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The national Dairy Research Institute is the national centre for the pursuit of knowledge of all branches of dairy science, to lead to increase in milk production and consumption in the country. The institute is spreading the knowledge gained by the work experience and results of researches conducted by its scientists and students. Its unending thirst of knowledge is making nation rich with the wealth of knowledge. Here below we are giving the processing technologies developed by eminent scientist for value addition of milk and scientific preparation of dairy products we use in our day-to-day life.

### Milk

<table>
<thead>
<tr>
<th><strong>1. Humanization of Buffalo Milk</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>In humanization of buffalo milk the following major steps are involved:</td>
</tr>
<tr>
<td>• Removal of as-caseins: the first endeavour was to reduce the level of as-casein from buffalo milk. For that purpose, whole casein in was fractionated by urea to selectively extract as-casein out from the mixture. The beta-K-casein thus obtained was reconstituted.</td>
</tr>
<tr>
<td>• Buffalo milk was collected and skimming was done at room temperature within an hour of collection using Alfa-Felix Cream Separator or hand driven cream separator. This was then subjected to proteolysis by incubating with Trypsin (1.75 mg/ml) for half an hour at 37°C. This was then pasteurized at 72.50°C for 15 seconds in order to restrict the proteolysis.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>2. Low Lactose Milk</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Dr. S. M. Datta</td>
</tr>
<tr>
<td>When milk is consumed, lactose-the principal sugar of milk is digested in small intestine by intestinal β-galactosidase, which cleaves lactose into glucose and galactose, which are then absorbed. More than 60% of the population in India, either lacks the enzyme in their intestine or have low activity. Such individuals suffer from severe stomach discomforts on consumption of milk. Investigations conducted at this Institute have culminated in development of a process for preparation of milk in which lactose is hydrolysed by a β-galactosidase of microbial origin before it is consumed. The lactose intolerant population of the country can thus consume such low lactose milk.</td>
</tr>
</tbody>
</table>

**Microbial Sources:** Five promising cultures belonging to yeast, Kluyveromyces fragilis and lactic acid bacteria Streptococcus thermophilus, S.cremoris, Lactobacillus bulgaricus and Leuconostoc cremoris maintained at the culture collection centre of the Institute are used for the production of the enzyme.

**Production Of The Enzyme:** The enzyme is produced by inoculating any of the above organisms in whey (either cheese whey or acid whey) supplemented with peptone and corn steep liquor and incubating the medium for periods ranging from 12-36 hours. The cells of the organisms are then harvested by centrifugation and the harvested cells are subjected to disintegration by ultrasonic disintegration. The enzyme is separated from the cell debris by centrifugation and used for hydrolysis of lactose.

**Hydrolysis Of Lactose In Milk:** The enzyme produced as above is mixed with milk at a concentration adjusted to 12° NP units and is incubated for a period ranging from 3 to 4 hours. The milk then is subjected to pasteurization. Milk subjected to enzyme treatment described above has more than 70% of its lactose hydrolysed and is suitable for consumption by lactose intolerant individuals.

### 3. Milk Shake

**Sh. A.K. Sharma & Dr. S.K. Gupta.**

Milk shake, a product of Western origin, is obtained by freezing a mix very similar to soft serve ice-cream mix and speed mixing the frozen product in a mixer to make it pourable and generate foam in it. It has lower fat and sugar contents and higher milk solids-not-fat (MSNF) content than ice-cream. In view of the increasing popularity of milk based frozen products, a study was undertaken to standardize the method of manufacture of milk shake. The study was also extended to obtain the product in a powder form which could easily be reconstituted by households.

**Combination**

Of the various combinations studied, the one with fact and MSNF levels of 4 and 13% respectively, was found to be the most acceptable with respect to the whipping ability of mix and foam stability and sensory evaluation of the milk shake prepared therefrom.

**Steps In Processing**

The ingredients required i.e. whole milk, skim milk powder, sugar and stabilizer (sodium alginate) were weighed and mixed as follows: Sugar (at the rate of 10%) and stabilizer (at the rate of 0.4%) were dry-mixed first. The milk was warmed up to 40°C and the skim milk powder was slowly added to it with continuous stirring. The temperature of the mixture was then raised to about 70°C before adding the sugar stabilizer mixture. After thorough mixing, the liquid was filtered through muslin cloth and while at about 60°C it was homogenized in two stages first at 175 kg/cm² and second at 35 kg/cm² pressure. The homogenized mix was pasteurised at 71°C for 30 minutes. The mix was then cooled to about 10°C and aged for 2-3 hr at 6°-10°C. Following the aging, the milk shake mix was frozen in a soft-serve ice-cream freezer using strawberry flavour (0.1ml/litre). The drawing temperature varied between -2°C to -6°C. The frozen mix was blended in a mixer for 90-120 sec to produce milk shake.

### 4. Milk Powder

**Drum Drying/Roller Drying**

**Principal:** Concentrated milk is applied in a thin film upon the smooth surface of a continuously rotating steam heated metal drum, roller of cylinder. The film of dried milk is continuously removed by a stationary knife/doctor blade/scaper. The drums/rollers are normally horizontal hollow cylinders 8-12 ft in length and 2-4 ft in diameter. They are heated internally by steam. In case of double drums driers drums are mounted parallel and one drum is fixed on a moveable frame so that the gap between the drums could be adjusted as desired. The speeds of the drums are also adjustable. The average speed ranges between 12-20 r.p.m. The milk film is recover from the drum after nearly 3/4 of revolution of the drum has...
**Spray Process**

**Principal:** The basic principal consists in atomizing the concentrated milk to form a spray of very minute droplets (fog like mist), which are directed into large, suitably designed drying chamber where they mix intimately with a current of hot air. Owing to the large surface area the milk particles surrender their moisture practically instantaneously and dry to a fine powder which is removed continuously.

**Manufacturing Process:** Concentrated milk (both standardized and skim milk) is atomized with pressure type or centrifugal type atomizer. The atomized droplets of milk are dried within a chamber within let hot air at 150°-230°C and outlet air at 75-100°C depending upon the drier characteristics. To reduce heat damage during dehydration and yet obtain the desired moisture in the powder a low exhaust air temperature is preferred. The atomized product is brought into intimate contact with heated air in the drying chamber for moisture removal. As the product is dried, it is necessary to separate the dried product from the air, Cyclone collector is most commonly used for powder collection. Multiple cyclones of relatively smaller diameter increase the efficiency of powder recovery. The dried particles should be removed from the drying chamber as quickly as possible to reduce the heat damage to the product. The dried product collected from cyclone separator is cooled and packaged. Skim milk powder is packed in kraft paper bags with a plastic liner and whole milk powder is gas packed in metal containers.

**Dried Milk:** Dried milk or milk powder is the product obtained by the removal of water from milk by heat or other suitable means to produce solid containing 5% or less moisture. Whole milk, skim milk or partially skimmed milk may be used for the purpose of drying.

**Legal Standards (PFA Regulation):** Whole milk powder shall contain not more than 5.0% moisture and not less than 26% fat.

Partially skimmed milk powder shall not contain more than 5% moisture and the fat content of the product shall be between 16.2-24.0%.

Skim milk powder shall not contain more than 5.0% moisture and not more than 1.5% fat. The minimum solubility and solubility index shall be as follows:

| Solubility % | 85.0% | 98.5 |
| Solubility index | 15 ml | 2 ml |

**Flavoured Milk:** As per P.F.A. standard, the flavoured milk, by whatever name it may be called, may contain chocolate, coffee or any other edible flavour, edible food colours and cane sugar. Flavoured milk shall be pasteurised, sterilised or boiled.

1. **Standardisation Of Milk:** It should meet the standards of different types of milk from which it is made. The standards for different types of milk have been prescribed by P.F.A.

2. **Addition Of Sugar:** The sugar should be added at the rate of 5-7% of milk.

3. **Filtration:** The sugar should be added to the milk at the rate of 1 ml per litre of milk and the colour should be added.

4. **Addition Of Colour And flavour:** The edible flavour is added at the rate of 1 ml per litre of milk and the colour should be added.

5. **Pasteurization:** Heating to a temperature of 63°C for at least 30 minutes or 71.5°C for 15 sec. and cooled to a temperature of 10°C or less and shall be maintained at that temperature until delivery.

**5. Evaporated Milk**

Lower heat stability of buffalo milk when it is heated after concentration has so far prevented the manufacturing of evaporated milk from it. Studies at NDRI revealed that addition of 0.5 to 1.0% acid casein to buffalo milk before its concentration increased its heat stability and enabled the manufacturing of evaporated milk. Conventional stabilizers (disodium phosphate and trisodium citrate) which are used in cow milk acted as destabilizing agents used in buffalo milk. However, the monosodium phosphate addition (0.05 to 0.10%) before concentration to buffalo milk caused a considerable increase in the heat stability of concentrated buffalo milk and enabled it to withstand the sterilization treatment without coagulation the stabilizing effect of monosodium phosphate was even better than acid casein.

**6. Coffee/Tea Whiteners**

**Dr. B. N. Mathur**

In metropolitan cities, a large amount of milk is used for the preparation of coffee/tea. Use of coffee/tea whiteners for this purpose will encourage the use of fluid milk for other purposes, such as feeding children, elderly group of people, etc.

Method has been standardised for the manufacture of two types of coffee/tea whiteners - one which is low in fat content (LFCW), is specially meant for the group users, who like to restrict calorie intake and other with high (HFCW) which is meant for the replacement of cream for whitening of coffee/tea.

**Equipment Used**

1. Mixing vats
2. Plate heat exchangers
3. Homogenizer
4. Spray drier
5. Packing equipment

**Steps In Processing**

1. Various ingredients (cream, sodium caseinate, glucose syrup, GMS, CMC, Trisodium phosphate and trisodium citrate) are mixed in the desired proportion as indicated in the table. Total solids are adjusted to 35 per cent.
2. The mix is preheated to 80°C/10 min. and then homogenised (1st stage 175 kgs/cm² and 2nd stage 35 kgs/cm²).

3. This mix is spray dried, employing drying air inlet temperature of 210°C and outlet temperature of 95°C. The moisture content of the dried product should be about 3 per cent.

4. The product is packaged under nitrogen and stored preferably below 15°C.

**Composition**

<table>
<thead>
<tr>
<th>Constituents (%)</th>
<th>LFCW</th>
<th>HFCW</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Fat</td>
<td>12.4</td>
<td>48.6</td>
</tr>
<tr>
<td>2. Sodium caseinate</td>
<td>37.0</td>
<td>20.8</td>
</tr>
<tr>
<td>3. Glucose syrup</td>
<td>37.0</td>
<td></td>
</tr>
<tr>
<td>4. GMS</td>
<td>5.6</td>
<td>3.8</td>
</tr>
<tr>
<td>5. GMC</td>
<td>1.2</td>
<td>0.7</td>
</tr>
<tr>
<td>6. Tri-sodium phosphate</td>
<td>1.2</td>
<td>0.7</td>
</tr>
<tr>
<td>7. Tri-sodium citrate</td>
<td>2.5</td>
<td>1.4</td>
</tr>
</tbody>
</table>

---

**7. Dried Milk Shake Mix Powder**

The milk shake mix was also spray dried and powder contained 3.3% moisture; 15.1% fat, 17.7% protein and the rest being carbohydrate and ash. Its solubility index was 0.45 ml, and bulk density 0.44 g/ml (loose) and 0.59 g/ml (packed).

The dried milk shake mix powder could be reconstituted by mixing calculated amount of crushed ice (to adjust the solids level at 28% in the final product) and blending in a mixer for 90-120 sec. The reconstituted product when subjected to sensory evaluation was found to be quite acceptable. However, it scored slightly less than fresh milk shake, on account of slight chalkiness and too large ice crystals. Aging of the reconstituted milk shake for 2 to 3 hours in refrigerator prior to mixing in a mixer would help improve the acceptability of the product.

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**8. Banana Milk Powder**

Milk is dehydrated, after mixing with fresh banana pulp sugar and stabilizers. This powder is suitable for the preparation of flavoured milk, custards, sups, pudding etc.

The final product contains:

<table>
<thead>
<tr>
<th>Constituents (%)</th>
<th>Moisture</th>
<th>Milkfat</th>
<th>Milk solids not-fat</th>
<th>Fruit Solids</th>
<th>Sugar</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2.0</td>
<td>18.0</td>
<td>53.0</td>
<td>13.0</td>
<td>10.0</td>
</tr>
<tr>
<td></td>
<td>2.5%</td>
<td>20.0%</td>
<td>55.0%</td>
<td>15.0%</td>
<td>12.0%</td>
</tr>
</tbody>
</table>

The product is marketed in gas packed tins.

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**9. Spray Dried Mango Milk Powder**

**Dr. P. P. Bambha**

Ready to reconstitute food products have always a demand and mango milk powder is an important one among them. It can be readily reconstituted into pleasant mango milk drink, or used in ice cream, custards, puddings, etc. The product can easily be made in dairy plants manufacturing dried milks with some additional equipment.

**Composition**

<table>
<thead>
<tr>
<th>Constituents (%)</th>
<th>Mango solids</th>
<th>Milk fat</th>
<th>Milk solids-not-fat</th>
<th>Sugar</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>18%</td>
<td>13.8%</td>
<td>36.7%</td>
<td>26%</td>
</tr>
</tbody>
</table>

---

**10. Spray Dried Malted Milk Foods**

**Dr. R. Balachandran**

Malted milk food was first developed in 1883 by Mr. Walliam Horlicks of Racine, Wisconsin, U.S.A. The product was commercially marketed in 1887. The product received patronage from medical profession and public due to its convenience, nutritive value, digestibility and palatability. Walliam Horlicks undertook the research at the request of some physicians who wanted to have a baby food combining milk solids and cereals. According to Hanziker, in the United States the first successful
A dried milk manufactured on a commercial basis was malted milk.

**Reg. For Malted Milk Foods IS-1806-1975**

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Characteristics</th>
<th>Requirements Type-I</th>
<th>Type-II</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Moisture % by mass maxi</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>2.</td>
<td>Total protein (Nx 6.25) on dry basis &amp; by mass, min.</td>
<td>13</td>
<td>11.5</td>
</tr>
<tr>
<td>3.</td>
<td>Fat (% by mass) % by mass min</td>
<td>7.5</td>
<td>6</td>
</tr>
<tr>
<td>4.</td>
<td>Total ash (% by mass) % by mass max</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>5.</td>
<td>Acid insoluble ash (on dry basis % by mass, min.)</td>
<td>0.1</td>
<td>0.1</td>
</tr>
<tr>
<td>6.</td>
<td>Solubility % by mass, min.</td>
<td>85</td>
<td>80</td>
</tr>
<tr>
<td>7.</td>
<td>Cocoa powder (on dry basis) % by mass, min.</td>
<td>-</td>
<td>5</td>
</tr>
<tr>
<td>8.</td>
<td>Test for starch -ive</td>
<td>-ive</td>
<td></td>
</tr>
<tr>
<td>9.</td>
<td>Bacterial count/gm max.</td>
<td>50,000</td>
<td>50,000</td>
</tr>
<tr>
<td>10.</td>
<td>Coliform count/gm max.</td>
<td>10</td>
<td>10</td>
</tr>
</tbody>
</table>

**Type-I:** Malted milk foods containing no cocoa powder.  
**Type-II:** Malted foods containing cocoa powder.

**Malted Milk Preparation**

Suggested method for preparation of malted milk is as follows: Crushed barley malt after steeping at 38°C should be mixed with cooked (at 95°C for 2 hours) wheat flour paste in ratio of 0.4 pounds of wheat flour per pound of malt. Mashing should be done by holding malt-flour mixture at 45°C for 30 min and then the temperature raised gradually to 70°C and holding at this temperature for 2 hours to complete the conversion of starch to sugar. After separation of wort, milk should be mixed to have the minimum statutory requirements of 7.5% fat. The mixture after forewarming (at 65°C) and condensing (68-70% T.S) can be dried in a special vacuum pan or in a drum drier or in a spray drier. Experimental studies have been conducted at NDRI, for the production of spray dried malted milk. The results of the study indicate that it is possible to produce good quality spray dried malted milk. The following processing variables were found to give good quality product. Concentration of mix to 45% total solids, atomization of mix at a speed of 25,000 rpm. The powder so obtained was found to contain on an average 2.93% moisture, 15.28% protein, 7.52% fat and 4.08% ash. Storage studies in the malted milk powder indicated that this product could be stored at 30°C for 12 months without much change in the sensory characteristics.

**11. Improved Infant Formula**

An industrial process has been developed that permits manufacture of an infant formula which resembles human milk in the ratio of protein: Fat: carbohydrates. The protein content in formula is adequate to fulfill the entire nutritional requirements of infants during the first year of the life, but without overloading the renal functions (which the presently available formulae do). This also permits extension of available bovine milk for the manufacture of higher quantities of infant foods, as well as reduce costs. Further modification also permits adjustment of whey protein to casein ratio, thus simulating human milk more closely. The fat content has been modified so as to incorporate nutritionally superior middle chain glycosides from vegetable sources. Significantly this aspect has both nutritional and cost advantage. Process has been also standardized for the manufacture of Malto dextrin through starch hydrolysis suitable for incorporation into the formula in order to adjust the ratio of calorie contributing nutrients.

Another outstanding feature of the formula developed relates to the bifidus stimulating property. Animal bio-assays as well as clinical studies carried out under medical supervision have demonstrated that Bifidobacterium bifidum can be implanted in the intestinal tract through feeding of formula developed. In this manner, the improved formulation is expected to favour superior utilization of minerals, synthesise "B-complex" vitamins in intestine, play a detoxification role in chronic liver diseases and provide protection against intero-pathogenic infections.

**12. Ice Cream Powder**

Ice cream is a delicious, wholesome, nutritious, frozen dairy food. It has occupied a unique place in the diet of the people in the West and is gaining steady in popularity all over India.

In India nearly 60 per cent of milk production is from buffaloes. In the lean season, raw milk is in short supply and most of the surplus milk available in the flush season is used for preparing butter, ghee and skim milk powder. There is considerable demand for ice cream in the summer season (incidentally it is also the lean season of milk production), which can be conveniently met by diversifying a part of the milk during the flush season for the manufacture of ice cream powder.

Use of gelatin as stabilizer in the manufacture of dried ice cream mix yields ice cream having coarse body and texture characteristics and foam melt-down. Moreover, use of gelatin hurts the sentiments of a majority of the people who are vegetarians. Ice cream powder prepared using polysaccharide stabiliser of vegetable origin, and which on reconstitution with water yields ice cream of smooth body and texture characteristics has been developed recently at NDRI, Karnal.

**Steps In Processing**

The ingredients used are fresh milk/skim milk, cream, skim milk powder, pregelatinized potato starch as stabilizer and Tween 80 as emulsifier. The composition of the ice cream mix is adjusted so that it contains only 25 per cent of the total sugar before spray drying. All the ingredients are weighed so that the mix contains 17.1 per cent fat, 14.2% SNF, 5.3% sugar, 0.7% pregelatinized potato starch and .07 % Tween-80. Pregelatinized potato starch is mixed with little amount of sugar and added to milk/skim milk and heated, accompanied by vigorous agitation. The required amount of cream is adjusted to 50°C. Skim milk powder mixed with the remaining sugar (to facilitate dissolution of powder particles) is added to the mixture with vigorous stirring/ The contents are filtered through a muslin cloth and Tween-80 added to the mixture. The temperature of the contents is raised to 70°C and the mix homogenized at 176 kg/cm² and 35 kg/cm² on the first and second stage respectively. The mix is then pasteurized at 68°C/30 min, cooled to 5-10°C, aged for 16 hours and spray dried using an inlet air temperature of 73°C and an
13. Dried Ice-cream Mix

Preparation of ice cream requires special efforts in the assembling of necessary ingredients like cream, milk powder, stabilizer, sugar etc. It is also necessary to mix the ingredients in definite proportions and process the same in special equipments to get a product of standard quality. By using a ready-to-reconstitute dry ice-cream mix containing all the necessary ingredients much labour can be saved. The development of this product has made it easy for the housewives and the small scale ice-cream manufacturers to prepare ice cream for use at short notice.

**Composition**

<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moisture</td>
<td>1.5%</td>
</tr>
<tr>
<td>Milkfat</td>
<td>30.0%</td>
</tr>
<tr>
<td>Milk solids not-fat</td>
<td>28.0%</td>
</tr>
<tr>
<td>Fruit Solids</td>
<td>1.0%</td>
</tr>
<tr>
<td>Sugar</td>
<td>35.0%</td>
</tr>
</tbody>
</table>


**Dharam Pal, B.B. Verma and F.C. Garg**

Kulfi is a very popular traditional frozen milk product of India. The chemical and organoleptic qualities of kulfi sold in markets vary to a great extent. Inferior microbial quality is another serious drawback of market kulfi. The existing small scale batch process of kulfi making is not suitable for industrial application. A technology has been perfected at this Institute for the manufacture of kulfi mix powder by spray drying process.

**New Technology:** Mix is formulated from milk fat, MSNF, sucrose and isabgol husk. The concentration of solids is adjusted in the mix and only 25% of the total sugar required is added before drying. The mix is homogenized and heat treated in a tubular heat exchanger. The mix is spray dried. The remaining sugar in ground from is dry blended with the powder and packaged in the tin cans. The approximate chemical composition of kulfi, mix powder is: fat-25.41%, MSNF-36.98%, isabgol 0.46%, sugar 34.65%, and moisture 2.52%. The product has a shelf-life of 7 months at 30°C in tin cans. The shelf-life can be extended upto 10 months with the addition of butylated hydroxy anisole and nitrogen gas flushing. The cost of production of kulfi mix powder had been worked out to be Rs. 95/- per kg. Kulfi mix powder can be instantly reconstituted and frozen to get kulfi of consistently good quality all the year round at an affordable price.

15. Utilization of Buttermilk and Soybean for the Manufacture Of Softy Ice-Cream

**Dr. R.B. Rajor & Dr. S.K. Gupta**

Buttermilk is an important by-product of butter industry. It is estimated that nearly 0.92 million tons of buttermilk is produced annually in the organised dairy sector. There is, however, little evidence of its economical utilization. The composition of buttermilk is quite similar to skim milk, except for little higher concentration of fat, mainly phospholipids. The utilization of buttermilk for popular frozen desserts such as softy ice-cream will conserve the solids of milk.

Buttermilk powder is considered to be an excellent replacement for the skim milk powder in the ice-cream mixes. Soybean is unique, in that it produces more protein per acre than any other protein source and its protein contains, in nearly optimum proportions, the essential amino acids except sulphur containing AA's. Two kgs of soy flour contains as much protein as 14 litres of milk. Soybean acts as a moisture retainer, emulsifier, stabilizer binder, as well as enhances the shelf life of products and improves product appearance. It helps food processors to produce generally high quality food at comparatively lower production cost. The present study was, therefore, undertaken to develop a softy ice-cream using butter milk and soybean. It was expected that the product would not only be cheaper but also nearly equal in nutritional value.

**Steps In Processing**

The process, as standardized, entails in presoaking the soybean overnight in sodium bicarbonate solution, blanching and dehulling. The cotyledons thus obtained were ground in various ratio with buttermilk. Fat and sugar were then added and the mixture was pasteurised and homogenised. The mix was cooled and aged, and then frozen in a soft serve ice-cream freezer.

**Composition**

In order to get the most acceptable product, various combinations of soybean: buttermilk solids were tested, such as 1.1:1, 1.3:1, 1.5:1, 2:1 etc. The first combination was liked most and the second was the next best. Amongst additional source of vegetable oils, three oils/fats locally available were tried, these were coconut, groundnut oil and hydrogenated vegetable fat. Of these, the last did not impart any of its own flavour to the product and, therefore, was found to be the most acceptable. Softy ice-cream was thus made using 1.3:1 of soybean and buttermilk solids, using hydrogenated vegetable fat for subsequent trials. By varying the fat, SNF and sugar concentration, the most acceptable combination was found, which was respectively, 9%, 12% and 15%. It was observed that addition of 0.1, 0.2 or 0.3% sodium alginate brought about unusually large increase in the viscosity of the mix, which was not appreciated by judges. It was then felt that there was no need for addition of a stabilizer in the soybean-buttermilk softy ice-cream.

The softy ice-cream mix was spray dried & stored in tin (packaged with / without nitrogen) and polyethylene containers and stored at 30°C 1°C and 5°C 2°C to assess the shelf life of the product. From this storage study, it was observed, from physico-chemical and sensory
properties (of reconstituted, softy ice-cream) that the product packaged in tins could be stored for 9 months at 30°C and more than 12 months at 5°C. While in polyethylene bags, the product had acceptable quality for 5 months at 30°C and 9 months at 5°C.

16. Softy from Soybean and Butter milk

An increasing trend is evident in the consumption of frozen milk products such as ice-cream, softy etc. in the urban area of this country. However, the short supply and high cost of milk solids, from which these products are made, are not within the reach of low-income families. Hence, a low cost softy yet of acceptable quality, is developed from soybean and butter milk.

**Composition**

<table>
<thead>
<tr>
<th>Fat</th>
<th>9.0% (Hydrogenated fat)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solids-not-fat</td>
<td>12.0% (Soysolids: buttermilk solids, 1:3:1:0)</td>
</tr>
<tr>
<td>Sugar</td>
<td>15.0%</td>
</tr>
<tr>
<td>Total Solids</td>
<td>36.0%</td>
</tr>
</tbody>
</table>

DAHI, YOGHURT, LASSI

**Dahi** is an indigenous fermented milk product with a pleasant aroma obtained through lactic acid fermentation of milk with lactic acid bacteria and consumed by almost all over India as a part of the diet or as a refreshing beverage. Dahi also forms the base for the preparation of several indigenous dairy products like Chakka, Srikhand and Payodhi.

**Starter Cultures**

Mixed starter cultures of unknown composition are being used for the preparation of dahi under market and household conditions leading to a product of unpredictable quality. Survey reports confirm the variation of cultures from market to market and also from batch to batch and the flora changes from season to season. Strains of Streptococcus salivarius ssp. Thermophilus, Lactococcus lactis ssp. Lactis, Str. Faecalis, Lactobacillus dextranicum, Lactobacillus bulgaricus, Lb. Casei and Lb. Brevis and of yeast have been found in various market and home made dahi samples. To avoid such an uncertainty in the quality of dahi and to prepare dahi with uniform and good quality, mixed cultures of mesophilic lactic acid bacteria with known composition have been formulated at NDRI. Recently developed dahi satarter ‘D’ consists of species, of Lactococcus lactis ssp. Lactis, Lc. Lactis ssp. Cremoris and Lc. Lactis ssp. Lactis biovar diacetylactis whereas the formulation of DAB is having Lb. Acidophilus and Bifidobactrium bifidum in dahi culture D. this combination improves the nutritional and therapeutic quality of the product.

**Preparation Of Bulk Starter**

For the preparation of bulk starter of dahi, good quality raw milk (with respect to bacteriological and chemical qualities) preferably skimmed milk is taken in a stainless steel container with proper lid. It is subjected to steaming in an autoclave or pressure cooker for 45 min. The heat treated milk is cooled to 30-37°C by keeping the container in chilled water (during summer) or under tap water (in winter season).

Then the milk is inoculated with an active starter of dahi (D/DAB) @ 1.0% taking all aseptic precautions. After mixing the culture well, it is incubated either at 30°C for culture combination ‘D’ or at 37°C for culture combination ‘DAB’ until the milk curdles, which generally ranges from 12-14 hrs. now the bulk starter is ready for use in the preparation of dahi.

**Selection Of Milk:** Dahi is prepared from cow or buffalo milk or mixed milk. The milk should be of good bacteriological quality and should not contain neutralizers, preservatives, antibiotics, pesticides and foreign matter. Dahi prepared from skim milk will have semi-firm body.

**Flow Diagram For Production of Dahi**

1. **Raw Milk**
   - (Cow/buffalo/mixed/standardized whole milk)
   - Heating: (90°C for 15 min in double jacketed vat/by keeping the milk container in boiling water).
   - Cooling: (30°C or 37°C by keeping in chilled water or under running tap water).
   - Inoculation: (With the dahi culture D/DAB @ 1.0%)
   - Packaging: (in plastic cups/stainless steel containers of 100, 250 or 500ml capacity with suitable lids)
   - Incubation: (30°C or 37°C for 12-14 hrs)
   - Dahi
   - Storage: (5°C in refrigerator)

**Heat Treatment Of Milk:** Efficient heat treatment of milk is essential for the preparation of good quality dahi. The heat treatment improves the quality of milk by destroying the unwanted bacteria of milk & thus provides favourable conditions for the growth of starter cultures. Heating the milk at 90°C for 15 min. in double jacketed vat or by placing the container in boiling water yields dahi or firm texture and pleasant aroma. Subjecting the milk to drastic heat treatment on direct flame should be avoided. Heated milk is immediately cooled to either 30°C or 37°C by keeping under running tap water. Proper care is to be taken not to expose the heated milk to the atmosphere.

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Inoculation: The cooled milk is inoculated with an active dahi culture D or DAB as pre-requirement @ 1.0% and mixed thoroughly.

Packaging: Inoculated milk is distributed in single service containers/plastic cups or aluminium foil cups/wide mouthed glass bottles/stainless steel containers of 100,250 or 500 ml capacity and covered with lids.

Incubation: Incubation is carried out either at 30°C or at 37°C for dahi cultures D and DAB, respectively until cured formation.

Storage of Dahi: The set product is stored at refrigeration temperature (5°C) till consumption. It keeps well at this temperature for one week.

Sensory Qualities: Good quality dahi appears as glossy with a slightly firm body. It gives a delicate aroma with mild acidity.

Standard: According to P.F.A. (Prevention of Food Adulteration Act), dahi shall have the same minimum percentage of milk fat and milk solids-not-fat as the milk from which it is prepared.

Titratable acidity of a good quality, sweet and sour, dahi should be in the range of 0.8 to 1.2% lactic acid. It is suggested that a minimum number of ten million cells of lactic acid bacteria per gram of dahi should be present. However, with culture DAB, at least on million cells of Lact. Acidophilus and Bifidobacteria should be present in the product to have the therapeutic benefit with the product. Dahi should not contain more than five organisms of yeast and moulds and one coliform bacterium per gram of the product and should give negative result with phosphatase test.

Defects In Dahi

Colour And Appearance
Good quality dahi will not show any objectionable colour defect. Browning due to over heating is considered as a defect. Presence of foreign matter represents unclean appearance.

Body And Texture

- Wheying off: Either free whey floating on the tips of curd or curd floating on top with free whey at the bottom is considered as a defect. The former defect is also associated with high acidity, high temperature and prolonged incubation. The latter defect is due to contamination of milk or starter with coliform group of bacteria.
- Watery with curd flakes: This is due to low total solid content of milk used for dahi making followed by mechanical stress to curd or due to improper heat treatment of the milk.
- Too weak body: this defect is due to insufficient acid production or low total solid content.
- Gassiness: The growth of yeasts or coliforms causes the presence of gas pockets in the body of curd or gassy appearance of dahi.
- Ropiness: This defect can be seen if milk is not heated properly or gets contaminated with slime producing organisms.

Flavour:
- High acidity: Excessive amount of inoculum or high temperature or prolonged storage leads to sharp taste and gives very acidic smell.
- Bitterness: Milk or culture exposed to open air gets contaminated with sweet curdling micro-organisms thereby causing bitter taste.
- Yeasty or alcoholic: This is due to the growth of contaminant yeasts.
- Burnt/cooked: Over or low heating of milk on a brisk fire leads to this defect.
- Metallic: This defect is due to contamination of milk with iron or copper and occurs when curd is set in metallic containers.

Benefits Of Dahi Consumption

Dahi has been recommended for curing dyspepsia, dysentery and other intestinal disorders. It is believed to improve appetite and vitality. Antibacterial compounds formed and low pH imparted by lactic acid bacteria help prevent the growth of putrefactive and other undesirable micro-organisms. Incorporation of special bacteria, i.e. Lact. Acidophilus and bifidobacteria, in dahi starter cultures help in lowering the cholesterol level of blood and thereby minimizes the chances of heart attack. It is also believed that consumption of dahi prepared with DAB helps in controlling the occurrence of cancer. It is more easily digested than milk, by persons suffering from lactose intolerance because the fermentation of dahi results in partial conversion of lactose into lactic acid. Consumption of dahi nullifies the adverse effect of drugs especially antibiotics administered in antibiotic therapy on the digestive system. An increase in the contents of vitamin B12, folic acid and niacin in dahi compared to the milk from which it is prepared has been reported. This indicates the advantage of consuming dahi at regular intervals by all age groups.

19. Dahi From Sweet Cream Buttermilk

Sh. R.G. Shreshta & Dr. S.K. Gupta.

Buttermilk is the fluid portion left behind after churning of cream or ‘dahi’ during butter manufacture. Since buttermilk is largely defatted cream, its composition is much like that of skim milk. It is estimated that 1.5 million tonnes of milk is annually used for the production of creamery butter and therefore nearly 8,000 tonnes of buttermilk solids are available for utilization. While a small portion of the by-product thus obtained is utilized for the manufacture of infant food, skim milk powder etc., a major portion does not find economic disposal, and is merely wasted.

This investigation was undertaken with a view to evolve a suitable technique for the manufacture of dahi from sweet-cream butter milk. Dahi is used as a part of diet in this country on account of its virtues from the nutritional standpoint. It has been reported that nearly 7.8 per cent of all milk produced in the country is used for dahi manufacture. If an acceptable quality of dahi could be made from buttermilk, not only it will open a way for its utilization but may also release part of milk currently used for dahi for other uses.

Composition

Dahi was made with cow and buffalo buttermilk using cultures such as Str. lactase, Str. diacetilactis, L.F.40 and Str. thermophilus and L. bulgaricus (1:1), with or without increasing total solids content by the addition of skim milk powder. The dahi thus made was analysed for total solids, fat, total nitrogen, non-protein nitrogen, per cent lactic acid, curd tension and diacetyl content, and
sensory evaluation by a panel of judges, and compared
with skim and whole milk dahi.

It was observed that dahi of acceptable quality from
sweet cream buttermilk could be prepared by subjecting
the buttermilk to cream separation (if desired) at 55°C,
(optionally adding 1 to 2 per cent skim milk solids) and
heating it to 90°C for 30 min. before cooling to 30°C,
inoculating with one per cent of a culture of Str. lactase
(for cow buttermilk) and 0.5 per cent of culture of Str.
diacetilactis (for buffalo buttermilk) and finally incubating
it for 16 and 12 hours respectively.

20. Production Of Yoghurt

Yoghurt is a product manufactured from boiled
concentrated whole milk or partly defatted milk
containing small amounts of skim milk powder by the
use of suitable known cultures. The fat content in
yoghurt may vary from 0.0 to 5% and the total solids
from 9 to 20%.

Yoghurt is one of the most popular fermented dairy
products all over the world. Its consumption has
increased tremendously in the last few years mainly due
to the introduction of wide variety of flavours/fruits to
the product, claims regarding its therapeutic value and
also changes in the marketing trend.

Types Of Yoghurt: Yoghurt is so popular that it has
assumed different forms, e.g. stirred, set, frozen, and
liquid yoghurt. Of all the varieties, set yoghurt is the
most common with a rather firm body. The flavour of
yoghurt irrespective of the type, is the same since the
main flavour compound is acetaldehyde.

Starter Cultures For Yoghurt: Yoghurt is prepared
by the combined fermentative activity of two specific
lactic acid bacteria viz. Streptococcus salivarius subsp.
Thermophilus and Lactobacillus delbrueckii subsp.
Bulgarcus which are in symbiotic association in the
starter.

Selection of good quality starter is the corner stone in
successful preparation of the product. The interaction
between the component strains produces the
characteristic body and texture as well as flavour in
the product. Acetaldehyde along with volatile acids and lactic
acid contribute to the flavour in yoghurt.

Preparation Of Bulk Starter: For the preparation of
yoghurt bulk culture, good quality milk (in respect of
chemical and bacteriological qualities) preferably
skimmed milk is taken in a container with lid. It is
subjected to 45 min steaming in an autoclave or
pressure cooker.

The heat-treated milk is cooled to 42°C and inoculated
with an active yoghurt starter @ 1.0% by taking all
aseptic precautions. After mixing the culture well, it is
incubated at 42°C for about three and half hours. The
curled starter is removed and chilled at 5°C till use.
Depending upon the availability, the starter may
comprise of individual component strains or mixed
culture. Separately maintained strains may be mixed at
time of product preparation.

Preparation Of Yoghurt

Materials:
- Weighing balance.  
- Whole/skim milk spray dried powder.

Method: Yoghurt is prepared from good quality
com/buffalo/skim milk. The milk should be of normal
composition and free from foreign matters including
those imparting undesirable flavours. It should also not
contain any preservative or neutralizers. Regarding
bacteriological quality, it should have methylene blue
reduction time of more than two hours. The selected milk
is standardized to 3% fat and then heated slowly to
60°C. Simultaneously skim milk powder upto 2 to 3% is
also added. The mixture is continuously stirred to get
maximum incorporation of milk powder. The insoluble
skim milk powder is filtered off with the help of a fine
quality muslin cloth.

In the production of sweetened Yoghurt, sugar in the form
of syrup is added to the level of 5 to 6%. Sugar syrup is
pre pared by dissolving 1000 g of sugar in 250 ml of tap
water in a flask and sterilizing by steaming in three
consecutive days. The quantity of sugar may be
increased 6 to 7%. However, beyond this concentration
certain starter strains get slightly inhibited.

Most of the yoghurt cultures give fairly firm curd, typical
of the product, or otherwise stabilizer (sodium alginate,
gelatin or guar gum @ 0.2 to 0.3%) may be added to the
milk mixture. Addition of higher quantities of stabilizer
affects the refreshing taste of the product. The milk and
mixture is then heated to 60°C and subjected to
homogenization at 100 kg/cm². Homogenization prevents
cream layer formation during setting and hence gives
uniformity to the texture of the product.

The homogenized milk mixture is then heat treated at
90°C for 30 min after which it is cooled rapidly to 42°C
without exposing it to atmosphere. Cooling is best
effected by passing chilled water into the jacket of the
vat.

The cooled milk is then inoculated with an active yoghurt
starter @ 2 to 3%. Care must betaken to maintain the
balance of the component cultures of yoghurt viz.
Streptococcus sub sp. thermophilus and Lactobacillus
delbrueckii sub sp. bulgaricus in the ratio or 1:1. The
inoculated milk is then distributed in 100 ml quantities
into plastic of glass containers with lid. The lids of
containers should be simultaneously replaced.

The inoculated milk (with all additives including cultures)
is then kept for setting in an incubator maintained at
42°C for about three and half hours. Subsequent chilling
improves the body and texture as well as flavour of the
product. The product has one week shelf at 4°C.

Defect In yoghurt: Lack of uniformity: This defect
results due to improper mixing of various ingredients
during its preparation.

- Browning effect: Due to excessive heating of milk,
milk proteins may turn brown which may effect
the colour of the final product.

- Wheying off: Wheying off in the product may result
due to any one of the following reasons: (a)
 disturbance of the product, particularly at the time of setting, (b)
 incubation at higher temperature than the recommended
one, and (c) prolonged incubation.
Thin body: Thin body of yoghurt may be due to (a) drastic heat treatment (b) pre-ripened removal from the incubator, (c) lower SNF content and (d) imbalance in the proportion of the two starter bacteria.

High acidity: Prolonged incubation and failure to cool the product promptly after setting cause development of high acidity.

Gassiness: This defect is due to the contamination of the product with either coliform bacteria or yeasts.

Yeasty flavour: This is due to the contamination of product by acetic acid forming yeast getting access through sugar or fruits.

Unclean flavour: Unclean flavour in the product is either due to poor quality of milk or contamination of product with unwanted bacteria especially of coliform type.

Cooked flavour: Excessive heating of the milk during processing develops cooked flavour which is carried to the product also.

Standards For Yoghurt: Although at present no standards are prescribed for yoghurt except for those applicable to milk, yet it is necessary that yoghurt should be prepared, packaged and stored under good hygienic conditions.

Fruits And Artificial Flavours In Yoghurt: The flavour of yoghurt is mainly due to the acetalddehyde content in the product although volatile acids and diacetyl also contribute to some extent. However, quite often the product is flavoured with artificial flavours like pineapple, orange, rose, lime, mango etc. which is entirely the choice of the consumer. The level of artificial flavours is adjusted in the product in such a way that it does not give harshness and palatability of the product is maintained. Flavours are added at the time of addition of culture, prior to incubation.

There is also practice these days to prepare fruit yoghurt. The presence of fruits in yoghurt adds to the nutritive value of the products. Trials at NDRI have shown that strawberry, orange, pineapple etc. go well with yoghurt. Seed free pulp of various fruits is adds at a rate of 10 to 15% prior to the stage of distribution and incubation. Care must be taken to distribute the pulp well in the packaging containers. Another thing to be borne in mind is that presence of fruit pulp causes a reduction in the shelf life of yoghurt, i.e. fruit yoghurt has only 2 to 3 days shelf life compared to that of plain yoghurt which keeps well for 7 days at 5°C.

Prospects of the Yoghurt: Being new to this country, yoghurt at present has only limited market but there are signs of healthy commercial competition, particularly in metropolitan cities. In the presence of assured outlets, returns are expected to be quite remunerative.

Nutritive Value Of Yoghurt: Yoghurt is one of the most nutritious and refreshing fermented dairy products. The complex protein fraction of milk is changed too much similar from which can be easily digested and assimilated by the body. Free fatty acid and vitamin B complex contents of milk increase in significantly during the process of yoghurt preparation. Compared to milk, yoghurt is also rich in essential and non-essential amino acids. The therapeutic value of yoghurt is unique which is mainly due to L. delbrueckii sub sp. Bulgaricus included in the starters. Consumption of yoghurt has simulative effect on the secreting glands of the putrefactive and pathogenic bacteria present in the bowel. Finally, the yoghurt is said to be beneficial to the patients of heart diseases, arteriosclerosis, hypertension and chronic inflammation of liver. There are reports that yoghurt bacteria exert an inhibitory effect in the cancerous tissues too.

21. Acidophilus Milk

Dr. D.N. Gandhi

Acidophilus milk is a sour milk product that have been allowed to ferment under conditions that favour the growth and development of a large number of lactobacilli, acidophilus organisms. Acidophilus milk differs from Indian dahi in that the milk used in the preparation and the type of micro-organisms involved are different. The final product differs from dahi in body, texture, consistency, flavour, chemical composition and in antibacterial activities.

Uses: Products of mixed fermentation such as acidophilus yeast milk being rich in alcohol and carbon dioxide excite the respiratory and central nervous systems. This improves the process of oxidation and reduction in the organism and hence there is an increase in the oxygen flow to the lungs. In the Soviet Union, acidophilus yeast milk is widely used in treating tuberculosis. The recent emphasis on feeding lactobacilli is attributed to the side effects of antibiotics. Antibiotics damage the intestinal microflora and intestinal discomforts caused by flatulence and diarrhoea. Induction of L.acidophilus into the intestine accelerates return to normalcy in the intestinal microflora. A Rumanian strain of L.acidophilus is claimed to have been produced for treatment of gastrointestinal disorders but also produces a feeling of general vigour and health. It has been reported that acidophilus milk products combined with chemotherapeutic preparations can also be used effectively for several diseases, such as typhoid, para-typhoid psoriasis, osteomyelitis, pneumonia, migraine and urological infection. Experiments have revealed that the body weight of a child, or an animal increases when fed with acidophilus milk preparations.

Preparation

L acidophilus-based fermented products differ in the type of starter culture and milk used for their preparation. Acidophilus sour milk, as the name indicates, is a sour milk beverage made out of standardized milk, acidifying it by means of pure culture of acidophilus rod (L. acidophilus). Milk culture of L. acidophilus has the therapeutic value described earlier but does not possess the buttery, acetalddehyde flavour of the regular fermented milk products such as dahi and yoghurt.

The procedure for the preparation of acidophilus sour milk has been standardized. The milk used for the preparation of acidophilus sour milk is standardised to 3.5% fat and 8.5% SNF content. For this preparation standardized milk is sterilized and is cooled to 40°C. The milk is inoculated with 24 hours old pure starter culture of L.acidophilus at the rate of 2 to 3% and filled into 200 ml glass or plastic container and incubated at about 35°C for 8-12 hrs. The product is then cooled and stored at 5-8°C till it is consumed.

The product so obtained is sour with 1 to 1.2% lactic acid (pH 3.7-4.0). The product should contain more than 2000-3000 million viable L.acidophilus organisms/ml which possess satisfactory antibiotic effect against E coli as well as other pathogenic and non-pathogenic undesirable bacteria of the intestinal tract. The viability of the organisms is of primary importance in the use of
the acidophilus milk. The acidophilus sour milk can be preserved up to a week, below 5°C.

22. Yoghurt From Buffalo Milk

Dr. D.N. Gandhi

It is an undisputable fact that the enormously increasing popularity of yoghurt, now becoming available throughout the world, is primarily based on the cultural and biochemical performance of lactic cultures, namely Streptococcus thermophilus and lactobacillus bulgaricus. These are the corner stones upon which the success or failure of yoghurt processing hinges. Although our knowledge regarding the growth and biochemical performance of yoghurt lactic cultures in cow milk has been well established, there is paucity of information on this aspect in milk of other species like buffalo. Attempts have been made to obtain information on the ability of lactic cultures in the preparation of three types of yoghurt; namely, plain yoghurt, fruit yoghurt and sweetened yoghurt by the procedure indicated in the flow sheet.

Processing

Cow and buffalo milk samples are individually steamed for 30 min., cooled to a temperature of 43°C and then inoculated at 3% level with Str.thermophilus and Lb. bulgaricus in equal proportions (1:1). The contents are mixed thoroughly and filled in glass bottles covered with lids or aluminium foil caps, transferred to water bath maintained at 42°C+0.5°C. After incubation for 3.0-3.5 hrs when the coagulum is formed, the bottles are removed from water bath, cooled at 30°C for 1/2 hr and transferred to refrigerator for overnight storage.

Procedure for the Manufactur & Quality Evaluation of Planin/Sweet/Fruit Yoghurt

Fruit/Sweetened Yoghurt

Plain Yoghurt

Milk (cow/buffalo)

Perform compositional test

(A) Adjust fat (2-3%)

(B) Add NFDM (2%)

(C) Add Gelatin (0.5%)

Stir

Homogenisation

Heat Treatment

Add Sugar (5-6%)

Add Fruit Pulp (15-20%)

Stir

Inoculation with Yoghurt starter (3%)

S.thermophilus+L.bulgaricus (1:1)

Incubation (45°C for 3.5 hrs)

Sensory Evaluation

A. Body

B. Texture

C. Flavour

Laboratory Analysis

A. Chemical

B. Physical

C. Microbiological

Storage at 5°C

Cooling (20°C)

(1-2)

23. Frozen Yoghurt From Soybean And Buttermilk

Dr. R.B. Rajor

The fermented milk products like acidophilus milk, Bulgarian buttermilk, Mazun, Kefir, Kusiss, Yoghurt and other related products occupy important place and are consumed regularly all over the world. Popularizing frozen yoghurt that too from soybean and buttermilk in India will not only help to improve the nutritional status of the Indian population but also would be a possible substitute for ice-cream which is luxury item due to its high cost.

The balanced soybean cotyledons were ground with buttermilk to get slurry having soy-solids to buttermilk solids ratio 1:1. The slurry (11% T.S.) was homogenised at 175 and 35 kg/cm² at 65°C, pasteurised at 85°C and inoculated with L. Bulgaricus + S. Thermophilus @ 3% after addition of gelatin as stabilizer. It was then incubated at 40°C for about 5 hours. The curd so obtained was added with 12% sugar in the form of syrup and synthetic pineapple flavour then mixed well and frozen. The product was hardened and stored. The product had protein 4.45%, fat 2.4%, ash 0.48%, carbohydrate 18.26% and T.S. 25.6% and a good acceptability.

24. Lowering of Calcium Level And Curd Tension

Since buffalo milk has significantly higher level of calcium than human milk, the lowering of calcium was given distinct emphasis. This was achieved in two manners, namely (a) by electrodialysis and (b) by rennet coagulation. It was possible to reduce the calcium by 50% by electrodialysis. By prolonging the rennet coagulation period, significant quantity of calcium could...
25. Lassi
Shri D.C. Bhattacharya
Lassi is prepared from Dahi. The set curd is broken with the agitator and required amount of water, sugar, salt and essence are added into the broken curd. The mix is then passed through a single stage homogeniser. The consistency of ‘Lassi’ is such that it can be sipped through a straw from the bottle. The major steps of production are below:

Steps In Processing
1) Standardised raw milk (3.5-40% fat)
2) Heated to 80°C /5 min.
3) Cooled to 25-30°C
4) Innoculated with culture (0.5-1.0%)
5) Incubated (12-15 hrs) at 25-30°C
6) Dahi
7) Breaking of curd with agitator
8) Water, sugar & essence added
9) Passed through homogenizer
10) Cooled and stored at 4-6°C
11) Filled in bottles

Composition: The composition of Lassi may range from fat 3.0-3.5%. T.S. 16-18% and acidity varying from 0.75-0.85 percent.

26. Lassi From Soybean And Buttermilk
Dr. R.B. Rajor
Lassi—a cultured drink made from dahi—is very common in our country. It is not only refreshing, delicious but also nutritious and easily digestible, due to which it is quite popular amongst all age groups. Unfortunately, the high cost of this product, and the short supply of milk put it beyond the reach of majority of population, particularly those belonging to lower income group. Replacement of milk solids in lassi, therefore, with vegetable proteins such as soybean in combination with buttermilk, will help in reducing the cost considerably.

A simple method of manufacture of Lassi (cultured drink) based on soybean and buttermilk was developed. The blanched soybean (soaked in 0.5% sod. Bicarbonate for 8-12 hours and then boiled for 30 minutes in the similar solution) cotyledons were ground with buttermilk to get slurry having soy-solids to buttermilk solids ratio of 2:1. The slurry (12% T.S.) was homogenised at 175 and 35 kg/cm2 at 65°C, pasteurized at 85°C cooled to 37°C and inoculated with L.bulgaricus + S. Thermophilus @ 2%. It was then incubated for 10-12hrs at 37°C. The Dahi (Curd) so obtained, was then added with sugar syrup, rose flavour, and thoroughly mixed. The resultant product was highly acceptable, and could be stored well in polyethylene pouches for 10days at 5°C without appreciable decrease in acceptability.

Composition Of Soy-Buttermilk Lassi

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protein %</td>
<td>3.26</td>
</tr>
<tr>
<td>Fat%</td>
<td>1.57</td>
</tr>
<tr>
<td>Ash%</td>
<td>0.60</td>
</tr>
<tr>
<td>Carbohydrate%</td>
<td>15.53</td>
</tr>
<tr>
<td>Total solids%</td>
<td>20.96</td>
</tr>
</tbody>
</table>

27. Cheddar Cheese From Cow Milk
Dr. S. Singh
Cheese is one of the most important dairy products in the world market. The growth rate in production of cheese is increasing steadily the world over. It provides one of the best methods of conserving and preserving milk solids. The standard method for its production is as follows:

Manufacturing Method
1. Selection of milk: Fresh, good quality milk, free from antibiotics and preservatives.
2. Selection of starter: A good, active and uniform starter is essential.
3. Clarification and Standardization of milk: Casein/fat ratio (C/F) - 0.7.
4. Pasteurization: 63°C/30 min. or 72°C/15 sec.
5. Cooling to 30°C.
6. Adding starter (LF-40) at 30°C: 1% by wt............0.5.
7. Adding rennet when titratable acidity of milk increase by 0.1 to 0.2%:2.5g/100 lit.................45-60 min.
8. Cutting the coagulum, whey acidity........0.1% 30 min
11. Draining, when whey acidity is 0.13-0.16% or about 0.02% higher than cutting acidity.............10 min.
12. Packing the curd, after piling, acidity of whey should be 0.17 to 0.20%..............................10 min.
13. Cheddaring, periodical turning of blocks and piling and repiling till whey acidity reaches 0.45 to 0.5%..............................................................2 hrs.
14. Milling..............................................10 min.
15. Salting: 2% by wt. Of curd, in three applications.................................30 min.
16. Hooping: After the salt has dissolved completely..........................................................30 min.
17. Pressing: Max. Pressure of 2 kg/cm² to be applied slowly..............................................30 min.
18. Drying the cheese: The hoops are removed from the press, cheese cloth is pulled to remove all the wrinkles and pressed again overnight......................................................2 days.
19. Removing cheese from press, when the rind becomes free from openings..........................12-24 hrs.
20. Drying the cheese: Dry at 10-15°C till dry, clean and bright surface is obtained..........................2-5 days.
21. Paraffining: Dip the cheese in paraffin heated to 105°C.
22. Ripening at 8-10°C.....................................4-8 months.

28. Cheddar Cheese From Buffalo Milk
Dr. S. Singh

<table>
<thead>
<tr>
<th>Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total solids%</td>
</tr>
<tr>
<td>17.54</td>
</tr>
<tr>
<td>Total solids%</td>
</tr>
<tr>
<td>15.02</td>
</tr>
<tr>
<td>Total solids%</td>
</tr>
<tr>
<td>12.79</td>
</tr>
</tbody>
</table>
In the manufacture of cheddar cheese from buffalo milk, the basic steps remain the same as applied to cow milk, however, certain modifications have to be introduced to get desirable product. Out of the three methods recommended (Czulak, Burde and Presalat) the last one results in superior product. The salient features of Presalat method are described as below:

a. The standardized (C/F, 0.7) and pasteurized (63°C/30 min.) Buffalo milk is cooled to 28°C followed by addition of common salt @ 1% with thorough mixing.

b. After 15 min. An active starter culture (LF-40) is added @ 2.5 per cent. Supplementation of regular culture with 0.5% L.Casei enhances flavour development. After about 10 min. Hansen’s calf rennet powder (2.5g/100 lit.) is dissolved in tap water (20 times) and added to milk with thorough mixing. Substitution of calf rennet with microbial rennet, viz, Modilase, Noury and Marzyme have stimulatory effect on flavour development.

c. After setting (50-55 min.) the curd is cut with 1.4 cm knife. Precaution should be taken to judge the exact setting time. Delay in cutting results in a tough coagulum which hampers uniformity of the cubes and higher losses in whey due to breaking up into small particles.

d. The stirring is started after 10-15 min. of cutting and the curd is cooked to 35-36°C in 40-45 min. After proper cooking the curd is left in whey undisturbed for 5-10 min. And then whey is drained. The curd expels moisture at a very fast rate and even a delay of 10 min. in drainage of whey was found to result in excessive drying and hardening of cubes, which ultimately led to tough body and mechanical openness in the pressed cheese. Hence, draining has to be quick and cooking time of 1 hr. to be critically observed.

e. Higher piling during cheddaring helps obtaining good texture at the end. It is essential to develop a good texture resembling chicken breast type during cheddading to ensure proper milling, salting, pressing and rind formation.

f. After pressing, green cheese blocks are transferred to cold storage for drying. The temperature of cold storage should be maintained preferably between 10-15°C. After proper drying generally in 2-3 days, the cheese blocks are paraffined. It is recommended to ripen the cheese at 15°C for about 3 weeks followed by completion of curing at 8-10°C.

### 29. Mozzarella Cheese

**Dr. S. Singh**

Mozzarella cheese originated from buffalo milk in Italy. It is a soft, white, unripened, plastic curd cheese with bland but mildly acidic flavour. It has special melting and stretching characteristics. It is mainly used in preparation of bakery products like pizza. Its manufacturing method is as below:

1. Selection of Milk: Fresh, good quality milk, free from antibiotics and preservatives. Buffalo, Cow or mixed milk can be used. Originally made from whole, raw milk, it can be made from pasteurized milk, partially skimmed milk.
2. Selection Culture: A good, active, uniform culture containing *S. thermophilus* and *L. bulgaricus* is often used. Also *S. thermophilus* and *L. bulgaricus* in the ratio of 1:1 can be used.
3. Clarification and standardization of milk to any desired fat level, mostly 3.2%.

### 30. Cottage Cheese

**Dr. S. Singh**

Cottage cheese is a soft, unripened variety made from skim milk to which cream and salt may be added. It is pleasant, mild in flavour. It is a good source of quality protein and low in calories, which is highly suitable to those conscious of over weight. Its manufacturing method is shown as follows:

1. Selection of milk: Fresh, good quality milk, free from antibiotics and preservatives.
2. Selection of starter: A good, active and uniform starter is essential.
3. Standardisation of milk: SNF of milk to 9.0% by fortifying with skim milk powder.
4. Pasteurization: 63°C/30 min. Or 72°C/16 sec.
5. Cooling: 30± 1°C.
6. Addition of Calcium Chloride @ 10g/100 lit.
7. Addition of starter Culture @ 6%.
8. Addition of rennet @ 0.4 g/100 lit. 75 min.
9. Cutting of curd at whey acidity 0.5% 240 min.
10. Cooking start
11. Cooking finish at about 55°C 60 min.
12. Washing of curd
13. Creaming of curd with dressing containing 18% fat.

### 31. Processed Cheese

**Dr. S. Singh**

Processed cheese is made from natural ripened cheeses. Cheese of different age is blended together and processed into a final product with pleasant flavour and smooth body and texture. The basic objective of processing is to blend natural cheese, water emulsifying salts into a homogenous mixture and pasteurize to obtain an end product which has sufficient fluidity for convenient pack-aging and which possesses long keeping quality. As per PFA process cheese should contain not more than 47% moisture, not less than 40% fat on dry matter basis, and not more than 3% common
PROCESSING TECHNOLOGY

Manufacturing Method

1. Selection of Cheese: The selection is determined chiefly by age, acidity, flavour, body, texture and composition of lots of cheese available. It is recommended that in order to obtain best quality product, the cheese should be at three different stages of ripening:
   A) Current cheese 25%, no over 1 month old.
   B) Short held cheese 50%, about 3 months old.
   C) Aged cheese 25%, 6 months or more.

2. Cleaning, Shredding and Mixing: The paraffin and other non-edible portion of natural cheese is trimmed off. The trimmed cheese is then ground.

3. Selection of Emulsifier: Emulsifying agents are used to prevent the separation of cheese into its three main constituents (fat, protein and water) during processing and also to improve the body and texture of finished product. The most common emulsifiers used are sodium citrate and disodium phosphate. Normally they are added at the rate of 2%. They may be added to the cheese during grinding or melting.

4. Processing: The purpose of actual processing is to blend the cheese and added substances into a homogeneous mixture, to pasteurize it and to attain sufficient fluidity for convenient packaging. This is accomplished by heating and stirring and by addition of suitable emulsifying salt and water. The cheese is pasteurized in a steam-jacketed kettle fitted with double action agitator. The ground cheese remains crumbly until a temp. of about 49°C is reached. Beyond this point the cheese becomes sticky, stringy and plastic and may effectively retain or reincorporate the fat without the addition of emulsifying agent. The heating and stirring are continued until final temp, is reached (75°C) followed by packaging in presterilized containers. The sealed tins are gradually cooled to 22°C. The packages should not be kept under refrigeration until they have attained this temperature.

Steps In Processing

i. Standardised raw milk 1: 0.7 casein fat ratio
   ii. Pasteurised 71°C/5 min.
   iii. Innoculated culture 0.04% at 35-36°C
   iv. Rennet added 7.5g/100 lit. Milk.
   v. Incubated 30 min at 35-36°C.
   vi. Set curd cut
   vii. Salt added 2.5%
   viii. Whey drained
   ix. Curd cubes filled in hoops.
   x. Applied pressure by weight
   xi. Turn curd block every 1/2 hr.
   xii. Turn 2 times
   xiii. Remove weight
   xiv. Cut into slices and pack with whey
   xv. Stored at 4-6°C.

Composition: Average Composition of Surti Cheese: - Fat 13%, moisture-72% TS 28%.

33. Soft Cheese

D.C.Bhattacharjee

Steps In Processing: Varieties made from cow milk are quite popular in Western Countries. In the context of popularising this type of highly nutritive dairy product in India NDRI has studied and standardised one soft sweet cheese variety. The major steps for the production of sweet cheese are described below:

1. Standardised cow milk 2.0-2.5% fat
2. Heated to 71°C/5 min
3. Added Ca Cl2, culture, Citric acid and Rennet.
4. Incubated for setting of curd.
5. Cut the curd
6. Whey drained and filled in cloth bag
7. Chakka or soft cheese base material.
8. Sugar, essence added.
9. Ground and kneaded
10. Stored at 2-4°C.
11. Packed 100g packets in butter paper.

Composition: The composition of Sweet Cheese may range from fat 12-16%. TS-35-40%, moisture 60-65%, sugar 25-30% by weight of soft cheese and essence 1 ml per kg of mix.

34. Ricotta Cheese From Different Whey Systems

Dr. B.N.Mathur

Ricotta cheese originated from Italy is a soft, granular variety having a bland taste. Its physico-chemical characteristics are midway between those of Chhana and Khoa. Ricotta cheese in its fresh form is quite suitable for the partial replacement of Chhana and Khoa for the manufacture of a number of sweets (such as Sandesh, Burfi, Gulabjamun, etc.) and Indian culinary dishes (such as stuffed potatoes, tomatoes, etc.). No special equipment is needed for the manufacture of Ricotta. In fact, the same equipment which is used for the production of casein cheese or paneer, can be employed. The process involved is relatively simple and is suitable for both small and large scale handling.

Process Of Manufacture

1. Adjust the pH of whey of 6.6 to 6.8 using calcium hydroxide.
2. Add 10% whole milk (cow or buffalo) to the above whey.
3. Heat with direct steam injection to 95°C and hold for 10 minutes.
4. Add sufficient citric acid (30% solution) with very slow stirring till granular curd appears and whey clears (pH 5.9-6.1). Allow the curd to settle.
5. Collect curd in a muslin cloth. Continue draining overnight.
6. Pack the product in suitable containers.
7. Yield of product is about 7%.

Composition

<table>
<thead>
<tr>
<th>Moisture</th>
<th>Proteins</th>
<th>Fat</th>
</tr>
</thead>
<tbody>
<tr>
<td>75.0%</td>
<td>12.4%</td>
<td>8.6%</td>
</tr>
</tbody>
</table>
**35. Cheese Spread Powder**

*Dr. B.D. Tiwari*

Processed cheese prepared from blending of differently aged cheese varieties is very popular. Cheese spread commonly used as a paste for sandwiches, is another cheese based product. However certain sections of the population in India are not used to strong cheese flavour. Taking into consideration the requirement of mild flavoured and smooth textured cheese product, a method for the mfrs of cheese spread powder has been developed.

**Steps In Processing:** The cheese spread was prepared by blending equal proportion of young (2 months old) and fully ripened (7-8 months) lots of buffalo milk cheddar cheese. Minced cheese alongwith predetermined amounts of moisture, butterfat, salt and emulsifying agents (trisodium citrate and trisodium orthophosphate in the ratio of 5:1) at 2.0% were mixed thoroughly in a cheese processing kettle, Gelatin (0.3% in dissolved form), flavouring agents like tomato juice, onion juice etc. (optional at 5.0% of the blend) were added at 60°C. The temperature was raised to 71°C with constant stirring and preservation (nisin or scorbic acid) were added at the rate of 0.02%. The hot slurry was then homogenised in a single stage homogeniser at 100 kg/cm² and collected in presterilized lacquered tin cans, covered with lids and seamed immediately. The sealed cans were kept in hot water at 80°C for 5 minutes and then kept at room temperature for 24 hours and transferred to cold store. Besides the ready to use form, cheese spread was also prepared in the free flowing powder form. For this purpose, the homogenised cheese slurry without any added preservatives was adjusted to 35% total solids and then spray dried at an inlet air temperature of 160°C and outlet air temperature of 100°C. The dried product was packed in lacquered tins under nitrogen packing.

**Composition**

<table>
<thead>
<tr>
<th>Particulars</th>
<th>Spread</th>
<th>Cheese</th>
<th>Dried cheese</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fat</td>
<td>21.50%</td>
<td>56.00%</td>
<td></td>
</tr>
<tr>
<td>T.S</td>
<td>42.50%</td>
<td>96.50%</td>
<td></td>
</tr>
<tr>
<td>Moisture</td>
<td>57.50%</td>
<td>3.50%</td>
<td></td>
</tr>
<tr>
<td>Salt</td>
<td>1.00%</td>
<td>2.00%</td>
<td></td>
</tr>
</tbody>
</table>

The samples of cheese spread powder were acceptable upto 6 months storage at room temp.

**36. Dried Cheese Spread**

During recent years, processed cheese has become increasingly popular. Many consumers prefer a milk flavoured cheese spread for use with sandwiches and biscuits and hence a cheese spread with about 55% moisture, 25% fat and 20% milk solids not fat has been developed. It has also been possible to make this highly delicious products available in the form of a powder which can be reconstituted into cheese spread with water, or can be used as such in the preparation of soup, butter-toast etc. It is also possible to prepare the spread with various flavours and spices.

**Composition:** The approximate composition of the product is:

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>2.0%</th>
<th>3.0%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moisture</td>
<td>97.0%</td>
<td>98.0%</td>
</tr>
<tr>
<td>Milkfat</td>
<td>46.0%</td>
<td>50.0%</td>
</tr>
</tbody>
</table>

**37. Paneer**

*Mr. D.C. Bhattacharya*

Paneer is primarily acid coagulated milk solid used as an ingredient in cooking of vegetables in Northern India. Mostly, buffalo milk is used for the production of paneer. The best quality product is made from milk of 6.0% fat content. Packed paneer could be stored for 3 days without any loss of freshness when refrigerated.

**Steps In Processing:**

1. Standardised buffalo milk 6.0%
2. Heated to 82°C for 5 min.
3. Cooked to 70°C
4. Coagulated by 1% citric acid.
5. Whey drained out.
7. Pressed by weight
8. Weight removed.
9. Cut into pieces.
10. Dipped in chilled water for and stored at 4-6°C. 1-2 hrs. at 4-6°C.
11. Chilled water drained out.
12. Packed into desired wt. and stored at 4-6°C.

**Preservation:** The paneer is highly perishable article. It cannot be stored for more than one day at room temperature. If it is prepared under sanitary conditions it can keep well for about a week at refrigeration temperature. Our research has shown that if paneer is dipped in sodium chloride brine solution (5%) prior to packaging it enhances the shelf life up to 22 days at refrigeration temperature. Almost the same result was obtained by dipping paneer in 0.2% hydrogen peroxide solution. When paneer was dipped in fungicide solution (delvocid, 0.5%) following hydrogen peroxide treatment, it’s shelf life increased up to 32 days at refrigeration temperature.

**Yield And Composition:** The yield of paneer ranged from 18-22% depending upon composition of milk. The average composition of paneer may be: Total Solid 45%, fat 24-26%, moisture 55%, protein 17%, carbohydrates 3.1% and ash 2%.

**Indian Sweets**

*Dr. G.S. Rajorhia*

The dairy plants in India usually face the problem of using surplus milk during winter. It has now been demonstrated that the organized dairies can profitably divert part of this surplus milk and some of the standard quality milk for the manufacture of Khoa. The problem concerned with limited shelf life of Khoa due to microbial spoilage and chemical deterioration was the major impediment in the adoption of this product by the organised sector. Small scale sector engaged in the manufacture of Khoa was also confronted with the limited shelf life of Khoa leading to uneconomic marketing situations. Investigations were, therefore,
conducted to standardize a process for the manufacture of Khoa with long shelf life using readily available packaging materials and permitted chemical additives.

**Increasing The Shelf Life:** The non-availability of tin sheets and prohibitive costs of tin containers warranted us to find out a suitable substitute. The flexible packaging materials such as food grade polyethylene, parchment paper, and laminated pouches were used. Khoa samples packed in sterilized four ply laminates afforded the same protection as tin containers. The product kept in good condition upto 13 days at 30°C. Khoa should be lifted while hot (70°C) in these containers and sealed employing all the aseptic precautions.

The shelf life of Khoa was increased to 75 days at cold room temperature of 7°C. Incorporation of 0.02% butylated hydroxy anisole (by weight of fat content in Khoa), addition of 0.2% potassium sorbate and mixing of nisin (100u/gm) improved the shelf life of Khoa upto 20 days at 30°C and 125 days in the cold stores. The studies showed that incorporation of potassium sorbate and nisin considerably enhanced the shelf life of Khoa without impairing its flavour and other marketable characteristics.

**New Technology:** Technology for the manufacture of khoa powder employs roller process, which is suitable for small entrepreneurs. Spray drying can be adopted for large scale production. Standardized buffalo milk is vacuum concentrated to desired level and heated at predetermined temperature to accentuate heated flavour prior to drying. Antioxidant and free flowing agents are added to improve the chemical and physical properties of khoa powder. About 14 kg. of khoa powder is obtained from 100 l of standardized buffalo milk. On reconstitution with water, this will produce about 21 kg of khoa. Khoa powder, can be utilized directly for the preparation of burfi, milk-cake, kalakand and gulabjamun. The quality of sweets made from khoa powder is highly acceptable. Khoa powder packaged in tin containers under nitrogen gas can be stored for up to 10 months at 30°C.

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**39. Khoa Powder**

*Dharam Pal, B.B. Verma and F.C. Garg*

Khoa cannot be stored for more than 5 days at room temperature without spoilage. At present, no preservative is legally permitted to be added to khoa. Many of the States and Union Territories ban its production during the summer months when the demand for khoa is invariably at its peak. Because of its bulkiness and demand in cities and towns, the cost of packaging and transportation of khoa is also high. The technology developed for manufacture of khoa powder would help eliminate these problems.

**Steps In Processing:** The coagulation of cow milk at pH 5.7 resulted in very soft chhana with high moisture and increased losses of milk solids in whey while at pH 5.1, chhana was soft and cohesive with minimum losses of milk solids in whey. Buffalo milk followed a similar trend although the effect was less pronounced. Temperatures above 70°C caused grainy texture and increased hardness while lower temperature produced highly sticky chhana which was difficult to drain. Compared to lactic acid, citric acid produced more cohesive chhana with lower losses of milk solids in whey. Best quality chhana from cow milk was obtained by coagulating milk at 70°C at pH 5.1 using 2% citric acid solution as coagulant. This combination of factors for buffalo milk coagulation produced less cohesive chhana. Treatment of buffalo milk with 0.05% sodium citrate before boiling, dilution of milk with 25% water, and coagulation with 1% citric acid solution improved the softness and product can be comparable with cow milk chhana.

**39. Khoa Powder**

*Dr. B.D. Tiwari*

Chhana, also called paneer in some regions of the country, is an Indian whole milk product which constitutes an important base for sweets like Sandesh and Rossogolla. However, it is mostly prepared on small scale by the disorganised sector of dairy industry for obvious reasons of its low shelf life and difficulties in transportation. Since, it was felt that drying of chhana and consequent increase in its shelf life would help in the growth of this product a method for production of dried chhana, as detailed below, was standardised. The dried chhana is suitable for preparation of Sandesh.

**Steps In Processing:** Raw cow milk is standardised to 4% fat, given first boil in the coagulation vessel and then lowered to 80-5°C. The emulsifier tri-sodium citrate @ 0.02% of milk is added as an aqueous solution. The milk is kept covered and left undisturbed for 2-1 hrs. Then coagulating acid (1-2% solution of lactic or citric acid) is added to milk with gentle stirring. At the end of coagulation (pH-5.4), the contents are poured over a piece of muslin cloth stretched over another vessel. The coagulated milk solids stay on the top of the cloth while whey passes through it.

The Chhana is transferred to milk can and calculated amount of water is added as to give 19-21% total solids in the slurry. After premixing with the held of a plunger, the mix is further passed through micro-pulveriser to give smooth slurry. The slurry is dried in a spray-drier using an inlet air temperature of 195°C and an outlet temperature of 100°C. The dried product is promptly removed from the drying chamber, cooled, packaged and stored at room temperature.

**Composition:** The average percentage chemical composition of dried chhana is: Moisture 3.5%, Fat 41.6%, Protein 46.3%, Lactose 4.2% and Ash 4.4%. The storageability of chhana powder is 2 and 4 months at 20-2°C under airtight and nitrogen gas packing respectively. The powder is rehydrated back to chhana for preparation of Sandesh.
42. Packaging Of Indigenous Dairy Products - Khoa & Chhana

Dr. S.K. Goyal

Khoa can be packaged in tin cans but these are very costly. There is, therefore, a necessity to investigate whether locally available flexible packages can be compared with tin cans and provide effective protection to khoa against heat, light and microbial contamination. The chemical, microbial and organoleptic changes which occur in khoa when packed in poster paper/Aluminium foil/low density Polyethylene(65/60 g. 0.02 mm, 150 g gauge)-P1; poster paper/Al foil/LDPE (55/60g, 0.09 mm 150 g gauge) -P2; poster paper/A1, foil/LDPE (300 gauge, 150 gauge)-P3 and tin cans-P4 were compared.

Standardisation Of Method: 500 g capacity packages of each type were filled with the same khoa and stored a 37° ± 0.5°C and 60% R.H. -(A) and 4-5°C at 100% R.H.-(Bs). The tests carried out at intervals covered; moisture content, lactose content, titratable acidity, peroxide value, free fatty acid, tyrosine content, standard plate count, acid producers, chromogenic, proteolytic, lipolytic, spore formers, yeasts and moulds counts and organoleptic evaluation. The following values recorded for various chemical, microbial and organoleptic tests refer to packaged khoa after storage of 15 days at conditions ‘A’ & 60 days at ‘B’.

Only the khoa packed in P3 showed maximum moisture loss (11%) at ‘A’ while at ‘B’ moisture loss was statistically not significant. The lactose hydrolysis was maximum in P2 followed by P1, P3 and P4 at ‘A’. The lactose breakdown was minimum in P4 and maximum in P3 at ‘B’. The titratable acidity (% lactic acid) increased from 0.45 to 1.01 in P3, 0.86 in P4 at ‘A’. The same trend was noticed for free fatty acid, tyrosine content and peroxide value of khoa at ‘A’ and ‘B’ for different packages as described earlier for titratable acidity. The microbial growth was maximum in P3 and minimum in P4 at ‘A’ while it was maximum in P4 and minimum in P3 at ‘B’. For organoleptic quality, the packages were rated in the following order: At ‘A’:- P3, P1, P2, P4, At ‘B’:- P1, P2, P3, P4. Khoa at ‘A’ was of acceptable quality up to 10 days while at ‘B’ upto 60 days in P1; and P2 & 40 days in P3 & P4.

The moisture loss through P3 at ‘A’ was maximum because of its more water vapour transmission rate. The moisture loss between the packages was not significant at ‘B’ as the vapour pressure gradient between atmosphere and inside package was not sufficient. The other chemical changes in packaged khoa are due to growth of micro organisms. From this study, it can be concluded that P3 is the best package followed by P1, P2 and P4 for storage of khoa at ‘A’ while P1 is the best package followed by P2, P3 & P4 for storage at ‘B’.

43. Preparation Of Sandesh

Dr. B.D. Tiwari

From Chhana: The chhana is first kneaded, then ground sugar added @ 30% of chhana and mixed with it. The mix is baked on a very slow fire, stirring all the time. Crushed cardamom, if desired, is added towards the end. When mixture starts forming balls, it is poured into tray and left for cooling and setting. It is then cut in desired size and decorated with pista and silver paper.
New Technology: Cow milk is ultra filtered under specified conditions of operational pre-determined temperature. The dried retentate is spray-dried using a standard technique. The dried retentate is blended with the selected additives to produce the desired flavour and texture in the finished product. The average yield of the mix powder from cow milk is 7% which will produce about 55 kg of sweet (drained weight). This is 20% higher than that obtained by traditional method. Dried rasogolla mix can be stored without spoilage for about five months at 30°C and for 10 months at 5°C in sealed containers.

47. Instant Kheer Mix

Alok Jha, A.A. Patel and R.R.B. Singh

Kheer, a cereal-based particulates containing dairy dessert, is popular throughout India. However, its limited keeping quality even under refrigeration has not allowed it to come out of the confines of the domestic kitchen. In the past, several attempts have been made including the use of preservatives to extend the shelf life of kheer, but these have been of little avail. Rice kheer produced in a dry form suitable for ready reconstitution has been found to overcome the problem of shelf life, thus providing the much need marketing and consumption convenience.

New Technology: The process for an instant rice-based kheer mix consists of separate instantization of the milk and rice phases of the product employing two-stage spray –bed and fluid-bed drying systems. Appropriate compositional and process manipulations ensure a high product quality. The two-phase product comprising powdered milk fraction and particulate (instant rice) faction is packaged bag-in-bag, a small polyethylene pouch of rice being carried in a bigger bag containing the powder. The mix packaged in metallized polyester/LDPE pouches has a shelf-life of at least six months at 37°C. Reconstitution of the mix involves rehydration of instant rice in boiling water for 10 min followed by dispersal of the powder into the rice-water mixture. The reconstituted product could be suitably flavoured and enriched with dry fruits etc., if desired. In its sensory status, the product is very close to the conventional kheer. The cost of the production has been worked out to be Rs. 47.30 per package of 500 g (enough for reconstitution into a quantity for 10 servings) assuming a production unit handling 10,000 litres of milk per day exclusively for kheer mix production (500 tonnes per annum).

48. Gulabjamun Mix Powder

Dr. G.S. Rajorhia

The existing method for the preparation of gulabjamun is suitable at cottage scale. Khoa is generally used as a base which causes wide variations in flavour, texture and chemical composition of the sweet. Good quality khoa may not be available all the year round in different parts of the country. In order to overcome these difficulties, a ready-to-form gulabjamun mix powder formulation based on skimmed milk powder with six months shelf life has been developed.

The formulated mix consists of skim milk powder (roller) 434 g; butterfat/vanaspati 150 g; maida 260 g; suji 150 g; baking powder 15 g and powdered cardamom 0.1 g (alternatively 2 cup SMP, 3/4 cup maida, 1/3 cup butterfat, 1/2 cup suji, 1 tea spoonful baking powder and a pinch of cardamom). All these ingredients are properly blended and packaged in a polyethylene bag. The mix powder stays well for about 6 months at room temperature and can be conveniently used in the preparation of gulabjamun at any time.

The production of gulabjamun starts with the preparation of sugar syrup. Equal proportions (on weight basis) of water and sugar are boiled till a syrup of about 60% concentration (one thread consistency) is obtained. The dirt and impurities gathering at the surface are removed with the help of a perforated ladle and the syrup strained through a nylon/muslin cloth. For the preparation of dough and balls, mix instant gulabjamun mix with required quantity of water (50-55 ml for 100 g mix) and knead well until smooth body is obtained. Normally 100 g instant mix yields 13 balls. The performed balls are covered with a wet cloth to arrest evaporation of moisture and case hardening until they are transferred to the frying pan. Deep fry the balls in refined vegetable oil or hydrogenated fat (Ghee optional) at 125-130°C for 20 minutes till the colour becomes brown. Drain the excess fat from the surface of the fried balls and finally transfer them into the sugar syrup maintained at 60°C. Soak for at least 2 hours. Pack the sweet in presterilised polystyrene containers and serve hot.

49. Manufacture of Co precipitates from buffalo milk

Dr. Vijay Kumar & Dr. S.K. Gupta

Manufacture of co precipitates of milk proteins has aroused worldwide interest because it contains not only casein but also whey proteins, which are nutritionally valuable. High recovery of proteins in co precipitate manufacture (97%) has been observed as compared to casein (80%) manufacture. The flexibility inherent in the co precipitate process enables products to be produced which vary in casein to whey protein ratio, solubility, ease of whipping water binding, equilibrium moisture, viscosity and compatibility with other food stuffs. Consequently, the range of application and properties of co precipitates is large.

Flow Sheet For The Manufacture Of Coprecipitates From Buffalo Milk

Whey Drinks

Steps In Processing: Processes were, therefore, standardized for the manufacture of low medium and high calcium co precipitates containing respectively 1.60, 2.45 and 3.30 per cent calcium, from buffalo skim milk. The protein recovery obtained in these coprecipitates, was respectively, 93.20, 94.30 and 94.80 per cent. For the manufacture of medium and high calcium co precipitates, 0.06 and 0.20 per cent calcium chloride had to be added to achieve the desirable precipitation and product. However, calcium chloride was not required for the manufacture of low-calcium coprecipitate since buffalo milk already contains more calcium than cow milk. It was further observed that holding times at 90.5°C, for 20, 12 and 2 min. combined with three number of washings of the curd were adequate to give a desirable low, medium and high-calcium co precipitates, respectively.
## 50. Whey Powder

**Background Information:** Whey is the by-product obtained during the manufacture of cheese, paneer, chhana, casein and other coagulated products. Growing demand for cheese and ever increasing industrial production of casein, and other coagulated products, have generated enormous quantities of whey. Whey contains nearly 5 percent of the nutritionally superior milk constituents like lactose, whey protein, water soluble minerals and vitamins. The whey is generally discarded resulting incolossal loss of precious nutrients. This also causes environmental pollution.

In order to ensure better utilisation of whey, a technology has been developed at this institute for the manufacture of whey powder employing reverse osmosis process, which is less energy intensive and more cost effective.

**Method Of Manufacture:** The method of production of whey powder involves, clarification of whey, its partial concentration employing reverse osmosis process followed by vacuum concentration, precrystallization of lactose and finally spray drying and packaging.

**Chemical Composition:** The chemical composition of the whey powder depends on the type of whey used. The average chemical composition of paneer and cheese whey powders is shown in the following tables:

<table>
<thead>
<tr>
<th>Constituents (%)</th>
<th>Paneer whey powder</th>
<th>Cheese whey powder</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moisture</td>
<td>3.84</td>
<td>3.78</td>
</tr>
<tr>
<td>Protein</td>
<td>5.68</td>
<td>14.33</td>
</tr>
<tr>
<td>Fat</td>
<td>1.06</td>
<td>0.87</td>
</tr>
<tr>
<td>Lactose</td>
<td>80.68</td>
<td>72.99</td>
</tr>
<tr>
<td>Ash</td>
<td>8.74</td>
<td>8.03</td>
</tr>
</tbody>
</table>

**Shelf Life:** The Shelf life of whey powders is more than six months at room temperature.

**Mode Of Utilization:** The proper utilization of whey will reduce the cost of production of main products, like cheese, paneer, chhana, casein, etc. the whey powder owing to their high nutritional and functional characteristics may find use in a wide range of food formulations, such as bakery products, confectionaries, biscuits, beverages, gravies, soups, sauces, ice cream, yoghurt, processed cheese, and infant food.

## 51. Fermented Whey Beverages

**Introduction:** Whey is one of the largest by-products of cheese industry. In India, where cheese industry is in its infancy, whey is mainly obtained during the manufacturing of coagulated milk products such as paneer, chhana and casein. During conversion of milk to cheese and coagulated milk products, about 80-90% of volume of milk used appears as whey. In other words to make 1 kg of paneer from 5-6 litres of whole milk, about 4-5 litres of whey is produced as a by-product which generally is discarded at all levels of production whether it is produced by dairy industries or halwais or even under domestic conditions. However, whey contains about 6-7% total solids, which is almost half of the total solids of milk from which it is produced. The main nutrients present in whey are lactose (4.5%), protein (1%), fat (0.5%), minerals, and water soluble vitamins which slightly vary from one product to another. Major constituent of whey is lactose which constitutes about 70-80% of the total solids. High organic matter content in whey poses serious problems in its disposal.
• It is a bulky material due to high water content and therefore, not economical to transport.
• Rapid spoilage due to microbial growth.
• Source of bacteriophage dissemination.
• Causes environmental pollution due to high Biological Oxygen Demand (BOD) B.O.D. of whey is 40000 to 48000 ppm which is about 200 times more as compared to domestic sewage.
• Draining of whey results in loss of valuable nutrients such as protein such as protein, lactose, fat, minerals etc.

Keeping in view the expansion of paneer and cheese making and tremendous demand of Soft drinks these days, National Dairy Research Institute has developed a fermented whey drink named ‘Acidowhey’. Through the process of Acidowhey making, the cheese and paneer making units in organized dairies can utilize a largest amount of whey into product into a highly nutritious low cost beverage which is not only refreshing and masks the effect of curdy flavour of whey. Whey is rapidly absorbed due to absence of fat emulsion.

Advantage Of Processing Of Whey Into Fermented Beverages: Conversion of whey to a non-alcoholic beverage form through lactic acid fermentation is one of the attractive avenues for utilization of whey for human consumption. Processing of whey into fermented beverages have several advantages which are as follows:

• Whey is an excellent growth medium for lactic acid bacteria to ferment lactose in whey to form lactic acid.
• Whey is genuine thirst quencher unlike most of the carbonated soft drinks.
• Whey as a drink can replace much of the lost organics and in organics to the extra cellular fluid.
• Whey is rapidly absorbed due to absence of fat emulsion.
• Whey is rapidly absorbed due to absence of fat emulsion.
• Whey has been used to treat various ailments such as arthritis, liver complaints and dispasia.
• On fermentation with lactic acid bacteria, it becomes suitable drink for lactose intolerant people.
• Fermentation of whey with lactic acid bacteria also masks the effect of curdy flavour of whey.
• At industrial scale, large volumes of whey can be used directly from Paneer/Cheese vats thus eliminating transportation and disposal problem.
• Conversion of whey into nourishing drink involves a very simple process.
• Potential profit margin is attractive.

Process Of ‘Acidowhey’ Making In The Organised Dairies

The process for manufacturing Acidwhey soft drink consists of the following steps:

Collection Of Whey And Its Standardization:
The whey obtained from cheese and paneer making unit is collected in storage tanks and passed through the cream separator to remove fat. The fat free whey is then heated to 85-90°C for 20 minutes to kill the micro-organisms. It is then cooled to 40°C and is fed (without disturbing the precipitate at the bottom) to incubation tank adjusted to 39±1°C temperature.

Culture Preparation: Culture for inoculum is prepared in a separate room to avoid the risk of contamination. About 200 ml of whey is taken in 250 ml flask and sterilized by heating for specified time followed by cooling to 40°C and inoculated with required amount of pure culture of lactic acid bacteria (L. acidophilus) previously grown in skim milk. After the incubation for requisite time at desired temperature the culture is cooled and it is further inoculated for the preparation of intermediate (2 ltr) and bulk culture in the same manner.

Fermentation Process: Inoculation of heat-treated and cooled whey is done with a pure and active bulk standard culture at a level of 2%. After inoculation is over i.e. when the acidity of the whey reaches at the desired level of 0.80-0.85% (as lactic acid), the fermented whey is cooled and filtered through a filter press.

Fortification With Sugar And Flavour: Filtered fermented whey is fortified sugar in the form of 50% sugar syrup which should be clear and free from micro-organisms. Then, it is flavoured with the combination of pineapple and orange essence at the required level. No colour should be added in the product, as the colours are not stable in the product due to low pH of the finished product.

Block Chart For The Manufacturing Technique Of Acidowhey.

Packaging And Storage: The prepared whey beverage is cooled to 5°C and then it is filled in polypack or glass bottles which are crown corked after filling, if...
intended for immediate consumption. For increased shelf life of product, beverage should be pasteurized before packaging or alternatively pasteurized in the container. The manufacturing steps involved for propagation of culture and preparation of Acidwhey are shown in Figures 1 and 2, respectively.

**Chemical And Bacteriological Quality Of Acidowhey:** Chemical and bacteriological quality of the finished product is examined for following tests according to the methods of Bureau of Indian Standard.

**Chemical Test**
- pH
- Total solids.
- Titratable Acidity (% lactic acid)
- Residual lactose.
- Fat content.

**Bacteriological Tests**
- Total lactic count.
- Yeast and mould count.
- Coliform count.

Chemical composition of the product possesses pH ranging between 3.45 to 3.60 total solids 15.5-16.5% residual lactose 2.5%, titratable acidity 0.80-0.85% and fat 0.1-0.5%. Bacteriological quality of the fresh product shows on an average 3x10⁴ viable cells of Lactic acid bacteria/ml and coliform and yeast and molds are absent in 1:10 ml solution. But with increase in storage period variation in this composition is likely to take place. The product must be stored under refrigeration conditions only and should be consumed within two weeks of storage. Use of improper processing technique and storage conditions may lead to yeasty fermentation in the product.

**Characteristics Of Acidowhey**
- It is a fermented and non-carbonated soft whey drink.
- It is palatable refreshing and genuine thirst quencher.
- It is nutritious soft whey drink having all the components intact.
- It possesses therapeutic value due to the presence of useful and viable LAB.
- It is suitable of the people having lactose intolerance.
- It is free from preservation and synthetic colour.
- It is free from curdy flavour.
- It is a cheaper soft drink.
- It generates additional income to the dairy plant.

**Whey has been found to be useful as a base for the growth of some of the starter cultures in the preparation of cultured products and beverages. These beverages are due to lactic acid bacteria (LAB) fermenting lactose in whey to form mainly lactic acid. This lactic acid imparts fresh flavour and suppresses the growth of pathogenic and spoilage organisms. In addition to this, some LAB particularly Lactobacillus acidophilus produces some antibacterial substances during fermentation reported to have curative properties in controlling several gastrointestinal disorders. Keeping in view the increased demand of soft and refreshing beverages in forms of cola and fruit juices in our country, attempts have been made at NDRI to convert surplus nutritive whey into a palatable, refreshing and economical "Acidophilus whey drink" named ACIDOWHEY.

**Preparation:** Paneer or cheese whey is separated to reduce fat content to 0.5%. Fat free whey is steamed for half an hour in an autoclave. It was then cooled to room temperature and allowed to precipitate protein to settle down and then filtered. Filtered whey was inoculated with pure and active culture of L. Acidophilus-R and incubated at 39± 1°C for 20-24 hrs. The acidophilus whey filtered to remove precipitate, if any, formed during fermentation. Adjusted the sugar in the product by using 50% sugar syrup and also added desirable amounts of pineapple flavour. Mixed all the contents thoroughly and packed in bottles. Bottles were crown corked, pasteurised and then stored at low temperature. The steps involved in the preparation of acidophilus whey drink are shown in following flow diagrams.

**53. Whey Protein Isolates (Wpi) From Different Whey Systems**

**Dr.B.N. Mathur**

Production of WPI in spray dried form from an attractive method for the utilisation of whey which appears as a by-product of Cheese, Casein and Paneer manufacture has a good scope. By this approach, it is possible to recover the most nutritious fraction of milk proteins, and use it for the formulation of a number of dairy and food products such as infant food, processed cheese, ice-cream, cakes soups, etc. This practice improves the nutritional quality as well as other desirable rheological characteristics of final products.

**Equipments Req. For Handling 5,000 lit. Of Whey**
1. Vertical storage tank with stirrer-1 5000 lit.
2. Scharples steam driven centrifuge-1 2000 lit./hr
3. Reaction vessels (Stainless steel)-2 500 lit.
4. Spray drier-2 30 kg water/hr.

**Process For The Manufacture Of WPI:**
1. Add sodium hexametaphosphate (technical grade) @ 5% to whey.
2. Adjust pH of whey between 2.0 to 2.5 with (1:4) HCl.
3. Clarify the whey in scharples centrifuge and recover precipitated whey proteins.
4. Dissolve the precipitated proteins in reaction vessel by adjusting the pH to 8.9 using freshly prepared calcium hydroxide solution (400 lit).
5. Clarify Scharples centrifuge, discard the precipitate of calcium metaphosphate. WPI is now free of excessive mineral load.
6. Adjust the fluid remaining after clarification to pH 5.0. Precipitated and demineralised WPI can now be recovered by passing through Scharples centrifuge.
7. Precipitate of WPI can be dissolved in water at pH 7.0 (Some ammonia added to adjust pH) and T.S. adjusted to 40%.
8. Spray dry the WPI with air inlet temperature of 180°C and outlet temperature of 95°C. There is a recovery of 70% by this process.

### Composition

<table>
<thead>
<tr>
<th></th>
<th>95.0%</th>
<th>1.5%</th>
<th>3.5%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protein</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ash</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Moisture</td>
<td></td>
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</table>

### 54. Weaning Food From Soybean and Cheese Whey

**Dr. S.K.Gupta**

The serious and widespread problem of malnutrition during the weaning period and the inability of lower income groups to purchase sufficient animal protein foods or high cost special children’s foods called for the development of a nutritious but inexpensive mixture based on vegetable proteins. This project was, therefore, undertaken to explore the possibility of utilizing soybean a rich source of protein and unsaturated fatty acids, and cheese whey a dairy waste by product, for the manufacture of a weaning food for children, aged 1-4 years.

**Composition:** The weaning food was prepared by soaking, bleaching and grinding the soybeans (in the presence of cheese whey), heating the mixture with the addition of vegetable oil, homogenizing and spray drying. The weaning food thus prepared was fortified with vitamins iron and methionine. The average composition of the weaning food was: protein-22.85%, fat-21-23%, carbohydrates-49.97% (Major component lactose), ash-4.49%, moisture-1.36% and crude fibre-0.1%. The solubility index of the spray dried product was 7.33 ml and viscosity of 12% dispersion-2.029 CP. The weaning food thus made, met the Indian Standards requirement for vegetable protein infant food with milk.

The protein efficiency ratio (PER) of the weaning food was estimated to be 3.24 as compared to 2.50 of casein. Storage studies revealed a drop in the PER, after one year storage, to 2.36 and 2.38 in tin and polyethylene containers at 5°C + 2°C while it dropped to 2.12 and 1.85 in tin and polyethylene containers, respectively at 30° + 1°C. The cost of production worked out to be Rs.4.86 per kg. exclusive of packaging cost.

The weaning food was independently assessed for its nutritional attributes by the Department of Food and Nutrition, Punjab Agricultural University, Ludhiana. Their evaluation revealed a PER of 3.23; true digestibility of 86.0% as compared to 94.9% for skim milk powder; and excellent value as a supplementary diet for pre-school children. The investigators emphasized the need for popularizing such a low-cost product for improving the health of the children from low-income families.

### 55. Manufacture Of High Protein Beverage From Soybean And Whey

**Dr. G.R.Patil & Dr. S.K.Gupta**

There is a rapid increase in the world population. It is presently increasing by 70 million each year. Unfortunately, this growth of population has associated with it unequal distribution of food. The average diet in our country is much inferior to the diet enjoyed by people in developed countries. The average intake of proteins in this country is 45 g per day. Corrected for quality it is estimated to be only 34 g per person per day. This indicates that an average Indian diet is short by about 20 g of high quality protein. The effect of this inadequate diet has resulted in widespread malnutrition. Milk, which is the most perfect food, is produced in insufficient quantity to meet the demands of the population, and is costly. In this fight against protein malnutrition and undernourishment of vulnerable groups, oil seeds, particularly soybeans, offer a potent and effective weapon. Soybean beverages represent an intermediate level of sophistication. Therefore, an attempt is being made to develop of sophistication. Therefore, an attempt is being made to develop a low cost, high protein, nutritious soy beverage from soybean and whey.

**Steps In Processing:** Two high protein beverages were made, one from soybean and whey which involved presoaking soybean in sodium bicarbonate blanching and dehulling the bean, and using the cotyledons for subsequent disintegration in the presence of whey. The other beverage involved the use of soy-protein-lipid-concentrate (SPLC) and whey. SPLC was obtained by grinding the cotyledons, obtained earlier, in presence of water to a slurry of 10% solids, the protein lipid was then isolated by isoelectric precipitation with hydrochloric acid at pH 4.5. The concentrate contained on an average 46.8% protein & 30% fat.

**Composition:** Whey was also concentrated, partially delactosed and spray dried. This whey protein concentrate (WPC) contained 22.6% protein, 7.54% fat, 53.76% lactose and 14.30% ash. Soy-whey beverage was made with both soybean cotyledons and SPLC by combining with WPC in different ratios so as to obtain soy-protein: whey-protein of 4.0:0.00 to 2.75; 1.25, and studies for their acceptability and viscosity (at pH 7.0). It was observed that the viscosity decreased as the soy-protein content decreased. However, after a ratio of 3:1, the flavour scores decreased too, on account of salty taste imparted to the beverage by the WPC.

### 56. Soft Drink Type Beverage From Lactose Reduced Whey

**Dr. R.B. Rajor**

Lactose reduced whey in powder form is abundantly available in Western Countries. This can easily be converted into soft drink type of beverage, a refreshing item which will not only supply carbohydrates but also contribute adequate quantity of protein in addition.

Cheese whey was concentrated to 60 to 62% total solids, rapidly cooled and kept for 18-20 hrs at 5°C for crystallization of lactose which was then filtered through muslin cloth. The mother liquor so obtained was spray dried using 200°C inlet and 80°C outlet air temperature of spray drier. The lactose reduced powder was reconstituted to give 1% protein; this was added with
57. Ready-to Reconstitute Whey-based
Kinnnow Juice Mix

**Dr. Kaushik Khamrui and G.S. Rajorhia**

Technology has been developed for production of ready-to-reconstitute whey-based kinnnow juice mix from vacuum concentrated Cheddar cheese whey and reverse osmosis (RO) concentrated kinnnow juice with a view to improve the nutritional value. Based on the sensory evaluation, beverage containing kinnnow juice 40%, whey 53%, sugar 7%, pectin 0.05%, carboxymethyl cellulose 0.15% and pH 4.25 was the most acceptable. For preparation of the concentrate, whey was concentrated to 45% total solids (TS) in vacuum pan, at a vacuum of 635 mm Hg and a temperature of 55-56°C followed by lactose employing RO to 23% TS at 35 bar pressure and a temperature of 50°C. Blending of the whey concentrate and kinnnow juice concentrate was carried out in a processing vat at room temperature for 5 min with the addition of sugar and stabilisers. The finished concentrate (44.9% TS), on reconstitution with 3 parts of water produced a beverage organoleptically similar to that of the ready-to-serve product.

58. Flavoured Type Milk Beverage From
Cheese Whey

**Dr. R.B. Rajor**

In most of the cheese producing countries utilization of cheese whey has become a problem, on the other hand it is an excellent source of protein "ranks high in nutritive value only next to egg protein", lactose minerals and water soluble vitamins. Utilization of cheese whey for the manufacture of flavoured type milk beverage is a most logical use to return whey to the human food chain in a palatable form, in the light of growing global food shortage. To standardize the method of manufacture of flavoured type milk beverage, a base material (prepared by taking whey + 5% skimmilk acidified with HCl, heated to 90°C followed by filtration through muslin cloth) was obtained in the form of curd. This curd was mixed with part of separated whey in a proportion so as to obtain 3.0% protein level followed by neutralizing with 10% sodium hydroxide solution, preheating to 65°C, homogenizing at 2,000 and 500 psi, pasteurizing at 75°C and finally cooling it immediately. The product with 6% sugar level and pineapple or rose flavour had a good acceptability. It has a shelf life of about 7 days under refrigerated conditions.

59. Sterilised Cream

**Sh. J.L. Bhanumurthi.**

Economic utilisation of seasonal and regional surpluses of milk is of great importance to the dairy industry and while the solids-not-fat content is used for the manufacture of dried milks, the surplus fat is used for the production of ghee. Preparation of sterilised cream would be a very profitable proposition for the utilisation of surplus fat and can fetch a much higher return by nearly 100% per unit weight of fat as compared to ghee. The product can be made either on a small scale or on large scale depending on the demand, in any dairy equipped with the usual facilities for milk handling.

**Composition:** The product has the following approximate composition:

i) Fat - 20-21%

ii) Milk SNF -6%

iii) Stabiliser- 0.2 to 0.3%

iv) Water - 72.7 - 73.8% (by difference)

**Steps In Processing:** The major processing steps involved are:

i) Adjustment of the fat level of cream to 20% (minimum)

ii) Forewarming to 85°C and holding for 15 minutes.

iii) Homogenisation at 65-67°C at a pressure of 175 kg/s.cm² for the 1st stage and 35 kg/s.cm² for the 2nd stage.

iv) Addition of trisodium phosphate as a stabiliser @ 0.2% by weight of cream.

v) Canning the cream in suitable size containers and leak detection.

vi) Sterilisation at 114±1°C for 14-15 min. and rapid cooling.

vii) Testing the final quality of the product.

**Additional Requirements Of Equipment**

i) Homogeniser

ii) Can filling and seaming equipment

iii) Steriliser.

The cost of the equipment depends on the proposed capacity of handling.

The product has an acceptable shelf life of about six months and can be used in beverages like coffee, tea and fruit-cream etc. The contents of the tin are to be shaken thoroughly before opening.

60. Creamery Butter

Creamery butter is mainly manufactured for obtaining fat which can be directly consumed along with bread, biscuits etc. at the table. About 6 per cent of the total quantity of milk produced in India is used for making creamery butter in dairies and creameries. The cream for manufacture of butter should have a fat content of 30 to 40 per cent and it should be produced from milk as hygienically as possible. Cream is then pasteurized by heating to 630°C for 60 minutes or to 880°C for 10 minutes. Over-acid cream must be neutralized to prevent excessive loss of fat in butter-milk before it is subjected to pasteurization. The neutralization is carried out by sodium bicarbonate solution or lime solution, the final acidity of the neutralized cream being kept at 0.25 per...
The cream may or may not be ripened depending upon the desired quality of the butter to be manufactured. Butter produced from ripened cream has a high flavour and is suitable for table consumption, but it has a relatively poor keeping quality. On the contrary, butter manufactured from unripened cream although lacking in flavour, keeps for a long time. Ripening is carried out by adding a good starter and the acidity is not allowed to exceed 0.5%.

To manufacture butter of uniform colour throughout the year, cream is coloured artificially by adding butter colour (annatto). The quantity of colour to be added depends whether cream from cow or buffalo is being used.

The cream is churned at 100°C to obtain butter of firm consistency. The loss of fat in butter-milk does not exceed 0.2% per cent. The process of churning should not exceed 30 to 40 minutes. When the cream is churned into butter and the butter-milk serum becomes clear, water at 30 to 40°C lower than the churning temperature is added, and the churning continued till butter granules are of the size of white kernels. Butter-milk is drawn off at this stage and the butter is washed two or three times with fresh clean water. Adequate quantity of salt is then added and the butter is worked so that the salt is uniformly incorporated. And it does not contain any excess moisture. The butter is then packed for marketing. Table butter should contain not less than 80 per cent milk-fat and not more than 16 per cent moisture. It may contain up to 2 per cent salt and may be coloured with annatto. No preservative is permissible.

Diacetyl may be added to the extent of 4 ppm to impart flavour to butter.

**61. Manufacture of Butter-oil**

In New Zealand and Australia, a somewhat different method of clarification of butter into butter-oil (ghee) is used. It consists in melting butter and in the removal of its moisture and curd by sedimentation and by clarification in mechanical clarifiers. This method is highly efficient and gives a recovery of 89 per cent of butter-fat. The machinery required is expensive and the services of skilled technicians are required to operate it. The method cannot, therefore, be used under village conditions in India, but may be adopted in modern creameries. The butter-oil lacks the flavour of Indian ghee, but it should be possible to adapt the New Zealand method of clarification for preparing a product which will suit the Indian conditions as well as taste.

**62. Butter Powder from Buffalo Milk**

*Dr. S.K. Gupta*

Free flowing butter powder (80% fat) could be manufactured (see flow sheet) from buffalo milk solids. The product having the most desirable characteristics is made by taking buffalo milk cream and mixing in it reconstituted skim milk powder so that the final total solids content including 1% each of sodium citrate and glycerol monostearate is 40%, and contains 80% fat and 16.5% SNF (on dry basis).

The mix (optionally containing 0.015% BHA) is heated (65°C), homogenised (141 & 35 kg/cm²), pasteurised (75°C for 1 min), ripened with LF-40% a mixed lactic starter culture (at the rate of 1%) to obtain 0.12 to 0.16% lactic acidity and spray dried at 82°C outlet and 175°C inlet air temperatures. The butter powder should be immediately cooled (to 50°C) and coarse sieved to break any lumps. The butter powder could be dry blended with 0.5% fine sod. Aluminium silicate to increase the flowability if desired. The finished butter powder contains 80% fat, 193.8% SNF and 0.7% moisture.

In order to obtain a butter spread from the powder, 19% moisture (i.e. approx. 4 parts powder + 1 part water) need be added and the powder reconstituted to a semi solid homogenous mass. If salt is desired in the spread, it should be added to the water before reconstituting the powder. To achieve the desirable colour and flavour, 0.5% annattoo butter colour and 4 drops of Butardol per 100 g spread respectively may be added. When stored in...
63. Low-Calorie Protein-Rich Table Spread

Dr. S.K. Gupta

A low-calorie protein-rich table spread, similar to cheese spread but with a flavour of butter, could be prepared from soybean, vegetable fat and other ingredients (see flow diagram). The process consisted of manufacturing a soy-protein-lipid concentrate (SPLC) from soybean which eliminated to considerable extent the undigestable carbohydrates without affecting the protein recovery (84%) of the various vegetable oils and fats available in the market, vanaspati was found to be most suitable as it gave the most bland flavour. A fat to soy solids ratio of 4 was found to be more favourable to achieve flowability at 65°C and emulsification of the base. Addition of 5% skim milk powder was observed to give a desirable flavour, texture and colour to the final product. Addition of 0.5% sodium citrate improved the peptization, 0.1% guar gum brought about the necessary firmness without losing spreadability. 1% sorbitol gave the necessary viscosity, 0.2% annatto butter colour and 1.5 mg % beta-carotene gave the pleasing colour in addition to enhancing the Vit. Content (to 3600 IU/100g compared to 3300 IU/100 g of butter), 0.3% (v/v) Butardol the typical butter flavour, pH 6.0 (with phosphoric acid) & 1.0% salt. The spread contains 46.6% moisture, 39.4% fat, 6.3% protein and 392 Kcal/100 g as compared to 16% moisture, 80.5% fat, 0.5% protein and 729.3 Kcal/100g in butter. One of the most important characteristics of the table spread is its spreadability.

Flow Diagram For the Production of Soya Based Table Spread, Soya Protein Lipid Concentrate (20% Solid) 100 Kg.

- Blending with (11 kg) SMP + (2.25 Kg) sod. citrate + (0.23 kg) Guar gum + (2.25 kg) salt
  - Adjusting the pH to 7.0-7.2 with 1 N, NaOH
  - Addition of (0.671) Butardol flavouring + (2.91) sorbitol + (251) water
  - Heating to 40-45°C
  - Mixing (80 kg) vanaspati + (3.35 g) beta carotene + (450 ml) annatto butter colour + 320 mg) Vitamin D.
  - Heating to 90-95°C
  - Holding for 10-15 min.
  - Adjusting the pH to 6.0
  - Adding (0.11 kg each) sorbic acid and pot. Sorbate
  - Grinding in colloid mill
  - Soy spread (223 kg)
  - Packaging
  - Storage at room temperature followed by transferring to cold store.

Unlike butter, it is spreadable both at 5 and 250°C. The table spread could be stored in glass jars for 10 weeks at 50°C and scored liked moderately to very much (score 7.6 on 9 point hedonic scale) by consumers, and was rated quite acceptable compared to butter by housewives. When produced as the sole product (at 2 tons/day), the cost worked out (in 1982) as Rs.18.33 per kg.

64. Ghee

Ghee (clarified butter oil) is the most important indigenous dairy product of India. About 33% of the total milk produced in India is converted into ghee. It can be prepared either from butter or cream by direct heating to 110-120°C. Conversion of butter or cream into ghee is a convenient method for the preservation of fat in the absence of refrigerated storage. Ghee should have maximum moisture content of 0.3%.

This ghee is sterilized in the process of preparation. Sterilization helps it to resist spoilage through contamination by micro-organisms or chemical action. Ghee is essentially butter fat prepared by the heating and drying of butter or cream so that the moisture is completely driven off. The desi method accounts for the bulk of ghee produced in India. In this method, dahi is prepared by seeding lukewarm milk with 2 to 10 per cent of the previous day’s butter-milk or dahi. The dahi is then churned in earthen or brass vessels by wooden churners for 20 to 30 minutes, and the butter formed is removed from the paddle and from the surface of the butter-milk by hand. The butter thus obtained is then heated over a medium and steady fire till the moisture is removed. Ghee produced at different places and different conditions vary in quality.

It is refined by heating in large iron or brass pans at 700 to 800°C the product being allowed to settle for 2 to 5 hours after removing the scum formed at the top and then stored in tins in a cool place for two days for proper crystallization or grain formation. The recovery of the fat is about 70 to 80 per cent of the total fat content in butter. The creamery method of making ghee is in vogue only in big dairies, where the surplus butter is melted in steam-jacketed kettles, which are equipped
with mechanical stirrers and heated with steam till the moisture is removed. The ghee is then filled in tin containers. The ghee prepared from creamery butter has a butter keeping quality but lacks the flavour of ghee manufactured from desi butter. Because of the lower curd content of creamery butter, the loss of fat in ghee-residue is lower & the recovery of butterfat is about 90%.

Ghee may also be prepared directly by boiling sour cream. The improved method for the manufacture of ghee directly from cream is to reseparate it after diluting it with water to the original volume of milk. This reduces the curd content of cream and therefore loss of butterfat in ghee-residue is less. As in the case of ghee manufactured from creamery butter, ghee manufactured by this method lacks flavour.

**Prestratification Method:** The National Dairy Research Institute, Karnal, has developed a special method and a clarifier for the manufacture of ghee from desi butter. The method consists in the butter being heated and held undisturbed at 800C for about 30 minutes, when it separates into three layers consisting, from above downwards, of thin serum, clear fat, and butter-milk serum. The butter-milk serum is drawn from the bottom and the rest boiled to free it completely from moisture and to precipitate the curd. This method is economical from the point of fuel consumption to the extent of 35 to 50 per cent. It saves time and consequently labour charges to the extent of about 45 per cent, besides yielding a product, which is superior in keeping quality.

### 65. Increasing The Shelf Life Of Ghee

**Dr. R.S. Patel & Dr. G.S. Rajorhia.**

Ghee undergoes oxidative deterioration at ambient temperature. The oxidation of unsaturated fatty acids produces hydroperoxides and their subsequent breakdown products viz. aldehydes, ketones, low molecular weight acids and oxyacids, cause the development of off-flavours in ghee. To prevent oxidation, the Food Adulteration Rules as amended in 1976, allow the addition of 0.02% by weight of butylated hydroxy anisole (BHA) and butylated hydroxytoluene (BHT) either singly or in combination in ghee. The continuous use of chemical antioxidants has been reported to cause taratogenic and carcinogenic effects in small animals and primates. In ancient times, edible vegetable sources such as betel and curry leaves were added to butter during clarification into ghee for unknown reasons. It is likely that they would improve the shelf life and flavour of ghee besides being safe to the health of the ghee consumers. An attempt was made to study the effects of boiling betel and curry leaves with butter during clarification at different concentration on flavour and antioxidative properties of ghee. Ghee samples treated BHA+BHT at 0.02% concentration. Curry leaves at 0.5, 0.8 and 1% and betel leaves at 0.2, 0.5 and 1% were stored at 30 Degree C and the samples were examined for peroxide value, iodine value, free fatty acidity, Butyrrorefractometer reading and flavour.

**Changes During Storage:** The initial peroxide value of ghee (0.00) did not increase up to 30 days of storage at 30°C. The control samples without antioxidants showed a steep rise in peroxide value after 60 days of storage. Ghee samples prepared with 1% curry leaves were most resistant to oxidation up to 135 days of storage and betel leaves at 1% level were second most potent as natural antioxidant. However, ghee samples treated with betel leaves at 1% concentration proved to be most acceptable and stable even after 147 days of storage at 30°C. The extent of hydrolysis of ghee during storage was measured by titration for free fatty acidity. After 30 days of storage, there was a progressive increase in the free fatty acid contents of all the ghee samples. The control sample of ghee after 147 days of storage at 30°C showed an increase in FFA by more than 100%. Betel leaves at 1.0% conc. provided maximum protection against the hydrolysis of ghee. Sunderajan observed that plant leaves contain phenolic compounds like hydroxychavicol, eugenol and some amino Acids like, Aspargine, gylcine, serine, aspartic acid, glutamic acid, threonine, alanine, proline and tryptophan. It is quite likely that these compounds might have served as potent antioxidants.

Although all the samples of ghee during storage showed varying degree of peroxide formation and increase in free-fatty acidity, only slight reduction in iodine value of treated ghee samples was observed. The initial iodine value of 35.9 in control sample of ghee got reduced to 35.6 after 147 days storage. The changes were non-significant in samples treated with higher doses of betel and curry leaves. Ghee samples treated BHA and BHT also offered similar benefits.

Ghee samples prepared with betel and curry leaves exhibited lower B.R. value. It is possible that the natural compounds which get dissolved in ghee during clarification might have lowered the B.R. values. Ghee samples were also evaluated for appearance, texture and flavour. All the samples of ghee were rated excellent at the beginning of the experiment. The judges preferred ghee samples treated with betel and curry leaves. These samples were awarded highest scores for flavour and colour. The samples treated with BHA and BHT were rated as ordinary. It can be concluded that betel leaves and curry leaves at 1% concentration can easily act as replacers for BHA and BHT for extending the shelf life of ghee.

### 66. Protein-Rich Biscuits From Jowar-Soybean Skim Milk

**Dr. R.B. Rajor**

The biscuits are versatile foods as they can eaten dry as a snack or can be softened with water/milk to serve as a weaning food, it serves equally well to children and adults. Such a product, particularly high-protein biscuits, can be a useful means of supplementing the diet of any section of a community with protein-calorie malnutrition. Use of locally available inexpensive ingredients such as jowar—a widely grown cereal and soybean—a source of high quality proteins, for the manufacture of protein-rich biscuits would be a healthy proposition, using a simple technology for its manufacture.

The protein-rich biscuits of acceptable quality were prepared using Jowar (Sorghum), Soybean and skim milk (in proportion of 60:30:10 respectively). The method of manufacture consisted of pregelatinization of 30 parts of jowar flour and dry mixing remainder 30 parts with 30 parts of full-fat soyflour. 10 parts of skim milk powder, 0.5 parts CMC and 1.0 part baking soda.
The vegetable fat (9.5 parts for low fat and 24.0 parts for high fat biscuits) was rubbed with ground sugar (36 parts for low fat and 44 parts for high fat biscuits) to creamy consistency and mixed with pregelatinized jowar flour and other dry ingredients. The dough was worked and then rolled to 3mm. Thickness, cut into small pieces, and baked at 170°C±5°C for 15-20 minutes.

**Composition of Protein-Rich JSM Biscuits**

<table>
<thead>
<tr>
<th>Characteristics Specification</th>
<th>High-fat</th>
<th>Low-fat</th>
<th>ISI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moisture %</td>
<td>4.58</td>
<td>4.47</td>
<td>6.0</td>
</tr>
<tr>
<td>Protein%</td>
<td>13.25</td>
<td>15.1</td>
<td>13.0 (Min.)</td>
</tr>
<tr>
<td>Fat%</td>
<td>19.50</td>
<td>12.50</td>
<td>12.0 (Min.)</td>
</tr>
<tr>
<td>Total ash %</td>
<td>2.85</td>
<td>3.60</td>
<td>......</td>
</tr>
<tr>
<td>Total carbo Hydrates%</td>
<td>59.81</td>
<td>64.25</td>
<td>......</td>
</tr>
</tbody>
</table>

**Coffee / Tea**

**67. Coffee Complete**

Sh. J.J. Bhanumurthi

Coffee complete is a product ready for reconstitution into a cup of coffee by the mere addition of boiling water. This can be easily made with a little additional equipment facility in dairy plants making sweetened condensed full cream milk. This product contains all the ingredients needed for coffee, namely, milk coffee extract and sugar.

**Composition**

1. Instant coffee 7.5%
2. Milk fat 8.5%
3. Non fat milk solids 20.0%
4. Sugar 39.0%
5. Stabilisers 0.2%
6. Water 24.80% (by difference)

**Steps In Processing**

I) Weighing instantly soluble coffee at 8.3% level on the basis of sweetened condensed full cream milk.
II) Making the instant coffee into a 73-75% solution in boiling water and allowing it to cool to room temperature.
III) Addition of 100 kg of sweetened condensed full cream milk and thorough mixing.
IV) Allowing the mix to settle for about 4 hrs. To allow the air to escape.
V) Packing the product in pre-sterilised lacquered containers.
VI) Aseptic precautions are to be taken both during manufacture and packing.

**Additional Equipments Required**

I) Jacketed vessel with plunger or kneader type mixer. 
II) Can sterilising equipment.
III) Can filling equipment.

**68. Tea Complete**

Tea complete is prepared from extract of choice blends of tea, milk solids and sugar. The dried product obtained in light brown powder is readily reconstituted into tea by the addition of hot water. It is packed in tin cans under nitrogen.

**Composition:**

<table>
<thead>
<tr>
<th>Moisture</th>
<th>2.0</th>
<th>3.0%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milkfat</td>
<td>12.0</td>
<td>13.0%</td>
</tr>
<tr>
<td>Milk solids-not-fat</td>
<td>30.0</td>
<td>31.5%</td>
</tr>
<tr>
<td>Instant Coffee</td>
<td>12.0</td>
<td>13.0%</td>
</tr>
<tr>
<td>Sugar</td>
<td>40.0</td>
<td>41.5%</td>
</tr>
</tbody>
</table>

**Casein**

Casein constitutes about 30 per cent of the total protein present in milk. Commercially it is the most important nitrogenous constituent of milk. It is a phospho-protein. In fresh milk, it occurs in chemical combination with lime salts and is held in colloidal suspension. The viscosity and white colour of milk are largely due to casein. Free casein is almost insoluble in water but is rapidly dissolved by dilute alkalies. Casein in milk can be precipitated with dilute acids, salts or rennet.

Casein is a mixture of at least 3 proteins, viz \( \alpha \) casein \( \beta \) casein and \( \gamma \) casein. Buffalo milk contains 44.5 per cent \( \alpha \) casein, 52.4 per cent \( \beta \) casein and 3.1 per cent \( \gamma \) casein, as against 54.5, 2.1 and 6.4 per cent in cow milk casein.

Milk of different species and of individuals within the same species differs in softness of curd produced on curdling. In general, buffalo milk yields harder curd than cow milk. On this account and also on account of the lower fat content of cow milk, the latter is more suitable for feeding infants. The casein content of buffalo milk is 4.3 per cent and that of cow milk 3.0 per cent. Casein is coagulated by heat, which partially destroys the union between casein and lime. Heated milk, therefore, yields a flaky curd instead of a smooth firm coagulum.

The liquid portion of milk left over after the removal of casein constituents is called whey. It contains proteins known as whey proteins or milk-serum proteins. The serum proteins are made up of lactalbumin and lactoglobulin. Large quantities of skim milk are available in butter-producing areas. Where the facilities for its conversion into edible products like condensed milk, milk...
powder or cheese are not available, it is used for the preparation of casein. Skim milk is heated to about 20°C and the strater in the form of lactic acid, sour whey or any diluted acid is added. The temperature is maintained for several hours until a firm curd is obtained. The curd is then cut and cooked to separate the whey. The cooking temperature is maintained only briefly before the whey is drained off. The curd is then washed carefully to remove most of the whey and is pressed overnight. It is then shredded and dried at about 55°C preferably by artificial means. The industrial casein thus obtained is used for various purposes.

Edible Casein is a long established dairy ingredient finding use in many dairy and food products. World production of casein is around 2.5 lakh tonnes. The largest producers are Netherlands (80,000 tonnes), New Zealand (74,000 tonnes) and Germany (24,000 tonnes), USA on other hand imports about 1 lakh tonnes of casein which is used mainly for manufacture of imitation cheese.

**Composition: Edible Casein**

<table>
<thead>
<tr>
<th>Composition</th>
<th>Edible Casein</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moisture</td>
<td>9.0</td>
</tr>
<tr>
<td>Milk fat</td>
<td>1.4</td>
</tr>
<tr>
<td>Milk Proteins and ash</td>
<td>89.5</td>
</tr>
<tr>
<td>Moisture%</td>
<td>7.0%</td>
</tr>
<tr>
<td>Milk fat%</td>
<td>1.5%</td>
</tr>
<tr>
<td>Milk Proteins and ash%</td>
<td>91.5%</td>
</tr>
</tbody>
</table>

**70. Formation Of Table Spread Using UF-Retentate**

M.Deepak Deshpande and D.K. Thompkinson

A technology for the formulation of table spread using UF-retentate was developed using milk protein concentrates (MPC) obtained through ultrafiltration and milk fat-vegetable blends for the manufacture of table spread with improved spreadability at refrigerated temperatures.

The investigation revealed that the product prepared by using 3 fold UF-retentate, 0.5% stabiliser with fat-oil blend consisting of 30% milk fat and 70% groundnut oil provided excellent physical properties and sensory characteristics to the resultant product at refrigerated temperatures. It was found that the mixture of cumin and black pepper (2:1) was most compatible with the table spread. The gross composition of the product was 62.42% total solids, 50.01% fat, 7.92% protein 0.71% lactose, 2.28% total ash, 1% salt and 0.5% stabilizer having total calorific value of 492 Kcal/100 g. Table spread had shelf life of 35 days at 6-8°C.

**71. Utilization of Sour Buffalo Milk for The Manufacture Of Edible Casein**

Dr. Vijaya Kumar

Various process parameters for the manufacture of edible casein from fresh 0.2, 0.3 and 0.4% T.A. buffalo milk have been standardized. Optimised processes are: Neutralize the sour milks with NaHCO₃ to 0.063-0.090% T.A. Heat the fresh and neutralized sour milk to 50-60°C and separate them once through the triprocess machine. Pasteurise the skim milk from fresh milk by HTST method and that from neutralized sour milks by heating to 80°C. Precipitate the skim milks from fresh, 0.2, 0.3 and 0.4% T.A. milks at 35-36, 36-37, 38-39 and 40°C and 3.7, 4.0, 4.2 and 4.6 pH respectively. Give three washings to the precipitates, each 15 min. contact time with wash water at 35-37°C. Maintain the pH of wash water for first two washings at 4.0 and of last one at neutral.

Press the washed precipitates overnight and shred them uniformly in trays. Dry the product in cabinet tray dryer with hot air circulation at 60-65°C. All the edible casein samples met ISI standards. Yield on skim milk basis from fresh 0.2, 0.3 and 0.4% T.A. milk was 2.83, 2.59, 2.53 and 2.40% respectively.

All the samples graded good to excellent on flavour evaluation. PER of fresh milk edible casein was 2.49 and that of sour milk products, 2.02-2.15. All the casein samples showed 12 months of storage ability at 30°C in polythene bags. Sodium and calcium caseinates were also prepared from different edible casein samples.

Edible caseins from different acidity milks did not significantly affect pH, solubility index, sinkability and wetability significantly of sodium and calcium caseinates. Calcium caseinates had significantly greater solubility index, sinkability, flowability and bulk density compared to sodium caseinates.

Emulsifying and whipping properties of sodium and calcium caseinates were observed to be unaffected with the different acidity milk edible caseins. Sodium caseinate was observed to possess better emulsifying properties and whipping ability than calcium caseinate.

**PFA Regulatory Standards**

The Indian Government have permitted use of artificial sweeteners in about 25 food items including carbonated water, soft drink concentrate, sugar/sugar free confectionery, chewing gum, biscuits, breads, cakes and pastries, traditional sweets like halwa, gulab jamun, khoya burfi, rasogulla and other milk products. According to a notification amending the Prevention of Food Adulteration (PFA) Rules 1955, issued by the Ministry of Health and Family Welfare, Govt. of India on June 25, 2004 the use of artificial sweeteners has been allowed in food items as per the limits prescribed and under proper label declarations. The notification permits use of four artificial sweeteners like saccharin, aspartame, acesulfame and sucralose in combination, within prescribed limits.