfaction, and design above delight. Tamsik food is associated with malevolent forces that cause lethargy, depression, anger, cruelty, and intoxication. Tamsik food is artificial, violent, and addictive. Hard spirits, hard drugs, tobacco, meat, stale foods are included in it. Physical and mental balance requires Carbohydrates, Vitamins, Proteins and other Nutrients. A vegetarian diet provides all nutrients, longer life and decreases morbidity. Right from the beginning advocate for non-cholesterol and suitable foods for our physical and mental balance so that living beings can perform Perfect Dharma without any obstacles and hindrances and achieve salvation.

PIVD-2

Can traditional dahi culture technology be replaced by scientific technology: A pilot level testing of NDRI dahi culture in India

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The presented study was conducted in Haryana state of India republic. Three community development blocks (CDB) and three villages were selected randomly. Thirty respondents were selected from each CDB and village. A pilot level testing means- any technology available first time and put use by the
Promoting the Image and Value of Dairy Foods

farmers/ clienteles first time in a small scale. NDRI, Karnal launched a scientifically good quality of dahi culture and it is successfully used in the dairy industry. No attempted has been made to introduce these cultures in the household level. This technology now needs to be tested at household level. Majority of the respondents were using old dahi culture in both rural (100%) as well as urban area (89%). Makhan or Tindi (butter) was more popular in rural area (67%) as compared to urban area 22 percent. The overall knowledge of NDRI dahi culture was 49 percent. It is obvious that high knowledge about place of culture store, herd size and milk converted in to dahi, have positive relationship with the knowledge level of dairywomen, whereas, age have negative relationship with the knowledge of women regarding NDRI dahi culture practices as it were significant at 5 percent level of probability. The pooled adoption in the household and 61 percent respondents adopted the right place of dahi culture storage whereas, multiply culture for future use (44%), NDRI culture use (34%), lid to cover dahi vessel (33%) and vessel for milk pre-heating 28 percent. The overall adoption of NDRI dahi culture practices was 34 percent of respondents. Data indicated that herd size, milk converted in to dahi and milk sale have positive relationship with adoption of dahi culture practices as it were significant at (5 %) level of probability. Difference in the choice of dahi culture with particular reference to appearance, body, colour and taste of dahi prepared by the respondents. Majority of dahi makers (63%) perceived that appearance of dahi prepared by NDRI dahi culture as similar, whereas, 22 percent and 14 percent respondent perceived inferior and superior appearance, respectively.

PIVD-3

Osteopontin: A milk protein of clinical, pathological and physiological significance

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Osteopontin is a negatively charged, acidic, hydrophilic, phosphorylated, metal binding glycoprotein. Although, highly expressed in bone, osteopontin is also detected in cells, tissues and body fluids (including milk) of various species. Osteopontin is a multifunctional protein with numerous biological activities such as chemotaxis, cell survival, signaling adhesion and migration. Osteopontin plays a significant role in prevention of kidney stone formation, sperm-egg binding and fertilization. Plasma osteopontin levels are associated with a wide range of diseases pertaining to heart, lung, eye, ear, teeth and malignancy. It is a potential biomarker candidate for cancer and fertility index. Patents have been granted for its isolation process and treatment of ectopic calcification and neurological diseases. In the present study, osteopontin was isolated from colostrum, milk and whey of buffalo by anion exchange chromatography. Isolated protein samples were purified by hydrophobic interaction chromatography, hydroxyapatite chromatography and sodium citrate elution followed by barium citrate adsorption. Osteopontin was detected on nitrocellulose membrane by dot blot method. Osteopontin was also isolated, purified and detected from milk and whey samples of cow and goat for comparative purposes. Electrophoretic mobility was assessed at various stages of isolation and purification. The samples were dialyzed, freeze dried and stored for physico-chemical and biological properties. It has shown strong antioxidant activity. Lyophilized samples were hydrolyzed with trypsin and thrombin for characterization.
PIVD-4
Cost of manufacturing of traditional dairy products in a cooperative milk plant in Haryana
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India strode too long to become ‘Numero Uno’ in milk production with annual milk production touching 100 million tonnes in 2005-06 (estimated). Side-by-side the dairy industry has also come off the age in post-independence era. For the viability and financial success of dairy plants, product mixes of the plant and production level of individual products are the important aspects. Estimation of processing costs and break-even level is an important step in this endeavour. Hence, the study has been conducted to examine the milk utilization pattern and the product mix of the dairy plant and to work out the cost of manufacture of different dairy products and assess the break even level of different dairy products. During the study period 28.35 million litres of milk was received at the plant. Ghee utilized maximum (25.87 percent) of total solids followed by FCM (24.12 percent), SMP (17.39 percent), SM (16.84 percent), DTM (9.89 percent), Paneer (4.25 percent). Sale of milk & milk products contributed 92.16 percent of total income. Contribution of different grades of milk (55.94 %) in total revenue was maximum followed by Ghee (32.84 %), Paneer (5.93 %) and SMP (4.78 %). Cost of manufacture were found to be Rs 115.53 per litre, Rs 63.92 per kg, Rs 74.18 per litre, Rs 14.28 per litre, Rs 9.38 per litre and Rs 14.33 per litre, Rs 7.64 per litre for Ghee, Paneer, SMP, FCM, DTM, WM and SM. It was observed that all the products were produced at the level higher than Break-even point.

PIVD-5
Income generation from value added traditional goat milk products for arid region of India
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An effort was made to prepare and popularise the goat milk products in the arid region by sale and imparting trainings to the rural womenfolk engaged in the activity of rearing goats in the small animal production system dominantly prevalent in the area. For this the traditional milk products like milk Kulfi and Paneer were made as per the conventional method used for processing cow milk in the region. In the process of Kulfi preparation- the goat milk was boiled to about 1/3rd of its volume and appropriate quantity of sugar, sliced cashew nut, pista, kesar and flavours were added. This masked the goatee odour from the product. The said mixture was poured in the market available moulds of Kulfi and kept in deep freeze maintained at -20°C.It is ready after 5-7 hours freezing. The Paneer was made by curdling the milk with 0.15% citric acid granules and by separation of whey. The curdled mass was flushed with chilled water for 2-3 minutes and it was pressed under 4 kg weight/ kg Paneer for 50-60 minutes. The Paneer had 53% total solids, 22% fat, 24% protein and 1.9% ash contents. The consistency of Paneer was as good as Cow milk Paneer and it has been accepted widely. The goat milk Kulfi was also popularised as a delicacy and it is being sold through the institute Agricultural Technology Information Centre (ATIC) regularly and remains in high demand. The revenue generation from the sale these goat milk products through ATIC in
the year 2006-07 was to the tune of Rs.60000/-. Looking into the acceptability of the products and its income generating capacity the training was imparted to the rural women of Borawas village in Jodhpur district of Western Rajasthan engaged in the goat husbandry activity about the processes of production of Paneer and Kulfi out of Goat milk. About 20 women were given the practical training and cost economics were illustrated which motivated the women to accept this activity as an income generating source. Efforts are being made to organise marketing of the goat milk products in the adjoining local marketable areas so that it can serve as a model for arid areas for sustainable livelihood activity to support the family income.

PIVD-6

Level of anxiety and depression in vegetarian and non vegetarian adolescent

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Reflecting a commonly held belief, research has confirmed that adolescent’s behaviour and mental health has deteriorated significantly over the past few years. Changes in nutrition and diet, provided in school and at home over that period may be a contributory factor. The following study, one of the first done in Rajasthan, investigates the impact of different types of diet on the level of anxiety and depression of the subjects Adolescents. The sample consists of 300 subjects: male and female, between 13 to 18 years of age, divided into two main groups: vegetarian versus non vegetarian, depending on their diet consumption. The main findings in the two psychological tests given to the subjects both male and female indicated the following trends. Significant differences in anxiety and depression was observed between groups, i.e. More anxiety and depression were reported in the non vegetarian groups in comparison with the vegetarian group, whereas comparison between gender showed no significant difference for anxiety, but significant difference for depression i.e. unlike anxiety more depression has been observed in Girls than boys.

PIVD-7

Global entrepreneurship

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The word entrepreneur comes from the 17th century French word ‘entreprendre’ which refers to individuals who undertook the risk of new enterprise. Today, in the world of liberalization, privatization and globalization (LPG), entrepreneurship includes more than mere creation of a business. Understanding team concept is critical to become a successful entrepreneur. The idea of a sole individual being able to take on enormous risks, attempt innovations, leap without the appropriate background research, and succeed by working long hours and preserving at all costs is no longer relevant in today’s global economy. International business has become increasingly important to firms of all sizes. Every firm now compete in a hypercompetitive global economy.

The paper will provide practical, detailed roadmap that defines the entrepreneurial strategic process and the skills needed for real world business practices. It addresses the challenges, issues and rewards faced by entrepreneurs on starting a new venture. The paper examines the essential components of
entrepreneurial strategy that make up the five stages of entrepreneurial process. The legal issues such as intellectual property protection and product safety and liability are also covered. It highlights the difference between international and domestic entrepreneurs and addresses the questions to be answered by an entrepreneur entering the international market. Brief about important government laws related to establishing and running an enterprise is also included in the paper. The paper explores the nature of global entrepreneurship, provide models for new venture creation and describe ways to help entrepreneurs succeed in global economy for global prosperity.

PIVD-8

Camel milk: New approach in white revolution

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Camel forms an integral part of ecosystem. In many countries camel is mainly reared for milk and meat but in India, the camel is not considered to be milch animal whereas the she camel has the potential to produce 1872 litre of milk in a lactation period of 12 –18 months with daily average ranging from 3.4 to 18.2 litres. In considering the alternative source of milk with therapeutic value camel is still by and large the desert nomad’s dairy. Camel milk remains quite stable at room temperature and takes a comparatively longer time to become sour. So, efforts were made to know its nutritional composition and compared to cow’s milk. Protein and carbohydrate content of camel milk was significantly higher as compare to cow’s milk. Similarly the fat content of camel was found to be lower. The percentage of sodium was lower whereas potassium was higher in camel milk. So it can be concluded that camel milk contain appreciable amount of protein, carbohydrate and potassium, which signifies the therapeutic value.

PIVD-9

New vistas of utilizing camel and sheep milk for health and nutrition in arid regions

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Adequate amount of milk (150-250 ml/day) should find a place in any balance diet owing to its good quality of nutrients. Although milk production in our country has increased many folds but still the per-capita availability remains low. The condition becomes more severe for resource poor families residing in harsh climatic conditions like arid areas. The indigenous breed of camel and sheep can be an important and economic supplemental source to augment the milk deficiency especially in the interior rural sectors of arid regions. The milk supply obtained from camel and sheep have been reported to be valuable with respect to its immense therapeutic utility, vital nutrient and sensory appeal. Possibilities of development of palatable products like ice creams, fruit shakes as well as khoa, paneer, curd and concentrated milk based products from camel and sheep milk proved as new vistas of value addition to Indian dairy industry. This not only can support livelihood security of camel and sheep rearers but would also bring better health and nutrition to the rural and urban masses.
PIVD-10

Microbial safety while handling milk products

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Dairy products are likely to remain important dietary components because of their nutritional value, flavor and texture. There will continue to be a demand for traditional, high quality dairy products, despite increasing competition from non-dairy based products. Pasteurization was established to ensure that milk was safe for human consumption. Bovine tuberculosis, brucellosis and Johne’s disease or paratuberculosis have a worldwide distribution. The mycobacteria responsible have been claimed to survive pasteurization recent studies using a strictly controlled commercial type pasteurizer, show that their organisms are effectively eliminated using the traditional pasteurization time and temperature. Pasteurization and/or other means will always be essential to ensure the absence of animal and environmental pathogens from milk and milk products.

Traditional methods of preservation- increased acidity; lowered water activity and lowered redox potential were used to preserve both butter and cheese. With easy sterilization of products, aseptic packing and food refrigeration, a wide range of fluid products can now be made, distributed and sold. Whereas most dairy products, processed to modern standards of hygiene, have an excellent safety record, consumers are demanding increased surveillance and control of all foods, including dairy. There will be no lessening in the demands of food producers to control risks and deliver assurance of safety. The increased costs associated with providing these assurances through effective process control will become the norm for dairy businesses in the future.

Although there is the potential to genetically modify the dairy cow and the milk it produces, the benefits need to be unambiguous and superior to standard breeding practice. Traceability of a problem from product pack to source cow as well as rigorous testing at every step of the process will be necessary to meet consumer requirements for “safe food”. New technologies that give dairy products a longer life without any compromise to their sensory properties are likely to arise.

PIVD-11

Global perspective of dairy products

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Comprehensive and authoritative, advanced technologies for dairy processing present the latest developments concerning the quality, analysis, and processing of dairy and dairy products. Production on farm will become increasingly efficient, resulting in continuing price benefits to the consumer, producer and manufacturer to safety and quality issues. Despite increasing pressure from nonmilk alternatives, milk and dairy will still be the best sources of nutrition for the young and for traditional dairy products. Consumer concern will be of overriding importance for the industry, and the safety of dairy foods must become absolute. Major importance has been attached to clearly targeted selection and breeding of cows...
and their feed. The availability of relatively simple technological advances, such as refrigeration, large-scale transport by road and sea, and high-speed routine business communication, has led to larger scale manufacturing and wide-ranging and complex warehousing and distribution system, thus allowing targeted production and distribution of a large number of specialist products. In turn, this has resulted in increased globalization, technological complexity, standardized milk quality, and lower product prices. The consumption of dairy and dairy-based foods has increased, and the industry has provided consumers in most socioeconomic groups with high-quality nutritious foods. This trend is predicted to continue worldwide.

**PIVD-12**

**Sustainable white revolution**

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Milk was always available in plenty, but the sad truth was that the middleman was in control of marketing and siphoned away the major share of the farmer’s profits. During seasons of plenty, the farmer’s were forced to drastically cut down their prices to sell off their surplus supplies. During lean period, milk production fell considerably, resulting in a shortage, unavailable market demand. The “White Revolution” shares in the national efforts to address poverty and malnutrition. Specifically it aims to: ensure availability and promote consumption of local milk and provide livelihood opportunities for rural farm families. The White Revolution is anchored on following development strategies: massive herd build-up, adequate post production support, existence of sustainable market, human resource development, research and development, national milk campaign, credit facilities and policy formulation and implementation. The White Revolution ensures a better quality of life for adequate milk supply, increase income of rural communities and healthier, brighter children. The war against malnutrition and poverty goes on. Victory can be reality through the White Revolution.

**PIVD-13**

**Historical perspective of yoghurt**

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Yogurt— a medicine “Let your food be medicine, and medicine your food.” –Hippocrates

Yogurt is one of the oldest fermented milk products known for its medicinal, therapeutic and nutritive value. Around the world today, yogurt is enjoyed by many nationalities. It is produced by bacterial fermentation of milk sugar (lactose) into lactic acid that gives yogurt its gel like structure and characteristic tang. It is a semisolid fermented milk product, which originated centuries ago in Bulgaria. In 1908, The Russian Biologist, Metchnikov suggested that the lactobacillus bacteria in yogurt were responsible for the unusually long life span of the bulgar people. Scientists took up the idea and probiotic movement came up. The word was acquired in the 1620’s from Turkish jugurt(and hence yogurt) deriving from the verb
yogurt mak, which means to blend, referring to how yogurt is made. It can be spelled myriad ways, yoghurt, yooghurt, yoghard, yaourt, or yogourt (traditional spellings or yogurt (modern spelling). Yogurt is known around the world by many names as a result of a diverse dispersion throughout the Mediterranean, the middle East, Central Europe and part of Asia and the far East: France (yaort), Bulgaria (Kiselo Mleko), Arabic world (Laban), Armenia (Madzoon or Matsun), Greece (yaourt Oxyzale), India (Dahi), Nepal (Dhai). Yogurt finds its regular mention in Vedic texts, biblical and Quranic records as a part of daily diet and for its medicinal value.

**PIVD-14**

**Casein as natural nano-encapsulation material**

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The natural ability of the milk protein, casein, to form nano-sized micelles can be useful as nano-vehicles for entrapment, protection and delivery of sensitive ingredients. Such nano-capsules may be incorporated in dairy products without modifying their sensory properties. This introduces new possibilities for encapsulation and delivery of sensitive health-promoting substances using natural GRAS (generally regarded as safe) ingredients. Food manufacturers are increasingly turning to encapsulation technologies as a way of achieving much-needed differentiation and enhancing product value. Tapping into key and emerging consumer trends with innovative techniques is becoming increasingly important for food manufacturers. While the majority of focus has been on microencapsulation, more and more research is looking at the potential of nanoencapsulation. The protein casein makes up about 80 per cent of the protein content of cow’s milk (30-35 grams per litre) and is found naturally in the form of spherical micelles with diameters ranging from 50 to 500 nanometres. The stability of these micelles during processing also makes them a very attractive nano-encapsulator. Also, the casein micelles are designed by nature to concentrate, stabilize and deliver nutrients to the newborn. “It’s a natural way to encapsulate and deliver nutrients”. The naturally excellent digestibility of caseins and the nanoscopic size of the micelles may improve the bioavailability of the encapsulated nutraceuticals. The application of nanotechnology and nanoparticles in food are emerging rapidly. Some analysts predict that nanotechnology will be incorporated into 16.4bn worth of food products by 2010. However enthusiasm over the rate of progress and the possibilities is being tempered by concerns over possible downsides of the science of the miniscule.

**PIVD-15**

**Flavor considerations in traditionally consumed cheese products in Brazil**

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In the Northeast region of Brazil, two cheeses, commonly known in Portuguese language as Queijo de Coalho and Queijo Pré-cozido (their equivalent in English language being “Raw curd cheese” and “Precooked cheese”) are the main cheese products which are highly appreciated. Even today, most of the production of these cheeses is still done by small-scale farmers wherein processing control measures are not stringent, consequently leading to a wide variation in the quality of these products. The present work was undertaken
to study and compare the chemical characteristics of the two cheeses, giving an emphasis to sensorial aspects of appearance, texture, aroma and flavour attributes. The volatile compounds of the two cheeses were also analyzed by using a simultaneous distillation and extraction technique utilizing Likens and Nickerson’s apparatus. Thirty gram of cheese was homogenized and extraction was carried out at 55°C for 120 min by using a mixture of pentane-ethyl ether (2:1) solvent. The extracts were concentrated and analyzed for the identification of volatile compounds using a system of high resolution gas chromatograph coupled with mass spectrometer. A total of 176 and 112 volatile compounds were identified in Raw curd cheese and Precooked cheese, respectively. A large variation in volatile profile of the two cheeses was observed and Raw curd cheese was preferred in aroma and flavour attributes as compared to that of the Precooked cheese.

PIVD-16

Entrepreneurship development to produce milk based heritage foods in the milk-shed areas

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India has attained the laurel of being highest producer of milk in the world. About 82 per cent of this produce is obtained from unorganized/non-institutional sector. A larger proportion is produced by the landless, small and medium farmers. The milk is collected from the village based milk-shed areas and brought to cities for processing in milk based food industries, the traditional milk based food processors called Halwaies and for direct consumption. Different types of transport means such as refrigerated van, non-refrigerated vans, can vehicles, motor cycle and cycle vendors are used. In this process of collection and transportation, 20-25 per cent milk gets wasted or spoiled. Several types of health hazardous adulterants/additives are used to enhance temporary shelf life of the milk. The micro-biological infections also take place during this handling, processing and transportation. As a result of this, the quality standard of the milk based traditional foods can not be maintained. Looking to the above wide-spread problems, a new model has been proposed to develop entrepreneurship in the milk-shed areas. The model will help in producing clean milk, its collection and processing under hygienic and safe conditions. The preparation of manufactured and speciality foods can also be undertaken in the rural areas at various levels of technological interventions and innovations.

PIVD-17

Science and technology for quality dairy products

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Today consumers are demanding quality in the food products they purchase. It is the duty of the manufacturers to enhance and assure the quality of dairy products at every link in the marketing chain – from the farms all the way to the consumer’s table. These programs combine new technologies and new quality management practices with our century-old commitment to quality and craftsmanship. This
ongoing effort underscores longstanding commitment to providing consumers with the best quality cheese and dairy products available. Dairy producers work with many resources and experts to help them maintain the health of their dairy cows and the quality of the milk they produce. A combination of on-farm “best management practices”, stringent regulatory requirements and regular on-farm quality assurance inspections help ensure that all of our cheese and dairy products begin with quality raw milk. Consumption of good quality dairy products as a part of a nutrient-rich diet has long been recognized as an important contributor to maintaining health and nutrition for people of all ages. Diets rich in milk, cheese, yogurt and other dairy products provide important vitamins and minerals essential for human growth and development. In addition to helping build strong bones, preventing osteoporosis, low fat dairy products can help reduce risk of hypertension and certain cancers, and can play a role in better weight management. Milk and other dairy products are the richest source of calcium with a lot of other benefits to boot but without compromising on quality.

PIVD-18
Potential applications of PCR in dairy industry
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Identification of microorganisms in food products has become an important subject in recent years with regard to food safety and authentication. To avoid adulteration and consumer safety, it is essential to develop rapid and consistent analytical procedures to be used by the dairy industry to fight adulteration of milk and milk products. Conventional methods to detect food borne organisms often rely on time-consuming procedures. Modern advances in technology have made detection and identification faster, more convenient, sensitive, and specific than conventional assays. Polymerase chain reaction (PCR) is one of the upcoming biotechnological tools, which is easy to use, rapid, and readily automated and has broad range of applications in the various areas including dairy industry for the rapid determination of microbial species. This paper describes the PCR technique and its application to the identification and verification of microorganisms associated with dairy products. This technique has been applied to detect the presence of cow’s milk in sheep’s and goats milk cheeses, viable yeasts in yoghurt, identification of various microorganisms/pathogens such as Staphylococcus, Salmonella, Campylobacter, Listeria, and Escherichia coli O157:H7 in milk and dairy products.

PIVD-19
Development of traditional dairy foods in Egypt
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Egyptian civilization probably began about 3100 B.C., following a predynastic period from 5500 B.C. the population supported itself first by hunting the many wild species that lived in and around the Nile. These included wild fowl, fish, pigs, cattle, antelope, and gazelle. As the population began to establish agricultural communities, the wild pigs and wild cattle were domesticated. The Egyptians kept cattle,
goats and sheep. Their milk was kept in egg-shaped earthen jars, plugged with grass as protection against insect and was drunk shortly after milking. It is often assumed that - because of the hot climate in which milk spoils in a few hours - milk not destined for immediate consumption was processed into something similar to quark or yoghurt-like labaneh. The Government 1980, walking a narrow path between protecting the poorest section of society and adopting a more open and liberal economic policy. Naturally the dairy sector is benefiting from this and the changes are encouraging investment by international groups as well as significant regional companies. Perhaps surprisingly, overall consumption of liquid milk is actually falling, reflecting the movement in the population from rural to urban locations, where milk supply is erratic. Some of milk is treated only by being boiled by the consumer. Processed milk, dominated by UHT, is growing slowly but as yet remains of secondary importance. Cheese comes in three basic types, and constitutes a significant part of the Egyptian diet - most of the population eats cheese with at least one meal a day. But again, artisanal production, particularly of white cheese, makes up the bulk of this, although processed cheese is the fastest growing area. Rayeb is a plain drinking yoghurt, similar to laban found in other Arab markets. Labneh is strained yoghurt. Butter, like butter ghee, is used in cooking and baking rather than being spread on bread in the Western manner. In 1974 the so-called “Open Door” policy opened the dairy industry to private sector investment. In the next ten years around 150 licenses for private dairy operations were issued. Today there are close to 20 new dairy factories opened. In spite of the establishment of these new factories however about 65% of Egypt’s dairy production still occurs in the “non-market” economy or artisanal sector.

PIVD-20
Changing dimensions of Indian milk products

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India has many challenges to pursue in future to dispose huge quality of milk produced. As time becomes more precious and the demand for convenience is heightened, technology is opening new windows for ready to use milk and milk products. Some consumers are more ready than others to participate in consumer direct services. Marketing of Milk & Milk products in these years will demand an approach that responds to changing consumers, new technology and a vastly different competitive landscape. Picture a sachet of milk with one month shelf life at room temperature, ‘Kheer’ prepared within ten minutes, the man knocking your door with one kg of appealing pack of Pista burfi you have ordered just now through Internet. Over the next five years, this industry must focus on two basic priorities: making milk food easier for the consumer to eat and making it cheaper for them to buy. How can this happen? Consumer direct services are about to become big business and Dairy Industry need to start thinking now of how to take advantage of this immediate boon, or else they’ll be left behind. Is the Dairy industry ready for so much upheaval?
PIVD-21

Anaerobic treatment of cheese whey

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Anaerobic treatment is the use of biological processes, in the absence of oxygen, for the breakdown of organic matter and the stabilization of these materials, by conversion to methane and carbon dioxide gases and nearly a stable residue. Whey is the liquid waste generated from the process of cheese making. It constitutes 80 to 90% of the total volume of the milk entering the process and contains approximately half of the solids of the original milk including 20% of the protein and most of the lactose. Because of its high levels of protein and lactose, discharging whey directly into the waterway could cause severe pollution problems. The primary aim was to develop a simple biological process to reduce the BOD of the wastewater from about 1000 to 250 mg/liters (about 75%) or lower, so that the effluent could be discharged to the sewage. The secondary aim was to determine the feasibility of further reducing the BOD and significantly, the biogas (methane gas) produced is a natural source of energy, which can be collected and used to generate heat or electric power. The effluent produced is rich in nutrients and is an excellent soil conditioner. It can also be used as livestock feed additive when dried. The advantage of this method is that it couples the treatment of the waste with energy production (methane).

PIVD-22

Whey utilization: Mother liquor (by product) - as a nutritional feed for dairy cattle

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Whey, the greenish yellow aqueous portion of milk is obtained during the manufacture of cheese, casein and paneer. It contains approximately 6% total solids, of which lactose is more than 90%. Whey has a high biological oxygen demand (B.O.D.) ranging from 32000 to 60,000 ppm, which is equivalent to 100-200 times that of domestic sewage. Thus from environmental and economic view point, it becomes necessary to utilize these whey solids. It is observed that mother liquor, obtained after primary crystallization and decantation during lactose manufacture, contains total solids in the range of 35-38%, mainly lactose. This being wasted is not only adding to extra load on waste treatment plant but also resulting in loss of useful solids. This Mother Liquor can be utilized effectively if it is subjected for drum drying to recover solids. These solids that are obtained in the form of powder can be used as an additive in the manufacture of animal feed (cattle and poultry). The economic analysis indicates that substantial money can be generated if solids are recovered and reutilized as a cattle feed.
Dairy extension for developing dairy entrepreneurship

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Dairy Extension can play a pivotal role in development and promotion of dairy and livestock based enterprise which is the main subsidiary occupation of the majority of Indian farmers. The need for developing entrepreneurship skill among the dairy farmers has increased in the present grim scenario of rural unemployment, especially in face of liberalized economy and globalization. The existing situation of live stock rearing and dairy farming in rural India needs to be looked at afresh for harnessing its full potential to promote dairy entrepreneurship especially in the light of underutilization of the available technologies and innovations by the dairy farmers. Extension professionals can change the negative attitude and traditional mindset of farmers by imparting them adequate skills not only related to technical subject but also related to management of enterprises and human resources. Extension education ensures conscious provision of pertinent information and communication support to rural prospective entrepreneurs in dairy sector by providing them management skills as well in terms of motivation, leadership, problem solving, decision making and most importantly risk taking capabilities required for entrepreneurship. The dairy extension system can act as a catalyst and enabling force to help dairy farmers to analyze their problems and identify the entrepreneurship opportunities with a need to further commercialization of production system at their dairy farm levels. This paper will throw light on the role and implications of extension education in promotion of dairy and livestock enterprise in rural India.
PRODUCT AND PROCESS DEVELOPMENT

(PPD 01 – PPD 96)
PPD-1

Optimization of cooking processes for indigenous dairy product processing

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Cooking is an important unit operation in the production process of many indigenous milk products e.g. Gulabjamun, Rosogolla, Chumchum, Kheer etc. Although cooking is the older process of treating food thermally, it was neglected by scientists and put aside as non-scientific. Most of the publish research on Indian milk product deals primarily with physico-chemical changes in product or in oil, while on the question of heat and mass transfer mechanism and rate during cooking remain untouched. Cooking is based on kinetics, heat transfer and mass transfer. Increase in temperature leads to increase in speed of molecule in the food. The greater speed more the collision. These collisions between the molecules lead to changes in molecular structure by creating new molecules. These new molecules have characteristics color, flavor and texture. The process becomes more complicated as the operation become transient due to continuously change in composition of the product and medium simultaneously. Apart from this various chemical reactions takes place in the product such as gelatinization of starch, denaturation of protein and decrease in moisture. These changes being about swelling of product, forming crusty layer, appearance of golden color, thermal softening good texture and taste. The paper aims at introducing the concept of optimizing cooking process in the manufacture of indigenous dairy products and to suggest suitable mathematical model for the process. This information is useful to selecting optimized process parameters condition. The approximate modes of mass transport phenomenon in cooking process of selected indigenous products have been defined and suitable mathematical model are suggested to optimize the process for mass production of indigenous milk products.

PPD-2

Process optimization of banana wine in bench top fermenter

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Banana is available throughout the year in India and loss of banana in the market is not noticed. One of the versatile technologies to prevent the loss of banana is fermentation. Fermentation is a potential tool in the development of new products from banana with modified physico-chemical and sensory qualities especially flavour and nutritional components. The present study aimed to develop good quality banana wine by selection of suitable variety of banana and yeast cultures. Evaluation of physico chemical properties which includes alcohol content, total soluble solids, pH, titrable acidity and colour were carried out in order to optimize the process parameters to get good quality banana wine. Three varieties of banana namely, Poovan, Rashahi and Robusta were screened using elite yeast culture for banana wine making in which BYC-2 recorded higher alcohol content of 12 percent. The duration of the fermentation was adjusted so that an alcohol content of 12 percent was attained. Banana juice fermented for 25 days recorded an alcohol content of 12 percent under static condition in fermenter. The duration of the fermentation could
be reduced to 20 days in a fermentation vessel by providing aeration @ 1.5 lph and stirring @ 250 rpm at ambient condition after inactivating poly phenols. Among the three varieties of banana viz., Poovan, Rasthali, and Robusta, the wine obtained from the juice of Robusta variety recorded the higher alcohol content, less acidic, high pH after fermentation followed by Poovan and Rasthali. Among the durations of fermentation studied 25 days of fermentation recorded higher alcohol content. Studies were conducted to improve the quality of wine by malolactic fermentation for seven days. The pH of the wine increased during malolactic fermentation. Also reduction in the titrable acidity level was noticed without change in the alcohol content and total soluble solids. To optimize the suitable aging temperature, wine is subjected to room temperature (28 ± 2°C) and refrigerated temperature (4°C), for a period of 90 days. During aging process, the titrable acidity decreased in wine with increase in pH both at refrigerated (4°C) and ambient (28 ±2°C) conditions. The reduction was high at refrigerated condition when compared to the wine stored at room temperature. However, no effect on both alcohol content and the total soluble solids were recorded. Wine made from Robusta variety of banana recorded higher alcohol content as well as recorded maximum organoleptic score. Robusta wine with a fermentation duration of 25 days using BYC - 2 yeast strain and aging at refrigerated (4°C) condition yielded higher sensory score followed by Robusta wine aged at room temperature (28 ±2 °C). The carbonated wine from robusta variety recorded the higher sensory score of 8 followed by carbonated wine from Poovan variety (7.5). The uncarbonated wines from Poovan and Robusta were on par with the leading commercial brand (mean score of 7).

PPD-3

Development of direct acidified lassi like beverage using paneer whey

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Lassi is a refreshing beverage generally made from curd obtained by lactic acid culture and by admixing sugar or salt. The maintenance and propagation of culture is a costly proposition. Accordingly, an attempt had been made to develop a lassi like beverage using paneer whey by addition of food grade acids. Studies were conducted to select types and levels of hydrocolloids and dietary fibre, thereby to optimise the product formulation. Preliminary trials served to select levels of hydrocolloids, viz., guar gum (0.1-0.4%), CMC (0.1-0.3%), and the type of dietary fibre (inulin 4-8%) to be integrated in a three factor Response Surface Methodology (RSM) design. Twenty experiments planned using the Central Composite Rotatory Design (CCRD) were carried out and the effects of different ingredients on sensory and physical attributes were studied. The data were analysed by Design Expert Software (Version 6.0.10), which gave an optimised formulation in terms of products sensory and physical attributes acceptability. The formulation containing 0.25 percent guar gum, 0.1 percent CMC and 5.92 percent inulin, gave the optimum product in terms of sensory and physical characteristics. Response surface analysis revealed that sensory scores for flavour, consistency, colour and appearance and overall acceptability of lassi like beverage varied from 6.50 to 7.25, 6.16 to 7.12, 6.20 to 7.41 and 6.00 to 7.20 respectively. The results of analysis showed that all the examined model solutions had significant influence on the different parameters indicating that the statistical model designed for these attributes fitted well in all the aspects of model efficiency check ($R^2 >85\%$).
PPD-4

Sensory properties of low fat partially filled frozen dessert using different intense sweeteners

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A study was carried out to study the effects of intense sweeteners on the sensory properties of a low fat, partially filled frozen dessert. The basic ice cream mix i.e. control (C) had 1.5 % milk fat, 3% vegetable oil blend, 11.75 % MSNF, 1.25% WPC-70, 15% sucrose, 0.25% stabilizer and 0.25% emulsifier. The experimental frozen desserts were formulated with polydextrose, maltodextrin, and sorbitol as bulk fillers replacing sucrose. In many sweetener blends, especially with intense sweeteners, a synergistic sweetness enhancement has been observed. Based on preliminary investigations, three intense sweeteners were used either singly or in combination viz. Aspartame, Acesulfame-K, Sucralose, Aspartame +Acesulfame-K (50:50 w/w), Acesulfame-K+ Sucralose (50:50 w/w), Aspartame + Sucralose (50:50 w/w). From amongst these six intense sweeteners/ sweetener combinations tried out based on preliminary ranking test it was found that Aspartame, Sucralose and Aspartame+Acesulfame-K (1:1) were preferred the most. All the experimental mixes were formulated to maintain the sweetness intensity and freezing characteristics of a 15% sucrose ice cream. Sensory characteristics of the frozen desserts were evaluated viz. flavour, body and texture, colour and appearance, and melting quality scores. In the final part of the study aspartame, sucralose and aspartame+aesulfame (1:1) were compared for their sensory properties. The sensory analysis panel scored sucralose as best overall intense sweetener in the dietetic frozen dessert.

PPD-5

Heat transfer performance and design aspects of continuous basundi making machine

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The Continuous Basundi Making Machine (CBM) is designed at SMC College of Dairy Science, Anand Agricultural University, Anand, based on the principle of Scrap Surface Heat Exchanger (SSHE). It consists of concentration unit of three SSHEs and chilling units of two SSHEs with specially designed scrapers, Variable Frequency Drive (VFD) to facilitate variation of speed of scrapers, Resistance Temperature Detector (RTD) sensors and other controls to optimize processing parameters, which results in to better quality product in terms of sensory and rheological attributes. Standardization of traditional process in terms of manufacturing techniques, sensory profiles, and compositional and physico-chemical attributes is done for attaining a product of uniform standard and assured quality. The machine and standard process developed to manufacture Basundi has considerable industrial potential and a number of advantages over traditional method. The new technology using Standard Process of making Basundi and employing CBM is energy efficient and the quality of the product is better compared to traditional product as concentration of milk takes place at atmospheric pressure. In the machine sugar syrup dosing is done in the third SSHE of concentration unit which develops typical pleasant caramel flavour and colour of the product. Simultaneously it is also expected that the process consumes less energy and has least deleterious
effects on the nutritional profile of Basundi. Heat transfer performance of continuous Basundi-making machine was evaluated in terms of rate of heat transfer, heat losses, heat utilization, energy conservation, estimation of overall heat transfer coefficients and estimation of film coefficients. Heat transfer correlations were derived using dimensional analysis to determine the scrap surface film coefficient and Wilson-plot technique was used to determine steam side film coefficient. Empirical relations and dimensionless numbers were obtained to study the effect of physical properties, thermal properties, kinematic variables and geometrical factors on heat transfer in CBM. Energy analysis of the process was done under different operating conditions. The operating parameters were optimized to get better product quality with minimum energy requirement. Sensory evaluation of Basundi prepared in the CBM was at par with control Basundi in flavour. The flavour and colour of Basundi prepared using CBM was better. The VFD used for controlling speed of scraper assembly helps to get desired typical caramelized flavour and flakes in the Basundi. The keeping quality of experimental and control Basundi samples was 2 days at room temperature (28-32°C) and 20-22 days under refrigerated conditions (7 ± 2°C). The cost analysis of Basundi manufacture in CBM revealed that the total cost of the Basundi from standardized milk is Rs. 38.42 per kg which consists of 89.01% raw material cost and 10.99% manufacturing cost.

PPD-6

Process optimization for preparation of buffalo milk chhana spread

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Process was aimed to prepare desirable quality chhana spread from buffalo milk chhana with incorporation of refined sunflower oil (0, 2.5, 5, 7.5 & 10%) and cream (0, 10, 20, 30 & 40%). Blending of sunflower oil and cream with chhana at different levels significantly influenced the sensory quality of chhana spread. Optimum scores for all the quality attributes were recorded for chhana spread made by blending chhana with 7.5% sunflower oil and 40% cream as compared to other levels using 20% water at 80°C. Further, addition of salt significantly improved the flavour and overall acceptability of chhana spread. It is concluded that desirable quality channa spread could be obtained by blending buffalo milk chhana with 7.5% refined sunflower oil and 40% cream.

PPD-7

Preparation of low fat paneer enriched with whey protein concentrate

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An Attempt was made to prepare low fat paneer from buffalo milk added with Whey Protein Concentrate (WPC). Paneer was prepared from buffalo milk standardized to 6% fat and at lower fat levels viz, 5%, 4% & 3%. Further, to improve upon the sensory quality of low fat paneer, WPC was incorporated at different levels. Results revealed that the quality attributes of paneer differed significantly with lowering of fat from 6% to 3% except appearance. The sensory scores for body & texture and overall acceptability of paneer made from buffalo milk with 4% fat and control paneer were comparable. Paneer made from milk with 6% fat recorded highest yield as well as recovery of fat and total solids. The product with 5% fat had
almost similar recovery of solids but with slightly low in yield. Incorporation of WPC at different levels significantly influenced the sensory quality of low fat paneer. WPC @ 2% was found most effective as compared to other levels for improving the quality attributes of low fat paneer.

PPD-8
Development of immobilised system for downstream processing of lectin from pseudomonas

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Lectins are the nonenzymic proteins or glycoprotein’s present ubiquitously in nature. They have specific recognition sites for specific carbohydrates. The binding of lectins is reversible to form molecular complexes of higher specificity. Many lectins are extracted from plants are commercially available and are called phytolectins, but few of them are extracted from bacteria are available commercially. So, lectin from microbial sources needs lot of exploring. A thermolabile lectin from Pseudomonas was extracted that inhibits glucose carbohydrate. An immobilized system with saw dust, rice bran has been developed for purification of this lectin.

PPD-9
Standardization of process for chhana podo preparation from cow milk

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It was intended to standardize process of manufacture and to study sensory attributes of chhana podo. Chhana was prepared from cow milk with 4 per cent fat and was used for the manufacture of chhana podo. Use of baking powder, suji/Maida, different levels of sugar and maida and baking time in chhana podo preparation were attempted. In phase-I of preliminary trials chhana podo was prepared with three levels of sugar viz., 15, 20 and 25 per cent with three levels of addition of maida (3, 4 and 5 per cent). From the result of preliminary trials two levels of sugar viz., 20 and 25 percent and two levels of maida 4 and 5 per cent were selected for the experimental trials. It was observed that chhana podo prepared from standardized cow milk (4 per cent fat), using 25 per cent sugar with 5 per cent maida and baked at 50°C for 80 min showed better sensory quality than other treatments tried.

PPD-10
Paneer whey beverage using kokum

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Attempt was made to use whey produced during paneer production for preparation of whey beverage blended with kokum (Garcina indica) juice. Varying levels of kokum juice from 1.5 to 4.5 per cent with 9 to 18 per cent levels of sugar were tried in paneer whey. In all the treatment combinations 0.1 per cent jeera
powder and raspberry colour were also added to improve the taste and colour respectively. Kokum juice at 2.5 and 15 per cent sugar was found sensorial most acceptable than rest other combinations in paneer whey beverage and was classed as “Liked Very Much”. Chemically it contained 16.44, 19.74, 4.66, 15.08, 0.417, 4.68 and 0.09 per cent TS, total sugar, non reducing sugar, acidity, pH and protein, respectively. Statistically interaction effect of all treatment combination on all studied constituents was non-significant, except TS and pH. The cost of production of most acceptable sample was Rs. 5.11/ litre, which was contributed by cost of sugar, Kokum juice, processing cost and labour charges.

PPD-11
Selection of levels of ingredients in low calorie, prebiotic ice-cream using response surface methodology
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Low calorie prebiotic ice-cream product was developed using sugar and fat replacers. The ingredients used were fat (0.053 – 11.946 %), raftline (2.243 – 11.756 %), sorbitol (4.243 – 13.756 %), aspartame (0.0004 – 0.0756 %), stabilizer (0.0378 – 0.4378 %) and emulsifier (0.0810 – 0.3189 %). Response Surface Methodology was used to design the experiment and select the optimum levels of ingredients. The overrun ranged between 70.75% to 133%. The meltdown time of ice cream varied from 40 min to 83 min and the specific gravity of the ice cream mixes ranged from 106.9 to 123.0 units. The sensory responses viz., overall acceptability, body and texture, flavor and color and appearance ranged from 4.8 to 8.5, 4.6 to 8.45, 5.2 to 8.6 and 4.9 to 8.6, respectively. Raftline decreased the overrun in the ice cream while stabilizer, fat, sorbitol and emulsifier increased the overrun. Sorbitol promoted faster meltdown of ice cream. Fat showed the highest effect on improving the sensory properties followed by raftline and sorbitol. Stabilizer affected the viscosity more than the other ingredients. Ice cream mixes showed non-Newtonian characteristics with shear thinning behavior. Optimum level of ingredients obtained by simultaneous optimization of overrun and overall acceptability was: fat-6.825%, raftline-11.42%, sorbitol-7.0%, aspartame-0.535%, stabilizer-0.3% and emulsifier-0.25% respectively.

PPD-12
Effect of exopolysaccharide producing cultures on technotextural properties of non-fat fermented milks
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The experiment was planned to study the effect of exopolysaccharide (EPS) producing cultures on textural properties of non-fat fermented milks. Six different EPS producing cultures, were isolated from dahi designated as: IC16, & K2 (Streptococcus thermophilus), Kl24 & B9 (Lactococcus lactis), V10 (Lactobacillus fermentum) and one NCDC 285 (Lactobacillus delbrueckii subsp. bulgaricus) were used for preparation of non-fat dahi and lassi. Both non-fat products were made from reconstituted (12%) skim milk with EPS+ cultures and compared with control batches of EPS NCDC 167 (mixed mesophilic cultures), 074
(S. thermophilus) and 09 (Lactobacillus delbrueckii subsp. bulgaricus) for technological properties. These products were analyzed for rheological parameters i.e. viscosity, firmness, work of adhesion and stickiness using TAXT2 texture analyzer. Sensory evaluation was done by panel of at least five judges using 9-point hedonic scale score card. All the EPS producing cultures had significant effect on rheological and sensory properties of non-fat dahi and lassi. The products made with EPS were more viscous, less firm in case of dahi and more liked by the judges in sensory scores as compared to the control samples. The viscosity of EPS containing dahi and lassi ranged from 0.175-0.437 pa. sec and 0.018-0.042 pa. sec. respectively as against 0.141-0.174 for dahi and 0.013-0.017 pa. sec. for lassi from non-EPS producing cultures. The sensory analysis of dahi and lassi revealed that products prepared from EPS cultures (dahi and lassi) received higher overall acceptability scores than the control, which ranged from 5.1-7.5 for dahi and 5.1-7.3 for lassi. All the EPS cultures gave better results than the control but best performance was obtained with K2 and Kt24. Although Lactobacillus cultures V10 & 285 produced maximum viscosity both in case of dahi and lassi but received lower sensory scores. The study showed conclusively that rheological properties of fat free dahi and lassi can be significantly improved by the use of EPS cultures.

PPD-13
Effect of k-carrageenan and tetrasodium pyrophosphate on the yield of direct acidified cottage cheese
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The recovery of whey proteins with improved water holding capacity, reduction of losses of curd fines as well as improvement of the ability of curd to retain moisture appear some crucial approaches to result in a product with comparatively higher yield. In the present study, endeavours were made to improve the yield of direct acidified cottage through the addition of k-carrageenan in milk before heat treatment and tetrasodium pyrophosphate immediately before renneting. k-carrageenan was added at the levels of 0.005, 0.015 and 0.025% and their effect on the total protein and whey proteins contents (DM basis), moisture retention and the resultant curd yield as well as the quality of cottage cheese was studied. The study showed that addition of k-carrageenan at 0.015% level followed by heat treatment at 90°C for 5 min significantly (P<0.01) increased the curd yield to 13.82% against 12.16% for the control with an additional increase by 13.65%. It was also observed that addition of k-carrageenan at the level of 0.015% significantly (P<0.01) increased the whey proteins and total protein contents to 14.76 and 88.48% against 73.41% and 1.20%, respectively with improved (P<0.01) moisture retention of 75.38% as compared to 74.35% for the control. However, the study showed that addition of TSPP at the levels of 0.02 to 0.08% neither put forth any effect on the recovery of whey proteins and moisture retention as well as the consequent curd yield nor the sensory quality of cottage cheese.
PPD-14
Performance evaluation of batch type scraped surface heat exchanger during manufacture of selected traditional indian food products

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Food industry in India at present is passing through a transition phase as major emphasis is being laid on manufacture of Traditional Indian Food Products (TIFP). Heat treatment and concentration is the major unit operations involved in preparation of many TIFP. Concentration of food product by traditional method using open pan is a time consuming, energy intensive and laborious process. Scraped Surface Heat Exchanger (SSHE) has been found most suitable to overcome the limitations of traditional methods of manufacture of such products. Department of Dairy Engineering, SMC College of Dairy Science, Anand Agricultural University, Anand, has designed a batch type SSHE suitable for manufacture of concentrated food products. The unit consists of steam jacket divided in to three compartments for better control of heating process as the content reduces during later part of concentration. The scraper blades are spring loaded on the assembly which is arranged in such a way that whole surface is efficiently scraped. The effort has been made to study performance of batch type SSHE during manufacture of selected TIFP like khoa, ghee, Dudhi (Bottle gourd) halwa, Gajar (carrot) halwa, kheer and tomato ketchup. The process parameters were optimized to obtain the product quality similar to the traditionally made product and process of manufacture of certain khoa/milk based sweets were standardized. The sensory evaluation of these products revealed that the products made in the SSHE were superior as compared to traditional way of preparation. Study on heat transfer performance of SSHE was carried out and process parameters are optimized to minimize energy requirement. The general range of overall heat transfer coefficient obtained for different food products were 700 to 3300 W/m² K, while general range of steam side and product side heat transfer coefficient obtained for different products were10,078 to 10,486 W/m² K and 600 to 5292 W/m² K respectively. The steam pressure used was in the range of 49 kPa (0.5 kg/cm²) to 171.67 kPa (1.75 kg/cm²), the speed of scraper assembly used was in the range of 0.33 rps to 1.33 rps, and the batch size was 60 litre. The specific steam consumption was in the range of 1.2 to 1.35 kg/kg of water evaporation, the heat utilization was in the range of 70 to 75%, and heat losses were in the range of 25 to 30%, including heat loss in the condensate. The use of batch type SSHE offers advantages like ease of operation, low manpower requirement due to mechanization and assurance of uniform quality together with energy economy.

PPD-15
Drying by desorption: A tool to determine spray-drying parameters

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The most frequently used technique for dehydration of dairy products is spray drying. This is an effective method for preserving biological products as it does not involve severe heat treatment and it allows storage of powders at an ambient temperature. Due to the variety and complexity of the concentrates to be dried, a more rigorous understanding of spray-drying based on physico-chemical and thermodynamic
properties have now become necessary. At the same time, the current state of the art and knowledge do not allow determination of the parameters of spray-drying of dairy products. The only way to determine these parameters is to perform several complex and expensive experiments with spray-dryer pilots. The aims of this study were to evaluate the ratio of bound to unbound water by using a method of drying by desorption (Schuck et al., 1998). The results, combined with thermodynamic and physico-chemical parameters (such as absolute and relative humidity of air, total solids and temperature of concentrate, air flow rate, etc.), provide more precise determination of certain spray-drying parameters such as inlet air temperature and mass flow rate. We performed more than 30 experiments to correlate, calculated and measured parameters in a pilot plant (Bionov) using water, skim milk, caseinate and maltodextrin. The results show that the difference between the calculated and measured inlet air temperature was below 5%, the determination coefficient being close to 0.96. The economic interest of this system is obvious, because it is easy to anticipate the spray-drying parameters by using a controller integrating the water availability of the concentrate and certain thermodynamic parameters. Software based on this step was developed (SD2P®, Spray Drying Parameters Simulation & Determination) and registered at the APP (Association pour la Protection des Programmes).

PPD-16

Studies on utilization of ki grains in preparation of dairy product

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Kutki (Panicum miliare) is the major food crops in dry land regions and comes under the categories of minor millets. It is the traditional staple food of a large segment of rural population. Nutritionally these grains are rich in proteins, minerals and vitamins and comparable or even superior to major cereals in certain nutritional parameters. It is also a popular food among diabetic patients and helpful in lowering Coronary Heart Diseases incidence, because of its low in saturated fatty acids, rich in carbohydrate and dietary fiber content. There is an increasing need and demand from the large segment of population for low cost, healthy and nutritionally rich products for all age groups. An attempt has been made to prepare products, which is rich in protein, carbohydrate, vitamins and minerals from kutki flour. The product was prepared by admixing 10, 20 and 30 percent each of kutki flour and sugar with respect to milk and cooked at 85°C for 9 minutes. These products were evaluated for physico-chemical and organoleptic characteristics. The study revealed that the product contains kutki flour and sugar of 10 percent and 30 percent, respectively had better nutritional value and sensory acceptability than the other formulations. The resultant product was packed in rectangle shape, small size LDPE and shelf life studies revealed that the product had better keeping quality upto one week under refrigeration conditions. This product was also found to be techno-economically feasible.
PPD-17

Membrane separation of natural fructo-prebiotics and utilization with lacto-probiotics for the development of milk based functional foods

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The probiotics and prebiotics (non-digestible food ingredient that beneficially affects the host by selectively stimulating the growth and the activity of one or a limited number of bacteria in colon and thus improves the host health) are the two increasingly popular ingredients that are incorporated in dairy based functional foods and other dietary supplements. Contrary to the present production of prebiotics by enzymatic hydrolysis of complex carbohydrates (like inulin) or enzymatic synthesis using simple sugars (mono and disaccharides), in the present study, oligosaccharides were separated from identified natural plant sources after screening (by HPLC analysis using standard oligosaccharides) 85 different sources (fruits, vegetables, cereals, pulses, dairy products, nuts, tubers, roots etc). The utility of such prebiotics was further studied using probiotics for the fermentation behaviour and feeding to quails in combination with probiotics. Membrane separation of oligosaccharides was carried out in a pilot scale plant from green gram, onion and tomato after extracting all the soluble sugars including oligosaccharides with hot water. Experiments with different ultra filtration membranes using different molecular weight cutoff range gave 60% concentration of oligosaccharides in the permeate. The permeate concentrate of ultra filtration showed a similar composition compared to the commercial oligosaccharide preparations produced by other methods and marketed in Japan and Europe. Fermentation behavior of certain probiotic organisms, namely Bifidobacterium and Lactobacillus species, using the concentrate of rotary evaporated nanofiltration retentate consisting of oligosaccharides and monosaccharides, indicated decreased levels of simple sugars up to three days and then utilization of complex sugars including oligosaccharides only after utilization of simple sugars. The animal experiments in quails for a period of one month by feeding only probiotic culture as one treatment and both prebiotics and probiotics as another treatment in comparison with the control quails, showed decreased levels of triglycerides and cholesterol in pre and probiotic fed quails. The immunity development against the RD disease was also better. The faecal pH, faecal micro flora and body weight gains indicated pre and probiotic feeding was beneficial in quails.

PPD-18

Studies on development and standardization of sterilized carrot kheer

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Traditional Indian Dairy Products contains a significant proportion of milk nutrients and therefore are highly nutritious. Carrot is most commonly used for preparation of the carrot halwa in the northern and central part of the India. It is available for a short duration in the market. Therefore, their is a need to preserve it most effectively and economically. An attempt was made to develop sterilized carrot kheer not only for their taste and delight of eating but also for their high nutritional quality and better shelf life. For
preparation of the carrot kheer shredded carrot was cooked in presence of ghee to develop characteristic flavour. Other ingredients like milk, sugar and dry fruits were added to it and the whole mass was cooked till the desired consistency was obtained and then sterilized. Shredded carrot was added at three different levels of 20, 30 and 40 percent with 8 percent sugar. The sensory quality of the kheer was evaluated using 9 point Hedonic scale. The carrot kheer containing 30 percent shredded carrot was preferred mostly by the judges. Despite the improved shelf life, palatability, and acceptability, product also posses improved taste and nutritional quality. Quality of the products was well within acceptable limit upto 1 month of storage at room temperature. Carrot halwa as an end product can also be obtained.

PPD-19
Studies on development and standardization of sterilized carrot based flavoured milk
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Carrot (Daucas Carota) is highly valued for its nutritional and therapeutic properties and carotenoids content. The high intake of carotenoids helps in decreasing the incidence of some diseases like cancer, muscular degeneration, cardiovascular and pathological processes in human health. Carrot juice is also helpful in growth of Bifidobacterium bifidum in the infant’s digestive system. Since, there is a need to develop the milk products based on carrot because when the carrot combines with milk, it gives a healthy, tasty, safe, and nutritious food. In order to get all these requirements in single ones this study was undertaken. In the development of this product natural colour and flavour of carrot would eliminate the addition of artificial colour and flavour to the flavoured milk. Carrot based flavoured milk have been developed using 10, 20 and 30 percent carrot juice and shredded carrot with 15 percent sugar. The product was sterilized and stored at room temperature for chemical analysis and sensory evaluation. The sensory evaluation of the product was carried out on 9 point Hedonic scale. The flavoured milk containing 20 percent carrot juice and shredded was preferred mostly by the judges. The product was well accepted upto 1 month of storage at room temperature.

PPD-20
Microencapsulation of probiotic microorganisms and food ingredients for functional foods
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With the growing urbanization and increasing quality consciousness, the market for processed foods and functional foods is expected to grow more rapidly. Microencapsulation paves way for development of innovative functional foods. Consumers are increasingly viewing nutraceuticals as adjuncts to traditional, pharmaceutical-based therapeutics. The growing awareness of the therapeutic potential of nutraceuticals has prompted the application of pharmaceutical controlled delivery technologies to the nutraceutical industry. While controlled release of nutraceuticals have thus far developed to a limited extent for both economic and technical reasons, delivery technologies are being developed to adapt to the unique demands
of the nutraceutical market. With developments in particle size control, microencapsulation is expected to play a vital role in ushering nano bio sensors. Fresh amla juice as source of ascorbic acid was encapsulated using alginate (3%) as matrix material. For increasing the retention of ascorbic acid starch (1, 1.5 and 2 %) was also added in alginate solution. The diameter of calcium alginate capsules was around 3 mm. The release rate was high for matrix containing 1% starch and it decreased as starch content increased.

PPD-21

Studies on preparation of wood apple burfi

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In the present investigation attempts were made to utilize the wood apple pulp for the preparation of burfi in order to enhance the flavour of burfi on one hand and to open avenues for gainful utilization of Wood apple fruits which otherwise fetch less price in the production season on the other hand. In an attempt to Prepare wood apple burfi the samples prepared with three levels of wood apple pulp viz., 20, 30 and 40 per cent w/w with 45 per cent sugar were selected for their detail studies in phase-II, as detailed:

\[
\begin{align*}
T_1 & \text{ Khoa + no Wood Apple pulp + 30 % sugar by weight of Khoa (Control)} \\
T_2 & \text{ Khoa + 20 % Wood Apple pulp by wt. of Khoa + 45 % sugar by weight of khoa} \\
T_3 & \text{ Khoa + 30 % Wood Apple pulp by wt. of Khoa + 45 % sugar by weight of khoa} \\
T_4 & \text{ Khoa + 40 % Wood Apple pulp by wt. of Khoa + 45 % sugar by weight of Khoa.}
\end{align*}
\]

Overall acceptability scores for all the samples revealed that they were above 70.00, hence they all were acceptable. However, burfi prepared by using cow milk khoa with 20 per cent wood apple pulp and 45 per cent sugar (T₂) was superior and hence recommended. The treatment combinations were studied for sensory, rheological and chemical quality. T₂ burfi secured highest score for flavour. The same burfi secured maximum scores for body and texture along with control sample at par with it. Colour and appearance of control sample was superior which was followed by T₂ sample. The highest overall acceptability scores (89.67) were obtained by T₂. Penetration value of sample T₁ was significantly higher than those obtained for T₂, T₃, and T₄ treatments indicating comparatively softer body and texture. The softness increased with an increase in the level of wood apple pulp, which was indicated by an increase in penetration values.

PPD-22

Standardization of whey for the development of bio-oral rehydrating solution (ORS)

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Use of probiotics is making an entry into Oral Rehydrating Solution (ORS) to combine the individual potential for its maximal outcome in diarrhoea reduction. Fermented dairy products are regarded as the best vehicle to carry these probiotic bacteria effectively. Hence, exploiting the concept of probiotic and use of dairy by-product, whey (a rich source of electrolytes), a BIO-ORS was formulated to convert whey into value added product through lactic fermentation.
Various samples of paneer and cheese whey were procured from experimental dairy of NDRI and market. The different whey samples were analyzed for minerals like Na+, K+, Ca2+, Mg2+, Cl-, Zn2+ and for their physiochemical properties like protein, lactose, fat, total solids and pH. In these studies, paneer whey was selected on the basis of its superiority to cheese whey regarding better in mineral composition. To standardize the formulation of whey based ORS, whey was fermented at 37°C for 24h with best-selected probiotic culture. After 24 hr of incubation, fermented whey was again analyzed for physiochemical properties and minerals. The glucose, tri-sodium citrate and flavor were added in the fermented whey samples. Osmolarity of the fermented whey was adjusted to 311mM/L as recommended by WHO. Reduction in lactose concentration during fermentation from 18.2mM/l±1.65 to 12.mM/l±0.917 was found to be significant for the diarrhoeal management. Further, lactic acid was detectable in considerable amount (30mM/l) in fermented whey, which exhibited antagonistic properties against test organisms. Chemical composition of Whey BIO-ORS was at par in minerals like Na+, K+, and Cl- with that of WHO-ORS calcium, magnesium, zinc, citrate and protein in BIO-ORS were also present, which were lacking in WHO ORS. and these nutrients are useful in controlling diarrhoea.

PPD-23
Preparation of milk cake fortified with mango pulp with special reference to chemical and sensory evaluation

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The present investigation was undertaken with a view to explore the feasibility of incorporation of mango pulp in milk cake along with different levels of sugars. The mango pulp at 5, 10 and 15 per cent along with sugars @ 3,4 and 5 per cent levels were tried to prepare milk cake. Average fat, total solids, acidity, total sugars, reducing and non-reducing sugars content of mango pulp were 0.87 %, 30.73% B, 0.42 % and 10.52 % respectively. The protein content in control sample (without pulp) was 17.10 % which decreased to 14.11 %. Different treatments had significant effect on protein content of milk cake. The various levels of mango pulp and sugar had non-significant effect on colour and appearance of milk cake. The lowest score for body and texture (6.76) was recorded in case of control sample i.e. without pulp. The highest score was recorded in (M2S2) 10 % mango pulp and 4 % sugar. Flavour of milk cake was found to be lowest (6.86) and highest in control sample and 10 % mango pulp and 4 % sugar (M2S2). Mango pulp and sugar levels had significant effect on flavour of milk cake. It was also found that on the basis of overall acceptability score, the mango pulp milk cake was preferred more than control (6.82). The treatment M2S2 scored highest than all other treatments.

PPD-24
Studies on development and standardization of sprouted wheat based milk product (doda burfi)

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Doda Burfi is one of the popular traditional indian cereal based milk product of northern India. Doda Burfi is made from sanmak (pretreated wheat grains), wheat flour, sugar and milk. It is prepared by concentrating
milk with sanmak, and wheat flour by prolonged heating till semisolid consistency is obtained and finally sugar and ghee is added to it. It contains all the nutritional value of sprouted grain, cereals and milk. This product gives an excellent flavour, body characteristics and fulfills the requirement of nutritious food.

For standardization of the Doda burfi (sprouted wheat based milk product) three levels of dry sprouted wheat grain (5 %, 7 %, 9 %) and sugar (7 %, 8 %, 9 %) with respect to milk were used. The prepared products was evaluated using 9-point hedonic scale for different sensory attributes like colour and appearance, flavour, sweetness, body and texture and overall acceptability. On the basis of sensory evaluation the most acceptable Doda Burfi was made of using 7 % dry sprouted wheat grain, 7 % sugar and 2 % wheat flour with respect to milk. The composition of final product with this combination was 9.2 percent moisture, 90.8 percent TS, 19.5 percent fat, 12.37 percent protein, 56.83 percent total carbohydrate and 2.10 percent total ash. On statistical analysis of the sensory scores it was indicated that the effect of sugar on body and texture was significant at 5 % level of significance.

PPD-25

Studies on manufacture of low fat ice cream

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With the current upward trend in nutritional and health awareness, the consumers’ demand for low-energy and low-fat foods has increased. This has forced the food industry to bring low fat product in the market with acceptable sensory characteristics and at a competitive price. The present study was made with an attempt to replace milk fat, with different levels of (3%, 4%, and 5%) fat replacer (maltodextrin). Ice-cream mix was standardized to 2% fat, 15% sugar, 0.5% stabilizer and milk solid not fat adjusted to 37% total solids for experimental ice-cream mix. Control ice–cream mix was standardized to 10% fat, 15% sugar, 11.5% milk solid not fat and 0.5% stabilizer. The ice-cream samples of different treatments and control were analyzed for total solids, fat percentage, overrun and organoleptic tests (flavour, body, texture, colour, appearance and melting resistance). The data obtained on various parameters were statistically analyzed. Based on the results, it was concluded that the low fat ice cream containing 3% level of maltodextrin (T\(_1\)) was at par with control, the calorific value in experimental ice-cream was reduced by 38%, however at slightly higher cost. The overall rating of different treatments in ice cream was (T\(_0\), T\(_2\), T\(_3\)).

PPD-26

Process standardization for preparation of kalakand

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Process was standardized to prepare desirable quality kalakand from buffalo milk standardized at 6 % fat. Kalakand was made in a karahi with addition of citric acid at varying levels after boiling the milk continuously for different duration and with addition of sugar (4, 5, 6, 7 & 8 %) at semisolid stage. Results revealed that kalakand made with addition of 0.05 % citric acid after boiling of milk for 10 min.
adding sugar at 6% level recorded optimum scores for all the sensory attributes as compared to that of other levels. Duration of adding citric acid and its levels exhibited significant effect. Thus, it is concluded that desirable quality kalakand could be obtained by addition of 0.05% citric acid in milk boiled for 10 min. and with addition of 6% sugar at semisolid stage.

PPD-27
Development of health oriented low calorie sandesh fortified with macro and micro nutrients and bifidus organisms

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Sandesh preparation from raw milk was found to possess good sensory attributes and also was found to meet the chemical and bacteriological requirements as per the stipulated standards. To enhance the nutritive and therapeutic value of raw milk used in Sandesh preparation was fortified with macro nutrients in the form of soya protein and whey protein concentrates. These two macro nutrients were limited to 2% level to obtain a product of very good sensory quality. Since Sandesh is rich in protein and fat apart from carbohydrate there is need to incorporate fibre to contribute to better digestion. Four different types of fibres namely- apple, orange, wheat and oat fibres were studied for the sensibility in providing good texture and finish. Among these wheat fibre gel was found to be the best in importing good sensory attributes to Sandesh. Fortification of Sandesh with wheat fibre is known to contribute to several health benefits. This is particularly justified in a protein rich product like Sandesh. Raw milk procured from good quality source was used in the preparation of Sandesh fat fortification with premix containing micro nutrients namely vitamin A, E, C, folic acid and riboflavin along with the most highly sought for iron compounds in the form of EDTA-iron. The addition of all the micronutrients in the preparation of Sandesh did not in any way affect the sensory attributes of the sweet. There was no significant change in the chemical and microbiological parameters. Hence development of micro nutrient fortified Sandesh has been standardized. A low calorie Sandesh was developed using skimmed milk as a base. Fat replacer in the form of maltodextrin at 5% level was successfully replaced the sensory attributes of the fat. The sugar was replaced with a low calorie sugarite, fructose and stevia, which was found to yield a product of matching quality with that of control prepared using whole milk. To further enhance the therapeutic value of bifidus culture (centrifuged suspension) was added at the last stage of Sandesh preparation to give a viable cell count of an average 30 * 10 per ml. Skimmed milk prepared with fat and sugar replacer was fortified with macro, micro nutrients known for imparting several health benefits was standardized. The product was found to possess all the sensory attributes without affecting any change in the chemical and microbiological parameters. Full fat and low calorie Sandesh developed was subjected to overall quality analysis and was found to meet the standard requirements stipulated by the regulatory authorities. The product thus developed is expected to provide both nutritional and health benefits. Shelf-life of Sandesh at room temperature is limited to only 3 days. The fungus growth was found to develop after 3 days, thus rendering the product unfit for consumption. In order to prevent the growth of fungus in Sandesh, channa used as the base was treated with permitted preservatives namely Sodium benzoate, Potassium sorbate and Sodium metabisulphite. Among this Potassium sorbate at 0.3% was found to be effective in preventing the growth of fungus for a period up to 10 days storage at room temperature.
PPD-28

Studies on the preparation of low calorie milk cake from cow milk

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Milk cake is a most popular sweet in the northern and central parts of India and gaining popularity in other parts of the country. Milk cake is typified by well defined grains having a caramel flavour which is prepared from granular variety of khoa. Studies were conducted to survey the method of manufacture and quality of milk cake prepared in local market of Udham Singh Nagar (Uttarakhand). Based on survey reports, a process of milk cake manufacture was optimized. A quality product was prepared in the laboratory from 3% fat cow milk, 0.02% citric acid (for granulation) and 3.5% of sugar. Low calorie milk cake was also prepared from 1% fat cow milk by adding 2% whey protein concentrate as a fat replacer, 1% stevia as a sugar replacer, along with 1% sugar and 0.005% citric acid. The milk cake prepared from 3 per cent fat cow milk had an average of moisture, fat, protein, lactose, sucrose and ash as 37.28, 12.98, 14.64, 17.30, 12.8 and 5.0%, respectively. The corresponding values for low calorie milk cake were 41.14, 7.36, 16.12, 20.48, 9.4 and 5.5%, respectively. Values of calcium, phosphorus and iron in normal milk cake were 568.43 mg/100g, 430.64 mg/100g and 4.14 mg/100g, respectively whereas corresponding values for low calorie milk cake were 542.28 mg/100g, 427.64 mg/100g and 4.08 mg/100g, respectively. The samples of milk cake were stored satisfactorily for 6 days at room temperature (30±1°C) and for 17 days at refrigeration temperature (5±1°C).

PPD-29

Studies on the preparation of bal-mithai - a traditional sweet of Uttarakhand

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Balmithai is a khoa based sweet of Uttarakhand originated in Almora. It has a dark brown colour, sweet caramel flavour, slightly granular in texture, coated with white sugar coated amaranthus balls. Studies were conducted to survey the method of manufacture and quality of balmithai prepared in Kumaon region of Uttarakhand. Based on survey reports, a process of balmithai manufacture was optimized. A good quality product was prepared from buffalo milk from 6% fat, 35% of sugar and 0.1% tartaric acid. The contents were dessicated to a total solid content of 90%. Low fat balmithai was also prepared from 3% fat buffalo milk by adding whey protein concentrate as a fat replacer to the extent of 100 per cent of the amount of fat reduced in milk. Average percentage of moisture, fat, protein, lactose, sucrose and ash in balmithai prepared from 6% fat buffalo milk were 10.50, 20.82, 13.01, 18.70, 35.51 and 2.46 respectively. The corresponding values for low fat balmithai were 12.70, 11.49, 14.51, 23.65, 34.90 and 2.75%, respectively. Values of calcium, phosphorus and iron in traditional balmithai were 536.27 mg/100g, 458.66 mg/100g and 1.32 mg/100g, respectively whereas corresponding values for low calorie milk cake were 536.25 mg/100g, 458.98 mg/100g and 1.30 mg/100g, respectively. The samples of balmithai were stored for more than 45 days after adding 0.15% Potassium sorbate and 0.02% BHT (on fat basis) and vacuum packed in high density polyethylene bags both at room (30±2°C) and refrigeration temperature (5±1°C).
PPD-30

Studies on the preparation of low calorie burfi from buffalo milk

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Studies were conducted to optimize the manufacture of low calorie burfi from buffalo milk. A quality product was prepared from 1% fat buffalo milk, 1% maltodextrin as fat replacer, 12.5% sugar and 0.075% stevia as sugar replacer. The low calorie burfi prepared from 1 per cent fat buffalo milk had average of moisture, fat, protein, lactose, sucrose and ash as 20.90, 5.20, 25.14, 31.78, 11.65 and 5.30 per cent, respectively. Values of calcium, phosphorus and iron in low calorie burfi were 710mg/100g, 530mg/100g and 4.01mg/100g, respectively. The titratable acidity (as lactic acid) of burfi ranges between 0.41 to 0.42 per cent and pH 6.2. The samples of low calorie burfi were stored satisfactorily for 10 days at room temperature (30±1°C) and for 20 days at refrigeration temperature (5±1°C). During storage of low calorie burfi the moisture and pH decreased significantly (p £ 0.05) whereas titratable acidity, soluble nitrogen and free fatty acid contents increased significantly (p £ 0.05). All the microbial counts namely total plate count, yeast and mold count, proteolytic count and lipolytic count increased throughout the storage. No coliforms were detected throughout the storage of low calorie burfi.

PPD-31

Studies on the development of fruit bars and toffees from custard apple fruits

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Custard apple (Annona squamosa L.) is one of the most important fruits due to its nutritional, medicinal and therapeutic values. The edible portion or pulp is creamy or custard like, granular with a good blend of sweetness and acidity. Study was carried out to utilize custard apple fruits procured from UP for making various value added products like fruit Bars and Toffees. The methodology for the preparation of these products have been standardized. The proximate composition analysis of these products shows good source of essential nutrients. The storage studies of these products at room temperature, 7°C and 37°C indicates that products prepared from custard apple stored at RT showed no significant changes with respect to moisture, total soluble solids, acidity and total sugar after 60 days of storage. Similar observations were noticed at 7°C and 37°C. The products were evaluated for sensory evaluation at various intervals. Formulation of such traditional products would definitely cater the need of a new blended health products which are nutritious and delicately flavored.
**PPD-32**

**Preparation of kheer from safflower milk blended with buffalo milk**


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*Kheer* is very delicious cereal based indigenous milk product. It has higher nutritive value, but inspite of remarkable increase in milk production, the milk and milk products are out of reach of the vulnerable group, due to high cost of milk and milk products. This calls of development of low substitute for milk and milk products in the country. The preparation of safflower milk seems to be an alternative to milk. Utilization of safflower in manufacture of *kheer* not only bring down cost but making them within the reach vulnerable people. For preparation of *kheer*, use different proportions of safflower milk and buffalo milk (100 parts buffalo milk + 0 parts safflower milk, 75 parts buffalo milk + 25 parts safflower milk, 50 parts buffalo milk + 50 parts safflower milk, 25 parts buffalo milk + 75 parts safflower milk, 0 parts buffalo milk + 100 parts safflower milk) with the addition of good quality basmati rice @ 2.5 and different level of sugars 6, 7 and 8 per cent was studied. It was observed that the sensory score of *kheer* tended to decrease with increase in the safflower milk. (8.71 to 5.20) The *kheer* prepared from 75 parts buffalo milk and 25 parts safflower milk was closer to control in overall acceptability (8.58). The *kheer* prepared from 50 part buffalo milk and 50 parts safflower milk was also acceptable scoring between ‘like moderately to like very much’ (7.50). Among the different levels at sugars eight present sugar was found to be the most acceptable level. (Score 7.53). The *kheer* prepared from buffalo milk blended with safflower milk (50:50) contains moisture 71.00 per cent, fat 8.80 per cent, protein 4.80 per cent, ash 0.74 per cent and total carbohydrate 14.66 per cent.

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**PPD-33**

**Studies on kalakand blended with ash-gourd (Benincasa cerifera) pulp**

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An attempt was made to prepare *kalakand* from buffalo milk blended with 20, 30 and 40 per cent of ash-gourd (*Benincasa cerifera*) pulp. The objects were to standardize the method for the preparation of ash-gourd fortified *kalakand*, to check the economy of the product and overall acceptability. The homogenous mixed pulp of ripened ash-gourd added to partially desiccated and citric acid coagulated buffalo milk at various levels, was heated for 10 minutes followed by addition of sugar @ 6 per cent by weight of milk, vigorous stirring and storing after cooling. The total yield of the finished product increased as incorporation of ash-gourd pulp increased from 10 per cent to 20 and 30 per cent. Addition of ash-gourd pulp up to 20 per cent level did not show any significant difference for colour with control, *Kalakand* from either 20 or 30 per cent added pulp did not differ significantly. Addition of pulp at various proportions significantly affect the flavour indicating delaying development of liking to such parameters. The trend for the scores recorded for body and texture followed similar pattern as flavour, this is due to higher proportion of moisture, which is increased with the increasing percentage of ash-gourd. Finally, incorporation of ash-gourd pulp in buffalo milk fortified @ 20, 30 and 40 per cent by
weight significantly decreased the overall acceptability of the product. The final product Kalakand having 30 per cent ash-gourd pulp is most economical.

PPD-34

Studies on the manufacture of fruit flavoured dahi from goat milk


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In the present investigation fruit flavoured dahi was prepared from goat milk blended with different fruits like Mango, (Mangifera indica), Banana (Musa paradisica) and Pineapple (Ananas comosus) in three different proportions 10, 15 and 20 per cent separately by addition of cane sugar @ 8 per cent and skim milk powder @ 20 per cent by weight of the mixture. The mix was inoculated with 1.5 per cent LF-40 culture with the object to study proximate analysis, economy and acceptability of the product. Maximum acceptability of judges was towards addition of mango and pineapple at 15 and 20 per cent proportions respectively. In case of banana incorporation, the overall acceptability score was decreased with increase in the per centage of banana juice. It may be inferred therefore, the two fruits namely mango & pineapple at 20 per cent could be better utilized for the production of fruit flavoured goat milk dahi. The fat percentage in the final product decreases with increase in the proportion of fruit pulp or juices (from 10 to 20) in case of all the three fruits namely mango, banana and pineapple. The increased proportions of fruit juices results significantly in lowering the protein content. As the proportions of fruit juice increases, the ash content of fruit flavoured dahi decreased. As the proportions of fruit juices increases the total sugar and total solid content in fruit flavoured dahi increases. The addition of fruit juices seemed to have enhanced the level of acidity proportionately in all the three fruits. The addition of fruit juice namely mango and pineapple resulted into the lowering of the values for pH significantly. Because fruit flavoured goat milk dahi falls towards the lower side of the curd tension of the cow milk as well as buffalo milk dahi. The banana juice blended goat milk dahi could be produced at a considerably lower cost Rs. 45 per kg as compared to fairly acceptable mango flavoured goat milk dahi (Rs.52.45 per kg).

PPD-35

Effect of processing parameters on the quality of pedha


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Pedha shows wide variation in the method of manufacture, chemical composition, microbial quality, packaging and shelf-life. No standards have been so far fixed for pedha either by Bureau of Indian Standards or local authorities. Lack of published information on pedha is the main constraint in prescribing legal standards, therefore the effect of different processing parameters on the quality of pedha was studied during standardization of processing parameters. Pedha samples were prepared from buffalo milk containing 6 per cent fat and 9 per cent SNF and sugar was added at the rate of 30 per cent of khoa. In processing parameters the stage of addition of sugar was at the start of boiling of milk, when volume,
of milk reduced to one half, just before pat formation stage and after preparation of khoa. Among the four stages, addition of sugar just before pat formation was most appropriate for preparation of good quality pedha (scale 8.38). Similarly addition of sugar after formation of khoa could also produce pedha with good score (8.30). For preparation of pedha two types of stirrers were used at a time when sugar was added. Wooden khunti having half round surface at contact edge produced better quality pedha (Score 8.38) than mild steel stirrer (8.170). This may be due to proper mixing of total milk solids. Effect of different stirring speeds (60, 80, 100, 120 rpm) was studied after adding sugar just before pat formation. There was improvement in all the sensory attributes of pedha with increase in speed of stirring. The highest sensory score (8.31) was obtained when the stirring speed was 120 rpm. This might be due to homogenous mixing of milk constituents causing proper blending.

PPD-36

Process design to manufacture sugar free extended life rasogolla

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The technological gaps in the commercially marketed sugar free rasogolla were identified as: health degrading characteristics of the sweeteners used especially if consumed in larger quantity, lower shelf life of the product (10 days) and rare availability in the market. With this in view a novel process has been developed to manufacture health - friendly sugar free rasogolla with extended shelf life (20 days) as well utilization of byproduct such as whey. The new process developed in this study involved preparation of cow milk chhana by boiling the milk with constant stirring and adding 1–1.5 % coagulant solution at slow stirring, retaining the chhana in whey for 10 – 15 minutes then straining by hanging the chhana in muslin cloth for about 5 minutes and kneading till firm and stable texture is obtained. Now making 8–10 mm diameter round balls and cooking them in the especially prepared cooking medium consisting 3 parts of the syrup (1% w/v solution of sweetener), 2 parts water and 1 part whey. The 3:2:1 ratio cooking medium helped in texture stabilization. Some amount of water and whey solution was continuously added to compensate their losses through evaporation and to maintain the right concentration during puffing. The puffed balls were dipped in syrup prepared using 2 % w/w sucralose. The mass containing puffed chhana balls and syrup was cooled to room temperature and conditioned for 4–6 hours. The rose water flavor was added to suppress the peculiar chhana smell. The product was packaged in PET Jar to store under refrigerated condition (5–7°C).

PPD-37

Intermediate automated process control in manufacture of Indian traditional rasogolla

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The automated process control system improves performance of material and resources vis a vis product quality and safety on the basis of computerized programmable instructions. In the intermediate automation some of the processes and measurements are exercised manually or using individual equipment. The quality milk is used for rasogulla manufacture. Fat & SNF analyser, pH, somatic cell count and microbial
count sensors, weight/volume measurement devices are required during standardization of milk for chhana making. In-line temperature, flow rate, pH, level sensors and timer alarms during coagulation; straining and gravity separation of whey and curd are needed. The weight, volume, temperature, mixer rpm, planetary mixer rpm sensors, image processor are required during chhana kneading, portioning and ball making. Brixometer, colorimeter and temperature sensors, size emitter, weight, volume sensors are required during balls cooking and syrumping. The sponginess, syrup holding capacity and interwoven fiber like texture is one of the important quality parameter which needs to be continuously monitored using texturometer. Finally during cooling, canning and can exhausting the sensors for temperature, vacuum, microorganisms are required. The use of electronic control methods on product preparation and packaging lines will ensure better use of time and temperature at each stage and will also help in saving energy. Efforts have been made by the authors through this paper to suggest the processes and process control systems to standardize the formulations, proportionate ingredients, processing steps so as to maintain their heritage taste, aromas and varieties of these products for the users at large who are settled abroad and have craze for the Indian sweets.

PPD-38

Standardization of kapoorkand preparation and study of shelf life

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Kapoorkand or bottlegourd burfi is a traditional and popular milk product of certain parts of North India and is prepared by incorporation of bottlegourd in milk. The present investigation was undertaken to standardize the preparation of kapoorkand and study the shelf life at room and refrigeration temperatures by using two levels of ratio milk to bottlegourd i.e. 60: 40 and 70: 30 and two levels of sugar i.e. 12 and 16 per cent. Fresh buffalo milk was standardized to 5 per cent fat and 9 per cent SNF and boiled in a karahi by placing over a brisk and non smoky fire in four lots. Milk was stirred with a khunti in circular motion continuously until it was reduced to one third of its volume and then bottlegourd pulp paste was added for two lots separately with continuous stirring and scrapping. When it was reduced to half the volume, sugar was added. When dough like stage was reached, contents were set in a greasy tray and allowed to cool and cut into required size and shape. Kapoorkand samples were wrapped in wax coated butter paper and packaged in cardboard boxes to study the shelf life. Kapoorkand prepared with 70: 30 milk to bottlegourd ratio resulted in significantly lower product yield and moisture content in the product. However such Kapoorkand had higher fat, protein and TBA values compared to kapoorkand prepared with 60:40 milk to bottlegourd ratio. Kapoorkand prepared with 12 per cent sugar resulted in lower product yield with higher moisture, fat, protein, titratable acidity and TBA values compared to the ones prepared with 16 per cent sugar. Kapoorkand prepared by using 70:30 milk to bottlegourd ratio and 12 per cent sugar registered highest scores for all the sensory attributes. A gradual decrease in moisture percentage and increase in titratable acidity and TBA values were observed in all formulations of kapoorkand at both storage temperatures. The study also revealed a gradual decrease in sensory scores of all eating quality attributes in all types of kapoorkand both at room and refrigeration temperatures. The shelf life was variable among the different treatment samples and storage temperatures.
PPD-39  
Modelling of vortical and turbulent sensible heat transfer in liquid — full scraped surface heat exchanger  
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Residence time distribution, flow pattern detection and sensible heat transfer experiments have been performed in pilot plant liquid full scraped surface heat exchanger (LF-SSHE) with water working liquid for buffalo sweetened condensed milk (SCM WL). The values of Re\textsubscript{e} for water varying from 10 to 215 indicated the rotational flow variation from vortical to turbulent, however, the same for SCM WL varying from 10 to 91 indicated the presence of vortical flow for SCM WL in the experiments. Effects of Re\textsubscript{e}, Re\textsubscript{r}, Pr, \(\text{d}_r/\text{d}_i\), DT/T\textsubscript{s} and m/m\textsubscript{w} were considered on Nu\textsubscript{r} in modeling the Nusselt equation in Cobb-Douglas form. For SCM W.L., the Nusselt model was significant at P\leq 0.01 and correlation coefficient was 0.84. The t-test of partial regression coefficient indicated that Re\textsubscript{e} significantly increased the Nu\textsubscript{r} at P\leq 0.01. The Re\textsubscript{r} and Pr also significantly increased film heat transfer coefficient (h\textsubscript{ij}) with their contribution lower than Re\textsubscript{e}. The factor m/m\textsubscript{w} decreased h\textsubscript{ij} values, however, DT/T\textsubscript{s} did not regress the Nu\textsubscript{r} significantly in case of water but it decreased Nu during sensible heating of SCM WL as fouling followed by scraping was important in SCM WL. The exponent of Prandtl number was higher with water in comparison to SCM WL; particularly in small rotor than that in large rotor LF-SSHE. The effects of backmixing on film heat transfer were correlated with Temperature Jump ratio (J) as a function of Ta/ Re\textsubscript{e}, \(\text{d}_r/\text{d}_i\) and Pr in Cobb-Douglas form. An increase in the value of Ta/ Re\textsubscript{e} resulted increase in backmixing. With the increase in \(\text{d}_r/\text{d}_i\) and Pr, the backmixing was decreased; their effect of decreasing backmixing was higher in SCM WL - a non Newtonian liquid. The modeling is found useful in scaling up the prototype model to industrial scale for continuous processing of viscous and sugar added buffalo milk products in LF-SSHEs.

PPD-40  
Modelling of overall heat transfer coefficient for a vertical flow in liquid-full scraped surface heat exchangers  
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Box Wilson models were developed for overall heat transfer coefficient (U\textsubscript{j}) for investigating the effects of mass flow rate (M\textsubscript{f}), blade rotational speed (V\textsubscript{c}), \(\text{d}_r/\text{d}_i\) and steam condensing temperatures (T\textsubscript{s}) during sensible heat transfer of working liquid for buffalo sweetened condensed milk (SCM WL) and water in horizontal LF-SSHE. Least square means and ANOVA with two-way interactions for U\textsubscript{j} with reference to true scraped surface heat transfer coefficients (h\textsubscript{ij}) have indicated the significance of M\textsubscript{f}, V\textsubscript{c}, T\textsubscript{s} and \(\text{d}_r/\text{d}_i\) x M\textsubscript{f} (P\leq 0.01), and \(\text{d}_r/\text{d}_i\) and M\textsubscript{f} x T\textsubscript{s} influenced at P\leq 0.05 to U\textsubscript{j} for water. However, for SCM WL, M\textsubscript{f} significantly affected U\textsubscript{j} at P\leq 0.01, \(\text{d}_r/\text{d}_i\) & T\textsubscript{s} at P\leq 0.05, but V\textsubscript{c} at P\leq 0.10. From the Box Wilson model, the optimum values of blade speed were evaluated using maxima-minima method as 3.69 to 5.40 rps for SCM WL and 4.84 to 7.97 rps for water considering the mass flow rate from 50 to 200 litre/hr. at T\textsubscript{c} of 127 °C. At a flow rate of 75 litre/hr (0.0231 kg/s) with \(\text{d}_r/\text{d}_i\) of 0.52 i.e. large rotor assembly (rotor dia 0.051 m and
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stator dia 0.098 m) LF-SSHE, the optimum rotational speed was estimated as 5.12 rps for forewarming under pressure (i.e. 147 KPa gauge) at Ts of 127°C and forewarming of SCM WL at 121°C during production of buffalo sweetened condensed milk to be compatible with integrated thin film SSHE for evaporation under vacuum. Effects of independent variable such as d/d, rotor speed, mass flow rates, T, DT on Uj and temperature profile are discussed in the report using Least square means and ANOVA with two way interactions to optimize the phenomenon of sensible heat transfer in horizontal LF-SSHEs for processing non-Newtonian and Newtonian food products.

PPD-41
Standardization of process for ready to serve spiced paneer

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A study was carried out to standardize the process for making ready to serve spiced paneer. Two categories of spiced paneer were prepared by marinating the paneer cubes with different levels of ginger+garlic and red pepper+black pepper separately, in thick curd with cumin, coriander, salt and sugar. Two best formulations (one from each category) were selected on the basis of sensory attributes. Selected formulations were kept for 60, 120 and 180 minutes for maturation and one marination time was selected on the basis of sensory attributes. Marinated and packed paneer samples were given heat treatment at different times at 15psi. Suitable time for heat treatment was selected on the basis of texture attributes of spiced paneer cubes. Results indicated that 10 per cent ginger + 5 per cent garlic and 1.25 per cent red pepper + 0.25 per cent black pepper formulations and 60 minutes maturation time were found to be most appropriate by the panelists on the basis of 9 point hedonic scale whereas, heat treatment for 10 minutes was found most suitable. It is concluded that ready to serve spiced paneer could be prepared with acceptable sensory attributes by adopting above studied parameters.

PPD-42
Development of peanut milk based “Thandai – like beverage”

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Nutritional awareness amongst the consumers regarding cholesterol and lactose levels necessitates modifications in the traditional dairy products. Peanut milk based beverage have been prepared from raw groundnut seeds. Groundnut are often thought of as high fat foods, however recent studies have shown that peanut can protect against heart disease. Being a plant food, peanuts contain no cholesterol. They are high in wide variety of antioxidants. Peanuts are good source of vitamin E but they don’t contain any vitamin C naturally, however process of germination increases their vitamin C content surprisingly. So keeping the above aspect and advantages of peanut for health, a cold beverage named “thandai”. Full-fat raw peanuts was soaked into water for overnight and germinated in BOD (biological oxygen demand) for 24 hours at 30°C. Germinated seeds of peanut were washed with distilled water and their seed coat was manually removed. Washed seeds were ground with freshly prepared jaggery solution (25 g of jaggery in 100 ml distilled water) into a fine and smooth paste. Black pepper powder was added @ 1g/200ml after addition of CMC @ 0.1% level. Total volume was made up to 200ml with distilled water. After slight
heating potassium sorbate was added @ 25 ppm as preservative. Now thandai was packed in presterilized bottles with corking and stored at temperature of 4-7 ºC. The sensory attributes of the freshly prepared “thandai” were adjudged by a panel of semi-trained 25 judges and evaluated on nine point hedonic scale. The developed product was found highly acceptable on all organoleptic traits i.e. colour, flavour, texture, taste, appearance and over all acceptability. The nutritive value of thandai, per serving (200ml) was measured. Per serving(200ml) contains 213.41 KCal, 28.67g carbohydrate, 5.7 g protein, 8.42g fat and 0.5g minerals. The amount of vitamin C was 9.21 mg/serving which is approximately 25 per cent of daily requirement according to RDA (recommended dietary allowances) as given by I.C.M.R.

PPD-43

Effect of incorporation of carrageenan into buffalo milk on the quality of rasogolla

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Available reports indicate that cow milk is most suitable for making a good quality rasogolla while buffalo milk tends to make a hard and rubbery type of rasogolla due to the presence of higher concentrations of calcium and casein in the latter. Buffalo milk was standardized to a SNF: Fat ratio of 1.4, heated to boiling and added with carrageenan separately at 0.050, 0.075 and 0.100% level prior to coagulation at 65°C using 1% citric acid solution. The chhana was kept undisturbed in whey for cooling followed by expulsion of moisture without applying any pressure. Chhana was kneaded for 5 min, balls made (each ball weighing 10 g, approx.), cooked in sugar solution (concentration 70%) for about 15 min and soaked overnight in sugar solution (concentration 40%) to get rasogolla. On sensory evaluation, the scores for flavour, and body and texture of rasogolla made by using 0.075% carrageenan were found to be highest followed by those made with 0.050 and 0.100% carrageenan, respectively. The colour and appearance score was, however, highest in the product prepared with 0.100% carrageenan. On rheological examination of the products by a Texture Analyzer (model no. TAHDi, Stable Micro System, UK), it was noticed that hardness, fracturability, adhesiveness and chewiness were inversely related while springiness of rasogolla was directly related to the level of carrageenan added to milk. No clear-cut trends on cohesiveness and gumminess of rasogolla were discernible. Addition of 0.075% carrageenan to buffalo milk was recommended for making a good quality rasogolla.

PPD-44

Development of technology for manufacture of Kunda – effect of type of milk

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Kunda is milk based indigenous delicacy popular in and around Belgaum area of Karnataka state. Kunda is being manufactured by halwais (Sweet makers) under unhygienic conditions. It is brown in colour with grainy texture, pleasant nutty flavour developed during prolonged heat desiccation of khoa, sugar and water/milk at high temperature. Presently there are no standards for manufacturing and composition as such quality attributes are not properly documented. Buffalo milk is preferred for Kunda manufacture. The qualitative and quantitative differences between cow and buffalo milk are the primary causes for
differences observed during manufacturing of Kunda. Kunda prepared from cow milk had gummy texture, sticky body with brown colour. Buffalo milk Kunda had uneven grainy texture due to its Casein micellar properties. Uneven grainy texture problem of buffalo milk was solved by simmering (slow boiling) of milk during khoa making stage itself. Further, Kunda characteristics were improved by admixing standardized cow milk (5.0 % fat and 8.5% SNF) and buffalo milk (6.0%fat and 9.0%SNF) in different proportions. It was found that mixing of standardized cow and buffalo milk in equal proportion (50:50) was most suitable to get best physico-chemical and sensory properties. Kunda manufacturing has been standardized by heat desiccation (vigorous boiling) of mixed milk with sugar (9.0%) and water (10-25% on Khoa basis) till characteristic brown colour, uniform grainy texture and pleasant flavour developed.

PPD-45
Development of low calorie flavoured milk
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The present study was conducted to develop the low calorie flavoured milk using artificial sweeteners. Equi-sweetness of saccharin and aspartame were evaluated on the basis of sensory scores to that of control level of 7 per cent sugar. Combination of saccharin and aspartame were tried to replace sugar and to know the synergistic effect and to improve the after taste with respect to bitterness due to saccharine. Four combinations of saccharine: aspartame i.e. 20:80, 25:75, 50:50 and 75:25 were tried. On the basis of the sensory score, a combination of saccharine: aspartame (20:80) was found to improve the flavour and after taste scores significantly (P<0.05). Slightly higher sensory scores were observed in this combination as compared to control, which can be considered due to synergistic effect of this combination. Three types of low calorie flavoured milks viz. flavoured toned milk, flavoured double toned milk and flavoured skim milk. In flavoured toned milk fat, protein, carbohydrates, ash and total solids were found to be 3.00±0.10, 3.92±0.72, 11.95±0.92, 0.81±0.06, and 19.68±0.17 per cent, respectively in the control sample with sugar. While these values were 3.00±0.01, 3.97±0.75, 4.98±0.92, 0.80±0.06 and 12.75±1.12 per cent, respectively in the milk containing artificial sweeteners. A reduction of 30.59 per cent and 43.54 per cent in caloric value was observed in the flavoured toned milk sweetened and flavoured skim milk with artificial sweeteners, respectively. Similarly, a reduction of 36.09 per cent in caloric value was observed in the flavoured Double toned milk sweetened with artificial sweeteners.

PPD-46
Effect of fortification of dairy ingredients on the quality of soy yoghurt
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Soymilk is very low in fermentable sugars and thus its performance in the manufacture of yoghurt is rated poor. Therefore, it needs to be supplemented with dairy ingredients to enhance the growth of lactic bacteria and perk up fermentation. The present investigation was undertaken to fortify soy milk with different dairy ingredients and evaluate the performance in soy yoghurt. A level of 25 to 75 % milk was blended with soy milk and incorporated with dry dairy ingredients (DDI) i.e SMP and two whey proteins concentrates (WPC 35 and WPC 60). Blends were homogenized, pasteurized and inoculated with
Lactobacillus delbruekii subsp. bulgaricus and Streptococcus thermophillus (1:1). Soymilk blends were fermented with and without addition of 1 to 3% DDI along with optimum quantity of sugar. The samples were evaluated at regular intervals for titratable acidity, viscosity, syneresis and sensory scores. The effect of addition of milk and all three DDI was found to be significant. The rate of acid development increased with increase in milk incorporation. It increased further with the inclusion of DDI being highest in SMP, followed by WPC35 and WPC60. The Viscosity (cP) increased significantly with the increment in DDI. The sensory scores for appearance, body and texture, flavour and overall acceptability also differed significantly. Incorporation of WPC improved smoothness of product whereas higher concentrations imparted an unpromising flavour. The overall acceptability of WPC containing yoghurt samples was comparable to that of SMP.

PPD-47
Development of suitable technology for low cost dietetic gulabjamun prepared from filled milk khoa

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The study was carried out in Dairy Technology Department, Allahabad Agriculture Institute – Deemed University. Treatments were T₀, T₁, T₂ and T₃ with 8.5 SNF where T₀ was without addition of vegetable oil and T₁, T₂ and T₃ were with 3, 4 and 5 percent oil respectively. The gulabjamun of all the treatments were replicated ten times for sensory evaluation as well as for nutrient estimation. Organoleptic test of the product was done by 9-point hedonic scale. The data obtained were statistically analyzed using analysis of variance and critical difference technique. In terms of flavors and taste, body and texture, color and appearance as well as with higher overall acceptability score, it may be concluded that the gulabjamun (T₁) prepared from filled milk khoa having 3 percent vegetable oil and 8.5 percent SNF was the best. The average of fat content, protein, carbohydrate and energy values of T₁ sample were 5.05, 8.86, 49.48% and 278.8 K Cal respectively. From the therapeutic point of view these findings would be very helpful where restricted amount of saturated but high polyunsaturated fatty acids are required in the diet. The PUFA profile is being supplied by vegetable fat from Saffola. These are for those people who are suffering from the lifestyle diseases like cardiovascular, liver and gall bladder diseases and obesity. For these patients as well as for normal human being these gulabjamuns can be very useful to minimize their saturated fat intake. The cost of vegetable fat is ½ to the milk fat and in the preparation of dietetic gulabjamun milk fat is replaced by vegetable fat so it makes it the lower cost product.

PPD-48
Incorporation of jamun (Syzugium cuminii skeels) juice in ice-cream

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The present investigation was undertaken to explore the possibility of use of jamun juice as a natural flavouring agent and as novelty product with greater therapeutic value. The seven times replicated trial
with four different levels of jamun juice at control 0, 5, 10 and 15% were analysed statistically by use of Randomised Block Design, Allied properties like effect on fat, total solids, titratable acidity, overrun and melting time, including organoleptic qualities were also checked by use of score card method using panel of judges. The treatment wise cost of production was also worked out for each level individually. The average fat, total solids and acidity of milk used were 4.53, 13.28 and 0.137%, respectively. The jamun juice having T.S.S., T.S. Reducing Sugars, non-reducing sugars, titratable acidity and pH were 11.40% Brix, 10.31%, 7.63%, 2.68%, 0.64% and 3.84% respectively. The average fat content in ice-cream showed decreasing trend with increasing level of jamun juice. The lowest average fat in ice-cream of treatment T3 with 15% Jamun Juice was 10.29%. Average total solids content in different types of ice-creams i.e. 0,5,10 and 15% juice levels was 38.53, 37.74, 36.94 and 35.99% respectively. Titratable acidity was lowest in TO (control) group while it was found highest in T3 treatment (15% jamun juice). Physical properties like melting down time and over run found lowest in T3 level of jamun juice added with 15% jamun juice. Organoleptic evaluation by score card method of properties like General appearance Body and Texture, and Flavour were analysed and shown highest over all scores for T1 treatment for ice-cream added with 5% Jamun Juice. In general highest overall acceptibility to ice-cream added with 5% Jamun Juice secured first place while last place was secured by T3 (15% Jamun Juice) treatment. The cost of production shown increasing trend with increasing level of jamun juice in ice-cream and was highest for T3 treatment. (15% jamun juice) and incorporation of jamun juice with 5% level emerged out as best possible level in terms of over all acceptibility. Incorporation of jamun juice in ice-cream as natural flavouring agent has special significance in human diet from the view point of nutrition and added value due to therapeutic importance of jamun juice in ice-cream.

**PPD-49**

**Effect of lactation order and stage of lactation on processing properties of Phule triveni (crossbred) cattle’s milk**

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Effect of lactation order and stage of lactation on processing properties of Phule Triveni (crossbred) cattle’s milk was studied to ascertain the suitability for processing. The highly significant (P<0.01) effect on curd tension (CT) and heat clotting time (HCT) due to stage of lactation was observed while lactation order and it’s interaction with the stage of lactation did not affect the values significantly. The overall mean curd tension (CT) of Phule Triveni milk was 28.17 g. While the mean values for heat coagulation time (HCT) ranged from 23.33 to 35.00 min. The calf rennet clotting time (CRCT) and microbial rennet clotting time (MRCT) could not show any effect due to both the factors. However, use of the microbial rennet recorded significantly lowest (76.86 sec) mean time for clotting than the calf rennet (86.89 sec).
PPD-50

Preparation and evaluation of paneer spread

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Panee is an indigenous and popular acid coagulated dairy product consumed in India. Smooth paneer spread was prepared from skim milk (1.5% fat) and whole milk (4.5%). The whole milk taken to prepare spread has 4.5% fat, 8.5% solid not fat (SNF) and 3.7% protein. The skim milk has 1.5% fat, 9% SNF and 4.4% protein. For preparation of paneer spread from skim milk and whole milk, the milk was heated to 90°C, cooled to coagulation temperature of 65°C and citric acid (2.5% and 2.0%) was added, respectively. The separated whey was drained out and paneer was dipped in chilled water to adjust its moisture content. The salt (0.5%) was added to paneer after draining the water and churned for 2 minutes in a mixer. The yield of paneer and paneer spread is 187.8g and 184.4g respectively by using whole milk. The spread prepared from whole milk has 18% fat, 1.2% ash, 45% moisture and 55% total solids. The paneer yield is 148.6g and that of paneer spread is 146g by using skim milk. The spread prepared from skim milk has 9% fat, 1.8% ash, 40% moisture, and 60% total solids. Sensory evaluations are also done on both the spreads. The studies showed that spread prepared from whole milk is more acceptable having smooth spreadable characteristics, whereas the low fat spread prepared from skim milk can be used as alternative to high fat cheese spread.

PPD-51

Preparation of fig burfi

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Research work on “Preparation of fig burfi” was undertaken in Dairy Science laboratory of Department of Animal Husbandry and Dairy Science, MAU, Parbhani during Nov 2005 to May 2006. It was intended to standardize process of manufacture, study the sensory and chemical qualities and cost of production of fig burfi. Buffalo milk standardized to 6 per cent fat was used to prepare fig burfi. Milk was concentrated in iron karahi over a gentle fire by continuous stirring-cum-scrapping process till pasty consistency to further incorporate predecided amount of fig paste and sugar. This combination was then heated on a low fire and allowed to cool and set. Three levels of fig paste (2.50, 3.75, 5.00 per cent) and 30 per cent level of sugar were selected for preparation of burfi. The experiment was laid out in CRBD to compare the treated samples among each other and with market samples of fig burfi. Organoleptically fig burfi prepared with incorporation of 3.75 per cent fig paste and 30 per cent sugar was found most acceptable as compared to other treatments. It was classed as “Liked very much”. The colour and appearance, body and texture, flavour, taste of this sample scored highest (8.12) on 9 point hedonic scale, while chemically it contained 14.18, 15.10, 17.30, 15.27 and 2.15 per cent of moisture, fat, proteins, carbohydrates and ash respectively. The cost of production of 1 kg of fig burfi of sensorily superior treatment was Rs.102.55 which was slightly higher than market sample of burfi (Rs.100 per kg). The higher cost is due to production of burfi at laboratory scale.
PPD-52

Enrichment of milk based products with under exploited carrot greens

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Carrot greens are the most under exploited class of greens despite of high nutritional value especially in beta carotene, vitamin C and iron. In daily diet, an increased intake of these inexpensive greens may be one of the strategies for improving the nutritional status. Recognizing the need for the identification of such unconventional, nutritious, inexpensive, locally available source may be helpful in achieving nutritional security. Milk is deficient in iron, vitamin C and limited in beta carotene. Therefore, the present study was undertaken with the objective to enrich milk based commonly consumed food preparations namely gulabjamun, kadhi and rabri with beta carotene, iron and vitamin C by incorporating inexpensive under exploited carrot greens. Organoleptic evaluation of all food preparations were conducted by a panel of ten judges using Hopkin’s seven point scale. Among all the three developed carrot greens incorporated food preparations, gulabjamun scored highest (6.96±0.27) overall acceptability scores with 30 per cent level of incorporation. Best level of incorporation of carrot greens in rabri and kadhi was 25 and 30 per cent with overall acceptability scores of 6.90±0.38 and 6.80±0.21 respectively. With the incorporation of carrot greens in gulabjamun, vitamin C, iron and beta carotene content increased to 24mg, 2.64mg and 1710µg per serving respectively. Increase of respective nutrients in rabri and kadhi were 20mg, 2.2mg, 425µg and 28mg, 3.08mg, 19mg per serving.

PPD-53

Studies on preparation of whey based mango RTS beverage

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Mango juice of Kesar variety and whey has been utilized for preparation of ready to serve (RTS) beverage. The whey and Mango juice were blended in various combinations (70:30, 75:25 and 80:20) for preparation of whey-based mango RTS beverage respectively. The RTS beverage was prepared as per FPO standards. The prepared beverages were subjected to various physico-chemical and sensory evaluation for the overall acceptance. The study revealed that the RTS beverage prepared with 70% whey and 30% mango juice in combination scored maximum for almost all sensory parameters such as color, flavor, taste and overall acceptability.
PPD-54
Mango soy fortified probiotic yoghurt: Effect of inoculum rate and temperature on textural characteristics

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Yoghurt is a coagulated milk product obtained by the activity of a symbiotic blend of yoghurt bacteria (Streptococcus salivarius subsp. thermophilus and Lactobacillus bulgaricus) and may contain probiotic cultures (Bifidobacterium bifidus and Lactobacillus acidophilus). Mango soy fortified probiotic yoghurt (MSFPY) samples were prepared by using blends of 78.3 % toned milk, 14.5% soy milk and 7.2 % mango pulp. Experiments were conducted according to CCRD to study the effect of different temperatures (10 °C, 20 °C and 30 °C) on the textural characteristics (HD, CO, AD, SP and GU) of MSFPY. The textural parameters at 10, 20 and 30 °C were fitted into non linear models to determine the effect of temperature on the texture of MSFPY. The quadratic model fitted well to the textural parameters of MSFPY. The temperature coefficients of all the textural parameters were determined and fitted into second order polynomial model and the effect of culture addition on temperature coefficients of textural parameters was studied. Hardness temperature coefficient ranged from -0.92 to -1.97 % per °C, negative value of cohesiveness temperature coefficients ranged from -0.01 to -0.42 % per °C while its positive value varied from 0 to 0.53 % per °C, adhesiveness temperature coefficients ranged from -2.74 to -3.73 % per °C, negative springiness temperature coefficients ranged from -0.08 to -1.47 % per °C and positive coefficients from 0.02 to 5.07 % per °C and gumminess temperature coefficient ranged from -0.94 to -1.92 % per °C.

PPD-55
Studies on qualities of buffalo milk yoghurt fortified with apple fruit pulp and honey

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Fortified yoghurts were prepared by using mixed starter culture containing 1:1 ratio of Streptococcus thermophilus and Lactobacillus bulgaricus. Seven samples of fortified yoghurt were studied to determine effects of fortification of apple fruit pulp and honey separately. The physico-chemical properties of these fortified yoghurts were evaluated by instrumental and sensory methods. The physico-chemical properties evaluated were Setting time, synersis, viscosity, acidity, per cent ash, pH and moisture content. Sensory properties were evaluated by 9 point hedonic scale with the consumer taste panels to compare the properties of apple fruit pulp and honey fortified yoghurt. The sensory properties evaluated were color, flavor, consistency, taste and overall acceptability. Yoghurts with superior sensory quality were obtained with 10 per cent apple fruit pulp and 5 per cent honey concentration.
PPD-56

Development of egg whey beverage

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A study was conducted to standardize the processing technology for a cheese whey based beverage in combination with whole fresh egg, sugar, sodium alginate and different flavors. Egg was incorporated at the levels of 3, 5, 7 and 10 per cent in the cheese whey to which 10% sugar, 0.2 % essence and sodium alginate were added. All the formulations prepared after blending and thermal processing was stored in crowned glass bottles at refrigerated temperature. Evaluation of beverage was carried out for physico-chemical attributes after every 4 days for a period of 20 days. There was no significant change in TSS, viscosity and specific gravity and organoleptic acceptability during storage. Sensory evaluation of the prepared beverage indicated that the beverage with 5% egg and kewra essence scored maximum on the nine point hedonic rating scale for the overall acceptability. It is concluded that a major dairy industry byproduct i.e. cheese whey can be utilized for preparation of acceptable egg whey beverage.

PPD-57

Development and quality evaluation of herbal sandesh

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The increasing consumers demand for consumption of convenient and natural food products of high nutritive value has resulted in development of herbal sandesh. The preparation of herbal sandesh is a new concept in dairy industry. In this study attempts have been made to manufacture herbal sandesh by fortifying chhana with basil, coriander and mint juice individually. The control and treated samples were stored at ambient (30+1°C) and refrigerated (7+1°C) conditions and shelf-life was evaluated with special emphasis on microbiological, physicochemical, textural and sensory characteristics of the samples. Studies revealed that addition of herbs had beneficial effect on the body and texture, flavour, colour and appearance as well as overall acceptability of the treated samples over control. The present research has revealed that the use of coriander herb with its antimicrobial and antioxidant properties increase the shelf-life of herbal sandesh up to 8 days at (30+1°C) and 30 days at (7+1°C) using HDPE bags as packaging materials.

PPD-58

Effect of kutki flour concentration on flavor characteristics of milk based custard

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Minor millets are a group of grassy plants with short height and small grains possessing remarkable ability to survive under severe drought conditions where most other cereal crops may not survive to produce grain. Kutki (little millet) is a leading produce under the categories of minor millets. Kutki is the staple food of remotely placed tribal people of Bastar. Value addition of Kutki flour with milk not only increases their protein content but also improves the nutritional and sensory characteristics. Milk
based custard like product was developed with different concentrations of kutki flour (10, 20 and 30 per cent) and prepared product was adjudged for flavor characteristics. Aroma and flavor characteristics are treated as the most important factor that governs appreciation or dislikeness of developed product. Product obtained from 20 per cent kutki flour with 20 per cent overall sugar addition was ranked as the most favorable with 6.40 score on 9-point hedonic scale. The flavor was pleasantly sweet with a creamy background. Developed flavor was inherited from kutki grains and milk and may also be a consequence of thermal treatment to milk, sugar and kutki flour.

PPD-59

Standardization of compositional parameters for development of milk based fermented product from kutki grains

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Food availability and nutritional security for the well being of rural, backward and tribal population of Bastar district of Chhattisgarh is a formidable challenge. Public Distribution System (PDS) identified exclusively for wheat and rice with instrument of storage, domestic procurement and international trade has greatly misunderstood the food consumption pattern of native people. Millet being as a staple food, PDS is a cause of concern for tribal folk of Bastar. Kutki millet a heritage food of Bastar is highly nutritious, non-glutinous and non-acid forming food. Kutki may also be popular food among diabetic patients being its low in saturated fatty acids content and rich in dietary fiber. Due to its high fiber content, it may also help in lowering CHD incidence. Visualizing the beneficial synergistic properties of kutki grains, and milk, a series of products were developed from it especially for tribal masses. The process of lactic acid fermentation is effectively carried out with a blend of milk and kutki flour in it (100:10, 100:20, 100:30, 100:40 and 100:50). The sugar addition was constant at 10 per cent of the total initial mass of mix and rate of inoculum was 1.5 per cent. The higher addition of kutki flour yielded in a custard like product of inhomogeneous consistency. The developed product was polyphasic emulsion. Besides excellent nutritional properties, it had a range of physical, chemical and biological attributes.

PPD-60

Process standardization of phirni and development of phirni mix powder

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Phirni is a cereal based indigenous milk product, commonly found in western UP and Hyderabad but popular in country wide. Payasam, Kheer, Basundi are the similar product profile of Phirni. Commonly buffalo milk is used for Phirni preparation. Rice in the form of paste @ 4%, ground sugar (12%) and green cardamom powder (1%) added to milk and cooked (85±5°C) for 20 minutes and poured in earthen pot, cooled at room temperature for setting. It is there after kept at refrigeration temperature (4°C) for 30 minutes before serving. Methodology have been standardized for the preparation of Phirni from cow milk where rice paste (6%), ground sugar (12%), cardamom powder (1%) are added to the milk and cooked at 85±5°C for 30 minutes followed by cooling at room temperature was prepared Phirni is placed in refrigerator for 30 minutes before serving. Phirni mix powder was also prepared in the laboratory where the 50 gm milk powder (WMP: SMP, 50:50), 18 gm of ground precooked rice, 31 gm of ground
sugar, 1 gm of cardamom powder, 0.1 gm of orange yellow colour (optional) were added and dry blended properly. Three levels of reconstitution of Phirni mix powder to water such as 50:30, 50:40 and 50:50 with a heating of 85±5°C for 5, 10 and 15 minutes each were studied. The 50:40 reconstitution level with a heating for 85±5°C for 10 minutes was found optimum for setting of Phirni as well as showed better result on sensory and rheological studies. The product made from Phirni mix power appeared to be at par with that prepared from fresh milk on sensory and rheological studies scoring 7.80±0.16 for overall acceptability and rheological scores for hardness were 38.86±2.78, softness 327.44±9.24 and adhesiveness -34.5±3.95 g respectively.

PPD-61
Process optimization for biofunctional whey protein hydrolysate
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Newer whey protein ingredients include hydrolyzed whey proteins that contain high level of bioactive peptides are known. In the present study, whey protein concentrate (WPC) with 70.14% protein was hydrolyzed with corolase PP, a pancreatic enzyme mixture and antioxidant activity of hydrolysates was investigated by ABTS (2, 2’ azinobis 3- ethyl benzothiazoline- 6- sulphonic acid) radical containing assay and results are expressed in Trolox equivalent antioxidant capacity (TEAC). The effect of process condition on the antioxidant activity of hydrolysate was investigated systematically using response surface methodology. It was shown that the antioxidant activity of the whey protein hydrolysates (WPH) could be controlled by regulation of five process conditions (preheating temperature, pH, and incubation temperature, E/S ratio and hydrolysis time). Hydrolysis conditions for optimal antioxidant activity were, 68°C, 7.6, 45°C, 0.02 % and 7.15 hours as preheating temperature, pH, incubation temperature E/S ratio and hydrolysis time respectively. Biofunctional WPH was characterized in terms of molecular properties, biofunctional properties and technofunctional properties. Whey protein hydrolysate prepared by using these conditions showed 22.03% degree of hydrolysis. The gel filtration pattern for hydrolyzed whey protein showed a number of peaks as compared to the unhydrolyzed whey protein in the lower molecular weight region. Similarly, the SDS–PAGE indicates the extensive hydrolysis of whey proteins with a number of low molecular peptides like 9731, 8330, 8028, 7707, 7211, 6796 and 3901Daltons. The Biofunctional whey protein hydrolysate showed a very good antioxidant and ACE inhibitory activity i.e., 21.86±0.045 iM of Trolox / mg of protein and IC50 value 279 ìg/ml respectively. The technofunctional properties were slightly inferior to the unhydrolyzed whey protein except overrun which is about four times higher.

PPD-62
Production and study of organoleptic and chemical properties of carrot yoghurt
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Carrots (Dascus carota L.) are good source of carbohydrate, calcium, phosphorous, iron, potassium, magnesium, copper, manganese and sulphur. It is an excellent source of vitamin A, B1, B2, C, E, thiamin, folic acid and riboflavin but lack in protein and fat. Yoghurt is rich in protein and fat but is deficient in iron and vitamin C. Blending of yoghurt with carrot juice would produce a nutritionally rich food. In this
study, the effect of carrot on sensory and chemical properties and consumer acceptance during cold storage of yoghurt were investigated. Plain and carrot yoghurt were prepared in the Jahad Keshavarzi on laboratory scale from cow’s milk obtained from local market. Carrot yoghurt was prepared by blending milk with 5, 10, 15 and 20% carrot juice before fermentation. The organoleptic, rheological and chemical quality of yoghurt samples were investigated during refrigerated storage at 4°C for three weeks. The Sensory scores increased for yoghurt samples with 15% carrot juice. Chemical analysis revealed an increase in acidity and decrease in pH with increasing carrot juice. The results of the study showed that carrot had significant effect on the acceptability of yoghurt during shelf life.

**PPD-63**

*Enrichment of dairy by-products with fruit juices for production of beverages*

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Commercially available dairy by-products like whey and buttermilk were utilized for the preparation of beverages by using different fruit juices at various levels of concentration. Whey and buttermilk beverage standard bases comprising of 0.5% acidity and 10-12% total soluble solids content were formulated for the preparation of fruit flavored beverages. Sensorial quality of beverages was found substantially enriched by fortifying with different type of fruit juices with respect to appearance, color, flavor, taste, mouth feel and overall acceptability. The beverage formulated and prepared from chhana whey with 20% mango juice was found most acceptable on the basis of organoleptic evaluation score as compared to other beverages. The nutritional quality of buttermilk beverage reported comparatively superior with respect to protein (0.91%), lactose (3.55%) and ash (0.82%) content. The predominant overall acceptability determinative feature of beverage as sparkling clarity of paneer whey beverage (16% orange juice) was found superior over others with respect to turbidity (94) and sedimentation value (1.0) irrespective of nutritional value. The perspective achievements of the research findings of this investigation are coiling around assessment of nutritional enrichment and safety of dairy by-products fruit juice beverages for commercial exploitation.

**PPD-64**

*Effect of whey protein concentrate on quality, shelf life and cost effectiveness of fruit flavoured beverages*

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The standard shrikhand whey base was scrutinized with respect to nutritional quality on the basis of fermentation processing technology. The whey base was deproteinised and defatted for notifying its quality features with respect to sparkling clarity followed by ultrafiltration using polyether sulphone membrane. The formulated whey beverage base was enriched with 12% sugar, 16% mango juice and pH 0.5. Analogous whey base was also formulated by using whey concentrate (10,000 MW cut off regenerated cellulose acetate membrane) and ultrafiltered mango juice by keeping per cent concentration of other ingredients unchanged. The efforts were made to enrich the nutritional quality of beverage by adding whey protein
concentrate (WPC) at 2, 3 and 4% levels. The sensorial quality score of all the parameters reported comparatively higher in case of beverage containing 3% WPC over that of other beverages. The storage study of formulated WPC beverage reported 40 and 15 days as active storage period at refrigerated (4 + 1°C) and room temperature (25 + 1°C) storage conditions respectively without significant changes in nutritional and sensory quality parameters. The standardized whey beverage could be stored for 40 days without alteration in the sensory quality parameters at refrigerated temperature for justifying its consumer acceptability within the specified storage period. The beverage stored at room temperature for 15 days reported significant changes in acidity and pH notifying its status as unfit for consumption beyond 15 days of storage period. The unit cost of production of beverage (300mL) worth of Rs. 7/- was observed to be comparatively higher because of small scale production. The detailed investigation on cost of production on pilot scale is in progress.

PPD-65
Production and quality evaluation of instant lassi
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The instant lassi was prepared from cow milk standardized to 4% fat and 8.5% SNF and heated to 85°C for 30 min followed by cooling at 37°C and adding 50% v/v lactic acid to adjust the pH to 3.4, 3.6 and 3.8. The sugar was added at the rate of 8, 10 and 12% and mixed thoroughly in waring blender, the synthetic flavor i.e. vanilla, strawberry and pineapple at the rate of 0.2% were also added and stored at refrigeration temperature. The sensory evaluation of flavored instant lassi adjusted to pH 3.8 and 12% sugar indicated no influence on color, appearance and overall acceptability of lassi compared to control. Among the different flavors used, pineapple flavored instant lassi scored highest for color, appearance and overall acceptability. The pH and sugar both were significantly affected i.e. flavored instant lassi had the higher specific gravity and lower viscosity than the control.

PPD-66
Fortification of fat spread with functional ingredients
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Today food industry is actively involved in new product development. This includes new formulations and imitation of foods being designed to compete with or replace existing products based on their superiority, in convenience, cost and quality. The latest trends in development of newer spreads are towards low fat content and incorporation of functional ingredients such as dietary fiber, w-3 fatty acid etc. A low fat table spread has been formulated to provide sufficient w3 fatty acid 11.73% and w6/w3 fatty acid ratio 1.67 that is reported to be beneficial in lowering the LDL, VLDL cholesterol in blood plasma. Further attempt was made to incorporate the dietary fiber in the form of inulin and oat. Higher level of oat fiber adversely affected sensory attributes of resultant fat spread. Addition of inulin cream gave better body and texture and spreadability scores. Attempts were also made to fortify the formulated fat spread with
three different calcium salts viz. calcium lactate, tricalcium citrate and tricalcium phosphate at the rate of 16, 20 and 25% of recommended dietary allowances per 30 gram serving of the spread. The fat spread with added calcium salts was subjected for sensory evaluation and rheological attributes in order to select the best product. The preparation fortified with tricalcium citrate at 16% of recommended dietary allowances was adjusted the best in terms of sensory and rheological attributes. The sample containing tricalcium citrate at 16% level obtained the least hardness, work of shear, work of adhesion and stickiness value as compared the product containing calcium lactate and tricalcium phosphate. The formulated spread was subjected to consumer acceptance study which was rated as very good.

PPD-67

Effect of additives on quality of yoghurt prepared from soy-cow milk blend

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The yoghurt was prepared by combining 20 parts of soy milk with 80 parts of cow milk (4% fat) and incorporating the various additives like acacia gum, guar gum and sodium hexametaphosphate. During the heat treatment, each additive was added at the level of 0.1, 0.2, 0.3 and 0.4% concentrations. The milk was cooled, cultures added and incubated at 42°C, till yoghurt was formed. The use of additives improved the sensory and physicochemical qualities of blended yoghurt. Among additives used, guar gum was found to be best up to the level of 0.3%, as it controlled the wheying-off with no adverse effect on qualities of the final product.

PPD-68

Production and shelf-life studies of low cost acido-whey beverages fortified with soy milk and fermented by Lactobacillus acidophilus

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Whey is one of the most important by-products of the cheese industry. Three million tonnes of whey is produced annually in India containing about 0.2 million tonnes of valuable milk nutrients and their use has not yet been appropriately commercialized. In this context, a study was performed to develop a value added product (fermented beverage) with the aim to increase the potential application of paneer whey and soymilk. A mixed substrate was prepared by selective combination, which contained paneer whey 75% and 50%, soymilk 25% and 50%. The substrate mixture was fermented by a mixed culture of lactobacillus acidophilus 5% at 39°+ 1°C for 20-24 hours incubation. The fermented beverage was lightly extra flavoured with pineapple and orange essence and synthetic colour and subjected to sensory evaluations, chemical tests and bacteriological tests also performed during storage period for 10 days at 4°C. Except a slight variation in the acidity, no other properties changed. The cost of production of acido whey is very cheap compared with the other beverages available in the local market. Regarding sensory evaluation 80% of the consumers accepted the product into the combination of 75% whey and 25% soymilk. The cost of production of whey drink was very cheap hence it can be used by all class of people. Results obtained in this study are quite encouraging because development of such product can provide a new
outlet for use of whey in a more nutritious product, better use of existing idle processing facilities for new product making, and a new outlet for making profit by increase in plant efficiency, utilization and stoppage of whey from draining.

PPD-69

*Streptococcus thermophilus*: The prolific producer of folate, a functional biomolecule

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Folates represent an essential nutrition component involved in many metabolic pathways, mainly in carbon transfer reactions such as purine and pyrimidine biosynthesis and amino acid interconversion. The daily-recommended intake for an adult varies between 200 and 400 µg. Folate deficiency has been associated with a high incidence of neural tube defects, cardiovascular diseases, coronary heart disease and in certain forms of cancer. Therefore, an exogenous supply of folic acid appears inevitable to prevent nutritional deficiency especially in view of the inability of mammalian cells to synthesize this vital biomolecule. Milk is a well-known source of folates in the range of 5–7 µg/100g and 5-methyltetrahydrofolate as the major form of folates in cow milk. Fermented milk products are reported to contain even higher amounts of folate as a result of the production of additional folates by starter bacteria. *S. thermophilus*, an industrially important LAB is extensively used for the manufacture of dairy products. Besides its technological attributes in terms of acid production and texture development, *S. thermophilus* strains have been found to be engaged in a number of functional activities as bacteriocin, vitamin production etc. Among these metabolites, *S. thermophilus* has been reported to produce higher quantity of folate in comparison to other LAB; majority of which is excreted into milk. *S. thermophilus* has been observed to be the dominant producer, elevating folate levels in skim milk from 11.5-çg g-1 to between 40 and 50 çg g-1. The present study deals with the isolation and screening of folate producing strain of *Streptococcus thermophilus* of indigenous origin from milk and fermented milks. Out of a total number of 250 randomly picked isolates from 100 samples of different milk and milk products as dahi, cheese, lassi etc, 150 isolates were presumptly screened as *Streptococcus thermophilus* on microscopic examination. Out of these strains, 120 isolates were biochemically (bile esculin hydrolysis, sugar fermentation profile, and growth in 6.5%NaCl and pH 9.5) and genetically identified (by species specific PCR) as *Streptococcus thermophilus*. Folate content was estimated by the microbiological assay, with the additional trienzyme treatment using *L. rhamnosus* MTCC 1408 as an assay organism. Among the 120 strains screened, about half of the population were found to produce folate in the range of 4-16 µgL-1 whereas about 40% were in the range of 20-30 µgL-1 and only 10% were in the range of 30-40 µgL-1.

PPD-70

Production of biothickener by *lactococcus lactis subsp lactis*

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Exopolysachharide (EPS) refers to all forms of bacterial polysaccharide, both slime and capsule, found outside the cell wall. Microbial EPSs are biothickeners that can be added to a wide variety of food products,
where they serve as viscosifying, stabilizing, emulsifying or gelling agents. These days, there is a considerable interest in finding new EPSs that are suitable for special applications, or that have a potential industrial relevance, either by applying different culture conditions or by using novel bacterial strains. The total yield of EPS produced by the LAB depends on the composition of the medium (carbon and nitrogen sources, growth factors, etc.) and the conditions in which the strains grow, i.e. temperature, pH, oxygen tension, and incubation time. The optimization of fermentation processes with respect to physical and chemical factors employing rationally selected strains is a promising strategy to exploit these biomolecules for improving technological attributes of food systems e.g. viscosity, suspension of particulates, inhibition of syneresis, stabilization, emulsification that may contribute positively to the mouth-feel, texture, and taste perception of fermented dairy products low-milk-solid yogurt/dahi, low-fat yogurt/dahi, sour cream, lassi, low moisture cheeses etc. Therefore, the influence of both nutritional as well as environmental factors on bacteria growth and EPS production needs to be understood. Hence the present study was carried out to study the environmental and cultural growth conditions affecting EPS production by Lactococcus lactis subsp lactic (NCDC 191), a strain of indigenous origin commonly used as dahi starter through a series of experiments employing various combinations, determine optimum conditions with the help of response surface methods and estimate EPS production under optimum conditions. The deproteinised whey was used as fermentation medium. An experimental design comprising of incubation temperature, pH, level of glucose, level of casein hydrolysate as factors was designed and responses were measured in terms of EPS production, absorbance, viscosity and plate count using response surface method. The highest EPS production was achieved when the cultures were incubated at 25°C in deproteinized whey medium maintained at 6.8 supplemented with 1.0% Casein hydrolyzate and 10 mg of glucose. However, no production was observed at incubation temperature of 40°C, pH 6.2, casein hydrolyzate and glucose concentrations of 1.5 and 7.5% respectively. The predicted response given by the design expert were as follows EPS production 127.42 mg/l, absorbance of 0.604, viscosity 26.28 cP and plate count 2.7X 10^7 cfu/g at incubation temperature of 25°C, pH of 5.6, Casein hydrolysate and glucose concentration of 1.04 % and 9.08 % respectively. These values were compared with actual values and found to be non significant at 5 % level. Findings of this study denote the adequacy of RSM for optimization of EPS production by NCDC 191. The outcomes of this study can be used for scale up of EPS production in a fermenter, purification and characterization of crude EPS, and further study of functional attributes in food systems.

**PPD-71**

**Defined strain starter for the manufacture of shrikhand**

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*Shrikhand* is a traditional fermented and sweetened milk product of Indian origin and is popular in Gujarat, Maharashtra and certain parts of Karnataka and Madhya Pradesh. It is prepared by fermentation of milk by lactic acid bacteria followed by removal of whey from curd either by hanging in muslin cloth or using mechanized methods e.g. centrifugation to obtain an intermediary product known as *chakka*. The chakka is finally blended with sugar, cream and other ingredients like fruits, nuts, flavour, spices, colour etc to achieve the finished product of desired composition, consistency, and sensory attributes. Starter culture
is instrumental in the development of body, texture, flavour and aroma in the finished product and thus contributes significantly towards the overall acceptance of product by the consumer. Presently, artisanal cultures comprising an array of undefined strains are being used for preparation of *Shrikhand* both on domestic and industrial scale. The use of such cultures is fraught with the risk of manufacture of product with inconsistent attributes in terms of make time, final acidity, appearance, flavour, composition, consistency, texture and shelf life. On the other hand defined strain starters are credited with predictable behaviour and performance and hence yield the product of desired attributes. Hence, in the present study various cultures were screened on the basis of their technological as well as textural attributes to select a particular culture/cultures as the defined strain starter for the manufacture of *Shrikhand*. Subsequently, the product was analysed for its sensory, textural and micro structural attributes. Various aspects selected for screening included the technological performances comprising of coagulation time, TS and acidity of *dahi*, *chakka* and whey, TSS of whey. In addition to these factors % recovery of TS and yield were also analyzed. In case of textural performances hardness and stickiness were given more importance. On the basis of interpretations of results NCDC 91+60 and NCDC 263 were selected for further studies. Shrikhand was prepared using the selected cultures for its sensory, textural and micro structural studies using traditional as well as mechanical method. These studies indicated that the product obtained by mechanical method was superior to that made from traditional method, in terms of flavour, body and texture, over all acceptability and shelf life. Mesophilic strains were found superior for contribution towards flavour, whereas thermophilic mixed strain yielded product with excellent body and texture. Textural as well as micro-structural studies of Shrikhand indicated that the product obtained from thermophilic cultures was harder than that from mesophilic cultures with a close-knit appearance of casein micelles as revealed by Scanning Electron Microscope. Hardness and moderate stickiness were a few of the detrimental factors for sensory attributes of Shrikhand as revealed by sensory evaluation.

**PPD-72**

**Formulation and evaluation of mango fruit kalakand**

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Kalakand was prepared by replacing 10 per cent ($T_1$) and 20 per cent ($T_2$) milk by mango pulp. Control ($T_0$) was taken as without any replacement of milk. The overall acceptability was rated as 8.94, 8.88 and 8.46 in the treatment $T_0$, $T_1$ and $T_2$, respectively. Proximate analysis of the product indicated the increasing trend of total solids content as the proportion of mango pulp increased. Fat content of the kalakand decreased significantly by the addition of mango pulp. Protein content also decreased but there were non-significant differences. However carbohydrate and ash content were increased by the addition of mango pulp. Acidity of the product was lowered down as proportion of mango pulp was increased. Cost of production of kalakand of $T_0$ treatment worked out was Rs. 81.53/kg which was dropped by 7 to 8 and 14 to 15 per cent in the treatment $T_1$ and $T_2$, respectively.
PPD-73

Studies on preparation of *satori* - a traditional *khoa* based sweet

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A traditional *khoa* based wheat flour confection viz. *satori* was prepared using three types of wheat flour fractions viz. whole wheat flour (WWF), semolina (S) and white flour (WF) for outer layer while *khoa* (K), semolina (S) and sugar (SR) were used at different proportion as inner material. The overall acceptability of the *satori* for the combination 10:40:50 (WWF:S:WF) was rated highest being at 7.4 on 9 point hedonic scale. As regards the score of inner content of *Satori*, the combination 25:25:50 (K:S:SR) rated highest being at 7.8 on 9 point hedonic scale. The chemical composition of the best treatment combination of *Satori* were as 19.12, 10.02, 14.02, 55.52 and 1.32 per cent for moisture, protein, fat, carbohydrate and ash, respectively.

PPD-74

Utilization of *lesser Yam* (*Dioscorea esculenta lour*) *burk* powder as stabilizer in paneer making

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Use of stabilizers has been practiced by food industry for long to improve the functional characteristics of foods. Utilization of *lesser yam* (*dioscorea esculenta lour*) *burk* powder as paneer stabilizers is studied to find its suitability on commercial level. The study was undertaken to study impact of these hydrocolloids on physicochemical, organoleptic quality of paneer and to evaluate the effect of these hydrocolloids on yield of paneer. It was observed that the addition of stabilizer decreases the total solids content as against the paneer with no stabilizer. Further, moisture retention, fat, FDM and acidity showed rising trend with increase in the level of stabilizer but the total solids content decreased with increase in the level of stabilizer. The sensory score of raw paneer of different treatments with respect to flavor, body and texture and appearance was observed as 7.3 in T1L3 to 8.0 in T2L2, 7.6 in T1L3 to 8.3 in T1L2 and 7.6 in T1L1 to 8.0 in T2L2 respectively. The yield of paneer in different treatments under study varies from 12.87 % in T0L0 to 15.40 % in T1L3 (LESSER YAM @ 0.30 %). From the results, it could be inferred that the use of lesser yam powder at 0.30 % level yields the paneer of desirable quality at comparatively low cost than that of the paneer with no stabilizer.

PPD-75

Utilization of Bhendi (*Abelmoschus esculentus*) gum as stabilizer in paneer making

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Hydrocolloids as stabilizers have been used by food industry for long to improve the functional characteristics of foods. Utilization of bhendi (*abelmoschus esculentus*) gum as paneer stabilizers is studied to find its suitability on commercial level. The study was undertaken to study impact of these hydrocolloids on physicochemical, organoleptic quality of paneer and to evaluate the effect of these hydrocolloids on yield of paneer. It was observed that the addition of stabilizer decreases the total solids content as against
the paneer with no stabilizer. Further, moisture retention, fat, FDM and acidity showed rising trend with increase in the level of stabilizer but the total solids content decreased with increase in the level of stabilizer. The sensory score of raw paneer of different treatments with respect to flavor, body and texture and appearance was observed as 7.3 in T1L3 to 8.0 in T2L2, 7.6 in T1L3 to 8.3 in T1L2 and 7.6 in T1L1 to 8.0 in T2L2 respectively. The yield of paneer in different treatments under study varies from 12.87 % in T0L0 to 15.40 % in T1L3 (LESSER YAM @ 0.45 %). From the results, it could be inferred that the use of lesser yam powder at 0.45 % level yields the paneer of desirable quality at comparatively low cost than that of the paneer with no stabilizer.

PPD-76
Bovine milk k-casein genetic polymorphs and cheddar cheese making
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The influence of genetic variants of milk proteins on the composition and technological properties of milk has been the subject of much intensive research in the recent times. The researchers around the world have shown considerable interest in using milk protein genes as genetic markers for increasing milk production, improving production related traits and altering composition of milk. The genetic variants in particular have well confirmed association with cheese making properties of milk. This subject area has not been investigated in India. The study was, therefore, taken up to determine correlation of genetic variants of k-casein with cheddar cheese making. Milk having either k-casein AB/BB genotype showed higher fat, protein, casein, ash, calcium, phosphorous content and lower lactose and citrate contents as compared to milk containing k-casein AA genotype and control milk from triple cross and Jersey cows. The coagulation properties (RCT and Curd firmness) were better for milk having k-casein BB/AB genotypes than k-casein AA and control milks irrespective of breed. The cheese yield and recoveries of fat, protein and total solids were also higher for k-casein BB/AB genotype milk than k-casein AA and control milks from these breeds. The losses of fat, protein and total solids were lower in cheese whey drained from milk having either k-casein BB and/or AB genotype. Milk having k-casein BB/AB genotypes was found to be superior in term of overall cheddar cheese making as compared to milks containing k-casein AA genotype and control.

PPD-77
Effect of whey and curd incorporation on the quality of mutton nuggets
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Whey proteins are widely used as functional ingredients and/or binders in the formulations of meat products to improve their yield and quality. Curd has been incorporated in some traditional meat products like meat kurma and a delicious Kashmiri mutton product like goshtaba cooked in gravy (yakhini) containing curd. Generally pork and chicken meat are used for processing of emulsion based meat products. However,
mutton is least preferred to make comminuted meat products due to typical muttony flavour. In this experiment, use of curd and whey, a byproduct obtained from paneer making, was tried in mutton nuggets to improve their flavour. Whey was incorporated at 9% replacing the added water in the emulsion based mutton nuggets and curd was added at 7% to the formulation. The prepared meat emulsions were filled in stainless steel moulds and steam cooked. The chilled blocks were sliced into nuggets and their sensory attributes were evaluated by the experienced taste panelists. Addition of both curd and whey significantly reduced the emulsion stability, yield and texture of the products due to their lower pH in comparison to the control. Incorporation of curd slightly improved the flavour, juiciness and overall acceptability of the nuggets. However, the use of whey had no beneficial effect on the product quality. Further studies are in progress to explore the benefits of curd and whey use in emulsion type of meat products.

PPD-78

Osmo-air drying of bitter gourd slices

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Bitter gourd is an important vegetable crop of Indian subcontinent. Osmo-air drying can be adopted on large scale to preserve the quality of bitter gourd for longer duration. Minimum (4.32/5.21 g water/g d.m.) moisture content in bitter gourd slices was obtained after 11.67% sodium chloride/sorbitol diffusion for 90 min at 60°C, while maximum (15.48/17.24 g water/g d.m) moisture content in bitter gourd slices was obtained at 0.34% of sodium chloride/sorbitol after osmotic diffusion at 40°C for 90 min. The moisture in control and osmo-air dried bitter gourd slices was reduced to 1233.33% db to 1153.10% db and 1233.33% db to 1146.75% db, respectively after 3 hrs of drying at 60°C. The dehydration rate in bitter gourd slices was reduced from 1.87 to 1.21 and 1.31 to 1.01 g water/min/100 g d.m. during drying of first 303 min in osmo-air dried and control bitter gourd slices, respectively.

PPD-79

Use of fruit pulp in burfi

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Burfi is one of the khoa based’ Indigenous’ milk product. Varieties of burfi are prepared with additives (fruit, nuts etc.) and sold in the market; consumed by the people. Fruits like mango, orange, coconuts are being used extensively in the burfi by the halwais. No special mention has been made about the use of fruits like Papaya, Sapota, Wood apple in the literature, reviewed. Use of these fruits not only attracts the consumers acceptance but, also improve the nutritional status of the products through value addition. The Wood apple burfi prepared with addition of 20 per cent Wood apple pulp and 45 per cent sugar, secured top score (89.67) and was rated “liked very much” by the panel of judges. Controlled sample
(plain burfi) scored (87.96) significantly (P<0.05) lower than that of Wood apple burfi. Higher proportion of Wood apple pulp reduced sensory properties of burfi and hence cannot be recommended. Removal of seed from wood apple is not necessary; on the contrary seeds give special effect for colour and appearance which may help to identify Wood apple burfi. Moreover, while eating seeds give feel of dry fruits. In case of Papaya burfi, it was noticed that burfi prepared with addition of 50 per cent papaya pulp and 40 per cent sugar secured 94.03, score which was, significantly (P<0.05) higher as compared to plain burfi score (89.18), for its overall acceptability. It was rated “highly acceptable product” by the panel of judges. Sapota burfi, prepared with the addition of 15 per cent sapota pulp and 35 per cent sugar by predetermined proportion, found superior over that of plain burfi. The overall acceptability score recorded 90.42 of sapota burfi was at par with plain burfi(score 89.18) prepared under same set of experiment.

PPD-80
Effect of substitution of milk fat with rice bran oil in softy (soft served ice-cream)
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Soft served ice-cream samples were prepared while replacing milk fat with the different proportions of rice bran oil. As the proportion of rice bran oil increased from 5 to 35%, the sensory score for texture was increased from 7.06 ± 0.18 to 8.88 ± 0.23. Flavor scores differed for the control and soft served ice-cream containing 35% rice bran oil, respectively. Data indicated that the melting resistance was not significantly different for all the samples compared to the control. The replacement of milk fat with rice bran oil from 5 to 10% in the soft served cream samples did not show any significant difference in terms of overrun. All the parameters viz. hardness, melting resistance, texture and flavor were regressed against the different proportions of RBO to achieve the mathematical models. Results indicated that all the models were found to be fit except flavor as can be indicated from the co-relation coefficient (R²).

PPD-81
Technology of low fat chhana spread and its shelf life
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Chhana Spread was prepared from cow milk of 1% and 2% fat, using citric acid and calcium lactate as coagulant and stored for 0, 10 and 20 days. The effect of various factors were examined on the basis of sensory, chemical and microbiological qualities. The effect of various factors on yield and cost of production were also observed. It was observed that cow milk of 2% fat level with citric acid coagulant and fresh sample of low fat chhana spread was found to be most suitable in respect to physico-chemical and microbiological qualities. The maximum yield of low fat chhana spread was obtained from cow milk of 2% fat level with calcium lactate coagulants followed by 1% fat with calcium lactate coagulant. Cow milk of 2% fat level with citric acid coagulant chhana spread can be stored for 20 days of refrigeration temperature. This spread is most suitable for lower income group due to low cost in comparison to cheese spread and cardiovascular diseased person, pregnant ladies and growing children.
PPD-82

Standardization of production technology of khurchan and its shelf-life

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Khurchan is a concentrated, sweetened whole milk product prepared by simmering milk and is popular in Uttar Pradesh. As Khurchan contains all the milk solids in approximately five fold concentration, together with an addition of sugar, its food and nutritive value is very high. At the same time it has very peculiar taste also. The shelf-life of product is 24 to 48 hours depending on storage conditions. No standard manufacturing technology of uniform quality is available for commercial exploitation. Hence, attempts were made to optimize the process for the production of high quality khurchan. Buffalo milk (6.0% fat), two methods of manufacturing (simmering and evaporation by boiling to half then simmering), two simmering temperatures (80°C and 90°C), three levels of sugar (3, 5 and 7 percent) and three packaging materials (butter paper, polyethylene and aluminium foils) were used for preparation of the product and stored for 0,3,6,9 and 12 days at refrigeration temperature (5°C). The effect of various factors on khurchan were evaluated and analysed for sensory, chemical and microbiological qualities. This study has shown that good quality khurchan could be produced from buffalo milk evaporation by boiling to half and then simmering at 90°C with 5% added sugar, packed in aluminium foil and could very well be stored up to 6 days at refrigeration temperature.

PPD-83

Influence of adjuncts as debittering aids in encountering the bitter flavour developed in cheese slurry during accelerated ripening

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Acceleration in cheese ripening can give economic advantage to a cheese-maker; however, there is a chance of encountering bitterness in such cheeses. An attempt was made to accelerate the flavour development in cheese base with the help of exogenous proteolytic and lipolytic enzymes (1:1 proportion, each at the rate of 0.025 % by weight of cheese-base) and ripening at elevated temperatures (i.e. 20°C) for up to 12 days. To counter the bitter flavour developed, adjunct cultures were used. Adjunct cultures were either viable or attenuated (freeze-shocked or heat shocked). Biochemical characteristics, electrophoretic pattern and sensory evaluation of the product were carried out. An acceptable enzyme-modified, lightly salted cheese base was obtained using 0.025 % each of proteolytic and lipolytic enzymes, along with 5 % starter culture and adjuncts followed by ripening at 20°C for up to 12 days. Freeze-shocked adjunct Lactobacillus helveticus produced enzyme-modified cheese base with no detectable bitter flavour, the excess acid production being curbed and the atypical flavor also eliminated. The usage of exogenous enzymes, temperature of ripening, ripening period and interactions amongst these parameters had significant (P<0.01) influence on all of the biochemical characteristics monitored. The results of the present investigations are very encouraging and a major breakthrough in eliminating the bitterness problem usually associated
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with accelerated cheese ripening process. Such cheese base could be successfully incorporated at the rate of 15% in the preparation of processed cheese products to obtain appropriate flavour.

PPD-84
Manufacture of value added colostrum cake
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Attempt was made to utilize nutrient rich colostrum, the first post partum mammary secretion of normal healthy cow for manufacture of colostrum cake - a traditional milk product of country. The typical off flavour of colostrum declines its acceptability, which could be improved by adding mango pulp. Colostrum cake was prepared by suitable method using sugar at 80 and 90 per cent weight of mix (colostrum 70 per cent + milk 30 per cent). Further the quality of cake was improved with two levels of mango pulp at 5 and 7.5 per cent. The products were judged sensorily by the panel of judges using 9-point hedonic scale. Colostrum cake made from 90 per cent sugar and 7.5 per cent mango pulp was liked very much (score 8.5) for its overall acceptability. Moisture, fat, protein, reducing sugar, non-reducing sugar and total sugar content in acceptable samples of colostrum cake were 5.17, 15.13, 4.80, 9.80, 3.39 and 67.91 percent, respectively. Further, it can be said that developed cake could be acceptable when stored for 15 days at room temperature. The cost of production was Rs. 40.45. for 1 kg of cake including the cost of raw material, fuel, labour and losses during manufacture of cake.

PPD-85
Development of eggless colostrum cake
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A technology for the manufacture of eggless colostrum cake was developed to provide an alternative avenue to the bakery industry for the manufacture of cake, particularly during difficult times caused by short-supply of eggs, outbreak of diseases like bird-flue, salmonellosis, ranikhet etc. in poultry as well as to offer a scope to the vegetarian people to relish cake. Cake was prepared utilizing cow colostrums, obtained from the first milking post-partum, in place of egg along with other necessary ingredients. Colostrum was added separately at 35, 40 and 45 percent by weight (based on other ingredients) to the mix containing soyabean oil, wheat flour, cane sugar, baking powder and vanilla essence. Control sample of cake was prepared using all the ingredients mentioned above except colostrum which was replaced by egg. Texture profile analysis of the products determined by a texture analyzer (Model TA-XT2i, Stable Micro System, U.K) fitted with a 250 Kg load cell revealed that the level of colostrum was inversely related to hardness, gumminess and chewiness, and directly related to adhesiveness and cohesiveness of the colostrum cake. On sensory evaluation, cake made by adding 40 percent colostrum scored maximum for colour and appearance, flavour and overall acceptability while control cake obtained highest score for only body and texture among all the samples. Based on results, addition of 40 percent of colostrum obtained from cow after first milking post-partum in place of egg was recommended for the preparation of eggless colostrums cake.
PPD-86

Improvement yield of Iranian traditional cheese with thermal treatment and usage of rennet and starter

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In past milk products have been prepared from unheated milk. One of the product that is made from unheated milk and without starter in Iran is Lighvan cheese. The resulting desired odour in this cheese results in good marketing for it in Iran and other countries. We evaluated the effect of heating process (LTLT) and starter addition in making of this cheese. In this research, firstly Circumstantialites test such as (pH, acidity, fat, temperature) tests were conducted for unheated milk, then 25 liter from it was taken in cheese maker vat at 34 C temperature and added 1% ppm starter and after about 30 min, acidity of milk was observed. After slight acidity had developed, rennet was added in the proportion 0.25 for every 25 liter milk and after about 40 to 50 min (for complete coagulation), cutting by blades was done by dividing in horizontal and vertical blocks with dimension 1*1*1, stirred and discharged the whey. These blocks were then pressed and after 50 min clod cut off and dipped in saturated brine that had been previously pasteurized. We produced 4 types of cheese that included, cheese with traditional style with starter, cheese with traditional style without starter, production pasteurized cheese with starter, pasteurized cheese with starter. Data from this research was analyzed statistically. Results revealed that thermal process increased yield and nutritional value of cheese.

PPD-87

Effect of whey protein concentrate on quality, shelf life and cost effectiveness of fruit flavoured beverages

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The standard shrikhand whey base was scrutinized with respect to nutritional quality on the basis of fermentation processing technology. The whey base was deproteinied and defatted for notifying its quality features with respect to sparkling clarity followed by ultra-filtration using polyether sulphone membrane. The formulated whey beverage base was enriched with 12% sugar, 16% mango juice and pH 0.5. Analogous whey base was also formulated by using whey concentrate (10,000MW cut off regenerated cellulose acetate membrane) and ultra-filtered mango juice by keeping per cent concentration of other ingredients unchanged. The efforts were made to enrich the nutritional quality of beverage by adding whey protein concentrate (WPC) at 2, 3 and 4% levels. The sensorial quality scores of all the parameters were comparatively higher in case of beverage containing 3% WPC over that of other beverages. The storage stability of formulated WPC beverage was observed to be 40 at refrigerated temperature without significant changes in nutritional and sensory quality parameters. The beverage stored at room temperature (25 + 1°C) for 15 days showed significant changes in acidity and pH notifying its status as unfit for consumption beyond 15 days of storage period. The cost assessment revealed that unit cost of production of beverage (300ml) at laboratory scale of Rs.7/- was to be comparatively higher because of small scale production. The detail investigation on cost of production on pilot scale is in progress.
PPD-88
Development and quality assessment of foam-mat dried weaning food mixes reconstituted with whey

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Weaning is one of the most important and dangerous phase in the life of an infant because it is transition period when the diet changes from complete breast feeding to other foods. Such a shift involves not only a change in the texture but also the nutrient constituents of the diet of the infant. Presently, some of the foam-mat dried weaning food mixes were developed by utilizing locally available cereals, pulses, vegetables/fruits and nuts. The GMS was tried at various levels @ 0.5, 1.0 and 1.5 g/100 ml of soy-whey to attain the maximum whipping quality. The level of GMS @ 1.5 g/100 ml was observed, it give optimum result by whipping the contents for 20 minutes in a mixer. The products were prepared as combolac, khichri, soup, porridge and cerealpro by this technique. The prepared products were dried in a cabinet drier at 60°C and packed in glass jars for further use. At the time of use, they were reconstituted with 20 ml soy-whey and cooked for 2 minutes. The mixes were evaluated for chemical, nutritional and organoleptic properties. The values for crude protein observed were 6.42, 12.44, 10.72, 13.57 and 11.54 per cent in case of combolac, porridge, khichri, soup and cerealpro, respectively. The values recorded in for crude fat were 12.54, 13.44, 20.09, 15.04 and 23.16 percent for same samples. The corresponding value of crude to be for these samples were 2.61, 3.62, 0.89, 1.55 and 1.47 per cent, respectively. The values for Ca, Na, K and P ranged from 189-219, 8.33-21, 27.66-42.00 and 202-249 mg/100g for the above in the same samples. The consumers preference for these products in decreasing order were soup cerealpro, combolac, porridge and khichri.

PPD-89
Effect of processing variables on sensory characteristics of low-fat chocolate soft serve ice-cream

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Ice-cream is fast growing segment amongst the western dairy products in India and soft-serve ice-cream is very much relished by people of all ages. The production and consumption of softy ice-cream has gained momentous because of the rapid growth of food service industry and food chains. Lowering the fat content and utilization of malt solids will not only provide a healthy image but will also add to growing range of dairy products available to consumers. Effect of two processing variables namely maltodextrin as fat substitute and malt extract was investigated by adopting a Central Composite Rotatable Design (CCRD). The design matrix consisted of 12 experiments and each variable were rotated at five levels. Organoleptic evaluation of the product revealed that maltodextrin had most significant effect on flavour, body & texture, melting quality, and overall acceptability and its effect was positive at linear level. Increasing the level of maltodextrin improved the sensory scores for these parameters. Addition of malt solid also significantly improved the flavour score and it had a synergistic effect with chocolate flavour.
Instrumental colour values expressed as L* (whiteness), and b* (yellowness/blueness) were significantly affected by malt extract level in formulation. Increasing the level of malt solids and maltodextrin improved the whipping ability of mix but overrun decreased at higher levels of maltodextrin.

**PPD-90**

**Kinetics of water activity change during cooking of milk caramel**

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Caramel is a popular and widely consumed confection characterized by delicious sweet flavour, brown colour and chewy taste in the minds of consumers. Caramel is manufactured by heating mixture of sugar, corn syrup, fat and milk solids at 110-130°C, followed by cooling and moulding of cooked mass into different shapes and sizes. The water activity of caramel determines the rate of various physico-chemical reactions, influences the textural attributes and its shelf-life. Water activity of caramel is greatly affected by the temperature and the duration of heating. The caramel was cooked at three different temperatures for 0, 2, 4, 6 and 8 minutes. The a_w decreased with an increase in temperature and duration of heating for milk caramel system. The rate of decrease in water activity was higher at initial stages of cooking as compared to later part of cooking, most probably due to the removal of free water during the initial stage of heating. The Arrhenius plot for decrease in a_w with time indicated that it followed zero order reaction with R² value and RMS value of 0.80 and 7.429, respectively. There were two activation energy zones, 22.242kJ/mol for temperature range 108-115°C and 284.170kJ/mol, with overall activation energy of 48.852kJ/mol for reduction in a_w of caramel.

**PPD-91**

**Comparative analysis of different methods for paneer making**

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Paneer (Cottage Cheese) is an indigenous version of cheese. There are over 500 established varieties of cheese world over. As a delicacy and base material for making different dairy products it has gained lot of popularity in India in the past two decades. The indigenous methods of paneer preparation lack consistency and the products thus made have different tastes and varied shelf-lives. The improved paneer preparation technology imparts better recovery, texture, taste and longer shelf-life. Keeping these factors in view present study was conducted to document the prevalent methods of paneer making in Karnal district of Haryana state and to compare the different types of methods of paneer making with the recommended scientific method. It was found that the farm women make paneer generally using butter milk, lemon and tatri. All these methodologies are traditional through which different tastes, grades and shades of paneer are prepared. The recommended scientific method of making paneer using citric acid was demonstrated to farm women through different trials comparing the paneer made with the traditional prevalent methods. The paper highlights the various steps used for making paneer. The comparative analysis of the recovery of paneer and the way produced using different methods was studied. The perception of the 50 farm women towards the paneer made using different methods have also been discussed in the paper.
PPD-92
Changes in stirred fruit yoghurt prepared with underutilized fruit pulp during storage
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Fruit yoghurts were prepared by using underutilized fruits grown in India: jamun, litchi and plum. For preparation of fruit yoghurt, the milk was standardized, pasteurized, inoculated with yoghurt culture and incubated at 42±0 1C for 4-6 h. After this, plum, litchi and jamun fruit pulp @ 10, 15 and 20% were incorporated, the product was stirred, packed and then stored at 5°C for 16 days. During storage, the samples were analyzed for chemical, organoleptic and microbiological characteristics at 4 day interval. During storage, a significant increase in acidity, tyrosine value and percent syneresis was observed, while pH was found to decrease. No change was observed in fat content of yoghurt throughout the storage period. There were significant increase in yeast & mould counts and coliform counts during storage of yoghurt at 5°C. On the basis of sensory evaluation, it was observed that there was a progressive deterioration in flavor, color and appearance, body and texture and taste of fruit yoghurt during storage; however, all the samples were organoleptically acceptable even up to 16th day of storage. Overall acceptability score was maximum for fruit yoghurt prepared by addition of litchi fruit pulp followed by jamun and plum.

PPD-93
Response surface analysis for selection of levels of ingredients in apple pomace and black soybean incorporated biscuits
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Apple pomace, a primary by-product of an apple juice industry, is considered as a rich source of dietary fiber along with other nutrients present in it. Inspite of its potential this rich source of nutrients is usually discarded as a waste. Hence an effort was made to utilize it in manufacturing an edible product. Biscuits were prepared utilizing apple pomace and were also incorporated with black soybean for further nutritional enrichment. Thus, experiments were conducted in three phases i.e. optimizing the ingredient levels for apple pomace biscuits; for soy flour biscuits; and for apple pomace: soy flour biscuits.

Experiments were designed using Central Composite Rotatable Design with four variables each at five levels. Biscuits were analyzed for thirteen responses i.e. diameter, thickness, weight, spread ratio, % spread factor, hardness, fracturability and sensory parameters. The data were analyzed and the response functions were developed using Response Surface Methodology.

Quantity of apple pomace significantly affected % spread factor, hardness and fracturability and quantity of soy flour significantly affected all the four factors in apple pomace and soy flour biscuits respectively. Quantity of apple pomace: soy flour affected % spread factor and overall acceptability. % Spread factor increased and overall acceptability decreased with increase in the levels of apple pomace, soy flour and apple pomace: soy flour. Hardness increased with increase in apple pomace and soy flour levels in apple pomace and soy flour biscuits respectively. The sensory score on 9-point hedonic scale ranged from 5.6 to 8.8, 6 to9 and 6 to 8.9 for apple pomace, soy flour and apple pomace:
soy flour biscuits respectively indicating the acceptability of apple pomace: soy flour biscuits. Study revealed that instead of allowing apple pomace to got waste we could utilize it in manufacturing value added products by incorporation of back soybean flour.

**PPD-94**

**The application of response surface methodology for standardization of technology for the manufacture of kradi cheese using culture NCDC 167**

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Kradi, (semi soft cheese) is a traditional dairy product of Jammu and Kashmir State prepared by coagulating milk, working out the coagulum into a pat and finally making the balls out of it which are manually spread out to a circular shape of varying diameter and thickness and then sun dried to a slightly firm texture. It is usually prepared from buffalo milk with sour butter milk as the coagulating agent. After characterizing the samples brought from different markets of J&K, a process was standardized for the manufacture of Kradi on the basis of scientific guidelines. During the product development, thirty trials were conducted as per the 4-factor CCRD, RSM design with culture NCDC 167. The four factors considered for study were: fat level: 1.5 to 4.5 %, pH: 5.0 to 5.4, milk to buttermilk ratio: 1 to 3 liter and coagulation temperature: 70°C to 80°C. The effect of independent variables (% fat level, milk: buttermilk ratio, pH, and coagulation temperature) was studied on yield, acidity, fat leakage, hardness, chewiness, colour and appearance of top surface, colour and appearance of bottom surface, flavour, body and texture, overall acceptability, instrumental colour lightness L*, redness a* and yellowness b*. The fat level had a significant (p<0.05) effect on flavour, body & texture at linear level and also on hardness, lightness L* and yellowness b* at quadratic level whereas the milk to buttermilk ratio had a significant (p<0.05) effect on yield at linear level and also on hardness, chewiness and lightness L* at quadratic level. The pH had a significant (p<0.05) effect on yield at linear level whereas the coagulation temperature had a significant (p<0.05) effect on yield at linear and quadratic level. The interactive effect of pH and coagulation temperature was significant (p<0.05) on yield whereas the interactive effect of milk to buttermilk ratio and pH was significant (p<0.05) on yellowness b*.

**PPD-95**

**The application of response surface methodology for standardization of technology for the manufacture of kradi cheese using culture NCDC 144**

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Kradi, (semi soft cheese) is a traditional dairy product of Jammu and Kashmir State. It is usually prepared from buffalo milk with sour butter milk as the coagulating agent. The method of preparation of Kradi is traditional, lacks scientific basis and therefore offers great scope for development. In the past, no attempt has been made by any food/dairy processing agency or research organization at government or non-government level to characterize or standardize this milk product. The standardization of technology for the manufacture of Kradi cheese using culture NCDC 144 was developed after characterizing the samples brought from different markets of J&K on the basis of modern scientific guidelines of dairy technology.
During the product development, thirty trials were conducted as per the 4-factor CCRD, RSM design with culture NCDC 167. The four factors considered were: fat level 1.5 to 4.5 %, pH: 5.0 to 5.4, milk to buttermilk ratio: 1 to 3 liter and coagulation temperature: 70 °C to 80°C. The effect of independent variables (% fat level, milk: buttermilk ratio, pH, and coagulation temperature) was studied on yield, acidity, fat leakage, hardness, chewiness, colour and appearance of the top surface, colour and appearance of bottom surface, flavour, body and texture, overall acceptability, instrumental colour lightness $L^*$, redness $a^*$ and yellowness $b^*$. The fat level had a significant ($p<0.05$) effect on redness $a^*$ at quadratic level whereas the milk to buttermilk ratio had a significant ($p<0.05$) effect on yield at linear and quadratic level. The pH had a significant ($p<0.05$) effect on yield, acidity, lightness $L^*$ at linear level and also on body & texture and overall acceptability at quadratic level. The coagulation temperature had a significant ($p<0.05$) effect on yield at linear and quadratic level. The interactive effect of milk to buttermilk ratio and pH was significant ($p<0.05$) on yield and lightness $L^*$ whereas the interactive effect of milk to buttermilk ratio and coagulation temperature was significant ($p<0.05$) on lightness $L^*$ and redness $a^*$.

**PPD-96**

**Characterization of kradi cheese**

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Kradi, (semi soft cheese) is a hitherto undocumented traditional dairy product of Jammu and Kashmir State with no information about the product composition or characteristics. It is prepared by coagulating milk, working out the coagulam into a pat and finally making the balls out of it which are manually spread out to a circular shape of varying diameter and thickness and then sun dried to a slightly firm texture. The manufacture of the product is still limited to certain sections of the tribal population and lacks scientific basis, which is necessary for the manufacture of the product on commercial scale and mechanization. This study was, therefore planned with the objectives of characterizing the market samples of Kradi cheese for various physico-chemicals, microbiological, sensory and textural attributes.

Sixty fresh Kradi cheese samples, fifteen each from four market areas viz., Shopian, Pahalgam, Rajouri and Poonch areas of Jammu and Kashmir were brought to D.T. Div NDRI Karnal in insulated containers within twenty four hours of manufacture from producers. All the samples were subjected to descriptive sensory analysis, physico-chemical, functional, microbiological, instrumental color and textural profile analysis. A descriptive sensory language for twenty six sensory attributes was identified to document the sensory properties (colour and appearance of surface, colour and appearance of bottom, flavor and texture). The average sensory score of the four market areas was compared and correlated by principal component analysis (PCA). The PCA distinguished and segregated market areas on the basis of sensory characteristics. The PC1 explained 79.13% and PC2 95.65% of variation. The PC1 revealed that samples from Shopian area were fermented and had glossy top & bottom. The PC1 also revealed that samples from Pahalgam area were curdy, smokey with smooth surface and had a glossy top. The PC2 revealed that samples from Rajouri area were mealy/grainy, nutty, bitter, moldy, foreign and unclean. The PC2 also revealed that samples from Poonch area were crumbly, rubbery and pasty. The analysis of variance revealed significant ($p<0.01$) difference between all the four market areas for physico-chemical, functional, microbiological, instrumental color and textural profile analysis. The mechanical property of tensile strength also showed significant ($p<0.01$) differences between the samples from two market areas of Shopian and Pahalgam.
SAFETY AND QUALITY MANAGEMENT

(SQM 01 – SQM 80)
SQM-1

Studies on physicochemical qualities of carbonated soft drinks packaged in polyethylene terephthalate (PET) and glass bottles

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Carbonated beverages are the preferred soft drinks to quench the thirst throughout the world. The taste of carbonated soft drinks depends on the fizz and the chillness. For easy handling and transportation the carbonated soft drinks are packaged in polyethylene terephthalate (PET) bottles rather than in glass bottles. The shelf life of carbonated soft drinks depends on the carbon dioxide content in the PET bottle because they act as a preservative. Soft drinks are the leading players of the 21st century for more than one hundred years. The present plan was aimed at diffusion studies in polyethylene terephthalate and glass returnable bottles. The carbon dioxide get diffused in polyethylene terephthalate bottles while in glass bottles gas volume is retained. Because of diffusion the physiochemical characteristics like gas volume, pH, total soluble solids and titrable acidity will be altered during the storage period of three months. In glass bottles the shelf life of product is about six months so the physiochemical parameters will have variation in the last month during storage due to inversion of sugar. The study was carried out in a leading multinational organization manufacturing soft drinks of leading brands. Three flavours lemon, cola and orange of leading brands were chosen for the study. Carbon dioxide diffusion studies were carried out for a storage period of 98 days for polyethylene terephthalate bottles and 182 days for glass returnable bottles. Among the three flavours cola flavour recorded higher gas volume reduction followed by lemon and orange flavour in polyethylene terephthalate bottles. In glass bottles gas volume is retained for a storage period of 182 days. The physiochemical characteristics like total soluble solids, titrable acidity and pH showed an increase during storage in both polyethylene terephthalate and glass returnable bottles. The shelf life of polyethylene terephthalate bottles can be improved by barrier coating, mixing with aromatic polymers and increasing the thickness of polyethylene terephthalate bottles.

SQM-2

Simple methods for detecting irradiated milk powders

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Irradiation of food for extension of shelf-life, control of microbial load, reduction of pathogenic microorganisms and disinfections, is regarded by many consumers with suspicion. One reason is the lack of methods within food-controlling laboratories, which are applied to control correct labeling. In this study, some simple methods for detecting irradiation of milk powders were tested. Samples of two types of imported milk powders (Nestogen-1 from France and Babylait-1 from Tunisia) were treated with gamma-irradiation at total doses between 0 and 10 kGy. The effects of irradiation treatment on some physical and chemical properties of milk samples were investigated through the determination of NPN%, water solubility, foaming ability, relative viscosity and color degree. The results showed obvious decrease in
water solubility and an increase in NPN%, foaming ability, relative viscosity, and color intensity in irradiated samples. A positive relationship between each of these properties and the irradiation dose, were observed. Furthermore, it seemed clearly that the low dose (1kGy) of irradiation was effective enough to cause the observed changes in the studied properties.

SQM-3
Inhibitory activity of menthol towards molds causing spoilage of fruits and vegetables
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Spices are valuable culinary addendums those have been well established as antimicrobial agents and scientific researches have documented that antimicrobial properties of these agricultural commodities are chiefly attributed to certain essential oils contained in them. Inhibitory potential of menthol (functional component of mint) diluted with dimethylsulphoxide (DMSO) at various concentration levels (10%, 20%, 30%, 40%, 50%, 60% and 70%) was examined in a model system against fruits and vegetables spoilage molds namely *Alternaria solani*, *Aspergillus niger*, *Cladosporium herbarum*, *Geotrichum candidum*, *Phoma exigua*, *Rhizopus arhizus* and *Rhizopus stolonifer*. It was observed that menthol at 10% level was quite ineffective towards all reference molds and at 70% level it exhibited distinct zones of inhibiton against all fungal strains under observation with diameter ranging from 5.00-12.50 mm. The order of sensitivity of various fungal strains towards menthol at 70% level was: A. *niger* > G. *candidum* > R. *arhizus* > A. *solani* > R. *stolonifer* > P. *exigua* > C. *herbarum*. The diameter of zone of inhibition at 60% of menthol was maximum for A. *niger* measuring 11.70 mm followed by 8.90, 8.43, and 8.03 mm for G. *candidum*, R. *arhizus* and A. *solani* respectively. Menthol at 40% and 50% levels exhibited inhibitory zones against A. *niger*, A. *solani*, G. *candidum* and R. *arhizus* while at 20% and 30% level it significantly arrested only A. *niger* among all molds tested.

SQM-4
Effect of incorporation of dietary fibre on quality of biscuits
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There is increasing demand from consumer for baked products with lower caloric density and higher level of dietary fibres. So an attempt was made to prepare fibre rich biscuits by adding wheat bran and barley (bran and flour) components. Barley has b-glucan compounds that are credited with serum cholesterol reduction. Addition of wheat bran and barley bran (0-15%) into biscuits resulted in increasing crude fibre content, while addition of barley flour (0-30%) resulted in increasing both protein (4.2 to 8.5%) and fibre content (0.39 to 0.85%). There was a highly significant increase in crude fibre content as a result of addition of wheat and barley bran. The increase was from 0.39 to 4.7 and from 0.39 to 1.8% for barley and wheat bran, respectively. Addition of brans upto 10% level did not affect much the flavour attributes of biscuits. Addition of barley flour upto 30% level was highly desirable, however, the spread factor in the case of all the three biscuits decreased with increasing level of incorporation. The compression force required to break the biscuits increased more significantly in the case of bran (wheat and barley) supplemented biscuits than in the case of barley flour biscuits. After baking, thickness, diameter and spread ratio was
also determined. Sensory evaluation revealed that increasing level of bran affected the overall acceptability scores but were acceptable upto 10% level of incorporation, whereas barley flour (upto 30% level) improved sensory scores.

**SQM-5**  
**Studies on fatty acid composition of fillets and balls prepared from Indian major carp *Catla catla* as affected by spices and methods of cooking**

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In the present paper, fatty acid composition of fillets and balls prepared from fresh water carp *Catla catla* was studied. For this purpose three factors with two levels each, namely two food products i.e. fillets and balls, two methods of cooking i.e. conventional and microwave oven and two levels of spices i.e. 0 and 2 % with all possible combinations were taken. In fish fillets cooked in conventional oven, saturated fatty acid (SFA) content was lower than in fish balls. In products cooked in microwave oven, the reverse trend was observed. The products cooked in conventional oven had lower amount of SFA than the products cooked in microwave oven, but fish balls cooked in microwave oven without spice had lower amount of SFA than fish balls without spice cooked conventionally. The fish products cooked in conventional oven with spice possessed lower SFA content as compared to without spiced products, but in the products cooked in microwave oven, the reverse trend was found. As regards the monounsaturated fatty acid (MUFA), the fish balls cooked in conventional oven had higher amount of MUFA when compared to the fish fillets cooked in conventional oven. A similar trend was observed in products with spice cooked in microwave oven, but the products without spices cooked in microwave oven had the reverse trend. Microwave cooked products contained lower amount of MUFA as compared to the amount in conventionally cooked products, but microwave cooked fillets without spice had higher MUFA values when compared to the conventionally cooked fillets without spice. In most of the cases, the fish products without spice had higher MUFA values than the products with spice. But in case of fish fillets cooked conventionally, the products with spice had higher value of MUFA as compared to the respective products and methods without spice. In case of conventional cooking fish fillets possessed higher amount of polyunsaturated fatty acid (PUFA) as compared to the fish balls. But while comparing microwave cooked products, fish fillets were found to have lower values of PUFA than the fish balls. Fish fillets cooked in conventional oven irrespective of spice had higher PUFA values than microwave cooked fillets, whereas the fish balls irrespective of spice when cooked in microwave was found to have higher PUFA values than balls cooked conventionally. In most of the cases, the fish products with spice had greater amount of PUFA as compared to the products without spice, while balls cooked in microwave oven without spice had higher amount of PUFA than spiced balls. Fish fillets possessed higher amount of omega 3 or n-3 fatty acids than fish balls. In most of the cases, conventionally cooked products had higher n-3 fatty acids as compared to the microwave products. But microwave oven cooked fish balls had higher amount of n-3 fatty acids as compared to the conventionally cooked fish balls. Concerning the spice effect, the products with spice had higher amount of n-3 fatty acids as compared to the products without spice. But conventionally cooked fish balls without spice possessed higher amount of n-3 fatty acids. It can be broadly concluded that spiced fish fillets cooked conventionally has greater amount of n-3 fatty acids which in turn have great medicinal values as anticholesterolemic, antithrombotic, growth promoter in kids and curative in skin diseases.
**SQM-6**

**Influence of solar radiation and microwave heating on hydroxy methyl furfural (HMF) content and penetration value of khoa**

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The influence of solar radiation and microwave heating on HMF content and penetration value of khoa during storage was studied. The total HMF values in khoa on day 0 ranged from 15.92 (S₀) to 18.93 moles/100 g (M₆). The control (S₀) as well as solar radiation treated samples (S₁ and S₂) showed lower HMF content than those in microwave treated samples (M₁ to M₆). It was further observed that the rate of increase in total HMF content in the product during storage period of 7 days was negligible. The influence of solar radiation and microwave heating on penetration values in the khoa samples during storage was found to be significant (P < 0.05). The mean penetration values in khoa samples under solar treatments (S₁ and S₂) were higher than microwave treated samples (M₁, M₂, M₃, M₅ and M₆) and differ significantly.

**SQM-7**

**Effect of type of milk and coagulation temperature on sensory quality of paneer**

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The present investigation was undertaken to find out the optimum quantity of buffalo skim milk that can be incorporated in whole cow milk in preparation of best quality paneer. This is done with the object of harnessing the benefits of buffalo milk proteins from buffalo skim milk. The drawbacks of the body and texture of the product made from cow milk can be minimized and the buffalo skim milk could be put to best possible use. The most acceptable milk mixtures viz., 20:80, 40:60 and 60:40 were selected from the preliminary trials for manufacture of paneer in final experimental trials. The results indicated that the milk mixture obtained by addition of 20 parts of buffalo skim milk in 80 part of cow whole milk produced better quality paneer when milk was coagulated at 70° C. It was comparable to that of control sample (M₀ T₀) for sensory quality and was rated as “Liked very much”.

**SQM-8**

**Antibiotic resistance in lactic acid bacteria: An imminent food safety concern**

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Lactic acid bacteria have been recognized as non-pathogenic, commensal bacteria. These organisms are traditionally part of fermented foods having reputation as health promoters and have been given GRAS (Generally Recognized as Safe) status. In recent times, various foods containing live cultures have been introduced in markets of western countries. Indian companies are also introducing such products as, the largest milk based cooperative Amul, has launched probiotics based ice creams recently. Since the
organisms in such foods are consumed directly by human beings, strict safety standards have to be followed before introducing any probiotic product in market (WHO/FAO, 2002). Antibiotic susceptibility of lactobacilli involved in these foods is a significant safety aspect. Spread of antimicrobial resistance genes throughout the human environment represents a major public health problem in developing and developed countries. Much attention on this aspect has been focused on pathogenic organisms; lactobacilli have received little attention in terms of their role as a reservoir of drug resistance genes and ability to transfer these genes to human pathogens. It is thus necessary to investigate the extent to which lactobacilli present in raw and prepared foods can contribute to the transfer of drug resistance bacteria. Food chain is considered to be an important route of transmission of antibiotic resistant bacteria between animal and human population. Plasmids and transposons are considered important genetic elements in transferring antibiotic resistance. In order to assess the significance and impact of such transmission, the incidence of antibiotic resistance bacteria in food and origin of their resistance genes have to be elucidated.

SQM-9

Aflatoxin M₁ content in some traditional dairy products

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Aflatoxins are toxic and carcinogenic secondary metabolites produced by some common *Aspergillus* during growth on feed, foods or laboratory media. When feed and fodder contain higher amounts of aflatoxins then they will be secreted in milk as Aflatoxin M₁ predominantly. The Aflatoxin M₁ gets concentrated in milk product where from it is prepared and consumption causes the health hazards. Looking to this aspect this study was carried out to estimate the status of Aflatoxin M₁ content in milk and milk products. Dahi, Khoa, Paneer, Burfi, Shrikhand, Rabri and Kulfi samples were collected from different localities of Chhattisgarh state. Collected samples were analyzed by adopting ISO method prescribed for Aflatoxin M₁ analysis by HPLC. It was observed that all the milk product samples were contaminated with Aflatoxin M₁ (0.0103 to 3.3094 µg/kg). Data obtained during the study reveals that the amount of Aflatoxin M₁ contained in milk (0.45 µg/kg) gets concentrated in the milk products, which exceeded the MRL (0.50 µg/kg) prescribed by FDA.

SQM-10

Isolation and characterization of *Lactobacilli* from cheeses

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The present study deals with isolation and characterization of *Lactobacilli* from cheeses. Four types of cheeses: Cheddar (2, 6 & 18 months old), Swiss, Asiago and Karadi were collected from Experimental Dairy NDRI, Karnal and markets of Kashmir, Saudi Arabia and America. All the samples were plated on MRS agar and incubated at two temperatures i.e. 30 & 37°C for 48 hrs. More than 90 irregular, mucoid and
lens shaped colonies produced on MRS agar were checked for morphology, production of catalase, and formation of curd in sterile reconstituted skim milk. Based on physical and biochemical tests 55 isolates were assigned to Lactobacillus group. Out of which, 36, 12 & 7 isolates were classified as Lactobacillus casei, Lactobacillus fermentum, and Lactobacillus plantarum respectively using PIBWIN software. All lactic isolates were subsequently confirmed by species-specific PCR targeting 16S rRNA region. It was observed that, cheddar cheese could be the potential reservoir for isolation of Lactobacillus species as it gave maximum number of isolates and among these Lactobacillus casei was the most predominant species in the entire sample studied.

SQM-11
Effect of pasteurization on the keeping quality of fermented camel milk (gariss) in Sudan

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The present study was carried out during the period of April to May 2005 with the aim of improving the traditional fermented camel milk (Gariss) in pastoral areas of Sudan. The effect of pasteurization of milk and refrigerated storage of the processed Gariss was evaluated. The processed Garris samples from non pasteurized and pasteurized camel milk showed mean values for fat content of 3.0± 0.445% and 3.0± 0.076%, respectively. The protein contents were found as 3.1± .14% and 3.2± 0.311 %, the ash values were 0.64± 0.108 and 0.71± 0.067 % and the total solids were 9.6± 0.445 % and 10.0± 0.801 %, respectively. Similarly the maximum and minimum values of these measurements were reported. Variations in developed acidity and the pH were plotted during incubation periods (18 hours) and storage periods (18 days) for Garris made with pasteurized and non pasteurized milk. The present study revealed that the shelf life of Gariss made from non pasteurized milk was less (10 days) than those obtained for Gariss made after pasteurization of milk (17 days) when stored at refrigeration temperature. Hence, it is concluded that pasteurization and refrigeration of camel fermented products will improve the keeping quality of the products.

SQM-12
Effect of processing and compositional variables on quality of pedha

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Pedha shows wide variation in the method of manufacture, chemical composition, microbiological quality, packaging and shelf-life. Lack of adequate published information on pedha is the main constraint in prescribing the legal standards. Therefore, a study was undertaken to investigate the effect of processing and compositional variables on the quality of pedha. In the processing steps, the stages of addition of sugar during desiccation were studied. Among the four stages, the addition of sugar just before pat formation was most appropriate for the preparation of good quality pedha. While making pedha, use of wooden khunti (stirrer) at the last stage of desiccation produced better from the view point of sensory quality than use of mild steel stirrer. Wooden stirrer after the addition of sugar 120 rpm stirring speed was found to be optimum to obtain good quality pedha. In the optimization of compositional variables, pedha samples were prepared by adopting suitable processing steps using the following compositional variables:1. Three level of sugar 2. Three level of moisture 3. Three level of fat content of the product. Out
of 27 treatment combinations the highest sensory score for overall acceptability was (8.66) obtained to the pedha prepared by addition of having 30% sugar, 15% moisture and 25% fat. The chemical composition of pedha prepared from 27 treatment combinations, the moisture, fat, protein, lactose, sucrose, total sugar and ash ranged between 8.97 to 15.93, 13.67 to 24.67, 12.23 to 23.63, 13.78 to 21.95, 24.10 to 34.87, 40.99 to 52.35 and 2.210 to 4.010, respectively. Further, addition of 0.05 percent lemon yellow colour was most acceptable. Cardamom and nutmeg commonly used flavoring agents in the form of powder were examined at different rates. It was observed that addition of cardamom @ 0.2 per cent and nutmeg @ 0.3 per cent were found to be most optimum. Shelf life study indicated that pedha samples packed in vegetable parchment paper (P1) could be stored for 15 days at 37 ± 1°C. Never the less Pedha packed in HDPE pouch and kept in card-board box remained very good up to 10 days, based on sensory score drastically reduced. The cost of production of pedha (best combination) was Rs. 56.02/kg.

SQM-13

Keeping quality of dairy ingredients

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The most widely used technique for dehydration of dairy products is spray drying. This is an effective method for preserving biological products as it does not involve severe heat treatment and allows storage of powders at an ambient temperature. The authors have described the physico-chemical properties of free and bound water and the effects of water on physical state, transition temperatures, sticking temperature, reaction kinetics and stability of milk products. The emphasis is on the physical state of non-fatty solids and the effects of water and its physical state on physico-chemical changes, growth of micro-organisms and stability. Spray-drying, storage and quality of dairy powders are significantly dependent on both the physical state of the lactose (one of the main components of dairy powders) and on the other carbohydrates, which themselves are dependent on the glass transition temperature (Tg) and water activity (aw). The maximum moisture content of a dairy powder (max 4% for skim milk powder) is defined in the product specification in relation to the aw and this must be close to 0.2 at 25°C for optimal preservation. In these conditions of water content and aw, the Tg will be close to 50°C. The aim of our study was to determine certain thermodynamic information (moisture sorption isotherm, aw, Tg and state diagrams) and to be able to anticipate the behaviour of a powder under given temperatures and aw conditions while maintaining the quality of dairy ingredients and the rehydration behaviour.

SQM-14

HPLC for vitamin testing

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HPLC is a form of column chromatography used frequently in biochemistry & analytical chemistry. It is used to separate components of mixture using a variety of chemical interactions between the substance being analysed & chromatographic column. Principle used is that analyte is forced through a column of stationary phase (usually a tube packed with small round particles with a certain surface chemistry) by
pumping a liquid at high pressure through the column. The parameters affecting are internal diameter, particle size, pore size, pump pressure. Our paper contains vitamin testing by using HPLC is more efficient because some older methods like CARR-price calorimetric test for vitamin-A & dichlororindophenol titrimetric test for vitamin-C are still official methods but are not used much. They frequently provide inaccurate result because of chemical interference present in many food samples & they are being replaced by faster, accurate HPLC methods in most of the cases vitamin testing labs both in houses, food company labs & contract labs no longer perform the older calorimetric methods. In HPLC the sample is pumped at high pressure through a tube lined with an absorbent material, to which the different molecules cling at different rates. Following separation or purification by HPLC, the vitamin is detected by color reaction or fluorescence reaction. In these reactions the amount of color of fluorescence that is formed is proportional to the amount of Vitamin in the sample allowing the analyst to calculate the amount of vitamin present in the original sample.

**SQM-15**

**Use of HPLC in analysis of different compounds in food & beverages industries**

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High Performance Liquid Chromatography (HPLC) and Accelerated Solvent Extraction (ASE®) can deliver increased productivity to the food and beverage analytical laboratory. Reliable instrumentation, coupled with targeted applications development, delivers powerful analysis solutions. Both IC and HPLC applications provide quality-testing capabilities that are both fast and accurate. Food product development that requires accurate analysis of carbohydrates, organic acids, and amino acids can be made more productive using Dionex’s application solutions. Food contamination can be efficiently tracked, especially with time- and labor-saving ASE technology. Food adulteration can be reliably and quickly determined; using both IC and HPLC systems. Dionex technology delivers reliable extraction and determination of dietary supplements, such as vitamins and herbal health products, using emerging chromatographic methods. The nutritional content of foods can be reliably quantified with the aid of Dionex’s unique ion exchange and reversed-phase HPLC column and detector technology. Using reversed phase HPLC separation and UV absorbance detection, many organic acids can be detected in beverage products. This chromatogram is an excellent example of the power of this method for a broad range of organic acids, using Dionex HPLC, Dionex Acclaim OA columns, and UV detection at 210 nm. One precaution, however, is that the organic acid must have a suitable chromophore, to allow detection by UV absorption. In addition, potential interfering (co-eluting) compounds must not be UV active. Using a Dionex HPLC system and the Dionex Acclaim OA (organic acid), low molecular weight organic acids can be rapidly determined. Dionex HPLC can be used to rapidly determine flavor additives, such as Quinine, as well as preservatives, such as benzoic acid.
SQM-16
Quality of skim milk paneer prepared by using combination of coagulants and preservatives
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Skimmed milk paneer (SMP) was prepared from buffalo milk (0.65% fat and 9.5% SNF) by using combinations of coagulants (1% citric acid + cultured whey in ratio of 3:1) and 0.2% NaCl. For preparation of paneer, standardized milk was heated to 96°C without holding, cooled to 55°C, coagulated to remove whey, curd was pressed for 20 minutes and chilled in water for 2 hours. Combinations of preservatives (sodium benzoate and potassium sorbate) at the level of 250 ppm or 500 ppm each were added during heat treatment. Samples were vacuum packaged in polyethylene bags and stored at room temperature (30±1°C) for 4 days. Results revealed increase in pH but decrease in titrable acidity due to use of preservatives. However during storage, there was significant decrease in pH and increase in titrable acidity in both control and treated samples. Non-significant difference was observed for total viable, coliform and yeast & mold counts of control and treated samples. However, there was significantly (P<0.05) increase in counts during storage but the increase in count was to a greater extent in control than treated samples. Sensory scores also decreased more rapidly in control samples. Overall mean values for flavour and body & texture scores were significantly (P<0.05) higher in preservatives added samples than control and no significant difference were noticed between 250 and 500-ppm levels of preservatives. These results indicate that SMP prepared by using combination of coagulants and preservatives were well acceptable up to 2nd day of storage at 30±1°C.

SQM-17
Thermal stability of indigenous enzymes in cow, buffalo and goat milk
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Like other enzymes, indigenous milk enzymes follow characteristic thermal inactivation kinetics. Therefore, inactivation pattern of individual milk enzyme can reflect on heat treatment provided to milk during processing. In present work, the levels and thermal stability of five indigenous milk enzymes viz., alkaline phosphatase, lactoperoxidase, N-acetyl-â-glucosaminidase, xanthine oxidase and â-glutamyl transpepetidase in cow, buffalo and goat milks have been reported. There were large differences in activities of LPO amongst cow, buffalo and goat milk. As compared to cow milk, buffalo milk exhibited nearly two fold higher activities while, goat milk contained nearly nine fold lower activity. Goat milk showed nearly four fold lower NAGase and GGTP activities as compared to either cow or buffalo milk. XO and ALP activities in buffalo milk were higher as compared to cow or goat milks. For all these five enzymes, goat milk, contained lowest enzyme activities. Thermal stability of enzymes was studied by heating milk samples for 15 sec at different temperatures ranging from 65°C to 90°C. At 70°C, alkaline phosphatase lost most of its activity. â-Glutamyl transpeptidase and N-acetyl-â-glucosaminidase lost 60% activity and xanthine oxidase and lactoperoxidase lost little activity. At 80°C, â-glutamyl transpeptidase and lactoperoxidase became completely inactive; N-acetyl-â-glucosaminidase had very little residual activity. Xanthine oxidase and N-acetyl-â-glucosaminidase inactivated completely. Enzyme activities of milk samples can be used as an index of heat treatment subjected to milk during processing.
SQM-18

A polarimetric method for the estimation of starch in gulabjamun mix and gulabjamun

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Besides milk constituent, cereals are used in preparation of some milk products and contribute to starch content in these products. A polarimetric method [ISO 6493:2000(E)] described for measurement of starch content in animal feeding stuff was validated for its applicability in gulabjamun-mix and gulabjamun. The difference in optical rotation of filtrates obtained after partial hydrolysis of sample and 40% ethanol soluble fraction is the basis of estimation of starch in these products. Partial hydrolysis was achieved by treating sample and ethanol soluble fraction with 0.31 M HCl (boiling/refluxing). While recovery of starch in gulabjamun-mix was nearly quantitative, over estimation has been noted in gulabjamun with a recovery values around 117%. Preparation of gulabjamun from gulabjamun-mix involves deep fat frying at 120 to 130°C for 20 min and this result in extensive Maillard reaction. This can make lactose (involved in Maillard reaction) insoluble in 40% ethanol and will result in overestimation of starch. Therefore, it is advised to apply this method for products undergone extensive Maillard browning with caution. It is expected that polarimetric method can be applied to other dairy products where drastic heat treatments are not employed in their preparation. The polarimetric method does not require any expensive reagents and therefore, it is a cost effective method and can be routinely used in the laboratories for proximate analysis.

SQM-19

Effect of modified atmosphere packaging (MAP) on the growth of microorganisms in paneer

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Conventional packaging protects food from external microbial contamination, oxygen, water vapour and light. However, newer packaging technique, i.e. modified atmosphere packaging (MAP) performs many more functions other than providing protection from outside influences. The preservation of Paneer (an Indian acid coagulated dairy product, mainly used for curry making) is a major problem as its shelf life is hardly one day at room temperature due to the growth of spoilage microorganisms, which impedes the organized marketing of the product commercially. Paneer samples were prepared by using buffalo milk (6%fat, 9% SNF) and packed in LLD / BA / Nylon-6 / BA / LDPE packages under five atmospheres (atm1: air, atm2: vacuum, atm3: 100% CO₂ atm4: 100% N₂ atm5: 50% CO₂ & 50% N₂). Periodically, the product stored at 3 ± 1°C was evaluated as to its microbiological condition. The growth of microorganisms in paneer samples in terms of total plate count, anaerobic microorganism count, coliform count, Y & M count, psychrotrophic count was slower under CO₂ atmosphere followed by atm5, atm4, atm2 and atm1 respectively, in descending order. The results of this study demonstrated that MAP is an effective means of controlling the growth of microorganisms in stored paneer.
SQM-20
Enhancement of shelf life of ready-to-serve pizza through modified atmosphere packaging (MAP)

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Modified atmosphere packaging (MAP) performs many functions other than providing protection from outside influences. Since it is the era of convenience foods, and consumers demand for ready-to-serve pizza, hence a study was conducted to determine its shelf life. For preparing the pizza samples, firstly the lower side of each pizza base was grilled (heated) for a minute in a microwave oven on a rotating table, and then the upper side of the pizza base was smeared with approx. 5 g table butter followed by spreading of tomato sauce (approx. 40 g) over the butter smeared pizza surface. Then approx. 4 g chopped green chillies (Capsicum annum var. acuminatum) and approx. 10 g grated ginger (Zingiber officinale) were evenly spread all over the pizza base. Then grated mozzarella and cheddar cheese in the ratio of 80:20 (approx 120 g per pizza) was topped on pizza base followed by vegetable toppings which included approx. 50 g sliced onion (Allium cepa), approx. 70 g sliced tomatoes (Lycoperscion esculatum), and approx. 50 g sliced capsicum (Capsicum annum var. grossum). The baking of pizza was achieved in a preheated (220°C) microwave oven. The baked pizza samples after cooling were packaged by employing MAP technique in high barrier bags (LLD/BA/Nylon-6/BA/LDPE) and stored at 7±1°C. The data of the overall acceptability were used as an index to define the product shelf life. From the study, it was concluded that the shelf life of ready-to-serve pizza increased significantly up to 45 days (a 300% increase) for the samples packaged under 100% CO2. Similar increase of 300% was observed in case of pizza samples packaged under 100% N2 and 50% CO2 / 50% N2, but with slightly lower sensory scores compared to conventional air pack (15 days).

SQM-21
Enhancement of shelf life of mozzarella cheese through modified atmosphere packaging (MAP)

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Consumer’s demand for fresh naturally preserved food products has grown dramatically in recent years. Modified Atmosphere Packaging (MAP) has proved to be most effective in food packaging. A study was conducted by employing MAP for enhancing the shelf life of mozzarella cheese. Mozzarella cheese was prepared from mixed milk (buffalo: cow: 60:40), standardized to 3% fat. The cheese was moulded in ball shape, each ball weighing approximately 300 g, which were then immersed in pasteurised chilled (8-10 °C) brine solution (20 % w/v) for 4 hr. After brining, the surface drying of mozzarella cheese was achieved in a cold storage maintained at 5-6 °C for 6 hr. Each ball of mozzarella cheese was placed in high barrier bags (cryovac, 70 i) under five different atmospheres viz., air (atm 1), vacuum (atm 2), 100% CO2 (atm 3), 100% N2 (atm 4), and mixture of 50% N2 and 50% CO2 (atm 5). A headspace to cheese ratio of 1-2 litres gas / kg cheese was initially set in the MAP. Product was stored at 7 ± 1°C. Periodically, the product was evaluated for sensory characteristics. The critical parameter was sensory degradation, and the results of the overall quality were used to define the product shelf life. From the study it was concluded that the
shelf life of mozzarella cheese significantly increased up to 12 weeks (300 % increase) for the product packaged under atm 3; 11 weeks (275 % increase) under atm 5; 10 weeks (250 % increase) under atm 4; 9 weeks (225 % increase) under atm 2 as compared to conventional air pack (4 weeks).

**SQM-22**

**Comparative study of milk procured and processed by private and co-operative dairy sector in Rahuri taluka of Ahmednagar district**

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The work was undertaken with a view to study the trends in procurement, processing and marketing of milk by Co-operative and Private sectors. Investigation was also undertaken to study the opinion of milk producers and quality of milk supplied by them to these sectors for determining the price of milk per liter. Study was based on the quantitative information obtained from both the sectors. The basic characteristics of milk producers, their opinion regarding these sectors, constraints faced and remedial suggestions were also studied by personal interviews. Chemical composition of milk supplied by the milk producers to both the dairy sectors was analyzed. The average fat was 4.00 per cent, Solid not fat 8.5 per cent, specific gravity 1.029 and Total solids were 12.52 per cent. Large number of milk producers was supplying good quality of milk to dairy societies. Almost 78 per cent milk producers were fulfilling the legal standards of 3.5 per cent fat and 8.5 per cent solids not fat as per PF A standards. The average price fetched on the basis of quality ranges from Rs. 6.50 to Rs. 7.10 for the fat ranging from 3.74 to 3.84 per cent, SNF 8.26 to 8.36 and specific gravity 1.027 to 1.028 respectively. Mostly the price depends on fat and SNF content of milk. Also the price given by Co-operative centers was less as compared to that of private collection centers.

**SQM-23**

**Effect of preservatives on keeping quality of vacuum packaged brown peda during storage**

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Peda is one of the popular khoa based sweets in India. Several varieties of Peda viz., Plain, Kesar, Brown (Lal), etc are sold in different parts of the country. Amongst these Brown Peda is more popular because of its long shelf life and delicious taste in addition to serving it as “Prasad” at many religious places. Despite having good shelf life Peda is normally encountered with oxidation of fat and microbial spoilage during storage at ambient temperature. In the present study the addition of BHA (@ 0.02% on fat basis) and the combination of BHA (@ 0.01% on fat basis) + Potassium sorbate (@ 0.1% on the basis of TS of Peda) along with vacuum packaging was attempted to enhance the shelf life of Peda. Brown peda was prepared by continuous desiccation of buffalo milk having 5.9% fat and 9% SNF to khoa stage, followed by blending of sifted sugar (Boora) to it and continuous stirring and scrapping till the brown colour appeared. Preservatives were added at the last stage followed by cooling and preparing flat round shaped balls of Peda. Peda balls were vacuum packaged in preformed LLD/BA/Nylon-6/BA/LDPE pouches and stored at 30°C. During storage the product was analyzed for physicochemical and microbial quality after 10 days interval. On the basis of sensory analysis it was observed that the shelf life of control sample was 40
days, the product with BHA alone had 50 days and BHA + Potassium sorbate added samples it was 60 days. During first 30 days of storage the rate of decline in moisture and pH is almost similar in all samples whereas, decline in pH is most rapid in control sample. However, increasing trend was observed in respect of acidity, free fatty acidity, peroxide value and total HMF content, but here also most rapid increase was observed in control sample.

SQM-24
Preparation of tetracycline-imprinted polymer and its use in concentrating tetracycline in milk
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Molecular imprinting is a chemical technique for the production of molecule-specific cavities in polymer. Methacrylic acid (monomer), ethylene glycol dimethacrylate (cross linker) and benzoyl peroxide (initiator) were used in polymerization reaction and polymerization was achieved in presence (imprinted polymer) or absence (non-imprinted polymer) of tetracycline. The polymer was grounded and then washed to remove tetracycline. Imprinted and non-imprinted polymers were evaluated for their binding to tetracycline in different solvents differing in polarity, ionic strength and at different pH values. Partition coefficients, selectivity values and binding capacities were calculated. Selectivity values, defined as ratio of partition coefficients for imprinted to non-imprinted polymer, in water, 1 M NaCl, methanol, and acetonitrile were 3.9, 1.8, 2.0 and 2.6 respectively. When selectivity was measured at pH values 4.0, 5.0, 6.0 and 7.0, the selectivity was highest at pH 7.0. There was not any selectivity at pH 4.0. Imprinted and non-imprinted polymers were evaluated as matrix for separation of tetracycline. Binding of tetracycline to imprinted polymer in water was quantitative and bound tetracycline could be eluted with linear gradient of water-acetonitrile mixture. In contrast, most of tetracycline did not bind to non-imprinted polymer in water. These results suggest the involvement of hydrophobic interaction in recognition of tetracycline by imprinted polymer. The specificity of the tetracycline imprinted polymer was checked by evaluating the binding of ciprofloxacin and amoxicillin. Tetracycline imprinted polymer could interact with ciprofloxacin (closely related molecule) but not with amoxicillin. Therefore, the prepared polymer could be used for concentration of ciprofloxacin as well. The performance of the prepared polymer was also evaluated in milk samples spiked with tetracycline and the imprinted polymer was able to recognize tetracycline in milk. Therefore, imprinted polymer can be used for concentration of tetracycline in milk. The prepared polymer was stable at room temperature at least up to 9 months and could be used repeatedly (at least 5 times) without losing efficiency.

SQM-25
Preparation of milk cake fortified with mango pulp with special reference to chemical changes of best combination of milk cake
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In the present investigation of chemical changes in the best treatment combination of milk cake during storage it was found that the period and treatment had significant effect on free fatty acid and peroxide
The bacteriological status of best treatment combination of milk cake during storage was studied. Bacterial count showed rise from zero to sixth day of storage. Lowest count was in control and highest recorded count in 10% mango pulp and 4% sugar level (M2S2) was 8.57 x 10^5 cfu/g SPC, 2.41 x 10^2 cfu/g E. coli, 11.95 x 10^3 cfu/g proteolytic bacteria and 10.28 x 10^3 cfu/g lipolytic bacteria. Organoleptic evaluation score was lower in control as against it was higher in best treatment (10% mango pulp and 4% sugar). Score for organoleptic evaluation i.e. colour and appearance, body and texture, flavour and overall acceptability decreased from zero to sixth day of storage.

**SQM-26**

**Bacteriological analysis and somatic cell count as indicators of subclinical mastitis**

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Subclinical mastitis (SCM) constitutes a major reservoir of bacteria that act as a source of infection to other unaffected animals and is an important cause of failure of milk quality assurance programmes all over the world. In the present study, 367 quarters of 92 lactating cows of crossbred and indigenous dairy herd of Hariana breed from an organized farm were screened for subclinical mastitis by bacteriological analysis and somatic cell count (SCC) following international dairy federation criteria (IDF). The prevalence was more in crossbred cows as compared to indigenous dairy herd of Hariana breed. On the basis of bacteriological examination and SCC alone, quarterwise prevalence was recorded as 29.42% and 11.98%, respectively whereas by following IDF criteria (SCC > 5 lacs/ml and culturally positive), 8.71% of quarters were diagnosed as having subclinical mastitis. Out of 118 organisms isolated, *Staphylococcus epidermidis* (55.08%) was found to be predominant followed by *Streptococcus dysgalactiae* (18.64%), *Streptococcus agalactiae* (12.71%), *Staphylococcus aureus* (11.08%), and *Streptococcus uberis* (2.54%). In our study, prevalence rate of SCM determined by IDF criteria was lower in the same animal population in comparison to that determined by cultural examination or SCC alone. An increase in SCC of milk might be due to a number of factors other than mastitis. Similarly, cultural examination alone is not fully reliable because a single bacteriological examination of quarter milk sample does not necessarily identify all the infected quarters. Therefore, the criteria adopted by IDF for the diagnosis of SCM provides a comprehensive picture of prevalence of SCM.

**SQM-27**

**Quality of domiati cheese from heat treated milk using starter culture**

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Domiati cheese was made from heated cow’s milk with 2 different levels of salt (low-salt, 5% or high salt 10%) by adding 1% commercial starter cultures of YC-X11 (*Str. salivarius* subsp. *thermophilus* and *Lb delbreukii* subsp. *bulgaricus*, T1), Bio Profit (*Lb rhamnosus* and *Propio.freudenreichii* subsp. *Shermenii*, T2) and LC 705 (*Lb. casei*, T3). Resultant cheese was pickled in its own whey for 6 months of low-salted cheese (5%) or 9 months of high-salted (10%). Resultant cheeses were analyzed for chemical, microbiological and sensory properties when fresh and during pickling period and compared to control without starter culture.
Moisture, salt and yield of low or high-salt Domiati cheese was decreased with adding starter culture while, acidity, soluble nitrogen (SN) and total volatile fatty acids (TVFA) values were increased. High salt cheeses had significantly higher moisture, salt and yield with significantly lower acidity, SN and TVFA values than low salt cheeses. The values of moisture, salt and yield gradually decreased during pickling while acidity, SN and TVFA were significantly increased. Domiati cheese with starter culture had higher total bacterial count (TBC) than that of control being highest in T3. Increasing the salt in cheese milk resulted in lower TBC. Values of TBC increased in all samples during early pickling and than sharply decreased till the end. There was a remarkable inhibition in the growth of spore forming bacteria and yeasts & moulds counts expressing longer shelf life of cheese with adding starter culture. Sensory quality attributes of Domiati cheese from heated milk improved with adding starter culture. Cheese Pickling up to different periods led to better flavour as well as body & texture but extending the period beyond caused lower quality. The rate of improvements was faster in cheese of 5% salt than that of 10%. Starter culture of Bio Profit (T2) produced Domiati cheese of heated milk with typical well ripened cheese flavor and texture and can be recommended for low or high-salt cheese.

SQM-28
Shelf life study of pineapple flavoured creamed cultured cottage cheese made from buffalo milk

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The pineapple flavoured creamed cultured cottage cheese was subjected to shelf life study by storing the product at room (32°C) and refrigeration temperatures (7°C). Product was analyzed by sensory, chemical and microbiological tests periodically. The sensory evaluation of the stored product revealed that at room temperature the product remained acceptable for one day only, while the same product at refrigeration temperature remained acceptable upto 15 days with negligible change in sensory evaluation score. Titratable acidity increased sharply from 0.44 to 1.29% within 24h at room temperature. The microbiological analysis of the product stored at room temperature revealed a rapid increase in total viable, coliform and yeast & mold counts at the end of one day storage. During refrigerated storage, very slight decrease in moisture content from 71.91 to 71.87% was observed. Also change in titratable acidity from 0.44 to 0.51% lactic acid was observed upto 15 days of storage. When the product was stored at refrigeration temperature, a significant increase in lipolytic and proteolytic counts (from 1 to 75 and 2 to 139 cfu/g, respectively) were observed. No significant change was observed in total viable count, coliform count and yeast and mold count upto 15 days. However, a decrease in numbers were observed for mesophilic lactic Streptococcal count (from 82x10^6 to 5x10^6 cfu/g).The storage study revealed that the product has good shelf life of up to 15 days under refrigerated storage conditions.
SQM-29

Studies on storage stability of microwave processed paneer (an Indian traditional fresh cheese)

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The effect of microwave treatment and packaging materials on the storage stability of paneer at 30±1°C was studied. Paneer samples were packaged in P1 (PET/PE) and P2 (PET/PE/Metellosin/PE), heated to 73°C/35 s in a 2450 MHz, 3 kW continuous microwave oven and stored at 30 ±1 °C. The stored untreated (M1) and microwave treated (M2) paneer in P1 and P2 packages were analyzed for chemical [moisture, fat, protein, acidity, pH, soluble nitrogen (SN), free fatty acids (FFA)], microbiological [standard plate count (SPC), yeast and mould count (YMC) and coliforms], rheological [hardness/firmness, springiness, cohesiveness and chewiness] and sensory [flavour, colour and appearance, body and texture] qualities at regular intervals. During storage, the acidity, SN and FFA contents, SPC and YMC increased significantly, while pH, rheological and sensory scores decreased significantly in untreated (M1) than Microwave (M2) treated paneer, whereas, fat and protein did not show any statistical difference except moisture. Coliforms were detected in M1 but not in M2 sample. Paneer in P2 package had significantly lower acidity, SN, FFA, SPC and YMC and had higher pH, better rheological properties and sensory scores than P1. The quality of microwave treated paneer in P2 package was better than the P1. The interaction effect between microwave treatment and the packaging materials was non-significant for all the parameters studied. The microwave treated paneer remained acceptable up to 2 days and the untreated paneer (M1) for 1 day at 30±1°C. Application of microwave doubled the shelf-life of paneer without adversely affecting the overall quality.

SQM-30

Effect of aloe vera gel juice incorporation on the quality characteristics of yoghurt

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Effect of incorporation of aloe vera gel juice in milk on the quality characteristics of yoghurt was studied. Yoghurt cultures L.bulgaricus and S. thermophilus and probiotic culture L.acidophilus were used singly or in combination to study the effect of varying levels of aloe vera gel juice added to cow milk containing 3.0% and 0.5% fat on quality of yoghurt. Medium and low fat yoghurt samples were prepared from milks containing 3.0% or 0.5% fat after adding 4% skim milk powder, 7% sugar and 0.2-0.3% Sodium alginate using C1 culture (L.bulgaricus and S.thermophilus,1:1,Control yoghurt), C2 culture (S.thermophilus and L.acidophilus ,1:1, Acidophilus yoghurt) and C3 culture (L.bulgaricus, S. thermophilus and L.acidophilus, 1:1:1, Biyooghurt). The moisture content of yoghurts ranged between 81.50 to 85.0%. The aloe vera added yoghurt had slightly lower fat, protein, carbohydrate and ash contents. The highest acetaldehyde (33.0 ppm) was produced in yoghurt prepared by C2 culture whereas maximum soluble nitrogen (0.078%) and free fatty acid (8.0 meq/ml) were given by C3 culture. Maximum syneresis (22.3 ml) was observed in yoghurt prepared using C1 culture while highest curd tension (45.5 g) and maximum viscosity (6200 cP)
was obtained in yoghurt without aloe vera prepared by using C1 and C3 cultures, respectively. Total viable counts significantly \( (P<0.01) \) increased on adding aloe vera gel juice to yoghurt mix. Good quality aloe vera gel juice added yoghurt was prepared by incorporation of 10% aloe vera to medium fat as well as low fat milks with a shelf life of 24 days.

**SQM-31**

**Electrical conductivity of milk for detection of subclinical mastitis**

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In the present study, electrical conductivity (EC) of milk samples from 79 dairy cows of an organized farm was tested to detect sub-clinical mastitis (SCM) using hand held electrical conductivity meter. Out of 279 quarters examined, 42.29% were found positive for SCM by bacteriological examination whereas 22.58% quarters were positive by EC. Relative frequency of isolation of different microorganisms was staphylococci (86.77%), streptococci (9.92%), *Corynebacterium* spp. (2.48%) and *Pseudomonas aeruginosa* (0.83%). Mean EC values were 4.88±1.06, 4.99±0.93, 4.95±0.45, 6.63±0.92, 4.73±0.40 and 5.5±0.00 mS/cm for mastitic samples infected with *Staphylococcus epidermidis*, *S. aureus*, *Streptococcus agalactiae*, *Str. uberis*, *Corynebacterium pyogenes* and *Pseudomonas aeruginosa*, respectively. Out of 161 culturally negative quarter milk samples, 77.42% quarter milk samples were also found negative by EC. Sensitivity, specificity and predictive values of EC were determined taking bacteriological examination as standard test. The sensitivity, specificity predictive value of positive and negative test of EC was found to be 38.14%, 88.82%, 71.42% and 66.20%, respectively. On the basis of higher specificity revealed by the electrical conductivity test we can conclude that electrical conductivity can be used as an effective and economical test for the screening and further selection of milk samples for cultural examination in a large herd on routine basis for diagnosis of sub clinical mastitis.

**SQM-32**

**Comparative studies on quality of market pedha and laboratory pedha**

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Pedha is an important indigenous, milk product remain neglected for number of years by industry as well as research workers. In Maharashtra also scantly information is available on the quality of *pedha*, therefore famous brands of *pedha* samples were collected from different regions of Maharashtra and evaluate the sensory and chemical quality. The sensory score of *pedha* samples were ranges between 7.19 to 8.31. This may be due to the difference in type of milk, technique of manufacture, content of sugar etc. The *pedha* samples were contains moisture 12.5 to 19.00, fat 9 to 24.5 per cent, protein 11.10 to 17.15 per cent, Lactose 14.30 to 17.48 per cent, sucrose 28.43 to 41.41 per cent, total sugar 43.64 to 57.34 per cent, total ash 2.42 to 3.44 per cent, acidity 0.36 to 0.74 per cent and free fatty acid content 0.056 to 0.092 per cent among all the *pedha* samples, one of the market *pedha* scoring highest sensory score (best market *pedha*) was used for comparison with laboratory made *pedha*. Both these samples were tested for sensory score and chemical...
quality. The sensory score of best market pedha and laboratory made pedha were 8.31 and 8.35. The best market pedha and laboratory made pedha contains 15.5 and 14.42 per cent. Fat 17.00 and 23.83 per cent, protein 14.23 and 14.54 per cent, lactose 17.33 and 15.77 per cent, sucrose 31.85 and 29.00 per cent, total sugar. 49.187 and 44.77 per cent, ash 3.04 and 2.70 per cent, acidity and free fatty acid content of both these samples were 0.36 per cent and 0.056 per cent.

SQM-33

Shelf life study of ready to serve spiced paneer

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Shelf life study was conducted for ready to serve spiced paneer. Paneer cubes were marinated with 10% ginger + 5% garlic (F1) and 1.25% red pepper + 0.25 black pepper (F2) separately in thick curd with cumin 2.5% + coriander 2.5% + sugar 2% + salt 2% and kept for 60 minutes for maturation and then in-pack heat treated for 10 minutes at 15 psi. The ready-to-serve (RTS) spiced paneer formulations were stored at room temperature (16-25°C) and samples were drawn for sensory analysis (9 point hedonic scale) on 0, 15th and 30th day respectively. Results indicated that F1 formulation of RTS spiced paneer (without heat treatment) was ‘liked moderately’ whereas heat treated sample was ‘liked very much’ and F2 formulation (without and with heat treatment) both were ‘liked very much’ at 0 day in terms of all the sensory attributes. A significant (P ≤ 0.05) decline was observed in flavour and overall acceptability in both the treatments during storage. At 15th day of storage judges ‘liked moderately’ the flavour of F1 & F2 formulations (with heat treatment) while in case of without heat treatment formulations were ‘neither liked nor disliked’ and ‘disliked slightly’ respectively. For their overall acceptability heat treated samples of both the formulations scored around 6.0 and above which indicated that these samples were ‘liked slightly’ where as without heat treatment samples of F1 & F2 were ‘neither liked nor disliked’ by the judges. However, texture scores remained unchanged statistically. Thereafter, at 30th day of analysis all the samples were found spoiled and were not offered for judging. It is concluded from the results that F1 & F2 formulations of RTS spiced paneer with heat treatment had 15 days shelf life at room temperature.

SQM-34

Effect of selected strains of Streptococcus thermophilus and different level of total solids on the commercial production of cow milk dahi

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Dahi is one of the most important indigenous product in the Indian diet. For its commercial production, a study was planned to assess the feasibility of three promising selected strains of Streptococcus thermophilus namely D-3(C1), MD-2(C2) and MD-8(C3) for commercial production of dahi. Whole cow milk was adjusted to 12(T1), 15(T2) and 18(T3) percent total solids and 3 per cent fat. The standardized and homogenized lots of milk were preheated to 85°C for 15 minutes and then cooled to 40°C. The standardized milk having individual level of milk solids was divided further into three equal parts. To each of these, D-3, MD-2 and MD-8 strain were individually added as inoculum at the rate of 2 per cent, filled in polysterene cups having lids and then incubated at 40±1°C. For assessing titratable acidity, changes in lactic count and
lactose degradation during preparation, a set of cups from each lot of milk were drawn at 0, 2, 4 and 6 hours period. T3 (18 percent T, S) showed significant (P < 0.05) result than other level of total solids with respect to the above said parameters. C2 and C3 showed higher acid production up to 4 hours than C1 and dahi with desired level of titratable acidity can be produced with these two cultures within 4-5 hours of incubation. All the three strains of S. thermophilus showed uniform rate of acid production, increase in lactic count and lactose utilization for the manufacture of dahi from cow milk with 12 to 18 percent T, S. However, from the point of view of firmness, whey expulsion etc. 18 percent T, S may be preferred to other solid levels which is best suitable for the commercial production of cow milk dahi.

**SQM-35**

**Studies on protein status of milk of Phule Triveni synthetic cattle**

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The total Nitrogen content of Phule Triveni Cattle milk ranged from 0.50 to 0.60 per cent. However, the overall means of total N was 0.55 per cent. Stage of lactation had highly significant influence on total N content of milk of Phule Triveni cow. The mean total protein content in the milk samples was 3.16 per cent in the 1st lactation which increased with each further stage of lactation reaching to the maximum 3.52 per cent in the 4th stage of lactation. The casein content in the milk also significantly affected by the stage of lactation. The minimum casein value of 2.62 per cent was observed in first stage of lactation which increased linearly in second, third and fourth stage of lactation. However, the mean whey protein in the milk of Phule Triveni was 0.61 per cent and did not vary significantly due to stage of lactation. The interaction between the lactation order and the stage of lactation also showed non significant effect on whey content protein in the milk of Phule Triveni synthetic cattle.

**SQM-36**

**Studies on fat, SNF and total solids of milk of Phule Triveni synthetic cattle**

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A study was undertaken to ascertain the influence of stage of lactation and lactation order on fat, SNF and total solids content of milk of Phule Triveni Synthetic cattle. The overall mean values of fat, SNF and total solid were 4.26, 9.13 and 13.39% respectively. All of them being significantly affected by stage of lactation but lactation order and its interaction with the stage of lactation was non significant. It was also noticed that fat and SNF content, important from pricing point of view, were well above PFA Value limits as well as fulfilling requirements laid down by the Govt. of Maharashtra. All these three constituent also showed increasing trend with the advancement of lactation. It is seen that the mean Fat content in the milk was 3.94, 4.13, 4.39 and 4.59% for the 1st, 2nd, 3rd and 4th stages of lactation, respectively. Further it was noticed that the fat content for 30 days postpartum remained minimum but from 31st day upto the end of lactation showed a gradual rise up to the advance stage of lactation. It may therefore, be stated that the fat content
in the milk of Phule Triveni synthetic Cattle increased with the advancing stage of lactation particularly 31 days after post partum onwards.

**SQM-37**

**Physico-chemical and sensory characteristics of retort processed basundi during storage**

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Basundi is an emerging traditional milk delicacy in Indian market due to its rich, caramel, pleasant and nutty flavour. Its limited shelf-life is an impediment for taking the product for wider marketing. A study was therefore conducted to evaluate the changes in physico-chemical and sensory characteristics of retort processed basundi during storage. Basundi was prepared by using standard procedure, packed in retortable pouches and subjected to the heat treatment at $F_0$ values of 3.0 (121.1°C with rotary mode), 4.0 (128°C with stationary mode) and 6.5 (115°C with stationary mode) to achieve commercially sterile product. The samples were stored at 37°C and subjected to physico-chemical analysis and sensory evaluation at an interval of 7 days for a period of 5 weeks. Results indicated that the heat treatment of $F_0 = 6.5$ given to the product, produced drastic changes both in physico-chemical and sensory quality during processing and storage and was found to be unacceptable. Whereas, the heat treatments of $F_0 = 3.0$ and 4.0 given to the product resulted in marginal changes in physico-chemical characteristics i.e. marginal decrease in pH and increase in acidity, HMF content, FFA and viscosity during storage up to 5 weeks. However, both these treatments ($F_0 = 3.0$ and 4.0) showed marginal changes also in overall sensory score (i.e. from 7.77 and 7.70 to 7.62 and 7.58, respectively) and product was found to be acceptable at the end of 5 weeks of storage at 37°C. The heat treatment of $F_0 = 3.0$ with rotary mode produced comparatively lesser changes in the quality of product. Hence, it is possible to produce commercially sterile and long-life basundi in ready-to-use form.

**SQM-38**

**Effect of repasteurization on sensory characteristics in low calorie flavoured milk**

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In low calorie pasteurized flavoured milk, sugar was replaced with a combination of saccharine: aspartame (20:80) at the rate of 33 mg + 360 mg/lit., respectively and effect of repasteurization (63±1°C for 30 minutes) on artificial sweeteners along with six type of essences viz. vanilla, strawberry, kewra, pineapple, chocolate and kesar were studied. Effect of repasteurization on sensory characteristics was evaluated on 9-point hedonic scale. All the essences were in the acceptable range but the essence pineapple was found to be most acceptable. Repasteurization resulted in a decrease in the sensory score which was non-significant ($P<0.05$) in low calorie flavoured toned milk, in low calorie flavoured double toned milk and in low calorie flavoured skim milk.
SQM-39

Effect of Nisapline (Nisin) to improve shelf life of low calorie flavoured milk at refrigerated storage

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In low calorie flavoured milk, 7 per cent sugar level was replaced with equi-sweetness of saccharine and aspartame in the ratio of 20:80 (33mg + 360mg/lit, respectively). The type of low calorie flavoured milk i.e. flavoured toned, Doubled and skim milk with two levels of 100 IU/ml and 200 IU/ml of nisin were added. The samples were aseptically packed and stored at refrigerated temperature at (5+1°C). The samples were tested for MBRT, acidity, pH, SPC and coliforms count and also evaluated for sensory score during storage periods. Sensory scores of fresh flavoured toned milk were found to be in the range, 'like very much'. With storage sensory score decreased significantly. Upto 9th day of storage, the samples were found to be on acceptable range of more than 7.0 and the lower concentration of nisin was also effective to extend sensory quality of the developed product upto this period while on 12th day of storage, a significant decline in sensory quality was observed and most of the samples showed overall acceptability score below 7.0. A desirable sensory quality was achievable only upto 9th day of storage with the use of nisin at refrigeration temperature of 5+1°C for duration of storage. The same trend in sensory scores was observed in flavoured double toned and skim milk during storage.

SQM-40

Correlation between chemistry, rheology and microstructure of rasogolla (an acid coagulated Indian dairy product)

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Five popular brands of "Rasogolla" (an acid coagulated Indian dairy product) collected from different regions in and around Kolkata were analyzed for their physical characteristics like weight and volume, rheological characteristics such as hardness using a Texture Analyzer (TA-XT2i) and micro-structure using a Scanning Electron Microscope(SEM). Significant variations in weight (14.79 to 27.93g), volume (15 to 25 cc), hardness (71.58 to 301.72 mN) as well as in the microstructure of "Rasogolla" were denoted within the same brand and also amongst the different brands. SEM study revealed agglomerated inter-linked and ragged coalesced protein particles forming protein bridges with numerous large voids and lumps of starch particles in few samples. In order to standardize the method of production of rasogolla with consistent quality towards extending its geographical popularity a more detailed study is warranted.
**SQM-41**

Effect of microwave treatment on shelf life of paneer


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Paneer is an important Indian dairy product, having limited shelf stability. Investigations were made on the effect of microwave (Mw) treatment on sensory characteristics and shelf life of paneer. In order to ascertain appropriate combination of wattage level & time of exposure of Mw treatment of paneer different combinations (wattage and time) were studied in preliminary trials. These treated samples were subjected to sensory evaluation after 12, 36 and 48 hrs of storage at 35+1°C. The treatment combinations extending maximum storage life without jeopardizing sensory properties of paneer were selected. On the basis of results of preliminary trials four wattage viz; 340 (W1), 425(W2), 510(W3), 680(W4) & three time of levels viz; 4(T1), 5(T2), 7(T3) minutes were selected and used for optimization of wattage and time combination. These 12 treatment combinations were stored at 35+1°C and examined at an interval of 12 hours for sensory qualities. The results obtained indicate that shorter period of Mw treatments at lower wattages (viz; 340 w for 2.5 and 5 min.) did not alter sensory qualities of paneer and were ineffective in enhancing storage life of paneer, while longer treatment at higher wattages adversely affected body and texture (increase in hardness and rubbery feel) to some extent colour and appearance (development of uneven surface and slight browning) of paneer. Body became harder, rubbery and it turned slightly brown though most of the paneer samples were acceptable after 48 hr of storage. In general, longer exposure at medium wattages were found more desirable as sensory characteristics of paneer were not affected serious at the same time storage period of paneer samples was more or less the same as was observed for those exposed longer at higher wattages. It was concluded that 425 wattage level (W2) and 5 min exposure time (T2) were significantly (P> 0.05) superior in terms of flavour, body and texture and colour and appearance score.

**SQM-42**

Application methods and levels of nisin for improving shelf life of paneer


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Nisin, a commercial available of bacteriocin, produced by *Lactococcus lactis* var.*lactic* is widely used for preservation of wide range of dairy products. In the present investigation suitability of stage of addition of nisin for effective preservation of paneer was tested. Nisin was used at three different stages viz; directly added in milk (M1), added in coagulum after removing of whey (M2) & by dipping of paneer in nisin solution (M3) at three different levels viz;(N1) 100 RU/g, (N2) 250 RU/g & (N3) 500 RU/g. During dipping studies variable levels of nisin (12.5, 60, 120 ppm) & period of dipping (5, 10, 20 min.) were assessed. Neither the strength nor the period of dipping could extend the shelf life of paneer stored at room temperature. All above treated paneer samples were preserved at refrigeration temperature (7±1°C). Sensory observation noted on 13th day of storage. It was observed that the addition of nisin at N2 levels (250 RU/g) and was superior showed no significant difference in flavour scores of paneer. The method of its application did not affect flavour score much on 13th day but it had some effect on body & texture as well on colour & appearance. In three application level nisin added at partial removal
of whey (M₂) produced paneer with lower score than rest of the treatments (M₁ and M₃). Among 3 applications M₁ scored better for colour & appearance & also being convenient for application.

SQM-43
Extension of shelf life of paneer
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Paneer, like other indigenous milk products, is highly perishable. An attempt was made to utilize recognized potential of microwave technology (425 watts for 5 min.) with chemical preservative (Sorbic acid 0.1%) bio-preservative (Nisin 100 RU/g) in combination and alone, in order to extend shelf life of paneer under refrigeration temperature (7°±1°C). Sorbic acid treated samples either individually or in combination with nisin, microwave treatments had an acceptable flavour up to 33 days, all the sample had flavour score above 7, however on 35th day flavour defects such as sour, putrid, rancid or mixed were noticed in other treatment combinations and score declined below 6. The control and one treated with nisin did not show definite flavour defect on 13th day. The body of the microwave heated paneer samples became harder and slightly rubbery, therefore, their score for this parameter was less than 8 while remaining samples scored well above eight and same trend continued during subsequent days of storage. All the sample had body and textured score well above 7.5 on the day of their rejection. A gradual but very slight decrease in the colour and appearance score was noticed during storage. The paneer samples which were not subjected to microwave treatment had highest overall acceptability score. From the result of sensory evaluation it was clear that untreated paneer wrapped in cling film could remain acceptable for near 13 days. Further, it was noticed that nisin (100 RU/g) alone or in combinations did not improve keeping quality of paneer at 7°±1°C. While microwave heating alone or with nisin was found slightly better as storage life was extended by two days than control sample. Sorbic acid alone or in combination preserved paneer for almost more than one month (33 days). Synergistic effect of all these treatment was there but negligible.

SQM-44
Effect of different coagulants and quality improvers on the organoleptic and chemical properties of soy cheese – like during cold storage
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Soy Cheese – Like was made from prepared bland soy milk using seven different coagulants namely; acetic acid, lactic acid, acetic and lactic, citric acid, gluconodelta lactone (GDL), Bifidobacterium bifidum and Lactobacillus acidophilus aiming to choose the best coagulants fit for processing an acceptable soy milk curd. Moreover, some quality improvers namely Bifidobacterium Bb₁₂, culture, Neutrase L or a mixture of both @ 2.5 % (w/w) and 200 mg / kg curd respectively were added to the chosen acceptable soy milk curd in order to improve its body and texture as well as its flavor perception. Organoleptic properties and gross chemical composition were carried out periodically during storage at 7°C for 30 days to assess soy cheese – like quality and shelf-life. The obtained results indicated that the use of lactic acid as coagulant
led to production of compact and acceptable soy milk curd from the body and taste points of view. But the resultant curd was hardly considered as cheese imitate; therefore, quality improvers were tried. The addition of quality improvers especially the mixture of *B. bifidum* and *Neutrase L* to the soy milk curd resulted from using of lactic or citric acid as coagulants softened the body of the resultant soy cheese-like and improved the degree of its acceptability throughout the storage period. The gross chemical composition of soy cheese-like resulted from lactic or citric acid coagulation associated with different soy curd quality improvers delineated that there were small differences in the chemical composition of the treatments as a result of using the two different coagulants. The ripening parameters (SN \ TN % and T.V.F.A.) were increased as a result of using starter and Neutrase L during the storage period. No obvious deterioration was observed throughout cold storage indicating good shelf-life property. It can be concluded that lactic acid is the best coagulant and the mixture of *B. bifidum* and *Neutrase L* is the best quality improver to be used in production of soy cheese-like.

**SQM-45**

**Volatile flavor compounds in goat milk**

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Goat milk is known to possess an off-odor attribute which is not quite appreciated by consumers in Brazil. Mostly the short-chain (C₆, C₈ and C₁₀) fatty acids are responsible for this undesirable sensorial attribute. The objective of the present work was to identify the volatile compounds present in goat milk and to relate the impact of their flavour characteristics. Volatile compounds from the milk were obtained by using a simultaneous distillation and extraction technique utilizing Likens and Nickerson’s apparatus. Two hundred milliliter of milk was used and extraction was carried out at 55°C for 120 min by using a mixture of pentane-ethyl ether (2:1) solvent. The extracts were concentrated and analyzed for the identification of volatile compounds using a system of high resolution gas chromatograph coupled with mass spectrometer. Better separation was achieved in a polar capillary column (HP-INNOWax 30 m x 0.25 mm x 0.25 mm). A total of 136 volatile compounds were positively identified and these represented mostly the classes of compounds belonging to esters, aldehydes, alcohols, fatty acids, ketones and aromatics. The most notable and off-odour characteristic compounds identified were 9-octadecenoic acid, 2-methyl propanol, tridecanol, a-benzyl alcohol, octadecanol, pentanal, heptanal, octanal, 2-pentadecenal, octadecanal, 2-pentanone, isobutyl acetate, isopropyl butanoate, ethyl nonanoate, methyl tetradecanoate, butyl dodecanoate, ethyl tetradecanoate, ethyl octadecanoate and d-pentadecalactone.

**SQM-46**

**Antimicrobial effect of spices and chemical preservatives on the storage life of paneer**

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The antimicrobial effect of spices *i.e.* ginger and garlic and chemical preservatives *i.e.* potassium metabisulphite (KMS) and sodium chloride was studied on the storage life of paneer. Paneer, an important
indigenous milk product, was prepared by the combined action of acid coagulation (2% citric acid) and heat treatment of buffalo milk (6% fat and 9.5% SNF). One ml each of spice extracts and chemical preservatives i.e. 5% NaCl and 0.3% KMS were used per litre of milk for preservation of paneer. Preservatives were added after heating of milk. The freshly prepared paneer was found to contain 53% moisture, 28.22% fat, 16.42% protein, 1.50% ash and 46% total solids. Paneer was stored at room temperature and refrigerated temperature. Stored paneer was examined for bacterial; yeast and mold count by using nutrient agar and potato dextrose agar (PDA). Paneer stored at room temperature and refrigerated temperature was examined after every 24 and 48 h respectively. Garlic extract was found to have shown the maximum preservative effect and the product remained microbial safe for 4 days and 8 days at room temperature and refrigerated temperature respectively. The shelf life of paneer stored at refrigerated temperature was more as compared to room temperature.

**SQM-47**

**Effect of different levels of citric acid on the physico-chemical and sensory attributes of buffalo milk paneer**

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Paneer, an indigenous dairy product, represents one of the soft varieties of cheese family and is used as a sweetmeat and culinary dishes/snacks. It is an excellent substitute for meat in Indian cuisine. This study was undertaken to evaluate the effect of different levels of citric acid incorporation viz. 0.2, 0.4 and 0.6 per cent (w/v) on the quality of buffalo milk paneer. Study revealed that incorporation of citric acid at the rate of 0.2 percent resulted in better yield, moisture, protein content, total solid recovery, flavour, body and texture and overall acceptability as compared to those prepared with 0.4 and 0.6 per cent citric acid, respectively. There was a significant (P<0.05) decline in the yield, moisture, protein and lactose content, total solid recovery, flavour, body and texture and overall acceptability of the products with increase in the level of citric acid incorporation, however, fat and total solid content of the product increased. Paneer samples prepared by the incorporation of citric acid at 0.2 and 0.4 per cent were statistically at par for yield, lactose content and total solid recovery. No differences were observed in pH, colour and appearance among all the samples. Hence on the basis of above findings citric acid incorporation at the rate of 0.2 per cent w/v was adjudged best for the preparation of buffalo milk paneer.

**SQM-48**

**Studies on antioxidative peptides generated in cheddar cheese at different stages of ripening**

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Foods containing antioxidative materials may be useful for the prevention of various degenerative diseases like cancer, atherosclerosis and diabetes. This relationship has led to interest in evaluating the antioxidant
capacities of many foods as well as dietary supplements. Milk fermentation has been described as a strategy to release antioxidative peptides from milk proteins. So in the present study, the changes in the antioxidant properties of cheddar cheese with stages of ripening and its isolation and purification were undertaken. Cheddar cheese was prepared with and without adjunct cultures. Adjunct cultures (Lactobacillus casei and Lactobacillus paracasei subsp paracasei) were screened from thirteen different lactobacilli starter cultures the basis of antioxidant activities. The antioxidant activity was measured using different methods viz 2, 2’-azinobis (3 ethyl benzothiazoline)-6-sulfonic acid (ABTS), DPPH (2, 2’-diphenyl dipicryl hydrazyl) and was expressed as Trolox equivalent antioxidant capacity (TEAC). The antioxidant activity of cheddar cheese was dependent on ripening period. There was a large increase in antioxidant activity during 2 to 4 months of ripening and subsequent ripening up to 9 months resulted in a gradual decrease in antioxidant activity. The antioxidant activity of cheddar cheese prepared with adjunct culture was similar to cheese prepared in absence of adjunct culture during entire 9 months of ripening period. 5 KDa Permeates of water soluble extract of cheddar cheese were having higher TEAC than the water soluble extracts of cheese. The permeates were then subjected to HPLC for further purification and the peak showing maximum antioxidant activity is lyophilized. Lyophilized sample is sent for amino acid sequencing.

SQM-49

Determination of aflatoxin M₁ in bulk tank milk samples in Mashhad, Iran

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Milk and milk products may be contaminated with aflatoxin M₁ (AFM₁) residues, leading to human health hazard. AFM₁ appears in milk and milk products as the direct result of the intake of aflatoxin B₁ (AFB₁) contaminated feed by dairy cows. Aflatoxin M₁ is a hepatic carcinogenic metabolite found in the milk of lactating animals that consume aflatoxin B₁ (AFB₁). This study was undertaken to determine the presence and levels of aflatoxin M₁ (AFM₁) in bulk tank milk samples of dairy industry farms of Mashhad, Iran. For this purpose, a total of 141 raw milk samples were obtained from bulk tank of dairy industry farms of Mashhad, Iran during 6 months (April to September 2005). The competitive ELISA, was used to determine the presence and levels of AFM₁. AFM₁ was detected in 100% of the examined milk samples in concentration ranging between 2.4 and 135 ng/L and 39.7% of the milk samples had AFM₁ greater than the maximum tolerance limit (50 ng/L) accepted by European Union. The results showed that there was no statistical difference between AFM₁ contents of spring and summer samples. Contamination with aflatoxin M₁ is a serious problem for public health. To achieve a low level of AFM₁ in milk, cow’s feed samples from various cowsheds must be evaluated routinely for aflatoxin and kept away from fungal contamination as much as possible.

SQM-50

Detection of rice bran oil adulteration in ghee and other vegetable oils

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Ghee (clarified butter fat), which is considered immensely superior to other edible oils or fats, is highly prone to adulteration. Besides animal body fats, vegetable oils are most easily available adulterants for
ghee. Rice bran oil is one of the cheapest vegetable oils available in the market which might be used as adulterant not only in ghee but in other vegetable oils and fats also. For the detection of added rice bran oil in pure ghee or vegetable oils & fats, a simple thin layer chromatographic method has been developed. The method is based on the presence of ß- oryzanol which is naturally present in rice bran oil. Gamma oryzanol was extracted from rice bran oil, adulterated ghee samples and adulterated vegetable oils and fats with the help of a solvent mixture consisting of methanol/water in the ratio of 9:1 and solvent was evaporated. The extracts dissolved in developing solvent along with standard gamma oryzanol were applied on thin layer chromatographic plate coated with Silica Gel 60 and plate was run in a developing chamber containing a developing solvent system comprising of toluene/ethyl acetate/methanol (90:8:2; v/v) for 20 min. After air drying, the plate was sprayed with visualizing agent i.e. 50% H2SO4 and heated to visualize the ß- oryzanol. This resulted in efficient separation of gamma oryzanol from tocopherols as well as other components present in the extracts. By using the developed method, addition of rice bran oil in ghee as well as in other vegetable oils such as soybean, sunflower, groundnut, coconut and palm oil at 5% level can be easily detected.

SQM-51
Evaluation of biofunctional properties of fermented whey protein hydrolysate
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Milk proteins are of physiological importance as a potential source of biologically active peptides. Bovine whey has many biological and physiological functions e.g. immunomodulatory, antimicrobial, anticarcinogenic, antihypertensive, mineral absorption and antithrombotic effect due to the production of bioactive peptides that are released by enzymatic proteolysis, gastrointestinal digestion or during fermentation by lactic acid bacteria (LAB) due to its good proteolytic activity. The effect of whey peptides on hypertension, induction of oral tolerance and response to disease and infections is not much explored. Keeping in view these facts, the present study was carried out to evaluate the biofunctional properties of fermented whey protein hydrolysate. The fermentation parameters were optimized according to the peptides production, antioxidative and ACE-inhibitory activity. Biofunctional properties viz. antioxidative, antihypertensive (ACE-inhibition) and immunomodulatory have been analysed by fermenting whey and whey supplemented with WPC with Lactobacillus helveticus (1%, 37°C/48 h). To confirm immunomodulatory potential (anti-allergic activity) of fermented whey hydrolysates, an in-vivo study using mice as an animal model was carried out. It was observed that fermented whey protein hydrolysate showed good antioxidative, ACE-inhibitory and immunomodulatory activity under in vitro conditions. Feeding of fermented whey products resulted in significant decrease in total IgE and ovalbumin-specific IgE levels in allergy induced mice by increasing the production of Th-1 cytokines (IL-2) and decreasing Th-2 cytokines (IL-4) levels. Thus fermented whey hydrolysates were able to control the ovalbumin induced allergy in mice.
SQM-52

Influence of milking time on composition of Jakhrana goat milk and paneer

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Reports on variation in the composition of goat milk due to breed, stage of lactation, feed, age and seasons are available. But the information on the effect of milking time on composition of goat milk especially from Jakhrana breed and its effect on paneer yield and quality is lacking. Therefore, this work was undertaken to study the influence of milking time on composition of Jakhrana goat milk and paneer yield and quality. Goat milk can be utilized to make several traditional products successfully and its composition affects the quality of the products. Total 92 batches of herd milk samples (46 morning and 46 evening) obtained from Jakhrana unit were analyzed for major milk constituents. Evening milk had significantly higher fat (5.35±0.13%), solid not fat (6.55±0.26) and total solids (14.92±0.27%) content as compared to morning milk (4.15±0.09, 8.63±0.16 and 12.77±0.14 %, respectively). However, protein and casein contents were significantly higher (P<0.05) in morning milk. Evening milk yielded significantly (P<0.01) higher paneer (16.38±0.53%) than morning milk 14.10±0.52%). The protein and ash contents of paneer did not differ significantly. The paneer obtained from morning milk had higher (P<0.01) fat (27.03±0.32) than evening milk (23.70±0.44). The moisture content was observed to be higher in paneer obtained from evening milk. Thus results of this study indicated that goat milk composition affected due to milking time in turn affects paneer yield and quality.

SQM-53

Effect of fat replacer on the sensory and physical properties of ice cream

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The dairy industry has developed a variety of fat-free ice cream products. Unfortunately, the flavor and mouthfeel of fat-free ice cream products are not acceptable to a large number of consumers. One major criterion that consumers require is that ice cream products should (fat-free or otherwise) taste good. Furthermore, consumers require that fat-free ice cream products have an acceptable mouthfeel and appearance. In this study, the effect of different levels of maltodextrin as a fat replacer on the sensory and physical properties of saffron ice cream and coca ice cream was investigated. Control sample was formulated based on Iranian ice cream standard. Maltodextrin replaced fat at three levels (20, 40 and 60%). Sensory properties including texture, flavor and total acceptance were judged using 15% panelists. Also some physical properties were measured for each treatment. Data were analyzed by factorial experiment in completely randomized design in triplicate. Comparison between means was done with Duncan’s test at level P = 0.01. Results showed that saffron had significant effect on the acceptability of ice cream. In addition, the sensory evaluation by panelists showed that sensory properties at 40% replacement in saffron ice cream showed no significant difference in comparison to control sample.
SQM-54
Textural studies on balmithai-a traditional dairy product of Almora (Uttarakhand)

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Balmithai is a popular heat-desiccated indigenous milk product popular in Almora region of Uttarakhand (India). It is characterized by a relatively hard body, intense caramelized flavour, and gummy as well as chewy texture. Surface of Balmithai is coated with sugar balls (bal dane). The product is being manufactured and marketed in Almora region since 1842 through more than 150 shops. The market size is estimated at about 1500-2000 kg/day. Sweetmakers’ Union of Almora is in the process of filing patent for this product under ‘geographical indicator’. There is very little documented literature available about the product characteristics. The present work was therefore planned to generate basic information about the texture profile, moisture content and water activity of selected market samples. Six samples of Balmithai were procured from different famous shops of Almora for their texture characterization. Analysis of samples showed moisture content to be in the range of 9.25 to 16.72% and water activity from 0.453 to 0.661. TPA of market samples of Balmithai showed a wide variation in the textural parameters and the values obtained were: hardness (3691.25 to 26901.28 g), fracturability (222.22 to 4573.63 g), gumminess (197.78 to 999.37 g), chewiness (24.17 to 362.80 g), cohesiveness (0.037 to 0.117) and springiness (0.122 to 0.363). Correlation statistics showed a significant positive correlation of moisture with hardness (0.88), water activity (0.89), springiness (0.86) and chewiness (0.79) while a negative correlation of cohesiveness was found with moisture (-0.60) and water activity (-0.85).

SQM-55
Analysis of multiple sweeteners and their stability in lassi

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An analytical method involving solid phase extraction (SPE)/HPLC was developed for the analysis of multiple sweeteners (aspartame, acesulfame-k and saccharin) and their degradation products (diketopiperazine, L-phenylalanine, acetoacetamide and 2-sulfobenzoic acid) in lassi. The sample preparation procedure involved dilution of the sample, Carrez clarification, filtration followed by SPE over C\textsubscript{18} cartridges. HPLC analytical conditions were standardized for the simultaneous analysis of multiple sweeteners and their degradation products in a single run using binary gradient programming over C\textsubscript{18} column at 200 nm. The recovery and detection limits of the method for sweeteners and degradation products were 88 - 99 % and 10-40 ng respectively. Sucralose sweetener was very poorly detected (detection limit 20 µg) under these HPLC analytical conditions. Hence, an analytical method was developed involving isolation of sucralose from lassi without the use of SPE C\textsubscript{18} cartridges followed by their clean-up/estimation over amino HPTLC plates and silica gel HPTLC plates for the semi-quantification and quantification respectively. Recovery of the method was 96 – 99 %. Detection limits of sucralose over amino HPTLC and silica gel HPTLC plates were 25 and 250 ng respectively. Storage studies over HPLC/HPTLC plates revealed no degradation products of the four sweeteners/sweetener blends in lassi upto 15th day of storage.
Preservation of paneer by antifungal substances of lactobacilli and antimicrobial milk proteins

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Contamination of dairy products with undesirable yeasts and molds is a serious problem in the dairy industry. They can grow even at low pH value existing in fermented products such as cheese and yoghurt and cause spoilage of these products. In this context the antimicrobial potential of lactobacilli other than bacteriocins is currently being exploited due to their broad spectrum of activity. The preservation ability of lactobacilli is also being used since ancient times in food and feed due to synthesis of antimicrobial compounds such as organic acids, bacteriocin like inhibitory substances and antifungal substances. Though there are many reports on the use of LAB for bio-preservation of dairy and non dairy foods, the reports on the use of antifungal substances of lactobacilli in bio-preservation of foods are scanty. Three lactobacillus cultures Lactobacillus casei spp. casei NCDC 17, L. acidophilus NCDC 195, Lb. collinoides NCDC 02 were screened for antifungal activity in MRS broth, skim milk and whey supplemented with different ingredients like nitrogen sources (peptone and yeast extract), carbon sources (glucose, maltose, mannose) and Tween 80 at varying concentrations. L. casei spp. casei NCDC 17, L. acidophilus NCDC 195 showed maximum antifungal substance (AFS) production in skim milk and whey medium. L. casei spp casei NCDC 17 showed antifungal activity against yeast as well as mold cultures used in this study and were therefore used for further studies. The skim milk medium was prepared by supplementing with maltose (0.5%), peptone (1%) and Tween 80 (0.1 %) for AFS production by Lb. casei spp. casei NCDC 17. It was found to produce AFS having maximum antifungal activity against many fungi and also antibacterial activity against both Gm+ve and Gm -ve bacteria. The antifungal substance synthesized in skim milk medium was applied for the bio preservation of paneer along with lactoferrin and pediocin. Among different combination treatments used, Treatment III (Pediocin along potassium sorbate and sodium citrate) and VI (Pediocin + Lactoferrin+ antifungal substance) gave relatively better results in preservation of paneer for more than 28 days at refrigeration temperature. On the basis of microbiological analysis and sensory evaluation of paneer, we can say that chemical anti fungal preservatives may be replaced by antifungal substances produced by Lactobacilli.

Comparison of the textural properties and microstructure of chakka made with a bacterial culture or direct acidification process

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Chakka, an indigenous milk product obtained by draining off the whey from curd (dahi) made by lactic fermentation of skimmed milk or whole milk, is widely used as the base material for production of shrikhand. In the present investigation, skimmed milk chakka was developed using conventional culture method as well as by direct acidification. Textural and microstructural properties of these chakka were determined using Texture Analyzer and Scanning Electron Microscope respectively. Also, colour of chakka
samples was measured using a Hunter Lab Colorflex. It was observed that method of manufacturing posed pronounced effect on all the parameters studied. Texture analysis showed that the direct acidified chakka was comparatively harder than its conventional counterpart. While studying the microstructure, it was observed that the direct acidified chakka was more porous with honey-combed like structure as compared to conventional chakka, the later had clustered microstructure. During colour measurement, it was found that conventional chakka had higher ‘L’ and ‘b’ values. Chakka developed using culture as well as direct acidification method was found to be different in terms of microstructure, textural properties and colour attributes.

SQM-58

The physico-chemical, sensory and rheological properties of misti dahi prepared from reduced fat buffalo milk

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Misti Dahi is the sweetened variety of dahi (curd) popular mainly in eastern India. Because of its pleasant caramel and sour taste cherished by all age groups, misti dahi is now being sold in various parts of the country. High fat and sugar content may pose a hurdle for the successful marketing of misti dahi because of the growing awareness of health impact of these main ingredients among consumers. There is no literature available on the impact of milk fat reduction on the quality of misti dahi. Hence, in the present study, the effect of reduction of milk fat, by keeping the total milk solids constant, was studied on the physico-chemical, sensory and rheological properties of buffalo misti dahi. Fresh raw buffalo milk was divided into three batches and was standardized to three different levels of milk fat viz. 1.5%, 3.0% and 5.0% using fresh raw skimmed buffalo milk and the total milk solids (TMS) content was adjusted to 18.0 percent using skimmed milk powder. The batch containing 5.0% fat was considered as control. Acidity, pH, whey separation, lightness (L*), redness (a*), yellowness (b*), firmness and stickiness were determined. Sensory evaluation was carried out by a panel of 6 judges using 9-point hedonic scale method. Acidity increased with the decrease in fat. Fat reduction did not cause any significant changes in the L*, a* and b* values of misti dahi. The firmness values of misti dahi with 1.5% fat were higher than that of 3.0% fat but the difference was not significant. The stickiness values of misti dahi with 1.5% fat was less than the control but the difference was not significant. Significant differences (p<0.05) were observed in the overall acceptability of misti dahi, that with 3% fat being better than 1.5% fat product. Hence, on the basis of above results it is concluded that misti dahi made with 3.0% fat and 15.0% SNF can produce highly acceptable product.
SQM-59

Biofilm formation by coagulase positive *Staphylococcus aureus* on packaging materials used for Indian traditional dairy foods

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Packaging is an important aspect in improving the commercial value of the processed foods. In addition to attracting the consumers, protecting the food from physico-chemical, microbiological and nutritional deterioration, the packaging material could be a possible source of contamination. Various packaging materials viz. LDPE, HDPE, glass, polystyrene, polypropylene, metallized polyester, tin and steel are used for packaging of Indian traditional dairy foods like paneer, kulfi, khoa, buttermilk, lassi, dahi, ghee, rasogulla, gulabjamun powder mix and gulabjamun. During processing and handling, these products are usually contaminated by potential foodborne opportunistic pathogen like *S. aureus*. In the present study, biofilm formation by coagulase positive *S. aureus*, on different materials used for packaging of Indian traditional dairy foods was studied. Biofilm was indirectly quantified by biomass indicator (crystal violet) staining. Biofilm formation was observed after following treatments: (a) 70% alcohol and UV treated substrates as control, (b) conventional treatment done before packaging, (c) other treatments like hydrogen peroxide, hot acid rinse, hot base rinse, surfactants, formaldehyde, sodium hypochlorite, iodophor, benzalkonium chloride (BZC) and a commercial disinfectant (Combatan). Maximum biofilm formation in control substrates was observed on tin and minimum on polystyrene, which was the most hydrophilic and hydrophobic substrates considered, respectively. The commercial disinfectant was found to be the most effective one in preventing the biofilm formation. This signifies that the substrate of packaging material should be considered before selecting an efficient concentration and type of disinfectant or sanitizer.

SQM-60

A study on the standardization and assessment of physico-chemical and sensory characteristics of low-fat paneer

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The conventional paneer is quite rich in fat content and not preferable by the health conscious consumers. The present study has been envisaged with an objective to develop low-fat paneer with comparable sensory characteristics by incorporating soy protein isolate (SPI) as fat replacer. Three batches of paneer were prepared viz. high-fat paneer (HFP), low-fat paneer (LFP) and soy protein isolate incorporated low-fat paneer (SLFP) using 0.2% (w/v) calcium chloride as coagulant at 75±1.0°C from high-fat milk (6% MF and 9% SNF), low-fat milk (3% MF & 10% SNF) and low-fat milk (3% MF & 10%SNF) incorporated with 0.2% SPI, respectively. The level of SPI was selected 0.2% based on earlier experiment. The titrable acidity and pH showed no significant change in different variables. The yield percentage of paneer was improved significantly (P<0.05) in SLFP than LFP and it is comparable to HFP. Fat percentage has been reduced significantly (P<0.05) from 23.06 in HFP to 13.18 and 12.66 in LFP and SLFP, respectively. The protein
content showed a linear increase with the increase in SNF content as well as incorporation of SPI. The moisture protein ratio was significantly (P<0.05) higher in high-fat paneer than low-fat paneer. The calorie content was reduced significantly by 24-26% in LFP and SLFP than HFP. The frying losses were significantly reduced with the decrease in fat content of paneer. It was observed that appearance and colour scores were significantly (P<0.05) lower for SLFP than LFP, however SPI did not affect the flavour scores of the product. The texture, juiciness and overall acceptability scores were significantly (P<0.05) higher in SLFP than LFP.

**SQM-61**

Comparative evaluation of texture and colour profile of high-fat and low-fat paneer incorporated with soy protein isolate as fat replacer – objective method

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Paneer is heat-cum-acid coagulated milk product used in various Indian culinary dishes. Low-fat paneer is preferred by the health conscious consumers. Texture and colour are the most sought after sensory attributes for the acceptability of paneer by the consumers. Therefore, the present study was envisaged with an objective to assess the instrumental texture and colour profile of the paneer prepared by using 0.2% calcium chloride as coagulant at 75±1.0°C from high-fat milk (6% MF & 9%SNF), low-fat milk (3% MF & 10% SNF) and low-fat milk with 0.2% Soy protein isolate (3% MF & 10% SNF) to obtain high-fat paneer (HFP), low-fat paneer (LFP) and SPI incorporated low-fat paneer (SLFP). The texture profile analysis (TPA) was conducted using Texture analyzer (TA-HDi), by keeping constant test speed of 1 mm/sec for a deformation of 3 mm having a load cell of 50N. The hardness was significantly (P<0.05) higher in LFP than SLFP and HFP. The gumminess and springiness of LFP was found to be significantly (P<0.05) higher and lower, respectively as compared to HFP batches. The above textural properties were comparable between HFP and SLFP. The resilience and chewiness were generally higher as the fat content reduced in paneer. The colour profile was measured using Hunter Colour Lab having setting of cool white light (D65) and 2°. L value contributes to brightness and varied from 90.42, 89.99 and 89.07 for HFP, LFP and SLFP, respectively. The b-value was recorded highest for SLFP and was significantly (P<0.05) higher than HFP. However a-value did not show any significant difference with the product formulation.

**SQM-62**

Diagnostic kit based method for cholesterol estimation in milk fat

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Increased consumer awareness has forced legal authorities to include cholesterol content in the nutritional labeling of foods. In India too, as per proposed food safety law, details on label should give complete nutritional information per 100 gm of product including cholesterol content. Existing methods of cholesterol estimation like Gas Liquid Chromatography is considered to be time consuming, labour intensive and requires expensive instrumentation as well as special analytical skills. Spectrophotometric method like
Liebermann-Burchard (LB) regent based methods commonly used for rapid estimation of cholesterol involve the use of acetic anhydride which is toxic and also banned under the Narcotic Drugs and Psychotropic Substances (NDPS) Act 1985. Such a situation emphasizes the importance of accurate, rapid and at the same time inexpensive determination of cholesterol in dairy products. An alternative method for cholesterol estimation using non-enzymatic diagnostic cholesterol estimation kit has been standardised in the present study. Conditions for rapid saponification were optimized using 5% methanolic KOH at 90°C/20 min. Hexane was preferred for the extraction of unsaponifiable matter. The recovery of the developed method was found to be 95.6% to 97.3%. Cholesterol content was found to be 237.42 to 278.61 mg/100 g and 187.77 to 216.95 mg/100 g in clarified cow and buffalo milk fat (ghee), respectively, using the developed method.

SQM-63

Effect of milk co-precipitate incorporation on the physico-chemical and sensory quality of meat loaves

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Milk co-precipitate was prepared from buffalo skim milk and incorporated in chicken loaves and buffalo meat loaves at various levels replacing lean meat in separate experiments. In chicken meat loaves, there was a significant increase (P<0.05) in emulsion stability and cooking yield percentage at 15 and 20% incorporation of milk co-precipitate. These changes were also accompanied with improvement in cohesion properties, flavour and juiciness. Thus incorporation of milk co-precipitate up to 20% level in chicken loaves is advantageous in terms of yield as well as quality. In another experiment, buffalo meat loaves were prepared with the incorporation of 10% freshly prepared milk co-precipitate and 10% skim milk powder (hydrated 1:1) replacing lean meat and compared for utility and enhancement of quality attributes. The emulsion stability and cooking yield of the products prepared with either of the milk proteins were better than control, but were comparable to each other. Buffalo meat loaves prepared with milk co-precipitate had better flavour than others, whereas loaves prepared with skim milk powder had texture comparable to control and better than product prepared with milk co-precipitate. The findings indicated that incorporation of milk co-precipitate and skim milk powder was advantageous in buffalo meat loaves with respect to yield as well as sensory quality. In buffalo meat loaves, milk co-precipitate and skim milk powder enhanced flavour and texture, respectively, and sensory ratings remained between good to very good.

SQM-64

Real time PCR: A robust tool for rapid detection of salmonella spp. in kulfi and paneer

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The aim of the study was to evaluate kulfi and paneer samples for the prevalence of salmonella spp. and its detection by SYBR Green I based real time PCR assay. Twenty samples each of kulfi and paneer were collected from market and pre-enriched in four different broths viz. Brain heart infusion broth, Tryptic Soya broth, Buffered peptone water and Universal-pre-enrichment broth (UPB) for 4hrs/37°C and
selectively enriched in Rappaport Vassiliadis (RV) broth followed by plating on RV agar after 8, 12, 18 and 24hr of incubation at 42°C. Out of 20 samples each, 9 samples of paneer and 13 samples of kulfi were found to be microbiologically positive for salmonella after incubation at 42°C for 24hrs. The preenrichment efficacy of UPB was highest in case of both types of samples. Samples were drawn for DNA extraction after 8, 12 and 24hrs from RV broth after preenrichment in UPB. While using real time PCR, 9 samples of paneer and 13 samples of kulfi were found to be positive with the formation of the specific product of 204bp with melting temperature (Tm) of approximately 85 ± 0.3°C after 8 or 12 hrs of selective enrichment. This is the first report documenting the application of real time PCR technology for rapid detection of salmonella spp. in Indian traditional dairy foods. The present study validates real time PCR assay as a rapid and robust technique for the detection of salmonella spp. in dairy foods as the diagnostic time was reduced to less than half when compared to the traditional microbiological methods.

**SQM-65**

Isolation and characterization of nisin producing cultures

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Nisin is considered effective at controlling a wide range of gram positive organisms including listeria, Enterococcus, *Bacillus sporothermodurans*, Clostridium, Alicyclobacillus, Desulfitomaculum, Lactobacillus, Leuconostoc, Microoccus, Pediococcus and Sporolactobacillus. It is effective against gram negative bacteria when used in conjunction with other preservatives. Around ten bacterial pure cultures were isolated from dahi and sour milk samples and biochemical tests were performed for their identification as the presence of *Lactococcus lactis*. Two cultures one each from dahi and sour milk samples were obtained on the basis of biochemical tests which had shown the characteristics of *Lactococcus lactis*. The bacterial cultures namely C1, SSM-1 and *Lactococcus lactis* NCDC 094 were selected for the production of nisin by the fermentation process. These cultures were found to produce inhibition zones against nisin sensitive culture. It was observed with the relationship between the growth phase and nisin production that log phase retains upto 6 hrs of incubation and nisin production starts in the late log phase as the cells entered the early stationary phase. The effect of pH on inhibitory effect of nisin had shown that nisin exhibited more stability in acidic medium from pH 2 to 6 and inhibitory activity was noticed in pH 8 and 10.

**SQM-66**

Optimization of the constituents and the effect of replacement of milk fat with soy milk on the various physico-chemical, sensory and microbiological attributes of soft-serve ice-cream

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Soft serve ice cream generally termed as “Softy” is marketed in soft condition and is ready for consumption shortly after it is drawn from the freezer. Soft ice cream is very similar in composition to ice cream that is frozen and hardened. The sugar content may be 2-3 % less than for regular ice cream and the drawing
temperature from the freezer is 6.6-7.7 °C or somewhat lower. The problems involved in the preparation of softy are somewhat different from those encountered in the manufacture of regular ice-cream. Therefore, the study was undertaken to optimize the proportions of ingredients by using Response Surface Methodology and to see the effect of substitution of milk fat with soy milk on the physico-chemical, sensory and microbiological attributes. Response surface analysis indicated that sensory flavour, texture and overall acceptability (OA) scores of soft ice-cream varied from 7.12 to 8.86, 6.66 to 8.03 and 6.90 to 8.45, respectively. The soft icecream containing a minimum level of 3.24% cream and 4.94% SMP resulted in a product having a minimum of 4.3% fat and 33% total solids, with a minimum OA score of 8. The derived mathematical second-order polynomial models against cream (X) and SMP (Y) were found to be adequate as coefficients of multiple determinants (R²) were more than 80% except for melting resistance. The effect of soy milk on melting resistance, overrun, texture and other physico-chemical and microbiological attributes were also studied.

**SQM-67**

**Microbial studies of cow milk samples from Parbhani city**

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Milk is considered as universal food. Milk being a nutritious food for human being also provides an ideal environment for microbial growth, thus the microorganisms, which may gain entry into milk, can multiply and bring about spoilage of these products and render them unsafe due to potential health hazards. A total 16 raw milk samples from Parbhani city were screened for Direct microscopic count (DMC), Methylene blue reduction time (MBRT) test, standard plate count (SPC) by spread plate count method as per the procedure described in ICMSF (1978) for Mesophilic, Thermoduric, thermophilic, psychrotrophic, and coliform and yeast and mould count. The DMC in these samples ranged from 54´10⁴ to 43´10⁶ with an average of 15.41´10⁶. The result of MBRT test judged 25% samples as very good quality and 50% samples as good quality and 25% samples as poor quality. The mesophilic count in these samples ranged from 51´10⁴ to 91´10⁴ with an average 31´10⁵, thermoduric count 1´10⁵ to 90´10⁵ with an average of 21.7´10⁵. Thermophilic count 0 to 1´10⁴ with an average of 0.2510⁴, psychrotrophic count ranged from 0 to 1´10⁴ with an average of 0.2510⁴, coliform count was 0 to 1 with an average of 0.2510⁴ and yeast and mould count ranged from 1 to 6´10⁶ with an average of 0.29´10⁵. The DMC of cow milk in present study is within the permissible limit of 5´10⁴ to 4´10⁵ as per Indian Standards. MBRT is also within the range. The all plate counts of cow milks in the present study were beyond the acceptable limit. But the high levels of DMC and SPC in milk can be dangerous for consumers, as some of these microorganisms could be pathogenic with its possible adverse effect on public health.
**SQM-68**

**Effect of varying different types of fat on composition of filled masala paneer**

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Paneeer is obtained through heat/acid coagulation of casein component of standardized buffalo milk, entrapping through complex physico-chemical interactions almost all the fat, a part of denatured whey proteins and colloidal salts, as well as a part of the soluble milk solids (in proportion to the moisture content retained). Typically, paneer is marble white in appearance, having a slightly spongy body, close-knit texture and possessing a sweetish-acidic-nutty flavour. In developing countries, it is unfortunate that the domestic market for milk and milk products is limited due to low purchasing power of the people; particularly the large numbers of economically weaker sections, which really need it most. Hence the attention of research workers concerned has been drawn towards reducing the cost of milk products by lending skim milk with other fat rich foods which could be made available at low cost. Therefore, an experiment was carried out that treatment T₃ brought about significant improvement in the fat and total solids content when the 5.5% vegetable fat was added. Like wise, lactose and ash content were slightly greater in experimental Paneer (T₃) than control paneer (T₀) standardized with the 5.5% milk fat. While the lowest fat and total solids of filled masala paneer obtained in treatment T₁ where 4.5% vegetable fat was added. Similarly the T₁ treatment showed significant impact in enhancing the moisture, protein, lactose and ash content where the lowest amount of vegetable fat was added. While the lowest moisture and protein recorded at T₃ treatment. It is quite obvious from the results that the fat and total solids percentage significantly increased with the rise in fat percentage. It is inferred from the observations that the fat, total solids, lactose and minerals (ash) went high in experimental paneer (T₃) prepared with 5.5% vegetable fat than control paneer (T₀) prepared with the same level of milk fat while the moisture and protein percentage in the filled masala paneer declined.

**SQM-69**

**Response of different levels of fat on sensory evaluation of filled masala paneer**

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There is general liking of tasty and delicious foods, spices are amongst the most important ingredients of the food items. They contribute maximum to the delicacy and tastefulness of Indian foods. The use of spices can also be made in the preparation of milk products. The present study has been aimed at exploring the possibility of utilizing the two low priced ingredients namely skim milk and vegetable fat along with spices (masala) to prepare “Filled Masala Paneer” that would be nutritious as well as relatively less expensive. An experiment was carried out with the object to study the “Response of different levels of fat on sensory evaluation of Filled Masala Paneer”. It was revealed from the results that the treatment T₀ prepared from buffalo milk with 5.5% fat found highest scores in taste & flavour, body, texture, colour & appearance. As far as coagulation was concerned, there was no difference in the paneer made from buffalo milk and filled milk. In view of minimizing the cost of production of paneer, filled milk with 4.5% vegetable
fat can conveniently be used for making satisfactory quality of filled masala paneer that could be equally good for the direct consumption and preparation of culinary dishes.

SQM-70

**Microbial load of different type of ice-cream in Parbhani city**

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The present study was undertaken to assess the bacteriological quality of ice-cream sold in Parbhani city. A total of 60 ice cream samples were collected from different sources viz 20 from local vendors, local ice cream factories and standard brands. Samples were collected and subjected for S.P.C and *E.coli* count. Mean count per gm. for S.P.C. was $1.5 \times 10^4$, $1.2 \times 10^6$ and $1.4 \times 10^5$ and *E.coli* was $1.17 \times 10^3$, $9.07 \times 10^4$ and $9.5 \times 10^4$ for branded, local vendors and local ice factories, respectively. It was concluded that samples collected from standard brands were safer as compared to local vendors and ice factories. On the basis of present study the ice-cream samples from local vendors and factories were extremely hazardous.

SQM-71

**Moisture sorption characteristics of dried acid casein from buffalo skim milk**

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An understanding of sorption characteristics of a food product and evaluation of thermodynamic functions of water sorbed provide valuable information to characterize storage and packaging problems and in appraising the shelf life of food under varying product-package-environment interactions. Over 55% of total milk production in India consists of buffalo milk. Inherent nutritional and physico-chemical properties of buffalo milk need to be fully exploited for value addition and developments of new products with special attributes. The production of dried milk has become an increasingly important segment of dairy industry and an important utilization of skim milk is in the production of edible casein and non-food industrial casein. Adsorption and desorption isotherms of dried acid casein prepared from buffalo skim milk were determined at 25°, 35° and 45°C over a water activity range of 0.11 to 0.97 using static moisture gain / loss from test samples. The isotherms were sigmoid and were fitted to G.A.B. equation. The monolayer moisture content of casein was found to be 3.815 % on dry basis at 25°C and it decreased with increasing temperatures. The temperature dependence of G.A.B. parameters was determined in the form of Clausius-Clayeyron equation. Net isosteric heat of sorption decreased with increase in moisture content and approached a constant value of 0.331kJ/mol after 28% moisture. The adsorption and desorption isotherms revealed the presence and extent of hysterisis effect. This effect was negligible in monolayer moisture content region, occurred predominantly in the water activity range 0.35 to 0.60 and decreased at higher water activities. The total hysteresis energy was evaluated from the sorption data using the Everett and Whitton plots. The effect of increase in temperature was to decrease the amount of hysteresis.
Changes in anti-oxidant content of watermelon during dehydration

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Watermelon (Citrullus vulgaris) fruits are popular in many parts of the world because of its delightful texture, colour and flavour. Watermelon is mainly consumed in summers because of its cool and refreshing taste. It is a rich source of ascorbic acid and carotenoids, possessing anti-oxidative activity. Watermelon flakes were prepared by conventional drying process and prior to drying flakes were subjected to pre-treatment of salt and citric acid @ 0.3 per cent each. Two watermelon varieties namely Sugarbaby and Shipper were used for flake preparation and dried flakes were analysed for ascorbic acid, lycopene and â-carotene content to investigate the change in anti-oxidant content during dehydration. The fresh edible portion had 50.25 and 29.7 mg/100g of ascorbic acid in Shipper and Sugarbaby varieties respectively, which reduced to 35.82 and 22.59 mg/100g (db). Lycopene content at initial stage was recorded as 52.5 mg/100g, which decreased to 6.97 in variety Shipper and in Sugarbaby it reduced from 51 mg/100 to 6.67 mg/100g. Similar decreasing trend was found in case of both the varieties for â-carotene also. It reduced from 0.487 to 0.031 mg/100 g in variety shipper whereas Sugarbaby variety showed reduction from 0.5 to 0.045 mg/100 g. The findings of the investigation indicate that during dehydration anti-oxidative activity decreases and is because of thermo-labile nature of anti-oxidants.

Optimization of parameters for maximum production of bacteriocin from a strain of streptococcus thermophilus isolated from natural habitat

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Research work done during the past two decades has revealed that S. thermophilus has properties that make it one of the most commercially important starter cultures. Moreover, research on the physiology of S. thermophilus has revealed important information on its technological aspects like lactose and galactose metabolism, proteolytic system, EPS production, urease activity and phage resistance. Strains of S. thermophilus have also been reported to produce potent broad spectrum bacteriocins. Keeping in view, the widespread technological applications and significance of S. thermophilus in milk fermentation processes, a total no. of 1255 S. thermophilus strains were isolated from 206 samples of milk and milk product including raw milk, raw cream, dahi, cheese and yoghurt collected from various sources on the selective M17 Agar medium. The isolates were screened for bacteriocin production by Spot on Lawn Assay. Incidence of bacteriocinogenic S. thermophilus was found to be highest among the isolates from dahi (35%). Out of 19 biochemically and genetically identified bacteriocinogenic strains of S. thermophilus selected for final studies, seven strains showed wide spectrum of activity against Micrococcus luteus, Lactococcus lactis subsp. lactis, Listeria monocytogenes Scott A, E. faecalis DSM 20478 and many strains of S. thermophilus, S. aureus, Lactobacillus spp., Streptococcus mutans etc. The inhibitory principle was identified as bacteriocin by treating the culture supernatant of strain D4 possessing anti bacterial activity with different proteolytic enzymes namely trypsin, pappain, pepsin, ficin, chymotrypsin, protease IV, X, XII, and XXIV. It was found that the
antibacterial principal was degraded by all enzymes except ficin and pepsin. Conditions for the maximum production of bacteriocin by strain D4 such as growth medium, pH, temperature, inoculum level and agitation were optimized. Maximum production of bacteriocin was observed for strain D4 in APT medium at pH 6.0, inoculated @ 2% and incubation at 37°C under static conditions. Maximum activity units for bacteriocin produced by strain D4 under optimized conditions were found to be $3.0 \times 10^4$ /ml.

**SQM-74**

**Antifungal property of lactic acid bacteria and their plasmid profile**

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Lactic acid bacteria are not only recognized for their health and nutritional benefits, but also for the preservation of dairy products. Some strains may contribute to food preservation by producing inhibitory substances such as antifungal substances and bacteriocin, which are of protein moiety. Cell free supernatant (CFS) of standard cultures of *Lactobacillus acidophilus* (014), *Lactococcus lactis* ssp. *lactis* (94), *Lactobacillus delbrueckii* ssp. *bulgaricus*, *Lactococcus lactis* var. *diacetylactis* (60) and *Lactobacillus acidophilus* (015) were tested for their antifungal activity against mold spore suspension of *Aspergillus flavus*, *Aspergillus fumigatus* and *Penicillium citrinum*. The antifungal activity of the supernatant of lactic cultures was found to be sensitive to trypsin. Heating the CFS of the lactic cultures to 100°C showed a significant loss of the antifungal activity. Electrophoresis of plasmid DNA showed that *L. lactis* ssp *lactis* (94), *L. lactis* var. *diacetylactis* (60), *L.acidophilus* (014) and *L. acidophilus* (015) harboured one plasmid each with molecular sizes ranging between 19.9kb and 26.69kb. Curing studies were conducted to establish the involvement of plasmid with the specific antifungal function of lactic acid bacteria. All the lactic cultures lost their plasmid and antifungal activity when subjected to growth at elevated temperature (45°C). The cultures when treated with intercalating (ethidium bromide) dye at concentration of 4, 6, 8 and 10 μg/ml of broth lost their antifungal property when their plasmid were denatured. Conjugation between *L.lactis* var. *diacetylactis* (60) and *L. acidophilus* (015) revealed non transfer of plasmid between the two strains.

**SQM-75**

**Effect of antimicrobial treatments on the storage stability of freshly cut carrots**

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Carrot is vegetable root crops that is relished by consumers and possess excellent nutritional profile. The objective of the present investigation was to evaluate the effect of various pre-treatments on the shelf life of fresh carrots to get acceptable quality minimally processed product. The prepared carrots were dipped in natural anti- microbial extracts of clove and tulasi (*Occimum sanctimum*) (both 2.5%). The extracts were prepared by boiling the measured amounts of distilled water followed by cooling and filtering. After dipping for 2, 4 and 6 min samples were removed and rinsed in distilled water at room temperature. The dipped carrots were stored at 5°C in LDPE packages to monitor their storage behavior. Results of the
experimental data established that the application of Tulasi extract, at a concentration of 2.5%, provided the most superior quality in terms of microbial load i.e. 50 cfu/gm (yeast and mold) and 90 cfu/gm (bacterial) as compared to microbial counts of 150 cfu/gm and 100 cfu/gm respectively for control. The investigation revealed that dipping in anti-microbial extract enhances the shelf-life by reducing the proliferation of microbes.

SQM-76
Effect of pH and neutralizers on the growth of lactobacillus acidophilus and streptococcus thermophilus mixed cultures

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The maintenance of pH of the growth medium at the optimum level required for the culture helps in increasing the cell number of several lactic acid bacteria. Moreover, the neutralizer used for pH control influences the maximum cell density of lactic culture in growth medium and the prevention of acid injury of the organism during fermentation. The present study was focused on the effect of pH and neutralizer on the growth of L. acidophilus and S. thermophilus alone and their mixed culture. SYG (skim milk, yeast extract, glucose) medium comprising skim milk (10%), yeast extract (0.5%) and glucose (1%) was used for this investigation. The pH of the medium was adjusted at 6.0, 6.5 and 7.0 to assess its growth pattern. The study revealed that about 2-fold increase in cell mass of L. acidophilus takes place at pH 6.0 more efficiently than at pH 6.5 and 7.0. Mixed cultures of L. acidophilus and S. thermophilus showed augmentation in growth at pH 6.5 when compared to respective control where the pH of medium was not neutralized to initial pH. The neutralizers used in this study were 20% NH₄OH and 20% NaOH solution. The selected SYG medium was neutralized after 8, 10, 14, 16, 18 and 24 hr of incubation with respective neutralizer. Pour plate method was used after 14, 16, 18 and 24 hr of incubation to determine viable cell counts. There were marked effects of neutralizer in attainment of higher cell counts. It was observed that neutralizer incorporated media with 20% NH₄OH showed effective result as compared to control (media without neutralizer). About 2-fold increase in cell count was achieved when neutralization was done with 20% NH₄OH solution. The difference between viable cell counts of neutralized and un-neutralized medium were significant at 1% level.

SQM-77
Storage stability of sucralose in burfi, a milk based confection

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Use of high potency sweeteners has emerged as a major way of cutting calorie intake via complete or partial replacement of calorie-laden sucrose in numerous sweet preparations. For commercial application, sweeteners need to be stable enough under usually practiced storage conditions so as to ensure consistent product quality throughout the shelf life of the product. Studies were conducted to elucidate the degradation behavior or stability of a relatively new high intensity sweetener, sucralose, in burfi, a popular khoa based
confection of India. Sucralose is a sweetener with a sweetening intensity of 600-650 as compared to sucrose, having a taste profile very similar to sugar without any aftertaste. HPTLC analysis of burfi samples showed that concentration of sucralose in burfi remained almost unaltered up to a storage period of 2 weeks at 30°C and four weeks at 5°C. Sensory evaluation of burfi containing sucralose vis-à-vis control samples containing sucrose also did not reveal much difference in sweetness intensity during storage. The excellent stability of sucralose was further affirmed by analyzing the stored samples for presence of any of probable degradation products of sucralose.

**SQM-78**

**Genetic variants of κ-casein and β-lactoglobulin and their association with milk rennet coagulation properties**

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Caseins comprise about 80% of the total protein content of milk and present polymorphism with changes in the amino acid sequence. kappa-Casein constitutes about 25% of the casein fraction of milk and beta-lactoglobulin accounts for about 75% of the albumin fraction and have been associated with differences in milk yield, composition and processing. Several polymorphisms have been found for each of these proteins. kappa-Casein variants A and B differ by two amino acid substitutions, Thr136/Ile and Asp148/Ala. The beta-lactoglobulin variants A and B also differ by two amino acid substitutions, Asp64/Gly and Val118/Ala. Present study has been undertaken with an objective to determine the frequency of κ-casein and beta-lactoglobulin genetic variants in cattle and buffalo and to determine an association between these genotypes and milk rennet coagulation properties. Genomic DNA was isolated by phenol chloroform extraction method from 270 cattle and 189 buffalo blood samples. Specific sets of forward and reverse primers were used to amplify kappa-casein and beta-lactoglobulin loci and genotypes were obtained by PCR-RFLP. Milk samples were analysed for fat, protein, somatic cell count and rennet coagulation parameters. All measured rennet coagulation parameters were significantly better for kappa-casein BB genotype as compared to AB and AA genotypes. Curd firming time and curd firmness were significantly influenced by parity, SCC and kappa-casein genotypes, while beta-lactoglobulin genotypes had no significant effect on milk rennet coagulation parameters. The use of milks with BB kappa casein genotypes may be suggested to obtain better yield and composition of cheese.

**SQM-79**

**Texture analysis of paneer on the basis of different fat content**

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Paneer Samples prepared from low fat milk is poor as far as the textural quality is concerned. The samples analyzed using seven different probes showed variation in textural characteristics with change in coagulation temperature. Pressure also has direct effect on the texture of the food as higher pressure provided the Paneer with harder texture. The Paneer prepared with higher fat content has soft and smooth texture.
Paneer with different fat content and coagulation temperature were subjected to the texture analyzer under seven different probes. It was found that the Paneer prepared from milk under 42 kg pressures was harder than other samples analyzed. Knife probe - sample of 0.5% fat required maximum cutting force among the samples analyzed. Needle probe - The minimum penetration force was noted for full cream sample coagulated at 95°C and set at 42 kg pressure. Cylinder probe - Sample coagulated at 90°C showed maximum force than the other two temperature regime. Ball stainless- Paneer sample coagulated at temperature (80°C, 90°C, and 95°C) are much harder when compared with other samples. The fat content also plays an important role in the hardness/softness of the outer surface. Compression plate – the minimum force is applied to the samples containing highest fat content (6%) as well as the maximum force applied to sample having lower fat content (0.5%) and higher pressure (45 kg). Butter cutter- the cutting force required was highest in the samples having lower fat content (0.5%) and higher pressure (42 kg) applied. Fracture wedge- The fracturability of the samples were almost identical when fat content was 3.0% and 6.0% but it varied greatly when fat content was 0.5%. In order to keep the textural quality of food sample up to mark, it should be prepared using high fat milk and coagulation should be done at optimum temperature.

**SQM-80**

**Effect of ingredients on textural characteristics of doda burfi**

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Doda burfi is one rare sweet gourmet, which is quite popular in northern India. The product is made by concentrating and desiccating a mixture of milk and germinated wheat flour along with sugar. The doda burfi is characterized by caramelized flavour, delicious taste, brown colour and sticky granular texture. Present investigation was carried out to elucidate the effect of ingredients (Malated barley flour, sugar) and processing variables (fat and acidity of milk) on textural profile analysis of Doda burfi using a central composite rotatable design (CCRD). The sugar level in formulation has most significant effect on primary textural properties i.e. hardness, adhesiveness, cohesiveness, at linear level. Increasing the sugar concentration in formulation increased the hardness, while adhesiveness and cohesiveness of doda burfi decreased. Linear and square terms of malted barely flour had significant effect on hardness and cohesiveness of doda burfi. The acidity and fat percentage of milk had no effect on the textural attributes of doda burfi. Secondary textural properties i.e. gumminess and chewiness are not affected by the ingredients. No ingredient or processing variables had any significant effect on springiness of burfi.
A. A. Askar 117  Anil Kumar 99,132  B. V. Balasubramanya 32
A. A. Hefny 126  Anjali Dewan 35  B. V. Venkateshiah 75,119
A. Augustine 52,104  Ankita Pagedar 135  Baljeet S. Yadav 79,127
A. Dang 130  Anne Dolivet 3,59,110  Balram Dwivedi 94
A. F. Lembhe 86  Anshu Sharma 117,120  Bhupendra Kumar 68
A. G. Bhadania 59  Aparna Gupta 31,33,84,128  Bimlesh Mann 31,33,39,84,128,133
A. H. Aziz 126  Aradhita Ray 106  Binita Rani 31,121
A. K Joseph 18  Archna Verma 145  C. Chakraborty 82
A. K. Bandyopadhyay 82  Arun Kumar Jain 120  C. D. Khedkar 92
A. K. Biswas 135  Arun. K. Das 131  C. J. Joseph 57
A. K. Dudeja 49  Arvind 28  C. Kathirvelan 35
A. K. Mohanty 33  Arvind Kumar 27  C. M. Kapoor 76,123,124
A. K. Patel 40  Asghar Khosroshahiaisl 97  C. N. Pagote 32,123
A. K. Punya 32,34  Ashish Kumar Singh 98,99,146  C. Naresh Kumar 143
A. K. Singh 88,89  Ashish. K. Makwana 41  C. Pandiyan 29
A. K. Thakur 50  Ashok Kumar 120  C. Singh 95
A. K. Tyagi 35  Avinash Singh 65  C. Stanton 22
A. Kaur 98  B. A. Jadhav 87  C. V. Bhambure 77,91
A. M. Chappalwar 55  B. B. Khutal 63,115  Chaitali Debnath 79
A. M. Natarajan 66  B. B. Verma 133  Chand Ram 32
A. M. Patel 54  B. C. Sarker 94,141  Chandrasah Sahu 108
A. M. Miri 84,131  B. D. Sharma 92,137  Charanriv Singh 94,138
A. Mohammadi 84  B. Dhanalakshmi 143  D. C. Rai 128
A. R. Sen 137  B. K. Goel 61,62,64  D. D. Patange 56,96,125,126
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