

# PACKAGING OF MILK AND DAIRY PRODUCTS

In a predominantly vegetarian population like India, milk and milk products form an essential component of the human diet and no other single natural food meets the nutritional requirements better than milk. In India, people consume milk as part of their daily diet and hence the consumption of fluid milk is very high. The production and per capita availability of milk in India is given in Table 1.



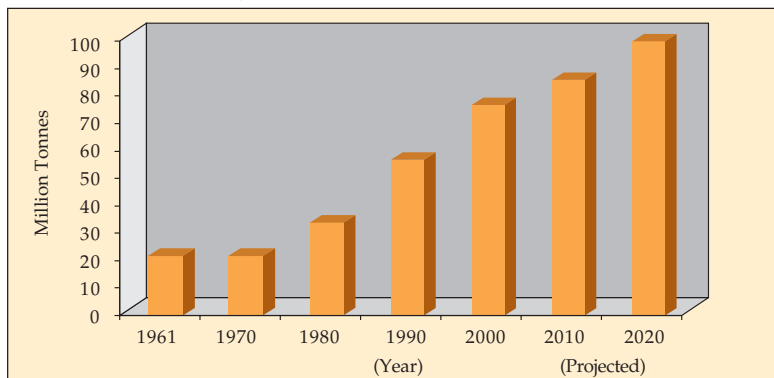
*Packaging of Milk and Dairy Products*

**TABLE 1**  
**Production and Per Capita Availability of Milk**

Year	Milk Production (Million Tonnes)	Per Capita Availability (grams/day)
1996-97	69	202
1997-98	72	203
1998-99	75	211
1999-00	78	214
2000-01	81	217

[Source : Economic Survey of India – 2001-02]

**Figure 1: Milk Production in India**



[Source: Faostat]

Today, India is the world's top milk producer with an annual production of 81 million tonnes. The production of milk is shown in Figure 1.

About 46% of the total milk produced is consumed in the liquid form and 47% is converted into traditional products like cottage butter, ghee, paneer, khoa, curd, malai etc., only 7% of the milk goes into the production of western products like milk powder, processed butter and processed cheese. Among the milk products manufactured by the organised sector,

some of the prominent ones are ghee, butter, cheese, ice cream, milk powders, malted milk food, condensed milk, infant food etc. The production of milk products is shown in Table 2.

**TABLE 2**  
**Production of Milk and Milk Products**

(in million tonnes)

Year	Milk Production	MP	MMF	CM	Cheese	Total Milk Products
1991	55.7	150	41	8.1	2.5	201.6
1992	58.0	165	41	8.4	2.9	219.3
1993	60.6	185	32	7.8	3.1	227.9
1994	63.8	195	44	8.1	4.0	251.1
1995	66.2	200	48	9.2	4.0	261.2
1996	69.1	210	53	9.3	4.0	276.3
1997	71.9	215	55	7.8	7.0	284.8
1998	75.2	222	65	9.0	5.0	301.0
1999	78.1	225	66	11.0	5.0	307.0
2000	80.1	230	67	11.5	7.5	316.0
2001	84.9	235	88	12.0	8.0	323.0
* Milk Production figures related to the financial year (2001-02) as the last year MP – Milk Powders                      MMF – Malted Milk Food                      CM – Condensed Milk						

[Source : Ministry of Food Processing Industry – Annual Report (2001 – 02)]

The post economic liberalisation scenario in India has immense potential for progress. The dairy industry especially, is gearing up to meet the export challenge. There are certain areas where major thrust is required, but all in all India is a good base for export operations. The exports of milk products from India are given in Table 3.

Presently only 12% of the marketed milk is represented by packaged and branded pasteurised milk. The appropriate packaging of dairy products is of utmost importance not only to preserve

**TABLE 3**  
**Export of Milk Products**

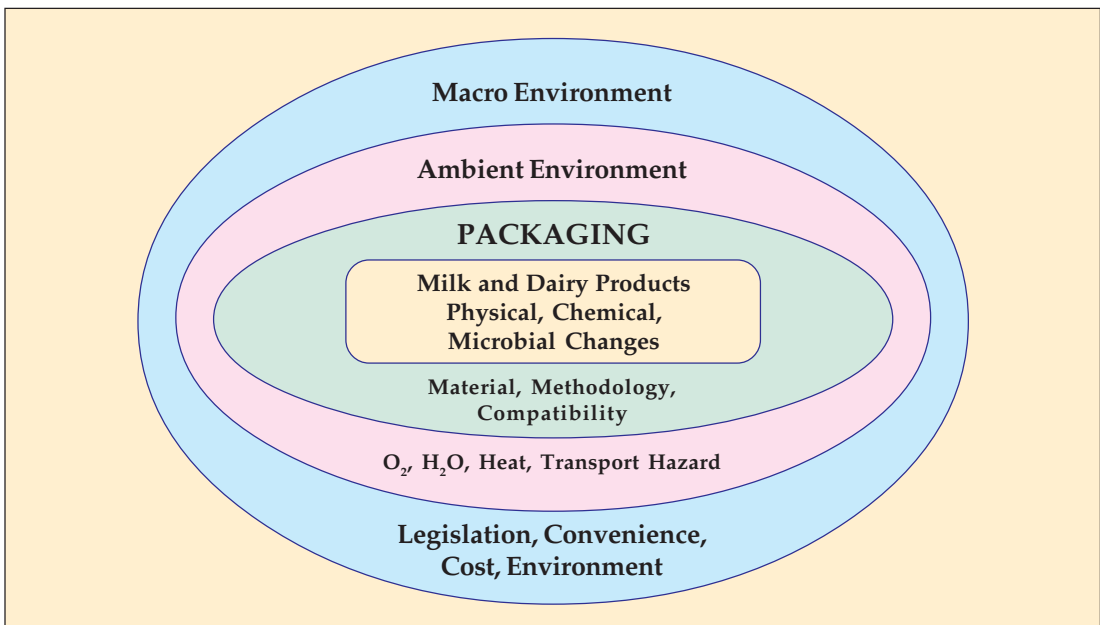
Year	Export (Rs. Millions)
1995 – 1996	325.6
1996 – 1997	153.6
1997 – 1998	133.9
1998 – 1999	136.5
1999 – 2000	372.1
2000 – 2001	839.0

[Source : Ministry of Food Processing Industry – Annual Report (2001 – 02)]

nutritive value and saving of wastage, but also to improve the marketability to achieve better returns. Milk in its various forms gives ample challenging opportunities to the packaging manufactures from the field of glass, metal, paper, plastics etc. to innovate and introduce packaging solutions which can be easily adopted in our country. The challenge to the packaging fraternity is to deliver the nutritious dairy products to the consumer in most economical, hygienic, safe and environmentally friendly packages.

For highly perishable commodities like milk and its products, packaging is very essential for safe delivery of the product to the consumer without altering its characteristics and nutritive value. Milk and milk products spoil rapidly at temperatures above refrigeration and in the presence of oxygen and other contaminating agents present in the atmosphere. The primary function of packaging is to protect these products from the adverse atmospheric conditions such as oxygen, moisture, heat, light etc. and to present the product in an appealing manner to the consumer. The important criteria for the selection of packaging materials and systems for milk and dairy products are shown in Figure 2.

**Figure 2: Package Selection Criteria for Milk and Milk Products**



## Classification of Dairy Products

For the purpose of this article the dairy products are classified into four groups as follows:

### Liquid Milk

- Pasteurised milk
- Flavoured milk
- Condensed and evaporated milk

### Dairy Products (where India has considerable manufacturing skills and marketing experience)

- Milk Powder
- Butter
- Ghee
- Ice-cream
- Malted milk food

### Relatively Newer Dairy Products

- Cheese
- Yoghurt

### Traditional Dairy Products

- Paneer
- Khoya
- Shrikhand
- Indian sweets

### Liquid Milk

- **Pasteurised Milk:** In our country, a large quantity of milk was earlier sold in an unprocessed, unpacked condition. Milk was brought by the vendors in aluminium containers to the doorsteps of the consumers, where the required quantity was measured and given out in the customer's container.

This led to considerable amount of handling of the product leading to contamination. Also, adulteration and short measures could not be ruled out. With the commencement of marketing of milk by the dairy co-operatives in packaged form, most of the problems mentioned were overcome.



*Liquid Milk Pouches*

In the packed form, milk was sold in returnable glass bottles sealed with aluminium foil cap. Clear glass bottles of 500ml capacity conforming to IS: 1392 – 1967 (specification for glass bottles for milk) were used. The glass bottles offered certain advantages like transparency, rigidity, hygienic and non-toxic nature and compatibility. However, due to the inherent nature of glass, certain problems such as high tare weight and fragility emerged. Also, the shortage of aluminium foil in the country was felt.



*Aseptic Packaging of Milk*

This led to developing an alternate packaging system and in the early 80's, plastic pouches replaced glass bottles. Plastic pouches are generally made of low-density polyethylene (LDPE film). Co-extruded LDPE-LLDPE film is also used because of its advantage of eliminating pin-hole problems. The films are of 65-70µm thick. The pouches are formed and filled on Form-Fill-Seal (FFS) machines in capacities of 500ml and 1000ml. The film should conform to IS: 11805 – 1999 - Film for Milk. The plastic pouches are clean, hygienic and safe for this application and since these are not reused, the cleaning operation is eliminated and energy loss is avoided. Moreover, these pouches are easily recyclable.

Another technological breakthrough in processing and packaging of milk is the Aseptic Packaging, commonly known as the Tetrapak milk. In this packaging system, both the package and the product are sterilised separately and the packaging operation is carried out under aseptic (sterile) conditions. This system offers a long storage life of about 3 months, without the need for refrigeration or added preservatives. A tetrapak carton is formed from a composite material, which has 5 to 7 layers including paperboard, aluminium foil and polyethylene.

In the distribution system, the pouches are placed in reusable multi-trip plastic crates. The crates are made of HDPE or PP and are nestable and stackable. The plastic crates conform to specifications laid down in IS: 11584 – 1986 Crate for Milk Pouches.

- **Flavoured Milk:** Flavoured milk drinks are generally skimmed or semi-skimmed and contain less than 1% fat. The package should be leak and tamper proof, should have sufficient wet strength and should not pass on any odour or taint to the product packed inside. The plastic based material used for sachets is octane LLDPE (O-LLDPE). OLLDPE when blended with 50% LDPE provides excellent puncture resistance, excellent seal strength and hot tack. Co-extended multiple level low-density films with an outer opaque film and an inner black film for reducing the transmission of light are also used.

In India, flavoured milk drinks are available in sterilisable crown cork glass bottles, glass bottles with aluminium foil lid or snap-on plastic lid, plastic sachets and aseptic packs (Tetra bricks). Recently 200ml, translucent bottles of HDPE with an aluminium foil cap have also been introduced.

Poly carbonate bottles with the leak proof screw cap are also used in place of glass bottles as these are unbreakable and are much lower in weight (1/6<sup>th</sup> the weight of glass bottle). PET containers are in use as they are light in weight, have good sales appeal and are strong.

- **Condensed and Evapourated Milk:** Traditionally, condensed milk was bulk packed in barrels or tins. In India, sweetened condensed milk is the most popular out of all other concentrated milks and is packed in conventional food cans with double seam ends. Evaporated milk is recently packed in aseptic tetrapaks.

## Dairy Products

- **Butter:** Butter consists of fat, which has been separated from the aqueous phase of milk. Butter should be kept under refrigeration. Butter usually contains 80-82% fat, 15-16% moisture and 0.5-2.5% salt. Because of this high moisture content, butter, unlike solid fats is susceptible to mold growth. Flavour and odour are easily affected by absorption from other materials or through spoilage of butter due to rancidification, due to oxygen and light. The package should, therefore, be opaque and a high barrier against oxygen and foreign odours.



*Packages for Table Butter*

Butter is generally marketed in capacities ranging from 100 grams to 500 grams. The most commonly used butter wrap is the vegetable parchment paper of 45 gsm. Although parchment paper is greaseproof, it does not provide a sufficient barrier to oxygen. For superior product protection and for longer shelf-life, aluminium foil laminated to parchment or greaseproof paper is used for which specifications are given in IS: 7161-1973 Specification for Vegetable Parchment or Greaseproof Paper/Al foil Laminate for Wrapping Butter. To avoid corrosion of aluminium foil (due to salt and lower pH of butter), it is coated with lacquer and a protective adhesive between the foil and paper is applied. The wrapped butter is placed in a plastic laminated paper-board carton to ease handling, distribution and storage at retail outlets under refrigeration.

Recently, embossed aluminium foil backed parchment paper has been introduced for UV light protection and sales appeal. **A popular packaging style in some countries is to use plastic cups and plastic tubs with lids in different shapes and sizes. For such applications, PP (Polypropylene) and ABS (Acrylo-Butadiene-Styrene) are widely used.**

When butter is to be stored for a very long time and transported over long distances, hermetically sealed tinplate containers are used. Recent development is the use of smooth walled light-weight aluminium containers, which are convenient, colourful and hygienic.

The containers are provided with printed or un-printed plastic or heat sealable foil lids. Butter packed in the metal containers has a shelf-life of one year and above.

- Ghee:** Ghee is a typically Indian product, known from almost vedic times. Ghee was almost exclusively a product made at home and consumed from home containers of glass, ceramics, earthenware or tinsplate. Over a period of time, the manufacture of ghee has become a commercially well organised industry.



*Flexible Plastic Pouches and Lined Containers*

Ghee is 100% fat with an off- white colour, grainy texture and a characteristic flavour. The product has a very low moisture content (less than 0.5%) and, therefore, unlike other dairy products, susceptibility to microbial deterioration is not very high. However, the product needs to be protected from chemical spoilage and rancidity caused by oxygen, light, heat, moisture and metal ions.

A major portion of ghee was packed in lacquered or un-lacquered tinplate containers of capacities ranging from 250 grams to 15 kilograms. Since the product is very sensitive to oxygen, the tinplate containers are filled to the brim without an air gap. Ghee packed in tinplate containers is fairly stable and has a shelf-life of over one year.

Alternate packages, which are plastic based, are now gradually replacing tins. For shorter shelf-life, 200 grams, 500 grams and 1 kilogram capacity pouches made of polyethylene film are marketed, which are economical. Ghee is also marketed in lined cartons with flexible laminated plastics as inner liner materials and in tetrapaks. In both these packs long shelf-life is achieved. Laminated pouches of metallised polyester based films are also used. **For packaging of ghee laminates of polyester, Nylon-6 and use of high barrier materials such as EVOH and EVAL can also be explored, as these materials could provide a fairly long shelf-life.**

- Milk Powder:** Milk powder is obtained by removing moisture from raw liquid milk by application of heat or by spray or drum drying. Reconstitution of the product with water yields liquid milk. If the fat as well as moisture is removed, skimmed milk powder is obtained. Both whole and skimmed milk powders are marketed. Milk powder is hygroscopic in nature and has a tendency to gain moisture from the atmosphere, which results in lumping or caking of the powder. Whole milk powder is highly sensitive to oxygen as well. Presence of oxygen causes spoilage of the product due to oxidation and rancidification, therefore the packages are required to be vacuumised or nitrogen flushed.



*Milk Powder Packed in Pouch in Carton*

Milk powder is bulk packed in 25 kilogram capacity multiwall paper sacks with plastic liner made of polyethylene. The two typical structures used are:

- 4 ply construction of:  
One outer ply of crepe paper of 168g/m<sup>2</sup>  
Three inner plies of 84 g/m<sup>2</sup> natural kraft  
One inserted liner of 80 – 90µ LDPE
- 5 ply construction of :  
One outer ply of kraft of 70 g/m<sup>2</sup>  
One inner ply of kraft of 70 g/m<sup>2</sup> plus 15 g/m<sup>2</sup> PE  
Three inner plies of kraft of 70 g/m<sup>2</sup>  
One inserted liner of 80-90µ LDPE

**Alternatively, the polyethylene liner can be laminated directly to the inner wall of the paper sack.**

The retail packs of milk powder traditionally are 500 grams or 1kilogram capacity tinplate containers with an aluminium foil tagger. The containers are flushed with nitrogen gas for extension of shelf-life. Besides high cost and availability problems, another major drawback of the containers is its ability to rust. To a certain extent, these problems have been solved by using aluminium ends and protective lacquers. Plastic (HDPE) bottles are also used for packing skimmed milk powder. Flexible plastic packages have emerged recently for packaging of this product. In most cases, the flexible sachets are enclosed in paper-board cartons. The flexible materials have evolved through polyethylene bags to sophisticated multiply laminates. Stand-up pouches of metallised polyester/LLDPE laminates and polyester/LLDPE laminates are used for skimmed milk powder. **For whole milk powder, a typical structure for a plastic pouch is 12µ polyester/ 9µ Al foil/50µ PE, and when gas flushed, these pouches are found to be as effective as canning to prolong shelf-life of milk powder.** Latest development is the increasing use of pouches made from co-extruded film of LLDPE–Nylon–LLDPE with gas flushing and laminates of Polyester/Al foil/surlyn/Pd catalyst/ surlyn, as oxygen scavenger (Punj Rath, 1955).

- **Ice-cream:** Ice-cream is a frozen dairy product prepared by mixing milk, cream, sugar, flavour and stabilisers, with the incorporation of air during the freezing process to provide



*Ice-creams Packed in Plastic Laminated Paper Board Cartons*



*Plastic Container for Ice-creams*



a smooth texture. Since it is a frozen product, the packaging should be designed in such a way that the pack performs efficiently to contain the product at freezing temperatures. Super smooth ice creams are extremely delicate products and must be packaged with utmost care. Conventional form of packages include paperboard cartons, paper cups and in some cases even metal containers. But, the above variety of packages are slowly but surely being replaced by other forms.

Ice-cream needs to be protected against contamination, moisture loss and fluctuations in temperature. The package should be attractive, easy to open and dispose. The distribution and transportation of ice-cream is done in frozen condition and to maintain its frozen state, refrigerated trucks or dry ice is used. Dry ice pieces are wrapped in paper and placed around the ice-cream packs inside an insulated container, which is generally a corrugated fibre board box. The various types of packages for ice-cream include:

- Paper board carton which is poly coated
- Thermoformed / injection moulded plastic containers made from HIPS (high impact polystyrene), PP (Polypropylene) or HDPE (high density polyethylene). The materials used for the lids are LDPE (low density polyethylene) or PS (polystyrene). The lids are of snap on type
- Laminates of BOPP (biaxially oriented polypropylene) or PET (polyethylene terephthalate) are used for candies.

The demand for thermoformed / injection moulded containers, tubs and cups are on the rise as this type of pack is hygienic and does not support the growth of micro-organisms. This type of package is suitable to be used on automatic filling equipment, because of its comparative strength and rigidity as compared to paper based packs. Tight control of dimensions and weight in case of plastic containers (thermoformed) lead to a most cost-effective style of packaging, particularly when high speed filling is desired. Besides, they are easily available in the market today in a wide range of shapes, white, clear, translucent with re-closable lids or sealable closures. The re-closable tubs present the consumer with a great value pack, since it prevents crystallisation of the partly consumed contents, and, when empty, the package offers a wide range of reuse facilities. The scrap value of thermoformed packages is high and recyclability is preferred by collection and reuse of the polymer material for other applications.



*Flexible Packages for Ice-creams*

An interesting application of innovative thermoformed packaging has been the recent introduction of the two-piece "kulfi" pack, where the lid doubles as a pedestal base. Truly an example of a sophisticated package, which hygienically presents a traditional product in its traditional shape.

- **Malted Milk Food:** The malted food beverage industry is popularly known as the health beverage sector. Historically, malted beverage has a strong association with milk. The Indian health beverages market is divided into white and brown health drinks. White beverages contribute about 65% of the market.

Malted milk food are highly sensitive to moisture and are prone to oxidative changes in the presence of light, heat and oxygen. Aroma retention of the product and prevention of moisture and oxygen ingress, therefore, is very critical in protecting the product, and in selection of the right packaging material.

Malted milk food are packed in quantities of 200 grams to 1 kilogram in a variety of packages. The types of packages used conventionally are glass jars, tinfoil containers, which are now slowly being replaced by plastic containers and flexible laminated pouches. Though



*Malted Milk Food in Cartons*



*Plastic Bottles with Shrink Sleeves for Malted Milk Foods*

glass containers are hygienic and safe and offer the advantage of a long shelf-life, it has the disadvantage of being heavy, fragile and costly. Tinfoil containers though provide good protection from gases and moisture, are likely to rust at body welding or at top and bottom seams. Tinfoil containers are also expensive.

The plastic containers used are blow moulded HDPE or HM- HDPE or stretch blow moulded PET containers / jars, for brown and white malted milk food products for capacities ranging from 200 grams to 2.5 kilograms.

The plastic containers are light weight, sturdy, unbreakable and hygienic, and have a good shelf appeal.



*Malted Milk food packed in laminated Pouches*

Besides the plastic containers, the trend is also to use flexible pouches, which may be with or without paperboard cartons. This type of pack has an advantage of low cost compared to plastic bottles. Moreover, the storage space requirement is low and the filling operation is comparatively faster.

Some of the typical structures of flexible materials used are:

- 50 and 100 grams  
12 $\mu$  PET/12 $\mu$  metallised PET/38 $\mu$  LDPE
- 500 grams  
12 $\mu$  PET/20 $\mu$  metallised BOPP/50 $\mu$  LDPE  
12 $\mu$  PET/12 $\mu$  metallised PET/50 $\mu$  LDPE
- 1000 grams  
12 $\mu$  PET/12 $\mu$  metallised PET/65 $\mu$  LDPE



Malted Milk Food in Plastic Containers

## Newer Dairy Products

- **Cheese:** Cheese is obtained from the curd of milk by coagulation of protein in the presence of lactic acid produced by bacteria. The moisture is then removed from this and it is pressed into a solid mass.

The present market for cheese in India is estimated at about 9,000 tonnes and is growing at the rate of about 15% per annum. Cheese is mainly consumed in the urban areas. The four metro-cities alone account for over 50% of the consumption. The demand for various types of cheese in the Indian market is shown in Table 4.

Cheese is a delicately flavoured product, with high fat content and moisture content. Cheese needs to be protected against moisture loss and ingress of oxygen in order to maintain the desired quality characteristics.



Packs of Cheese Cubes, Slices and Slabs

TABLE 4  
Demand for Cheese in the Indian Market

Type Of Cheese	Percentage Consumption
Cheddar	50
Cheese Spread	30
Mozzarella	10
Flavoured / Spiced	5
Others	5

In India, the traditional package of cheese is a hermetically sealed printed tin-plate container in 400 / 500 grams capacities. Of late, 500 grams size slabs of cheese are also packed under vacuum in high barrier flexible laminates. Individual packed slabs are then placed in rectangular transparent injection moulded plastic containers with lid. This type of packaging is more convenient and hygienic as compared to the traditional pack of tinplate. Moreover, the pack is lighter, more economical, and has a reuse value.

Today, the flexible packaging films and laminates generally used for packaging of cheese to provide

adequate moisture and oxygen barrier properties and to retain the vacuum are:

- Co-extruded LLDPE – TIE – Nylon – TIE – LLDPE
- Co-extruded LLDPE – TIE – EVOH – TIE – LLDPE
- Co-extruded film based on PVDC as the core material
- Laminates of metallised polyester / co-extruded nylon based film

Cheese / cheese spread is also packed in rectangular or triangular chiplets of 25 grams. The wrapping material generally used is aluminium foil. 8 or 10 of the packed chiplets are placed in an outer plastic or paperboard container. Cheese spreads may also be packed in plastic tubs or plastic laminated or co-extruded squeeze tubes.

Cheese is also available in slices individually wrapped in plastic films. Ten such slices are placed and sealed in an outer high barrier plastic film pouch.

- **Yoghurt:** Yoghurt is the product obtained from milk by souring it with a harmless lactic acid bacteria. In our country the popular variety of yoghurt is “dahi” or “curd”. In developed countries, the market of this product is rapidly expanding by the introduction of a wide variety of flavours.

Yoghurt has a very short shelf-life at room temperature. On prolonged storage it becomes highly acidic and unfit for human consumption due to growth of micro-organisms. The recommended storage temperature is 5°C to 10°C.

In our country, this product has been a household item and was rarely available in retail packs. The traditional pack so far was the earthenware pot with a loose cover of glassine or greaseproof paper. The earthenware pots are very heavy, easily breakable and because of oozing of water from its body, the product inside develops shrinkage cracks. Recently, injection moulded polystyrene and Polypropylene cups have been introduced with aluminium foil based peelable lids. These cups are available in capacities of 200 grams and 400 grams and provide a shelf-life of about 10 days under refrigeration. **The plastic cups are light in weight, easy to handle and are hygienic.**



*Yoghurt Packed in Plastic Containers  
with Flexible Peelable Lids*

In the overseas markets, Polystyrene or Polypropylene plastic cups with heat sealable Al foil based lids are most popularly seen on the supermarket shelves. The latest trend is to use two compartment packages, wherein crunchy nuts and dried fruits are housed in one, and yoghurt in the other. After removing the foil lid, the contents could be mixed before consuming.

Drinking yoghurt is available in 200 ml up to 1kilogram packs. Besides tetrapaks and gable top carton, recently plastic bottles have also emerged in the Western markets, for this product.

## Traditional Dairy Products

A variety of dairy products are made in our country (Table 5). Some products are popular throughout the country, whereas, others are region-specific. These products conserve and preserve milk solids for relatively longer periods. However, lack of proper infrastructural facilities, coupled with inadequate technological support has impeded the growth of this sector.

Traditionally, Indian dairy products have been manufactured by individual sweet makers-“halwais” and small entrepreneurs. Most of the preparations are labour intensive and rely on local inputs. Very little attention is paid to sanitary handling practices and packaging. A number of surveys conducted on the market quality of indigenous milk products have

**TABLE 5**  
**Traditional Dairy Products**

Category	Products
Heat desiccated products	Khoa : used as the base for preparation of kalakand, gulab jamun, pedha, and a variety of burfis. Rabri Khurchan Pyodhi
Heat or acid coagulated products	Chhana or Paneer
Fermented products	Dahi Misti Dahi ( sweet Dahi) Lassi/ Chhaas / Mattha Chakka : base for Shrikhand Shrikhand
Fat rich products	Makkhan made from Dahi Ghee obtained from heat clarification of Makkhan or Butter
Concentrated products	Kheer Payasam or Palpayasam Basundi / Rabri Milk sweets / Delicacies – Burfi Kalakand Gulab Jamun Pedha Rasgolla Sandesh Rasmalai

revealed alarmingly high incidence of microbial contamination, large variations in chemical composition, flavor and texture. Most of the products have high water activity, leading to rapid deterioration at ambient temperatures. These products form a good substrate for the growth and multiplication of bacteria. Bacteria have the ability to utilize various milk constituents to grow and multiply in an exponential pattern. While growing at the expense of milk constituents like, lactose, proteins and fat, these organisms release certain metabolites like lactic and organic acids, gases, enzymes, toxins etc. This directly affects the quality of the products and also render the products unsafe for consumption.



*Shrikhand Packed in Plastic Containers*

Traditionally, indigenous products have been packed in leaves, paper cartons or paper-board boxes. These materials do not provide sufficient protection to the product from atmospheric contamination and manual handling. Consequently, the sweets soon lose their typical body and texture, absorb foreign odours, lose their aroma characteristics and show mold growth. Moreover, the products are stored in open metal trays. According to customer's demands, the item is weighed and placed in paper bags or dhak leaves or earthen pots (for fermented products like dahi), glassine or grease-proof papers and/or sold in paper board boxes. What is necessary is immediate packing of products after their preparation to protect the product from atmosphere and contamination by handling. Use of saran coated films, laminates of aluminium foil with various substrates, metallized films and combinations of various packaging materials need to be tested for suitability for these products.

For instance, products like, gulab jamun and rasgolla need protection from light, oxygen, ingress or egress of moisture and micro-organisms; lacquered tinsplate can is the most protective material, but this is very expensive.

Hence, there is a need to develop a plastic can similar to the ones used in European countries. The pack is extruded and laminated with PP-Al foil material. The foil provides the necessary water vapour barrier properties, smooth curved corners and good printing surface for multi-colour designs. The ends are injection-moulded and lined with the same type of laminate as used for the body. The size and dimensions can be adopted to suit the distribution systems and consumer's needs. The material is heat resistant and suitable for food contact. Similarly, suitable applications of retort pouches, stand-up pouches, tetrapak cartons and bricks need to be explored in the Indian dairy industry.

Recently, organized dairies have taken up the production of indigenous products like gulab jamun, shrikhand, lassi, mishti doi, khoa and with the ball set rolling by this process, innovation is expected to gain momentum. The three-fold challenge before the Indian dairy industry is to focus on quality, product development and global marketing. It calls for upgrading, on a sustained basis, of managerial and professional skills and updated knowledge of markets. Conscious R&D efforts are needed to expand the indigenous capacity for the manufacture of dairy equipment and also bring in innovations in the fields of packaging, transportation and distribution.

## Studies Conducted at IIP on Packaging of Milk Barfi

Milk barfi is one of the popular items of traditional Indian sweets. It is generally sold over the counter at the retailers where a weighed quantity is placed in a grease-proof paper lined paper board carton and handed over to the consumer. Packaging of such a product at the time it is manufactured, would not only reduce the handling of the product, and make it more hygienic, but also help to extend the shelf-life of this perishable item. A number of packaging materials/ systems could be explored to select a suitable one for the marketing requirements of the product. In view of the above, the studies were undertaken to identify a suitable package for the product.

Barfi is a milk based Indian sweet with a high percentage of fat content. It is prepared by boiling together milk, sugar and fat till it forms a solidified mass. The product is characterised by a specific texture and flavor / aroma. Barfi has a fairly high moisture content and at ambient conditions has a tendency to lose moisture and become dry in texture. Due to its high fat content, it can also become rancid on contact with oxygen in the atmosphere. Barfi is also prone to microbial growth.

The methodology adopted for the study was to procure freshly prepared product from the market, pack it in different packaging materials/packaging systems and carry out storage trials at room conditions. (Trials at refrigerated conditions were not carried out, as generally, there are no facilities to market these products at cold conditions with the local sweetmeat vendors). Depending upon the type of pack/packaging material, besides the ordinary packing, vacuum packaging and flushing with an inert gas like nitrogen was also considered. The details of the packaging materials/systems selected for the studies are given in Appendix Table 1 at the end of the article.

The shelf-life / storage studies of milk barfi were conducted using all the selected packaging materials / systems. Barfi was cut into pieces and about 200 grams of the product was packed. The packs were closed by heat sealing / capping / wrapping depending upon the type of packaging system. When the vacuum packaging was done, it was observed that due to the soft nature of the barfi and the high fat content, the fat from the product oozed out, and lumping together of the product was also observed. Therefore, vacuum packs were found unsuitable and not considered. Adequate numbers of filled packs were stored at room conditions of  $30^{\circ}\text{C} \pm 2^{\circ}\text{C}$  and  $65\% \pm 2\%$  RH. The samples of the stored packs were drawn at regular intervals of time and the product from the drawn packs was assessed for its keeping quality. The parameters determined were:

- Texture
  - Colour
  - Change in taste
  - Change in aroma
  - Microbial quality
- } Organoleptic evaluation

Besides assessing the product quality, the packages were also observed for any changes like retention / leakage of gas from nitrogen flushed packs, softening / delamination, opening of seal etc.

The shelf-life of the milk barfi based on the studies in different packs is indicated in Appendix Table 2 at the end of the article. The recommended specification details for the suggested materials are given in Appendix Table 3 at the end of the article.

## Conclusion

The technological progress and revolutionary improvements in the efficiency and economy of distribution of milk and milk products have led to innovations in packaging line. New systems, materials, machinery, designs (taking into consideration the environmental concern) are some of the innovations in the dairy packaging sector.

These innovations have provided greater convenience to consumers, extended the shelf-life of products, lowered the costs and also led to improvements in sales, better hygienic conditions and introduction of new products and easier handling. **Plastics have played a major role in introducing improvements in the packaging systems and therefore marketing of milk and milk products. Not only have they contributed in providing longer shelf-life and convenience but due to their hygienic nature, also helped to deliver the various products in a wholesome and safe manner to the ultimate user.**

However, to meet the global demands, the Indian dairy industry has to strive and match the product and packaging standards, for which continuous efforts and research is required.



**APPENDIX TABLE 1**  
**Selected Packaging Materials/Systems for Study**

Packaging System/ Materials Selected	Type of Pack		
	Ordinary	Vacuum	Gas Flushed
Carton in Pouch E-fluted paperboard carton with outer ply of duplex board in a flexible pouch. Material selected			
(a) 10 $\mu$ PET/9 $\mu$ Al Foil/150 Gauge LLDPE	Ordinary	Vacuum	–
(b) 10 $\mu$ PET/150 Gauge LLD/HD/LLDPE	Ordinary	Vacuum	–
(c) 12 $\mu$ Met. Polyester/170 Gauge LDPE	Ordinary	Vacuum	–
Flexible Pouch in a Carton (Flexible pouch in an E-fluted paperboard carton with outer ply of duplex board) Materials selected			
(a) 10 $\mu$ PET/9 $\mu$ Al. Foil/150 Gauge LLDPE	Ordinary	–	Gas flushed
(b) 10 $\mu$ PET/150 Gauge LLD/HD/LLDPE	Ordinary	–	Gas flushed
(c) 12 $\mu$ Met. Polyester/170 Gauge LDPE	Ordinary	–	Gas flushed
Thermoformed PP (polypropylene) container with hinged lid	Ordinary	-	Gas flushed
Thermoformed PP (polypropylene) container with a peelable lid of heat seal lacquered aluminium foil	Ordinary	–	Gas flushed
PVC (food grade) tray with a cling film in an E-fluted paperboard carton with outer ply of duplex board	Ordinary	–	–
Injection moulded HDPE container with a snap-on lid	Ordinary	–	–

**APPENDIX TABLE 2**  
**Shelf-life (in days) of Barfi at Room Conditions**

Packaging System/ Materials Selected	Type of Pack		
	Ordinary	Vacuum	Gas Flushed
Unpacked Barfi	2-3	–	–
Paperboard Carton in Pouch		Lump formation and fat seepage on the inner surface of pack observed	–
• 10 $\mu$ PET/9 $\mu$ Al Foil/ 150 Gauge LLDPE	6		–
• 10 $\mu$ PET/150 Gauge LLD/HD/ LLDPE	6		–
• 12 $\mu$ Met. PET/170 Gauge LDPE	6	–	–
Flexible Pouch in a Carton			
• 10 $\mu$ PET/9 $\mu$ Al Foil/150 Gauge LLDPE	8	–	9
• 10 $\mu$ PET/150 Gauge LLD/ HD/LLDPE	6	–	7
• 12 $\mu$ Met. PET/170 Gauge LDPE	6	–	7
Thermoformed PP Container with hinged lid	7	–	9
Thermoformed PP Container with a peelable lid of heat seal lacquered Al. Foil	7	–	9
PVC tray with a cling film in an E-fluted paperboard carton	9	–	–
Injection moulded HDPE Container with a lid	9	–	–

**APPENDIX TABLE 3**  
**Specification of Packaging Materials**

Packaging Material	Specification
<b>Flexible Pouch</b> Material of construction  Thickness	Laminate of Polyester / Al. Foil / Linear Low Density Polyethylene  Total               – 82 μ Polyester           – 12 μ Al. Foil             – 20 μ Polyethylene      – 50 μ
<b>Thermoformed Container</b> Material of construction Thickness	Food grade PP (Polypropylene) 0.15 mm
<b>Peelable Lid</b> Material of construction  Thickness	Aluminium foil coated with heat seal lacquer 0.02 mm
<b>Cling Film</b> Material of construction  Thickness	Food grade PVC film (poly vinyl chloride) 0.032 mm
<b>Injection Moulded HDPE Container</b> Material of construction Thickness	Food grade high density polyethylene 0.075 mm

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