

Paper no.: 12

Paper Title: Food Packaging Technology

Module-17: Packaging of Confectionery Products

17.1 Introduction

Confectionery items are commonly consumed by the populace and generally used for taste and desire and becoming very popular especially amongst children and youth. There are various types of confectionery items available in market i.e. cakes, pastries, doughnuts, candies, wafers, chips, chewing gum and chocolates. There are some leading industries in the field of confectionery products are Cadbury, Nestle, Perfetti, Wrigley, Parle and Amul etc.

A package intended for sugar and chocolate confectionery has to perform several functions during distribution, storage and sales. Essentially, the package has to preserve the quality attributes of the product and afford protection against chemical and microbiological deteriorative reactions. For sugar confectionery items and chocolates, the major functional packaging requirements include protection from:

- a) Dust, dirt and other contaminating agents
- b) Moisture/water vapour pickup or loss resulting in sugar and fat bloom, stickiness, hardening and desiccation.
- c) Rancidity due to interaction with moisture and oxygen.
- d) Colour and aroma loss and tainting.
- e) Physical damages like dusting, breakage and loss of shape.

In addition to the above, the packaging material should be amenable to run well on machines, should be hygienic and do not cause any health problem. Currently the major addressable problem is that it should be eco-friendly and easy to use and dispose-off.

17.2 Role of Water Activity (a_w) in Confectionery Products

The end of shelf life due to moisture loss or gain, with subsequent changes in textural and other properties, is often the main problem in confections. Thus, an understanding of water activity is important for control of shelf life and stability. Water activity in confections generally falls below the critical values for microbial growth, with few exceptions. Water activity is influenced by the presence of dissolved sugars, other sweeteners (e.g. polyols), salts (e.g., caramel), and humectants in confections. Microbial growth is directly related to a_w , with certain types of microbes unable to grow when water activity is below some critical value. The following table shows the water activity range of different confectionery items is listed below in Table 17.1.

Table 17.1: Range of water content and water activity (a_w) in confections

Category	Crystallinity (%)	Moisture (%)	a_w
Hard candy	0-2	2-5	0.25–0.40
Caramel, fudge, toffee	0-30	6-18	0.25–0.60
Chewy candies	0-10	6-10	0.45–0.60
Nougat	0-20	5-10	0.40–0.65
Marshmallow	0-20	12-20	0.60-0.75
Gummies and jellies	0	8-22	0.50-0.75
Jams	0	30-40	0.80-0.85

Fondants and creams	35-55	10-18	0.65-0.80
Chewing gum	30-40	3-6	0.40-0.65
Soft panned coating	60-75	3-6	0.40-0.65
Hard panned coating	80-95	0-1	0.40-0.75
Tablets and lozenges	75-95	0-1	0.40-0.75

17.2.1 Growth of microorganisms dependent on water activity (a_w)

Microbial growth also decreases with reduction in water activity. Majority of bacteria and many yeasts stop growing below water activity of 0.88. Only few osmophilic yeasts and molds grow below water activity of 0.7 and no microorganisms can grow below the water activity of 0.6. Growth range of microorganisms in terms of water activity is shown in Table 17.2.

Table 17.2: Water activity and growth of microorganism in confectionery products

a_w	Microorganisms that can grow	Confections
>0.88	Normal bacteria and pathogens, many yeasts	Ganache, very soft fondant
0.80-0.88	Normal molds, some yeasts	Soft fondant, soft jellies, etc.
0.70-0.80	Molds, yeasts	Fondant, fudge, jellies, grained nougats, marshmallow, etc.
0.60-0.70	Osmophilic yeasts, some molds	Fudge, fondant, hard jellies, nougat, soft caramel, etc.
<0.60	None	Caramel, toffee, jellies, gum, hard candy, chocolate, etc.

17.3 PACKAGE FORMS

Different package forms are used for packaging of chocolate and other confectionery items. The different types of package forms are: Consumer unit packages, Shipping/bulk containers, Flexible packages, Semi-rigid packages, Rigid containers, Conventional bags, Corrugated fibreboard boxes, sacks and boxes.

17.3.1 Consumer Unit Packages

17.3.1.1 Flexible packages

The basic styles of flexible pouch/bag used to contain sugar confections and chocolates are - flat and pillow type, satchel bottom and stand-up types. The materials of construction comprise functional papers, plastics, aluminium foils, metallised films and composites of these materials.

Although conventionally, different kinds of papers such as Poster, grease-proof and glassine, vegetable parchment and even sometimes news-paper are used for making bags, newer materials include polyolefins, polyethylene terephthalate (PET or polyester), polyamide (Nylon), aluminium metallised plastic films and co-extruded structures are being increasingly used.

Since polyester, polyamide and metallised films (PET, PP and PA) films possess very good barrier properties towards oxygen and aromas, but unsupported, do not provide good heat-seals. They are generally combined with polyethylene and its modifications to provide sealability and inertness.

Recent developments in the flexible packaging field is the availability of co-extruded structures. A most common combination suitable for sugar confectioneries is an outer polyethylene - Low-density or linear low density (LDPE or LLDPE), core or middle layer of polyamide (Nylon-6) or ethylene-vinyl alcohol (EVOH) copolymer and inner or contact layer of Ionomer or Ethylene-Acrylic Acid (EAA) copolymer film.

To enhance the shelf life of the products, either vacuum or gas packaging can be resorted to. The former technique is suitable for packing sweets having rigid structure such as sohan papdi and Mysore pak, while gas packaging is better suited for softer confections. For these applications, materials such as plain and metallised PET with PE, or copolymer of HD-LDPE, Nylon and EVOH based co-extruded films and polyvinylidene chloride (PVde) copolymer, coated PP would be the better choice.

17.3.1.2. Semi-rigid containers

These comprise folding cartons, set-up boxes, lined-folding cartons and thermoformed containers.

Collapsible folding cartons of tray-type with coated or laminated paperboard base are extensively used to package dairy food-based sugar confections. These cartons with outer embellishments are best suited for gift and display applications. The liner material may be PE-wax-EVA blends or PVC or PET films. Set-up boxes of either half or full telescopic type having inner glassine liner are economical and provide good physical and mechanical protection.

Lined folding cartons system is of bag-in-box type where an inner pouch is lined (fixed) to the outer paperboard carton. The selection of the material of the pouch is decided by the functions required, economics and marketing requirements. Materials such as paper/PE, PET/PE, paper/ Al-foil/PE and the almost ultimate choice, PET/Al foil/PE are used. Provisions for reclosing, reduction of headspace volume and such features can be incorporated.

Thermoformed containers include blister packs, single and multi-cavity trays, thin-walled containers with lids etc. These are produced by the process of thermoforming by vacuum, pressure or matched techniques. For packing sweets, thermoformed tray type containers are better suited. For multi-coating trays, the number, shape and size of cavities is determined by the product to be packed. Such trays are useful when a number of similar or assorted items are packed.

17.3.1.3 Eco-friendly packages

Bio-containers or eco-friendly packages based on natural materials such as leaves of banana can also be used to contain and distribute sugar-based confectioneries. The processes developed by CFTRI to manufacture these involve only heat-treatment without recourse to any additional adhesive or chemical treatments.

17.3.1.4 Rigid packaging systems

Among the metal containers, the conventional tinplate cans are being used to process *rasagolla* and *gulabjamun* in syrup. Tinplate cans are available in various standard sizes. For

flat sweets, 100 g cans are preferred. For gas flushing applications, formed cans with aluminium top cans are used. Newer metal containers include differentially coated cans, chromium coated (Tin-free-steel) cans. The provision of ring-pull ends (Easy-open-end; EOE) facilitates easy opening for consumers.

Aluminium containers are made by different techniques. These are available in circular, oval, rectangular or any fancy shapes and can be decorated in an unlimited range of design and colour variations. EOE ends with reclosable polyethylene lids are finding greater applications for sugar and dairy products.

17.3.1.5 Composite containers

These are made of paperboard body and metal or plastic ends. The container body may either be spirally or convolutely wound with fibreboard lined with aluminium foil. Composite can having a body material of 25 mm PE/Paper-board/0.009 mm aluminium foil/37 mm LDPE are well suited to package sweet meats.

17.3.2 Shipping containers

Corrugated fibreboard boxes (CFB) are being employed as exterior containers for packing unit packs both for inland and export markets. They can be used up to a maximum weight of contents of 75 kg. The BIS specifies, depending on the maximum of mass of contents:

- a) Maximum combined internal dimensions (LxWxD),
- b) Minimum bursting strength of the boards
- c) Combined liner grammage
- d) Moisture absorptiveness value (Cobb value).

The style of the box is decided by the contents, protection required and marketing destinations.

17.4 Packaging and Storage Studies

For designing packages, the primary requisite is the knowledge of relationship between moisture content and equilibrium relative humidity (ERH) (and hence water activity) denoted through moisture sorption isotherm.

17.4.1 Sohan papdi

This confection which normally has a shelf-life of about 12 days with critical moisture content of 3% corresponding to 0.3 water activity. Chemical and sensory analysis carried out on BHA-treated packed product has indicated that the product could be stored well for 20 days in PET/PE, 120 days in HDPE and 225 days in paper/foil/PE pouches and rigid metal container.

17.4.2 Sohan halwa

This product with permissible moisture pick up of 1.7 percent and stored at normal environmental conditions has revealed storage life of 30 days in LDPE, 120 days in HDPE and 180 days in foil-laminate pouches. The shelf life has also been determined in package of tagger-top tinplate containers.

17.4.3 Milk peda

Studies on buffalo milk peda with preservative at two concentrations were carried out. Sample containing 0.002% sorbic acid extended the storage up to 9 days at 30°C/70% RH and 37 days at 7°C/90% RH conditions. Sorbic acid added at 0.05% was effective against chemical and microbiological deterioration up to 50 days at 7°C. Milk *peda*, having 0.84

water activity or 14.0% moisture packed in laminates pouches of PET/PE and PET/Al foil/PE and co-extruded LLDPE/PA/EAA has indicated that ambient-air packaging did not extend the shelf-life. Usage of free-oxygen absorber sachets extended the life up to 42 days.

Extensive studies have been carried out on hard-boiled sweets, toffees and chocolates on moisture sorption characteristics. Packaging and storage studies have revealed that sucrose in amorphous state in hard boiling have critical moisture content in the region of 1.2 to 1.5%. Modified and plain toffees had higher critical values, which was in the region of 4-6%. Plain and milk chocolates having moisture contents of 0.7% and 1.33% respectively, equilibrating to 0.64 water activity was found to be critical with respect to maintenance of good colour, aroma and texture.

