

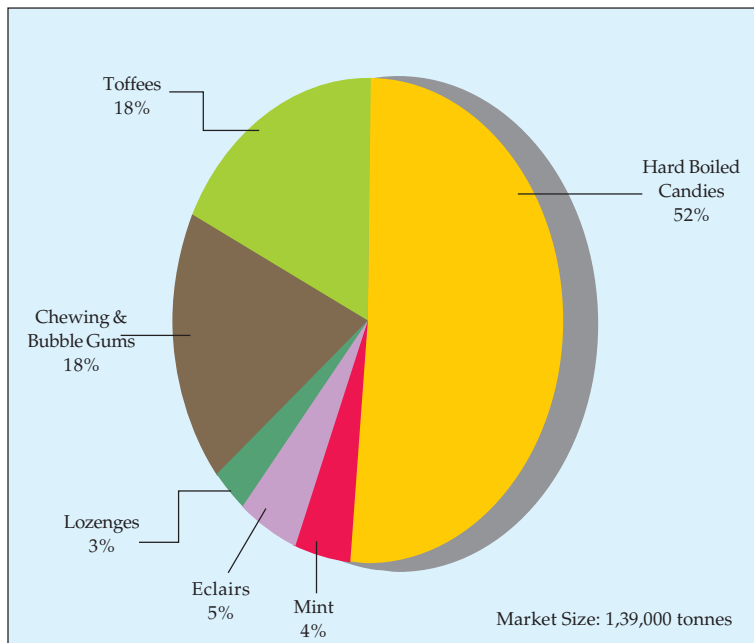
# PACKAGING OF SUGAR CONFECTIONERY AND CHOCOLATES

Confectionery is the general term applied to various varieties of sweets and chocolates. Organised market for sugar confectionery is estimated to be 1,39,000 tonnes per annum and is growing at the rate of 10 - 15% per annum. The confectionery market has undergone a metamorphosis in the last few years. From the commodity market controlled by local players, it has changed to a branded products market with strong presence of



*Display of Confectionery Items*

**Figure 1: Sugar Confectionery Market**



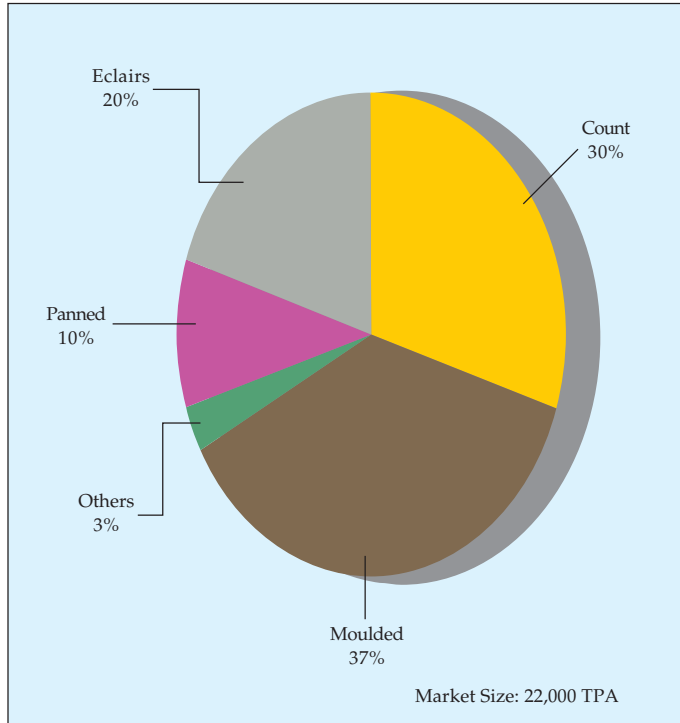
multinational companies. The confectionery market is highly fragmented with several players with strong regional presence.

The entire sugar confectionery market can be divided into seven major categories, viz. hard-boiled candies (HBCs), toffees, eclairs, chewing gum, bubble gum, mints and lozenges. As shown in Figure -1, HBCs form 52% of the entire market, 18% is formed by toffees and 18% by chewing gum and bubble gum collectively. Eclairs form just 5% of the entire market. Mints and

lozenges form 4% and 3% of the market respectively.

The market size of chocolates in India is estimated to be around 22,000 tonnes per annum valued at Rs. 3.5 billion. Market growth in the chocolate segment has hovered round 10 – 20%.

**Figure 2: Chocolate Market**



In the last five years, the growth rate has been 14 – 15% on an average and the same trend is likely to continue in the next five years. The market presently has 60 million consumers located mainly in the urban areas.

Chocolate market can be segmented into moulded chocolates, count chocolates, panned chocolates, eclairs and assorted chocolates as shown in Figure 2.

Moulded chocolates are the largest segment, accounting for more than one-third of the market.

### Product Characteristics and Packaging Requirements

The key raw materials for sugar confectionery are sugar

(60 - 65%), glucose, citric acid and flavoured essences.

Confectionery is hygroscopic in nature and requires protection against the ingress of moisture, and exposure to high temperature (as far as possible). A candy or confectionery product may be adversely affected by many things. Hard candy, brittles and crunch products are most sensitive to moisture and absorb water vapour fairly rapidly from the atmosphere. Various gums are less sensitive while some creams tend to lose moisture considerably. The factors that lead to spoilage of confectionery are highlighted as below.

### Crystallisation

The sugar component of most types of confection is in a soluble form and it is essential that this form be maintained, since crystallisation of the sugar alters the taste and texture giving impression of an old product. Moisture interchanges play a major decisive role in deciding the shelf-life of confectionery items. The Equilibrium Relative Humidity (ERH) of a confection during its life determines its sensitivity towards all physico-chemical changes that occur

due to environmental conditions. Data on moisture sorption characteristics of a confectionery item are very important in understanding the storage stability as regards its chemical and physical changes, growth of microorganisms and also drying characteristics and product formulation and package selection.

The ERH of confectionery products are given in Table 1.



*Twist Wrapped Hard Boiled Sweets in Flexible Plastic Pouches*

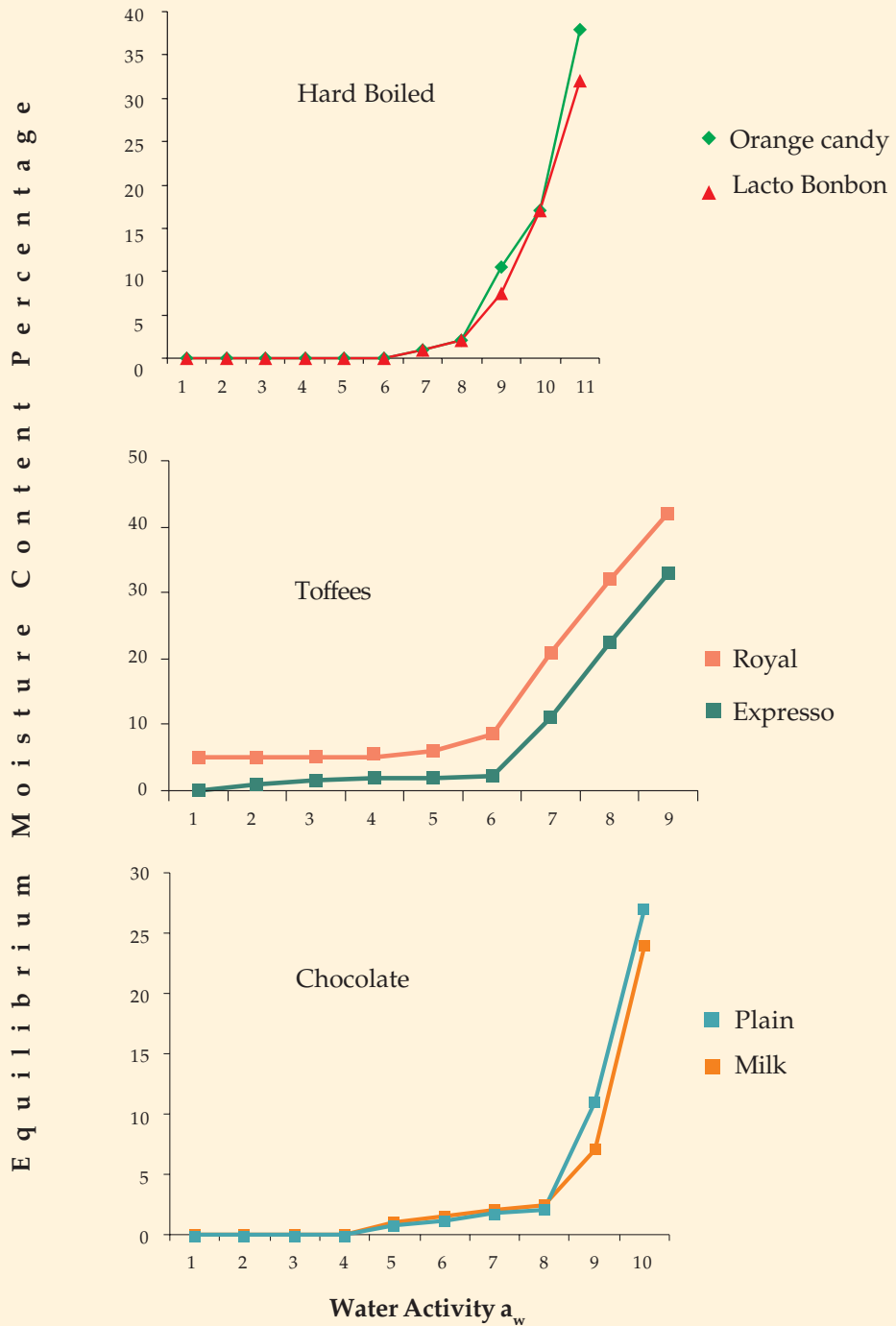
**TABLE 1**  
**Equilibrium Relative Humidities of Confectionery**

Confection Type	Type of Deterioration	ERH (%)
Boiled Sweets	Graining and Stickiness	< 30
Toffees (caramel type)		< 50
Gums and pastilles	Stickiness, micro-organism growth	65
Liquorice paste goods		55 - 65
Turkish delight		60 - 70
Fruit jelly goods	Slight effect	60 - 75
Cream paste goods		65 - 70
Marsh mallows		65 - 75
Marzipan		70 - 85
Fondant cream	Drying out and mould growth	75 - 85
Jam		75 - 85
Milk chocolate	Syrup formation and sugar bloom	80
Plain chocolate		85

[Source: Minifie 1988]

Studies were conducted at CFTRI, Mysore, to investigate the moisture sorption characteristics of three types of sugar confectionery - hard boiled, toffee and chocolates. In general, acceptable crispness was lost when the water activity was above 0.44, while below 0.11 water activity, the products became hard. The moisture sorption isotherms of the products were typical of high sugar food products. Texture evaluation of specimen-hard boiled by compression and toffee by shear force was carried out. Complete liquification of the products was noticed above 0.86 water activity. The texture values are given in Table 2 and the moisture sorption isotherms are given in Figure 3.

Figure 3: Moisture Sorption Isotherms of Confectionery



**TABLE 2**  
**Texture Values of Confectionery Items**

Water Activity	Hard Boiled (Lacto Bon Bon) Hardness (KN)		Toffee (Royal) Shear Value (N)		Plain Chocolate Shear Value (N)	
	Mean	+ s.d	Mean	+ s.d	Mean	+ s.d
0.11	2.02	0.03	56.26	4.20	20.33	0.44
0.22	1.88	0.02	52.30	4.90	20.24	0.44
0.32	1.65	0.04	51.95	6.52	18.90	4.09
0.44	1.37	0.04	49.33	2.75	16.68	2.45
0.56	1.02	0.08	31.94	20.46	11.30	1.56
0.64	0.69	0.02	20.46	1.25	8.01	0.31
0.75	0.53	0.04	8.81	1.02	9.31	0.62

### **Oxidation**

If the confectionery contains fat, then rancidity can occur as a result of oxidation. Fat containing confectionery will also react with moisture to produce fatty acids and their degradation products. Oxidation of fats in chocolates is a minor problem as cocoa butter contains natural antioxidants. Being high in fat, however, chocolate is likely to absorb odours from the surrounding atmosphere.

### **Fat Bloom**

It is a surface defect in chocolate, which occurs during storage, whereby the initial gloss of the chocolate is first lost and then replaced by a white or grayish haze. This defect, occurring more frequently in summer, is deleterious to the aesthetic appearance of many chocolate products. The defect, however, does no harm to the eating quality of the chocolate, unless it brings along with it other defects such as staleness or mould growth.

### **Sugar Bloom**

Chocolates can be affected by condensation giving sugar bloom, in which a fine layer of sugar crystals form on the surface of the product. This renders it unsaleable and if left unchecked can lead to mould growth.

### **Odour Absorption**

Odour absorption by oils and fats can also be a problem. Odourous compounds are often very soluble in oils and fats and can be readily absorbed from materials such as paints, printing inks, petroleum oils and disinfectants. When the product is eaten, the odours are released in the mouth producing objectionable flavours.

Confectionery can also deteriorate in other ways including exposure to heat, light, moulds, yeast, foreign odours and mechanical damage.

## Selection of Packaging Material

In selection of packaging materials for confectionery the following need to be considered:

### Water Vapour Transmission Rate (WVTR)

Knowledge of WVTR of packaging materials and the effect of folding, creasing, crumpling of materials on papers and aluminium foil show considerable effect. However, thermoplastic materials are not much affected. Table 3 gives the effect of folding, crumpling on WVTRs of some thermoplastics.

**TABLE 3**  
**Effect of Folding and Crumpling on the WVTR**

	WVTR, g/m <sup>2</sup> , 24 hr. 38°C & 90% RH.			
	Flat	Folded	Crumpled	Gelboflex
Met PET (12μ)	0.9	1.7	3.4	18
Met PET / LDPE (50μ)	0.5	0.6	0.7	0.6
2-sides PVDC coated PET	4.2	3.7	5.9	4.8
2-sides PVDC coated PET/LDPE	2.9	3.6	3.3	3.1

[Source: Dulin (1978)]

### Gas Transmission Rate

Permeability to gases like oxygen decides the shelf-life of oxygen sensitive confectionery items. The oxygen transmission rates (OTR) of some plastic materials and the effect of folding and crumpling is shown in Table 4.

**TABLE 4**  
**Effect of Folding and Crumpling on the OTR**

	Oxygen transmission rate, ml/m <sup>2</sup> , 24 hr. Atm. at 25°C.			
	Flat	Folded	Crumpled	Gelboflex
Met PET (12μ)	< 1	5.5	16	59
Met PET / LDPE (50μ)	< 1	< 1	2	3.5
2-sides PVDC coated PET	6	6	8	7
2-sides PVDC coated PET/LDPE	7	7	9	11

[Source: Dulin (1978)]

Besides OTR, permeability to volatiles and flavours is important in confectionery packaging. Polyolefins have high values, whereas plastics such as polyester, nylons, ethylene vinyl alcohol (EVOH) have good barrier properties for transmission of volatiles. The odour permeabilities (for volatiles used in confectionery) of some materials is compared in Table 5.

**TABLE 5**  
**Odour Transmission of Packaging Materials**

Packaging Material	Thickness ( $\mu$ )	Days to Aroma Leakage			
		Vanillin	Menthol	Piperonal	Camphor
BOPP / PE	17/50	6	2	1	13
PET / PE	12/50	2	16	5	< 30
PET / EVOH	12/15	< 30	< 30	30	< 30
OPP / EVOH / PE	18/15/50	30	< 30	27	< 30
PET / EVOH / PE	12/15/50	15	25	27	< 30

[Source : Koch and Messengale, 1962]

### Grease Resistance

Grease Resistance of the packaging material is important to avoid seepage of oils and fats and smudging of the print.

### Tensile Strength & Elongation

Tensile Strength and Elongation properties of materials need to be studied as their running on high-speed machines should be suitable.

### Tear Strength

For a confectionery film, tear strength is of importance as low tear values are necessary and useful for opening packages by hands.

### Heat Seal Strength

The performance of a finished package is determined by the effectiveness of the package seal i.e. the permeabilities to water vapour, gases and volatiles increase if the seal is not perfect. Thermoplastic films such as polyethylene give excellent heat seals.

### Performance Properties

Apart from the above mentioned important properties, a material has to perform well on machines, therefore knowledge of physical



*Plastic Gift Packs for Chocolates*

properties like slip, stiffness, blocking resistance is also necessary. Twist retention for twist wrap is also of importance.

The initial function of packaging is to protect. However, the emotional role played by packaging is also of importance, especially when the confection is a gift. A sophisticated packaging using deluxe materials is often used as a way of expressing feelings.

Confectionery packaging must also be specialised for specific target groups. Children's sweets are to be packed differently from adult sweets and chocolate bars for adolescents should look different from expensive chocolates for discerning consumers. A different pack size is required for quick impulse buys at petrol stations and roadside shops than for the super markets selling predominantly family sized packs.

## Packaging Materials used for Confectionery Items

A very high quantum of polymeric materials, besides cellulose and aluminium foil are used



*Foil Wrapped Chocolates with Paper Board Cartons*

for confectionery items. Paper board and metal containers are also used for certain applications. Although a variety of packaging materials are available, the ultimate choice of the wrapper depends upon the required shelf-life, performance on the wrapping machine and the cost which is purely based on the segment of the market targeted by the manufacturer.

provides the required protection and preservation, grease resistance, physical strength, machinability and printability. Plastics being lighter in weight are, therefore, the most preferred material for packaging of confectionery.

There are many changing trends in the packaging of confectionery. Plastic films and their laminates are increasingly replacing waxed papers due to better properties and aluminium foil laminates due to price and better flex crack property.



*Chocolates Packed in Heat Sealed Laminated Plastic Films*

Depending on the type of package i.e. twist wrap, pillow pack and vertical flow pack or roll pack, the plastic based packaging films used for confectionery are listed below.

### Polyethylene (PE)

It is considered to be the backbone of packaging films. Since one of the greatest threats to the integrity of confectionery products comes from moisture, polyethylene with its low water

vapour transmission is of definite interest. Polyethylene films are fairly free of plasticizers and other additives and are quite extensively used as a part of lamination. Its ability to heat seal increases its value.

Low Density Polyethylene (LDPE) is an economical material with low WVTR, however, it has high permeabilities to flavours/volatiles, poor grease resistance and are limp. High-density polyethylene (HDPE) is stiffer, more translucent and has better barrier properties but needs higher temperature for sealing.

Later additions include high molecular weight high-density polyethylene (HM HDPE) and linear low-density polyethylene (LLDPE). HM HDPE is a paper like film with high physical strength and barrier properties, but is less transparent than ordinary polyethylenes. HM HDPE is available in twist-wrap grades. Polyethylene films are also suitable for making bags and pouches. A copolymer of polyethylene and poly vinyl alcohol, and EVOH has outstanding gas barrier properties specially when dry.

### **Polypropylene (PP)**

Polypropylene films are undergoing a growth trend in the confectionery industry. They have better clarity than polyethylenes and enjoy superior machineability due to stiffness. Lack of good sealability has been a problem, however, PVDC and vinyl coating have been used to overcome this problem. Some varieties of PP have been specially developed for twist-wrap applications as they have the ability to lock in position after twisting.

Pearlised polypropylene with an opal finish and attractive gloss is also used. Both as laminates and overwraps, PP film is now widely used for all types of confectionery packaging applications.

### **Poly Vinyl Chloride (PVC)**

PVC is a stiff and clear film having low gas transmission rate. PVC can be used as small wraps, bags and pouches. PVC when co-polymerised with polyvinylidene chloride is known as Saran. Since it is a costly material, it is only used as a coating to obtain barrier properties and heat sealability. PVC film is also used for twist wraps, as it has twist retention properties and is excellent on high-speed machines.

### **Polyesters (PET) and Polyamide (PA)**

Polyethylene terephthalate film has high tensile strength, gloss and stiffness as well as puncture resistance. It has moderate WVTR, but is a good barrier to volatiles and gases. To provide heat seal property, PET is normally laminated to other substrates.

Nylons or polyamides are similar to PET, but have high WVTR.

### **Metallised Films**

When polymeric films are metallised there is an improvement in their barrier properties. Metallisation is also used for decorative purposes and aesthetics. The films, which are used



*Chocolate Packages*

for metallisation are PVC, PET, PP and polyamides.

Hard-boiled sweets are generally twist wrapped individually in twist retaining plastics such as Poly Vinyl Chloride, Polypropylene and High Density Polyethylene. To provide greater protection against water vapour ingress, a secondary pouch made of LDPE or PP containing 100 grams to 1 kg of the product may be used. Hard-boiled candies are also packed in tuck-fold heat sealable films. Medium hard sweets and chewy candies such as caramels and toffees are

either twist wrapped or packed in heat sealable tuck-fold wraps. Special grades of HMHDPE, PP and PVC are used for this purpose. For gums, moderate moisture barrier is required, "sweating" is to be avoided and a slight liberation of moisture is necessary. The possibility of condensation is avoided by polyethylene.

The traditional wrapping for the chocolate slab is aluminium foil for the inner layer (0.012 mm) with the dull side inside, a glassine layer over the foil to protect it and a printed coated bleached kraft sleeve.

A modification of this style of chocolate bar wrap is to use a heat seal coated foil inside the paper sleeve. Securing of the paper sleeve is by hot melt adhesive. Another popular method of wrapping chocolate slabs is on the horizontal form-fill-seal (HFFS) machines, when the reel of laminate is wrapped around the slab, cut and heat sealed at both the ends and along a fin-style back seam. Typical constructions are:

- 12 $\mu$  Polyester / 9 $\mu$  Al foil / heat seal lacquer
- 40 gsm coated bleached kraft / 9 $\mu$  Al foil / LDPE plus cold seal coating

Chocolate bar lines are mostly individually wrapped on the horizontal form-fill-seal (HFFS) machine. The typical wrapping materials are Polyester, OPP - pearlescent or metallised.

The Indian Standard stipulates that confectionery shall be wrapped in plain or printed cellulose film, waxed paper, aluminium foil, polyethylene or other flexible packaging materials. In the case of printed packaging materials, it is specified that the printing ink shall not come in direct contact with the product.

To safeguard the interest of the consumer, the Standards of Weights & Measures (Packaged Commodities) Rules, have imposed a limit on the weight of the wrapper. Under this, it is essential that in the case of twist wrap and pillow wrap confectionery, where the weight of the individual pieces is less than 10 grams, the size of the wrapper and the type of wrapping material selected is such that it meets the limit on weight of wrapper, under the above rules.

## Future Trends

The confectionery market is one of the most competitive in the FMCG area. Major companies continuously battle to entice sweet-toothed consumers from competing brands. A strong brand

identity is complimented by innovative packaging designs to deliver a product capable of meeting the consumer demands.

The developing trends in confectionery packaging are:

- Widespread and increasing use of cold seal
- Use of laminated structures and cold seals for premium products
- Increasing use of opaque multi-packs for grocery outlets
- Switch over to higher yield opaque films for cost reduction
- Replacement of Al foil / paper wraps by OPP laminates
- Developments in low temperature heat seal packs

## Conclusion

Emerging trends in the confectionery and chocolate packaging industry have given wide scope for development of a variety of innovative packaging media depending on the required shelf-life and performance of wrapping machines. Plastic films and laminates are the most popular choice as a packaging media, replacing traditional waxed paper and aluminium foil. Polyethylene is considered as the backbone of packaging films along with other polymers like PP, PVC, PET and PA. The ability of plastics to pass all selection criteria as an effective packaging media has led to very high quantum of polymeric material used for confectionery items.

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