

PACKAGING OF BAKERY PRODUCTS

The bakery industry, production of which has been increasing steadily in the country, is the largest among the processed food industries in India. The two major bakery industries, viz. bread and biscuit account for about 82% of the total bakery products.



Range of Bakery Products

The annual production of bakery products, which includes bread, biscuits, pastries, cakes, buns, rusk etc., is estimated to be in excess of 3 million tonnes. The production of bread and biscuits in the country, both in the organised and unorganised sectors, is estimated to be around 0.44 million tonnes and 11 million tonnes respectively. The cake and pastry market estimated at 0.4 million tonnes, is the fast growing market with volume growth of 16%. The break up of

production of bread and biscuits is given in Table 1.

TABLE 1
Production of Bakery Products

(‘000 tonnes)

Year	Biscuit Production	Bread Production
1975	189	340
1980	n.a.	539
1986	735	n.a.
1992	900	800
1994	n.a.	1300
1995-96	1000	1400
1996-97	1100	1500
1997-98	1400	1600
2000	1700	1700

India’s bakery market at Rs. 49.5 billion tonnes makes it the third largest market in Asia Pacific, only after Japan and Australia.

The bakery industry in India comprises of organised and unorganised sectors. The organised sector consists of large, medium and small-scale manufacturers who produce packaged biscuits and bread. The unorganised sector consists of small bakery units, cottage and household type manufacturing their goods without much packaging and distributing their goods in the surrounding areas. Bread market is estimated to be growing at around 7% p.a. in volume terms, whereas the biscuit market has witnessed a higher growth at around 8-10%. Within the biscuit category, cream and speciality biscuits are growing at a faster rate of 20% p.a. The per-capita consumption of biscuits in India is around 900 gms as compared to 15-20 kg. for developed countries. The consumption of biscuits is equally divided between the urban and rural population. Demand for biscuits in 2003-2004 is likely to exceed 1.2 million tonnes.

Bakery products are an important source of nutrients viz. energy, protein, iron, calcium and several vitamins. Commercial bread and biscuits contain around 7.5% to 7.8% protein respectively. Biscuits are amongst the lowest cost processed food in the country when compared to other Indian sweets and salted snacks. Biscuits are easy to use during travel or at home because of its availability in variety of pack sizes. They also offer substantial energy. Thus biscuits have an important role to play as a diet supplement for both adults and children. It is no longer viewed as a luxury tea-time snack but essential daily food component for an average Indian household.

The packaging of bakery products is closely interlinked with production, preservation, storage, transportation and marketing. The importance of packaging can further be gauged from the fact that packaging constitutes a fair portion (10 to 25%) of the entire cost of the pack.

Product Range

Bakery products contain high nutritive value and are manufactured from wheat-flour, sugar, baking powder, condensed milk, ghee (fat), salt, jelly, dry fruits, various essences and flavouring etc. Different type of bakery products can be classified as:

Dry Bakery Products

- **Biscuits:** Soft biscuits, hard biscuits, cookies, crackers, fancy biscuits, cream wafer biscuits.

Moist Bakery Products

- **Bread:** Sweet bread, Milk bread, Masala bread, Garlic bread, Fruit bread etc.
- **Buns:** Fruit buns, hamburger buns, dinner rolls, crisp bread, pizza.
- **Others:** Cakes, pastries, doughnuts, muffins etc.

Product Characteristics

Dry Bakery Products

These products are fragile and characterised by a low moisture content (<6%) low water activity ($A_w = 0.30$) and are highly hygroscopic. Moisture is the decisive criteria for the organoleptic

properties and acceptability by the consumers. The basic characteristics of dry bakery products are given in Table 2.

TABLE 2
Basic Characteristics for Dry Bakery Products

Properties	Basic Characteristics of Products
General	Foodstuffs for long storage
Physical-mechanical	Fragile Light Low resistance to moisture Variable sizes
Organoleptic	Crisp or crunchy texture Distinctive flavours Flavors that may change (loss of initial flavour or ingress of foreign flavour) Flavour that may deteriorate (go stale, soapy or bitter, etc.)
Physico-chemical	Low moisture content Hygroscopic Containing fatty matter Greasy surface Sensitive to: <ul style="list-style-type: none"> • Oxidation • Enzymatic reactions • Non-enzymatic browning • Light
Technical – economical	Industrial Low sales price

- **Loss of Crispness:** Biscuits have a low moisture content, high fat level and are fragile in nature. Hence, they have to be protected from these three aspects. Since the biscuits consists of wheat flour, fat and shortening, sugar, salt and flavouring agents they are pre-dominantly sensitive to water vapour interchanges (moisture) and oxygen reactions. They generally have an initial moisture content of 2-3% equilibrating to 10-15% RH. The critical moisture level from the point of loss of crispness varies between 4 to 6%. The shelf-life of biscuits depends upon:
 - Inherent characteristics of the product
 - Barrier and other functional properties of the packaging material

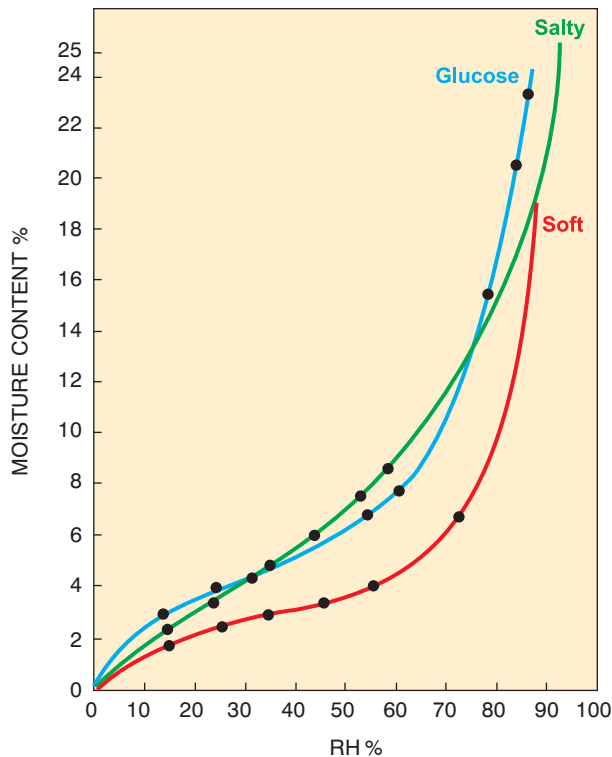
- Packaging operations adopted
- Distribution and storage patterns followed
- Economic considerations

There is a well-established relationship between water vapour sorptions and chemical, physical and stability characteristics of biscuits. For predicting product shelf-life and package performance with respect to water vapour transfer, the data required is:

- Water sorption isotherm
- Water Vapour Transmission Rate (WVTR) of the packaging material
- Storage Conditions

Since these are moisture sensitive products, water vapour transmission rate of the packaging material used is of importance as it is closely associated with drying, physical structure and protective action against oxidation. These products not only become brittle and hard but also develop oxidative rancidity at very low moisture contents. Temperature also plays a very important role. As the temperature increases the critical moisture gets reduced since the Equilibrium Moisture Content (EMC) corresponding to the same water activity is decreased. The sensitivity of three types of biscuits is given in figure 1.

Figure 1: Moisture Sorption Isotherm of Biscuits



IS 1011-1992 specifies the maximum limits for moisture, acidity and acid insoluble ash for biscuits. Table 3 gives the requirements for biscuits.

TABLE 3
IS 1011-1992 Requirement for Biscuits

Characteristics	Requirement
Moisture, percent by weight, maximum	5.00
Acid insoluble ash (on dry basis), %	0.05

- **Rancidity:** Another requirement due to high fat is the prevention of rancidity. When fat gets exposed to moisture and atmosphere, it gets oxidised and this results in rancidity and lowering of shelf-life. Fruits and nuts used are also susceptible to oxidation in presence of oxygen. Hence the packaging material must be grease resistant to prevent seepage of fat and staining of the pack and have low oxygen permeability to prevent oxidation and rancidity of the fat.

Light is also detrimental to colours or cause oxidation of fats leading to rancidity producing undesirable off-flavours. In such cases, opaque packaging material is used.

Some biscuits are susceptible to tainting by inks, adhesives and coatings used in the packaging material. The packaging material, therefore, should be free of residual solvents etc; to avoid development of off-flavours.

There are several basic requirements of a package intended to contain bakery products. These include:

- Water vapour permeability of packages
- Oxygen exchange from within and outside a package
- Aroma impermeability characteristics of packaging materials
- Resistance to seepage of fats and oils
- Protection against deteriorative visible and ultra violet radiation
- Good printability and appearance
- Physical, mechanical protection to the products against shocks, crushing and vibrations
- Compatibility and safety of the packages

Packaging, in general, must meet the following four basic requirements:

- The biscuit pack must give mechanical protection to the product. This can be achieved either by packing the biscuits in end-fold style portion packs or by gas flushing the pillow packs, thus preventing breakage during transport and retail handling. Ready to sell individually wrapped packs eliminates the hygiene factor risks since the biscuits



Flexible Plastic Pouches for Biscuits

do not come in contact with the external environment. The appropriate films and correct sealing prevents any infestation by insects. The result is a product, which is fresh and tasty throughout its shelf-life. The pack must be perfectly heat-sealed in wrapping materials with the required barrier properties against light, humidity and external odours.

- The packaging must appeal to the potential customers and stand out against other competing products and serve as an effective advertising tool.
- Detailed information about the product such as composition of the product, nutritional value, price information etc.
- Satisfy consumer demand for convenience packaging by providing different pack sizes, convenient packet opening facilities like tear tapes, incision cuts etc.

Moist Bakery Products

Breads and cakes are another category of baking products with comparatively less shelf-life. These products have high moisture content (>12%), supple texture and high water activity between 0.6 to 0.85 with low resistance and tendency to crumble and go stale. Their basic characteristics are given in Table 4.

TABLE 4
Basic Characteristics of Moist Bakery Products

Properties	Basic Characteristics of Products
General Physical – mechanical	Foodstuff for medium to long storage Fragile Light Low resistance Varied sizes and shapes
Organoleptic	Supple and creamy texture Distinctive flavours Flavours that may change (loss of flavour or fixation of foreign orders) Flavours that may deteriorate (go stale or soapy) Appearance that may change (drying out)
Physico-chemical	High moisture content High Aw Sensitive to : <ul style="list-style-type: none"> • Oxidation • Enzymatic reactions • Microbiological alteration



Plastic Packages of Cakes



Cakes Packed in Plastic Pouches & Trays

Since it contains hydrated starch it is prone to staling, thus limiting its shelf-life. It has low fat content and short distribution life, hence it does not need protection against oxygen. Bread is also susceptible to loss in aroma/flavour, so the packaging material used must prevent pick up of undesirable off-flavours.

The undesirable changes during storage include moisture loss, staling and loss of freshness. The packaging material must possess moderately effective moisture barrier properties. The inner portion of bread has equilibrium humidity in the range of 90%, hence it tends to dry out rapidly and becomes harder. The crust however, has low equilibrium humidity and it tends to become soggy under moist conditions. Too good a moisture barrier, has effect of promoting mold growth on the bread and allows the bread to become soft. If a poor barrier film is used, the bread will tend to dry out and stale. Staling of bread starts within 3-4 days of manufacturing. This is an inherent property of the type of flour, method of baking and storage conditions. It is caused by the migration of water from the starch to the protein portion of the interior, the starch then becomes dry and loses texture. Since this activity is independent of the moisture content of the inner portion of the bread, an effective packaging material must protect the bread until staling occurs. The ideal bread packaging material must be attractive, strong and inexpensive. It must have adequate moisture barrier properties to improve the shelf-life, able to run on automatic machinery and lastly should protect the shape of the product.

Hence the packaging material selected must conserve the moisture content, prevent staling and keep the bread in a fresh condition as long as possible.

The ideal bread packaging material must:

- be attractive
- maintain adequate shelf-life
- run on automatic machinery
- be strong
- be inexpensive
- be an adequate moisture barrier, and
- protect the shape of the product

Since most of the bakery products are packed on automatic form-fill-machine which run at fairly high speeds, the packaging material selected must be capable of running efficiently on these machines.

Packaging Materials

Biscuits

A wide range of packaging materials is used to pack biscuits. Since paper cartons, tins have lost out to flexible packaging materials as the packaging medium, focus is now on the latter. A variety of flexible packaging materials are used for packing biscuits due to advantages such as functionality, lower cost, printability, light weight, savings in freight and other such factors.



Packages for Biscuits

- Flexible Packaging Materials:** These are used as wrappers, pre-formed pouches or form-fill pouches. The oldest flexible film to be used was cellophane because of its excellent gas barrier properties and heat sealability. MST, MSAT, Coated Cellophane (MXXT) offer excellent moisture barrier, heat sealability and gloss. Cellophane became less popular when it became too expensive and with the introduction of new materials with better properties.

Another material, which is widely used is Biaxially Oriented Polypropylene film commonly known as OPP. For less demanding applications OPP monofilm is used while for higher quality products, duplex OPP or OPP combinations (pearlised or metallised) such as OPP/PE, OPP/PET etc. are used.

Today most of the biscuits are packed in flexible laminates of composite structures, where every component fulfills a specific function. These laminates have desirable properties such as moisture barrier, gas barrier heat sealability,

printability characteristics, high production and overall economy.

The different types of plastic films and its uses are tabulated below.

Plastic Films	Uses
Low density polyethylene (LDPE)	Preformed pouches
Polypropylene (PP)	Preformed pouches
Biaxially Oriented Polypropylene (BOPP)	Plain or pearlised films as overwraps preformed pouches, pillow pouches on FFS machines
Polyester/LDPE laminates	Preformed pouches or FFS pillow packs
Metallised polyester / poly	FFS pillow packs
Paper/Foil/Poly	FFS pillow packs

- **Thermoformed Plastic Trays:** Thermoformed plastic trays of polystyrene or PVC with multiple cavities are used to pack assorted biscuits, pastries, cookies etc. They are closed with a snap-on lid or overwrapped or shrink-wrapped or sealed with a lidding material. The products rest nicely in the compartments and make a good presentation. Use of active packaging with oxygen absorbent and antimicrobial properties for bakery products helps to significantly increase the shelf-life and maintain the original quality of the product. PVDC coated nylon, polyester, LDPE, PP, ethylene vinyl alcohol, polystyrene are examples of flexible packaging material used with active sachet.

Bread

Traditionally, bread in India was packed in waxed paper wrappers. The search for lower cost over wrapping materials led to the use of polyethylene film and nearly 80% of all



Packages of Sliced Bread

bread is now packed in plastics films such as LDPE, LLDPE-LDPE and PP. Also, auto-bagging machines require high slip PE resin i.e. pouches with good openability. LLDPE/LDPE bags of 1 to 1.5 mm thickness secured by plastic clip or twisted wire ties are normally used.

Cakes, Pastries, Doughnuts

These products are available in various sizes, shapes and forms. Since these products contain high moisture content they are prone to mould growth and hence the packaging material selected should not encourage mould growth. **The packaging material used is Polypropylene (PP), Cast Polypropylene (CPP), Poly Vinyl Chloride (PVC) etc., while the choice of the film depends upon the machinability and economics required.**

The Packaging Styles

There are several popular wrapping styles, which are applied widely to a variety of biscuits (of all shapes and sizes).

Biscuits packed using the following two wrapping styles must be of common size and shape with a certain consistency and rather narrow tolerances in their dimensions. Standard wrapping machines can be used.

Endfold Wrapping

This wrapping style is the classic, traditional biscuit wrapper. A portion of biscuits standing on edge is roll – wrapped or fold wrapped into a heat sealable film. The longitudinal packet seal is sealed tightly in a fin seal style. The packet ends are folded neatly and heat-sealed. Due to the neat and tight surrounding of the film, this packet gives utmost mechanical protection and acceptable barrier properties for hard and semi -hard biscuits and many other cracker types. Endfold wrapping is considered the most effective in terms of presentation by many marketing specialists - not only due to neat and impeccable shape, but also due to its ability to clearly distinguish the product amongst the host of pillow pack items on the retail shelves.

Pillow Pack Wrapping

This is the standard wrapping style for smaller biscuit packs (snack packs/single serve packs) containing one or more piles of biscuits. In addition, pillow pack wrapping is used for bigger packets with products standing on edge (Slug wrapping) as well. In this configuration, it often serves as a primary wrapper, to be over-wrapped by a carton to improve presentation and acceptance.



Square/Rectangular Biscuits in Plastic Laminates - Flo Pack

The main advantage of pillow packs on edge, is its flexibility with regard to the slug length. For instance, it allows the machine to automatically adjust the length during wrapping by means of tendency controlled check weighers. This feature ensures the highest weight accuracy. Additionally, the pillow packs typical fin seal style sealing is somewhat tighter than the endfold wrap.

This disadvantage of pillow pack slug wrapping is its limited mechanical product protection due to its rather loose packing. Further, the presentation of products packed using the pillow pack style is considered by most to be less attractive than endfold packets.

Packing for Odd-sized Biscuits

Besides endfold wrapping and pillow pack wrapping, which by the way cover about 85-90% of all biscuit products, there are some speciality biscuits with their own unique wrapping needs. These include an assortment of small cocktail crackers filled in bags by vertical FFS, machines and cookies of uneven sizes whose tolerance do not allow a standard wrapping. The latter are automatically or manually loaded into decorated trays and subsequently over-wrapped on pillow pack machines.

Conclusion

Bakery products include items of different packaging requirements, which are met by a range of plastic materials in the form of films, laminates and thermoformed trays. These materials provide adequate protection against moisture loss/gain, retain the taste and aroma, and are hygienic and safe for food contact. Other additional properties such as machinability, printability and cost effectiveness make them the ideal choice for a package.

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