1. Introduction
Confectionery means the food items rich in sugar and often referred to as a confection. Confectionery making is an art of creating sugar based dessert forms. Confectionery products were developed by confectioners working by trial and error and not from an understanding of the science. The term sugar confectionery refers to a range of food items, generally known as sweets e.g., boiled sweets, toffees, marshmallows, and fondant. Panning is an art of framing layers on candy-based centers in a very controlled way. Generally, it is carried out in a rotating pan called dragees pan. Sugar panning means application of a thin coat of sucrose solution to every individual tumbling centers followed by evaporation of moisture so that a thin layer of crystallized sugar is formed. Chocolate panning is a generic term for the continuous application of a fat based coating to a prepared center. Now a days, there is a tremendous increase in market value for panned confections. The reason for increase in demand could be, consumers want a novel product and combination of different textures and flavours in the product. This chapter deals with the technological aspects of chocolate and sugar panned confectionery products and development of novel products as well as scope for improvement in the existing ones.

2. Panning process
Panning process is the controlled build-up of a center through application of successive layers either of solid or liquid coating material in a revolving pan, with or without the use of warm or cool air to dry or set the coating (Lynch, 1992).

Panning process consists of the following three steps:

   a. Pretreatment of the centre
   b. Chocolate/compound panning
   c. Polishing and sealing

   The pretreatment of the centre is basically precoating process which means application of a separate coating layer between the centre and the panning layers. It is also called engumming, isolation and stabilization of the centre.
The second process step is coating with chocolate or compound coating. It is a molten fat-based mass which is applied to the centres either manually, automatically or by spraying system. Under cold air, the molten mass solidifies and forms a homogeneous layer on surface of the centre.

After the coating process, chocolate or compound panned goods are subjected to polishing layer, or dusting with icing sugar, cocoa powder, rased coconut or other powders on the product surface. When dusting is done with powder, the outer layer is not completely crystallized but when it is done with icing sugar or another powder, it sticks to the surface.

As this chapter deals with technology of sugar and chocolate panned confectionery products, only chocolate and sugar panning will be discussed here.

2.1 Sugar Panning

Sugar panning is a process of building up a layer by layer coating of sugar on centers. The coating may be hard or soft, depending on the thickness, sugar composition and method of manufacture. The resultant sweets are called dragees.

Sugar coating of confectionery using a pan is an ancient process. These products were made in an open pan suspended over a fire. The operator swing the pan by hand, consequently coating of the product with sugar syrup takes place, and then it is allowed to crystallize the coated sugar. Generally, a rotating dragee pan (see Figure 1) is used for the small scale panning. A dragee pan is an elliptical vessel, traditionally made of copper but now more commonly of stainless steel. Though smaller pans are used for small-scale work, the diameter of typical pan sizes are between 0.9 to 1.5 m. Generally, it is equipped to be rotated and there is a system for supplying and extracting air and possibly with a system for spraying the sugar syrup in the dragee pan. The panning process can be controlled by factory employees very effectively but as any mathematical model involves partial differential equations, it becomes a difficult process to understand.
2.1.1 Hard Panning

In hard panning, the centres are tumbled in the pan and a sugar syrup is applied. Both together, the rotation of the pan and the tumbling of the centres results into spreading of the syrup over the surface of the centres into a thin layer. The evaporation of water in the sugar syrup causes crystallization of sugar. Since, the water can evaporate at certain rate only, the rate of sugar crystallization cannot be accelerated. However the evaporation rate of water can be increased by increasing the temperature and the rate of air flow as well as reducing the humidity of the air. Increasing the temperature reduces the rate of crystallization. The layers applied are only 10-14 µm thick, and as they are so thin, contours of the product occurs. In traditional process the syrup is applied by hand, while modern installations use a spray system. The heating system is heated air either electrically or by steam. In an unventilated pan the process slows down because the air becomes saturated with water vapour.

The centres have to be coated with a concentrated sugar syrup for hard panning. Some centres, such as nonpareils, quickly take the sugar syrup coating, while others such as nuts or chewing gum have a hydrophobic surface, need some pretreatment. The syrup is dosed in pan which is called ‘wetting’ and ‘engrossing’ when the coating is built up. Hard panned confections have a hard crystalline coating and include products such as sugar almonds, mint imperials, non pareils and sugar coated chocolate lentils and eggs.

2.1.2 Soft Panning

Soft panning syrup is not intended to crystallize. The syrup used can either be an all glucose syrup or a 50:50 mixture of sucrose and glucose syrup. The centres are wetted with the syrup just sufficiently to coat them. Then caster or milled sugar is added which dissolves in the water of the syrup rather than evaporating the water as in hard panning. Any excess of sugar
convert the syrup from a non-crystallizing syrup to a crystallizing one. Then the centres are removed from the pan and placed on trays for drying purpose.

Soft panning is a cold process and it do not use drying air. Dust extraction is needed for health and safety reasons. Soft panning puts on thicker layers. A product that has been soft panned can be finished by dusting with milled sugar followed by a number of hard panned coats. Typical examples of soft panned products are jelly beans and dolly mixture components. Soft panning applies a thick, soft layer to centers such as moulded jelly beans or chews. Hence, soft panning is a cold process, it uses a non-crystallizing syrup rather than using the crystallized sugar coating which require heat to dry it out. It is also a first process and thick coating can be built up in a very short time. Comparison of the features of hard and soft panning is given in Table 1.

**Table 1** Comparison of hard and soft panning

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Hard panning</th>
<th>Soft panning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coating chemistry</td>
<td>Pure sucrose</td>
<td>Sucrose and glucose syrup</td>
</tr>
<tr>
<td>Panning conditions</td>
<td>Heat and ventilation</td>
<td>Cold</td>
</tr>
<tr>
<td>Coating build up</td>
<td>Slow</td>
<td>Quick</td>
</tr>
<tr>
<td>Coating thickness</td>
<td>Thin</td>
<td>Thick</td>
</tr>
<tr>
<td>Pan size</td>
<td>Large</td>
<td>Small</td>
</tr>
<tr>
<td>Crystallization caused by</td>
<td>Evaporation</td>
<td>Adding milled sugar</td>
</tr>
<tr>
<td>Typical products</td>
<td>Sugared almonds, mint imperial, nonpareils, sugar-coated chocolate beans</td>
<td>Jelly beans, dolly mixture compounds</td>
</tr>
</tbody>
</table>

(Edwards, 2000)

2.1.3 Sugar panned confectionery products
Sugar panned confectionery products include soft panned products such as jelly beans/eggs (gourmet, seasonal, sports beans), gel center products (fruit sours, candy fruit rocks), sugar coated marshmallow eggs, some imperials and hard panned products such as chewing gum, licorice, nuts, compressed tablets or high-solids chewy candy, non-pareils.

2.1.4 Technology

2.1.4.1 Jellybeans
Jellybeans is the most common starch-molded soft-panned confectionery product. A jellybean center consists of a gelling agent (starch, pectin, or gelatin), sugar, corn syrup, and water. Ingredients for jellybean preparation are: extra fine granulated refined cane sugar, pure cane confectioners’ sugar with added cornstarch to prevent caking and corn syrup (solids: 79.7-80.9%, DE: 41-45, and pH: 4.5-5.2). Formulation of panning syrup (Isganitis, 1993): Boil sugar (30% w/w) and water (15% w/w) and then mix it with 43 DE corn syrup (55% w/w). The process flow diagram for the manufacture of jellybeans is given in figure 1.

Disperse thin boiling starch in liquid sugar and water
↓
Add corn syrup
↓
Cook the slurry to a solid content of 75-79%
↓
Deposit the cooked starch slurry into starch molding trays
↓
Stove it and then cool it
↓
Hold the centers for a least four weeks at 21.1°C, 50-75% RH in slotted plastic trays
↓
Add centers (3 kg) to the pan and initiate tumbling
↓
Add panning syrup (approx. 0.3 kg) and extra fine granulated sugar (approx. 1.4 kg)
↓
Continue tumbling until the surface is no longer tacky and sugar is not clumping on the surface
↓
Add extra fine granulated sugar (approx. 0.49 kg) to the centers
↓
Continue tumbling until the surface was smooth and no longer tacky
↓
Complete three syrup-sugar cycles (approx. 45 parts syrup: 250 parts sugar)
↓
Complete fourth cycle using confectioners' sugar (approx. 0.22 kg)

Figure 1 Flow diagram for the manufacture of sugar panned jelly beans (Troutman et al., 2001).

2.1.4.2 Sugar coated confectionery product with a crispy starch based center
The manufacturing process for the production of sugar coated confectionery product with a crispy starch based center is shown in figure 2.
Prepare a dry mix containing 87% rice flour, 7% sucrose, 3% flavor, 2% salt and 1% dextrose (all ingredients in w/w proportion)

↓

Feed the dry mix into twin screw extruder

↓

Place a mixture of water and malt extract into the extruder

(Die temperature of 157° C and pressure of about 1000-1020 psi)

↓

Cut the extruded puffed rice emerging from the extruder

(Using a high speed rotating knife to form extruded puffed rice centers having about 9% by weight moisture)

↓

Dry and toast the extruded puffed rice centers in a gas heated, convection belt dryer

(Temperature: 112-120°C for 6 minutes, moisture content of centers: 1-1.3% by weight)

↓

Condition the dried centers at 45°C for 12 h and 55% RH

(aw of 0.34, moisture of 6-8% by weight)

↓

Cool the conditioned samples to room temperature

↓

Spray chocolate on centers

(Weight ratio of chocolate to center about 5:1)

↓

Again coat it with conventional sugar shell

(20% by weight of the coated confectionery)

Figure 2 Flow diagram for the manufacture of sugar coated confectionery product with a crispy starch based center

2.2 Chocolate Panning

All types of chocolates (Dark, white and milk chocolate) can be used for panning purpose. The total fat content of chocolate should be 28 to 35%. Here, decisive role is played by milk solids and fat content. The quantity of milk constituents influences the viscosity and the proportion of cocoa butter to milk fat which consequently influences the hardness of the final product.

The chocolate is mostly delivered in liquid form or is molten before use at around 38–42°C and then applied or sprayed on. The advantage of using non-tempered chocolate is that the viscosity of the chocolate is low, thus the danger of stickiness is reduced. Another advantage could be a more homogeneous surface and consequently reduces smoothing time. Since tempering machine is not necessary, it eliminates high investment. On the other hand, the
application of tempered chocolate has the advantage of reducing the cooling time between the separate layers and reduction in the quantity of chocolate sticking to the coating pan’s walls.

2.2.1 Chocolate panned confectionery products

Any confectionery inclusion can be chocolate coated through panning process. The coating material used can be milk chocolate, dark chocolate, white chocolate, sugar free dark or milk chocolate, compound coating or combination thereof. Chocolate panned confectionery products include dried fruits (raisins, blueberries, cherries, apricots, and cranberries), nuts (almonds, peanuts, cashews, and macadamias), espresso beans, soft pieces (fondant, caramel, and jellies) and crunchy pieces (maltballs, cookie pieces, flavoured bits). The most popular among them are nutmeats (peanuts, almonds and cashews), fruits (raisins, cherries) and malted milk balls.

2.2.2 Technology

2.2.2.1 Chocolate panned caramel

Caramel is a pale to dark-brown colour confectionery product made by heating any variety of sugars. It is used as a flavoring agent in puddings and desserts, as a filler in bonbons and as a topping for ice cream, custards and caramel corn. The initial bed temperature of the caramel centers should be 10°C because the spherical caramel centers deforms rapidly at temperatures above 15°C therefore. The application of uniform spray of small droplets of chocolate (40°C) is done for minimizing mixing and redistribution of the chocolate prior to solidification of that chocolate on the surface of the pieces. For the chocolate panned caramel production chocolate coating of 45% (percentage of total finished piece weight) is required equating to a 1.43 mm thick uniform chocolate coating. Total amount of chocolate require is 73.5 kg \{[73.5 \text{ kg chocolate}/ (73.5 \text{ kg chocolate}+90 \text{ kg centers}) = 45\% \text{ chocolate}]\}. The flow diagram for the manufacture of chocolate panned caramel is shown in figure 3.

Place spherical caramel centers (90 kg, diameter 13 mm) into a cylindrical drum (diameter: 1 m and length: 2 m)

↓

Set the speed of the drum at 15 rpm

↓

Continuously apply liquid chocolate (40°C) with a uniform spray of small droplets through 6 nozzles

↓

Supply cooling air of 10°C at 1200-1800 cubic feet per minute (CFM) to the drum

↓
As the bed temperature reaches 24°C, stop chocolate spray while continue cooling air to blow

**Figure 3** Flow diagram for the manufacture of chocolate panned caramel

### 2.3 Future trends

It is a difficult task to predict the future of sugar confectionery products although some ideas can benefit the industry as well as consumers. Novel ingredients should be developed which can help in new product development. Finding genius fellows and paying them well could be a good investment for developing new products or even improving the existing ones. The growth of sugar-free products is an emerging area for the sugar confectionery products. It would become dominant, if the problems of sugar-free products are overcome. Since there would be energy reduction in sugar-free products, some individuals would not get benefited.

As raw materials becoming more expensive special attention should be paid to engumming and stabilization of the centres in order to decrease rework and prolong shelf life. Since, panning is a time-consuming and labour-intensive process, the scope for improvement could be for processes that are automated and for production to be rationalized further. In respect to rationalization and automation, in stead of conventional coating pans, belt coaters can be used for polishing. Mainly for reasons of hygiene, copper vessels can be replaced by belt coaters. There should be development of polishing agents that allow direct polishing in the belt coater. However, the polishing agent must achieve the gloss by less friction and pressure in the shortest period. The gloss on chocolate panned goods should be made resistant and long lasting by means of a sealing agent. Panning on nearly every centre type and combined with chocolate panning allows clueless combinations of flavour and texturing. Current scenario such as functional food, value-addition of the product by vitamins, fibre or light snacks can be combined with one another and create an exciting subject which may have a stake in the future.

**References:**


