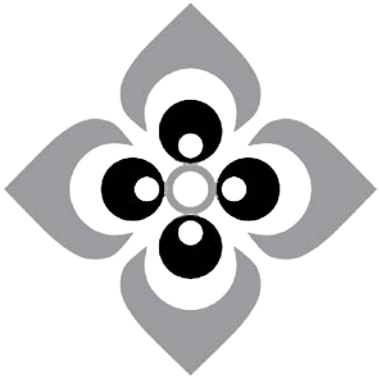

Consortium for Educational Communication

Module
on
Confectionary: Raw Materials And Products

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TEXT

Introduction:

Confectionery also called sweets or candy is a sweet food. Sugar confectionery includes sweets, candied nuts, chocolates, chewing gum and bubble gum, sweetmeats, pastillage, and other confections made primarily of sugar.The term confectionery varies in different countries. In Britain, Ireland, and some commonwealth countries, sweets or, sweeties, candy in US and Canada, and lollies in Australia and New Zealand, are used commonly for the most common varieties of sugar confectionery. Nutritionally, confections are low in micronutrients and protein but high in calories. Most of the sugar confections are considered empty calories. Excessive consumption of confectionery has been associated with increased incidences of type 2 diabetes, obesity, and tooth decay.

Sucrose is produced in vast quantities throughout the world and it is the basic ingredient for classical sugar confectionery. Indeed, the whole confectionery industry has been built around the physico-chemical properties of sucrose and their modification by other traditional sweeteners. Sugar occurs widely in the vegetable world, in the roots and stems of grasses and root vegetables and in the sap of many trees. It also appears in the juices of many fruits. Commercially, however, it is extracted from sugar cane, which is grown in tropical areas, and from sugar beet, which is grown in temperate climates. World sugar production is upwards of ninety million tons a year, out of which roughly 60% is from cane and 40% from beet. The principal sugar constituents are mentioned in **Table 1**

Commercially available types of sugar:

Types of sugar available in the market are:

1. Granulated
2. Caster
3. Icing

4. Liquid sugars
5. Brown sugars
6. Molasses
7. Microcrystalline sugars

1. Granulated: They are available in several grades as explained below.

a) *Granulated:* This is white sugar, sold industrially and domestically. It constitutes to highest proportion of total production of granulated sugar.

b) *Industrial granulated:* This sugar has a slight off-white colour and is used where white sugar is not required for e.g. in the manufacture of toffee, fudge and chocolate.

c) *Cubes:* These are usually produced by moistening granulated sugar with one percent water, pressing into cubes and drying.

d) *Nibs:* These are agglomerates of granulated sugar crystals, made by dampening the sugar and dried into thick mass. The product is sieved to various sizes.

2. Caster sugar**:** White sugar with small crystal size, for domestic and industrial use.

   It is produced either by boiling in vacuum pans or milled from granulated sugar.

3. Icing sugar: Produced by double milling granulated sugar to fine crystals. Usually, an insoluble anticaking agent is added. Used mainly for bakery.

4. Liquid sugars**:** Granulated sugar dissolved in distilled water to produce the highest quality liquid sugars. In the confectionery industry, the decolorized liquor from the refining process is used, instead of evaporating to produce granulated sugar. Lower grade syrups are used to provide colour and flavour. The total solids ranges between 66 to 84%.

5. Brown sugars: A typical composition of a raw demerara sugar and three types of refinery brown sugars are shown in **Table 2**. The non-sugars from the original cane are responsible

for the flavour. Prolonged storage in a low relative humidity leads to slow evaporation of the water and resulting in the hard sugar.

6. Molasses:A one million tones a year cane refinery produce 600-800 tonns of molasses per week, from which no more sugar can be extracted. Some part is used for human consumption, but the bulk goes to cattle food and to the fermentation industries, e.g. alcohol and citric acid. Treacle is clarified molasses and can be mixed with higher purity syrups to mellow the taste.

7. Microcrystalline sugars*:* For this form, sugar syrup is evaporated to around 95% solids and then subjected to intense shear. The sugar crystallizes instantly as very fine crystals (5-20 um), then dried, milled and sieved to final products.

Types of sugars based on composition

Detail methods of analysis for sugars, is given in the ICUMSA (International Commission for Uniform Methods of Sugar Analysis).Based on composition there are four types of sugar

1. White sugars

2. Brown sugars

3. Liquid sugars

4. Treacle and molasses

1. White sugars**:** Refined white sugar is probably the purest food known, containing over 99. 95% sucrose, on a dry basis. The composition varies a little between refiners, (**Table 3).** Colour is measured in international Units (IU).

2. Brown sugars**:** It is either an unrefined or partially refined soft sugar consisting of sugar crystals with some residual molasses content (natural brown sugar), or it is produced by the addition of molasses to refined white sugar (commercial brown sugar)

3. Liquid sugars**:** The range of liquid sugars available is extensive. These are decolorized liquor from the refinery before evaporation in the vacuum pans. It is pure enough to be used for most confectionery purposes. Other liquid sugars are less pure and would be suitable where colour, etc is not of prime importance. There are wide range of blended syrups available which, can be tailor-made to a confectioner's requirements. In addition, refinery syrups of varying flavour levels can be added, imparting a natural flavour to the end product.

4. Treacle and molasses**:** Beet molasses is rarely used in confectionery, due to its unpleasant flavour. The flavour of cane molasses is very strong and is often mellowed by adding higher grade refinery syrups. When this is done, the products are usually called 'treacle' (**Table 4)**.

Chemical reactions of sugar confections: Chemically two types of reaction takes place in sugar confectionary. They are Primary and secondary.

Primary reactions:

1. **Caramelisation:** Cane or beet sugar (sucrose) deteriorates on heating to form

coloured breakdown products known as caramelisation. The resultant product is 5-hydroxyl methyl furfural.

2. **Inversion:** The second important reaction is the breakdown of sucrose into two

Simpler sugars. This process is known as inversion. Invert sugar is a mixture of two simpler sugars dextrose and fructose. This reaction is induced deliberately to get desirable characteristics in a sweetmeat.

3 Maillard reaction: The third chemical reaction encountered during the manufacture of sweetmeats is the maillard reaction. This takes place between amino acids, proteins and peptides and the reducing groups in sugars. The products of this reaction are brown condensation pigments known as melanoidins, which contribute flavour, colour and texture. The reaction was first described by Maillard in 1912 . The reaction stimulates the development

of flavour and the texture.

3. **Crystallisation:** The main effect which involves a change of state during the

production of sugar confectionery is transformation of ingredients held in a highly saturated syrup to the crystalline form. Presence of other ingredients, such as other sugars and gelling agents cause distortion in the crystalline from of sucrose.

4. **Polymorphism:** Polymorphism is the ability of a material to exist in two or more

crystal forms. Sugar boiling remains stable provided sufficient water is removed during manufacture and the product has been protectively packed to prevent the ingress of water. Unfortunately, sugar confections tend to pick up moisture from the atmosphere and this water is deposited on the surface of the sweet. The deposited water leaches sugar from the confection. Water in the syrup will evaporate as the external temperature conditions change and the syrup crystallizes. The crystal grain which occurs induces a layer-by-layer change of state in the main body of the confection moving from the stable amorphous state to the crystalline state.

5. **Starch:** The starch molecule is composed of amylase and amylopectin fraction. In the

process of starch gelatinization, the starch swell in water during heating. The temperature at which this process takes place is usually referred as the gelatinization point. The presence of sugars inhibits the process of gelatinization. Prolonged heating will also destroy the gel by causing disruption of the structure, resulting in leaching from the swollen granules into the liquid fraction, affecting the gel-forming capability.

Secondary reactions:

Other chemical reactions occurring during sweet manufacture involve the breakdown of protein in gelling and in whipping agents such as egg albumen. These usually occur during

heating and are under acid conditions.

Industrial aspect on sugar confectionery manufacture

The successful manufacture of sugar confectionery products is dependent on a limited but key group of physical and chemical changes which influence recipe composition and methods of production.

Compositional effects**:**

A) Carbohydrates/Sugars

The composition of recipes for the manufacture of sugar confections is based on the composition of raw ingredients i.e. carbohydrates (sugars), fats, thickeners and stabilizers, and proteins. Among the sugars. They are:

Boiled sweets, Caramel toffee and fudge, Gums and jellies, Chewing gum, medicated sugar confectionery.

1. Boiled sweets**:** Technically the term 'boiled sweet' is applied to mixtures of sucrose and glucose syrup which are cooked to such a high temperature that the cooked mass becomes clearly marked by the following characteristics:

1) Non-crystalline, clear and glassy in appearance.

2) An extremely low amount of residual moisture (1-3%) with an equilibrium relative humidity (ERH) below 30%, which can result in a marked tendency to absorb humidity from the atmosphere.

3) After cooking, the two main components, sucrose and glucose syrup, are accompanied by a variable amount of invert sugar, the result of partial inversion of sucrose which takes

place during the cooking process.

Commercially they are also called high boiled sweets, hard candies, drops and are represented by three general types:

a) *Plain hard candy:* This is the generic name for an infinite number of a large variety of candy which, as shown in **fig 1,** is produced in a wide range of shapes and sizes, flavours and colours as well as textures. They can be classified as follows in four main groups: 1) Acidified hard candies/fruits drops,2) Non-acidified hard candies like peppermint drops, cough drops, etc.,3) Hard milk caramels,4) Hard candies with added-value ingredients such as: Honey – honey drops/ honey comb., Malt extract – malted hard candy, Peanut – peanut brittle.

b) *Filled boiled sweets***:** These are composed of a clear, pulled, striped or grained jacket enclosing a centre which can be liquid, semi liquid, pasty or powdery. The main filling types are:

1) Simple sugar-glucose syrup filling flavoured with natural, nature-identical or artificial flavour.

2) Fruit filling which, besides sugar and glucose syrup, contains fruit pulp or jam.

3) Alcohol filling.

4) Fat filling based on chocolate, hazelnut or almond paste, peanut butter, etc.

5) Powdery filling like sherbet filling, liquorice filling.

c) *Sugarless boiled sweets***:** Clear, pulled or grained sugarless boiled sweets, plain or filled, are characterized by the fact that they are composed of one or a combination of polyhydric alcohols. The following polyols are used:

1) Sorbitol, mannitol, xylitol – the first –generation polyols.

2) Maltitol, lactitol, isomaltitol – the second – the second –generation polyols.

It is important to note in most countries their use is subject to legal restriction. In compliance with legal status, sugarless candies can be classified in three main categories:

1) Hard candies for diabetics.

2) Tooth-friendly hard candies

3) Low-calorie hard candies.

2. Lollipops ---Basically three types of lollipops based on preparation techniques.

They are as explained hereby (**Fig 2)**

a) Depositing process by using special moulds.

b) Moulding/ stamping techniques including the following steps: cutting or a well-tempered sugar rope, free fall of the cut pieces into a mould, and stamping the cut pieces in a rotating disc.

c) Moulding/ stamping process as shown in **Fig 3.**

2. <u>Caramel toffee and fudge</u>**:**

Originally toffee did not contain milk and were high-boiled products containing brown sugar, glucose syrup or invert sugar and fats, usually butter. These products all have moisture levels below 5%. The introduction of milk into toffees led to the production of higher moisture products with up to 8 or 9% water content, and for some of these products

the name caramel was used.

Toffees or caramels can be deliberately made to crystallise or grain and are then known as soft toffees or grained caramels. These products are very similar in eating texture to some fudges but are made by a different process. The name fudge is used for a wide range of products ranging from short crumbly textures to quite plastic masses for which names like Jersey Cream or Italian Creams are sometimes used. In all the these products the sugar crystal is developed during the manufacturing process and the structure has stabilised before the product is packed.

3. Gums and Jellies:

Hydrocolloid sweets- gums and jellies – now represent about half of the sugar confection sold, and their popularity continues to grow. Examples include hard, soft and foamed gums, laces, tubes and corrugated strips, jujubes, fruit leathers, lemon slices, pastilles, Turkish delight, gummy bears, jelly babies, etc. Gums and jellies are also used in other confections, e.g. reformed fruit pieces or pectin jellies in cereal cluster confectionery.

Selection of the hydrocolloid system enables considerable textural modification. Plant gums like agar agar, bacterial gums like xanthan gums and pectin and animal gums like gelatin are used as hydrocolloids. The sweets may be shaped by various moulding techniques from fluid liquor, extrusion from semiplastic mass, cutting from preformed slabs, etc. inclusions such as fruit pieces or liquid centres can be accommodated. Coatings such as sugar sanding, non-pareil, crystallization, waxing/ oiling, soft panning and chocolate are common. In addition, multilayering with for example, fudge, mallow, nougat or toffee makes this a most diverse range.

4. Chewing gum:

Chewing gum is used for sustained release of actives. Sugarless formulations assist tooth

and gum protection, re-enamelling and plaque reduction. Zinc salts in buccal cavity contact for cold protection and nicotine in smoking reduction therapy are patented. In gum, 'actives' incorporation and 'encapsulation' are restrictive.

Sugarless gums usually require much more careful handing, and the proportioning of crystallizing and anticrystallising phase ingredients is critical. These gums usually require a greater quantity of gun base and have different textual and elasticity properties during forming. The addition of actives is performed in a similar way to that used in regular sugared gums.

Teeth whitening, gum protection and plaque claims are made with patented usage of urea and other compounds. The latest technology uses anhydrous gum formulations in which plasticity and softness are assured for much longer shelf-life periods than was previously possible.

5. Medicated sugar confectionery:

Medicated sugar confectionery encompasses formulations mainly for symptomatic relief of minor throat irritations, coughs, colds, respiratory tract congestions and allergies. Some stronger actives have other specific uses, and herbal extracts, vitamins, food supplements and antacids are also incorporated.

Medicated sugar confectionery has evolved from the original tableting and panning techniques.

The most common forms of medicated sugar confectionery are manufactured in the high boiled sugar format followed by the vegetable gums, lozenges and sugarless product varieties.

B) Fats: One of the commonest fats in use in the manufacture of sweets is hydrogenated palm kernel oil and is relatively simple in chemical structural terms. Most sugar confectionery fats are non-lauric in origin. Their brittleness, hardness and flavour are related to their types of fatty acids i.e saturated or unsaturated. Fats are used to improve texture and to lubricate the product to achieve better chewing characteristics.

C) <u>Thickeners and stabilizers</u>: The thickeners and stabilizer, includes gelatin, agar agar, pectin, starch and gums. Most can be modified chemically or extracted preferentially to obtain materials with specific properties. The use of these materials improves resistance to water attack from atmospheric deposition and resistance to graining by inhibiting crystallization For e.g pectin contains a high number of galacturonic acid units in the form of methyl esters. Thus rapid-set pectin are likely to have esterification levels of 75% whilst slow-set pectins are only 50% esterified..

4. **<u>Proteins:</u>** The presence of proteins in a recipe can give rise to one of the major chemical reactions which takes place during the production of sugar confectionery and chocolate and has a profound influence on the quality of the product. Proteins provides body strength.This body strength is necessary to prevent the deformation of the piece, as most sugar confections containing milk solids are relatively high in water content.

Alternate or low calorie sweeteners.

Apart from these sugars other sugars are also used in confectionery industries. They are

a) Polydextrose: Another new ingredient available to the confectioner is polydextrose, which has a low-calorie content. It is a polymer of dextrose with sorbitol and an acid. The ingredient is hygroscopic in character and has a viscosity which is greater than sucrose.

b) Sorbitol, xylitol and mannitol: These are commercially available for use in recipes for sweet products. These are not sugars in the conventional sense but polyhydric alcohols, more usually known as sugar alcohols. These materials are promoted for their role in inhibiting

changes during storage or as a low-calorie replacement for sucrose or for their value in minimizing tooth decay when compared to conventional sugars.

c) *Lactose hydrolysates:* The careful choice of processing conditions for the selective hydrolysis of lactose, a sugar present in milk products and for this process obtained from whey, produces lactose hydrolysates. These hydrolysates are high in two simpler sugars, namely galactose and dextrose. A typical enzymes used to achieve hydrolysis is β-galactoside.

d) *Intense sweeteners:* The use of intense sweeteners such as saccharin, aspartame and acesulphame potassium (acesulphame K) has found little adoption in the sweet industry. This is because most confectionery products require a high-mass viscosity to assist in processing and to gain consumer acceptance for their texture.

Contaminants and colouring agents in confectionery

Contaminants and colouring agents in confectionery can be particularly harmful to children. Therefore, confectionery contaminants, such as high levels of lead, have been restricted to 1 ppm in many countries.

Candy colorants, particularly yellow colorants such as Tartrazine, Quinoline Yellow and Sunset Yellow FCF, do have many restrictions around the world. Tartrazine, can cause allergic and asthmatic reactions and was once banned in Austria, Germany, and Norway. Some countries such as the UK have asked the food industry to phase out the use of these colorants, especially for products marketed to children. Sugar confections are usually eaten as snack food. This includes sugar candies, chocolates, candied fruits and nuts, chewing gum, and sometimes ice cream. Both bakers' and sugar confections are used to offer hospitality to guests.

Table – 1, Principal sugar constituents present in commercial glucose syrup used for manufacture of sugar confectionery. DE rating and composition (%)

	Acid conversion			Enzyme conversion	
	Low-DE	Regular-DE(%)	High-DE (%)	High-DE (%)	High-maltose(%)
DE value	34	42	52	62	43
Monosaccharides (dextrose)	12	19	32	36	7
Disaccharides (maltose)	11	15	14	31	46
Trisaccharides	10	13	10	13	11
Tetrasaccharides	8	9	6	3	4
Higher sugars	59	44	20	17	32

Note: Under US Federal terminology the higher sugars are described as higher oligosaccharides.

Table – 2Composition of brown sugars

	Refinery brown sugars			
	Raw demerara	Light	Medium	Dark
Total sugars (%)	99.3	95.8	95.0	94.2
Non-sugars (%)	0.5	2.0	2.5	3.5
Water (%)	0.2	2.2	2.5	2.3
Colour (%)	2900	3000	7000	21 000

Table - 3 Composition of white sugars

	Pure sucrose	Granulated	Industrial granulated
Maximum impurity limits			
Invert (%)	0.002	0.015	0.20
Ash (%)	0.002	0.013	0.13
Colour (IU)	8	17	220
SO2 (ppm)	1	15	15
Average moistures (%)	0.010	0.020	0.070
Average organic non-sugars (%)	0.001	0.012	0.065

Table – 4 Composition of different grades of Treacles

	Grade 1	Grade 2	Grade 3
Sucrose (%)	30.5 – 33.5	29 – 33	35.5 – 39.5
Invert (%)	31 – 35	27 – 31	16.5 – 20. 5
Ash (%)	6 – 8	8.5 – 10.5	10.5 – 13
Colour (IU)	90 000 – 120 000	125 000 – 170 000	180 000 – 220 000
Total solids (%)	81 – 82	80 – 81	79.5 - 80.5
Organic non-sugars (%)	6.5 – 8.5	8.5 – 11.0	12.5 – 15

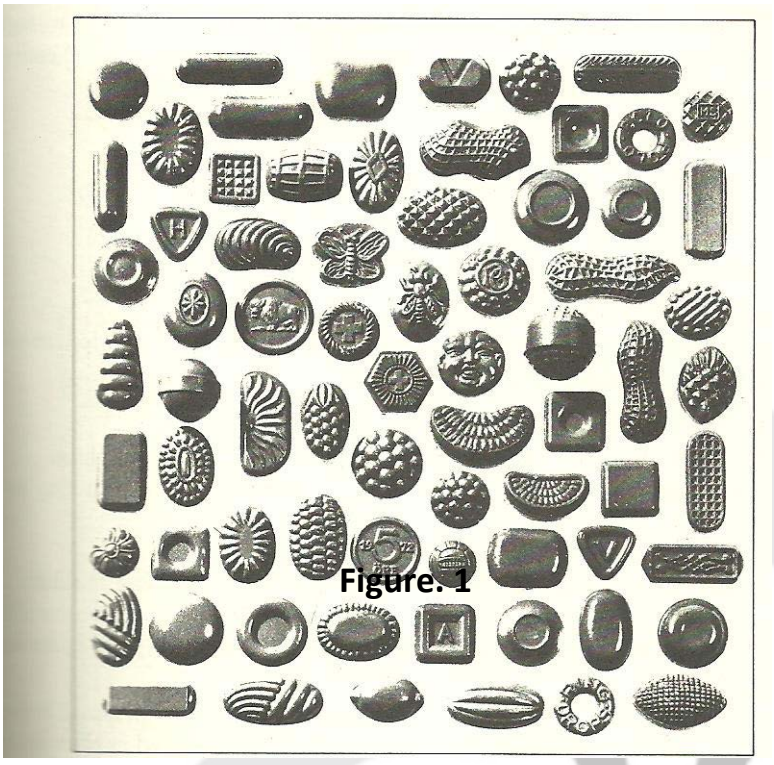

Figure. 1

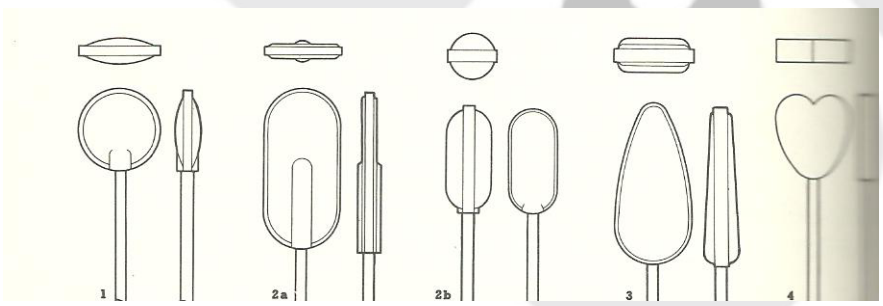

Figure .2.

1, round, flat lollipop; 2a, elongated, oval, flat lollipop; 2b, flat, spherical lollipop; 3, elliptical, flat lollipop; 4, special flat lollipop shape.

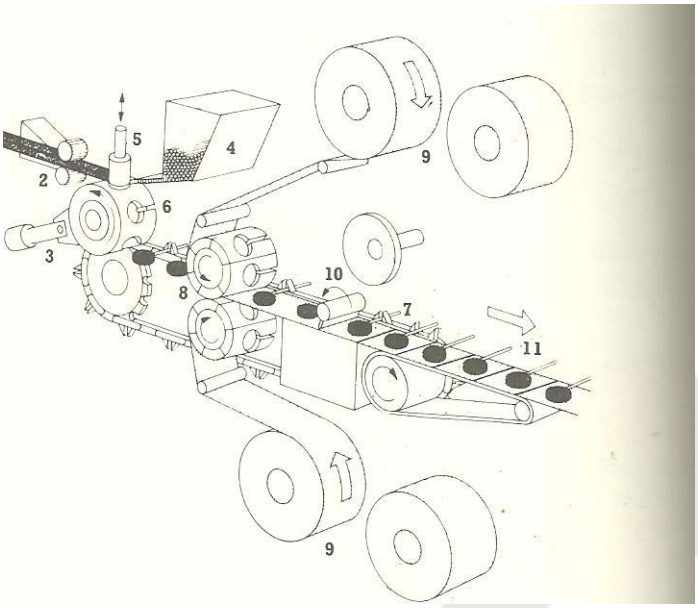

Figure 3.

Flow diagram of a flat lollipop forming – wrapping machine- System Aquarius ALM 4P/W.

1, sugar rope; 2, sizing feeding rollers; 3, forming plunger; 4, stick feed; 5, cutting and performing die; 6, forming die-head; 7, chain conveyor with gripper jaws; 8, sealing rollers; 9, wrapping materials reels; 10, rotating cutting knife; 11, transfer to conveyor belt and cooling tunnel.