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Unit 2 Topic 4

INSTANT COFFEE

33.1 Introduction to Instant Coffee

Instant coffee, also called **soluble coffee** and **coffee powder**, is a beverage derived from brewed coffee beans. It is the dried soluble portion of roasted coffee, which can be presented to the consumer in either powder or granule form for immediate make-up in hot water. Instant coffee is commercially prepared by either freeze-drying or spray drying, after which it can be rehydrated.

Instant coffee was invented in 1901 by Satori Kato, a Japanese scientist working in Chicago.

Historically, most instant or soluble coffees first contained added carbohydrates (~ 50% w/w) such as corn syrup solids, as simple aqueous extract of roasted coffee, extracted under atmospheric conditions (100°C). However, it could not be spray dried to a satisfactorily free-flowing low-hygroscopic powder.

In 1950, Instant coffee of 100% pure coffee solids became commercially available. In 1965, Instant coffee in soluble form, somewhat darker in colour and improved retention of aromatics became available.

The manufacture of instant coffee is accompanied by some slight hydrolysis of the polysaccharides in the roasted coffee (by further aqueous extraction at temperatures up to 175°C and addition to the simple extract before drying), which is reflected in the slightly increased reducing sugar content (i.e. arabinose, mannose and galactose) and probably assists solubilization of these polysaccharides, not otherwise easily possible at 100°C. This provides a powder of satisfactory physical properties.

Advantages of instant coffee include speed of preparation (instant coffee dissolves instantly in hot water), lower shipping weight and volume than beans or ground coffee (to prepare the same amount of beverage), and long shelf life.

About 20% of all processed coffee beans are used for making Instant coffee. The capacity of the plant available is up to 500 kg of Instant coffee per hour.

33.2 Classification of Instant Coffee Powder

33.2.1 Non-agglomerated instant coffee powder

This type of powder consists of individual spherical bead-like particles giving the powder its free-flowability and good solubility in hot water. It is most economically produced in spray

dryers with tower drying chambers. Powder bulk density is adjusted through inert gas injection into the concentrated coffee extract prior to high pressure atomization.

33.2.2 Agglomerated instant coffee powder

This type of powder consists of either medium-sized or large agglomerates with a minimum of fines, giving the powder superior free-flowability and solubility in hot and cold water. Medium sized agglomerates are most economically produced in spray bed dryers incorporating fluid bed agglomeration within the drying chamber. Large agglomerates are produced in a powder agglomerator where spray dried instant coffee is rewetted and dried, under strictly controlled conditions.

33.2.3 Granulated instant coffee powder

This type of powder consists of large granules, free from fine particles that gives the powder excellent free-flowability and solubility in hot water. It is most economically produced in freeze dryers, where the low temperature drying environment maximizes aroma retention. The size of the granules is determined by the degree of size reduction and size classification applied to the frozen extract.

33.3 Production Method for Instant Coffee

As with regular coffee, the green coffee bean itself is first roasted to bring out flavour and aroma. Rotating cylinders containing the green beans and hot combustion gases are used in most roasting plants. When the bean temperature reaches 165�C the roasting begins, accompanied by a popping sound. These batch cylinders take about 8�15 min to complete roasting with about 25-75% efficiency. Coffee roasting using a fluidized bed only takes from 30 sec to 4 min, and it operates at lower temperatures which allow greater retention of the coffee bean aroma and flavor. The yield of soluble solids from roasted coffee is presented in Table 33.1.

Table 33.1 Yield (on dry basis) of soluble solids from roasted coffee

Conditions	Yield (on dry basis)
Brewed coffee	21.0% w/w
Exhaustive extraction at 100^{o}C	Up to 32.0% w/w
Instant coffee	40.0-55.0% w/w

The beans are then ground finely. Grinding reduces the beans to 0.5�1.1mm (0.020�0.043 in) pieces in order to allow the coffee to be put in solution with water for the drying stage. Sets of scored rollers designed to crush the beans.

Once roasted and ground, the coffee is dissolved in water, referred to as ﷺextractionﷺ. Water is added in 5-10 percolation columns at temperatures of 155-180ﷺC; this concentrates the coffee solution to about 15-30% coffee by mass. This may be further concentrated before the drying process begins by either vacuum evaporation or freeze concentration.

Although freeze drying is expensive, it generally results in a higher-quality product.

33.3.1 Manufacturing process for instant coffee

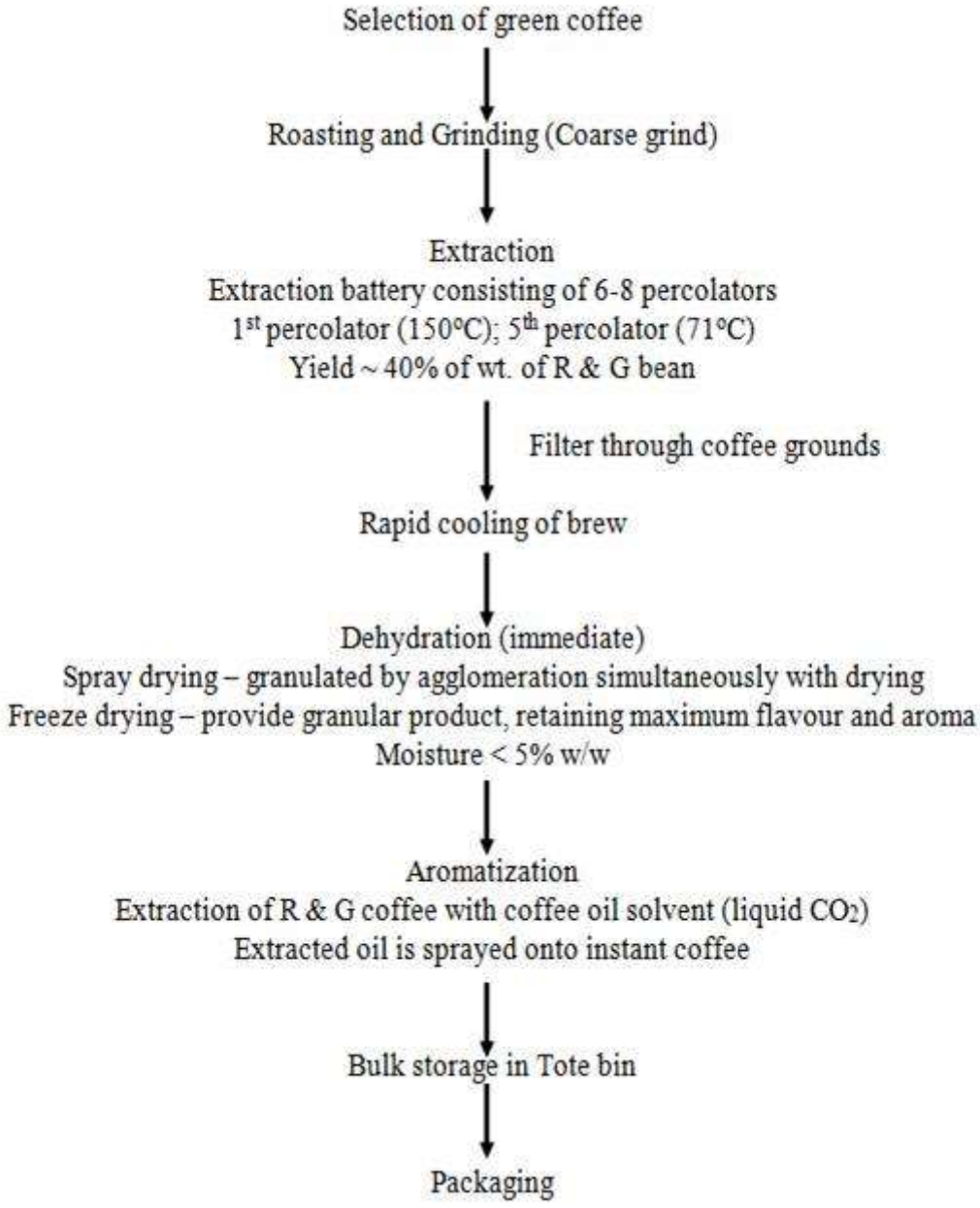

Fig. 33.1 Flow chart for preparation of Aromatized coffee

33.4 Drying Techniques

33.4.1 Spray drying

Spray drying is the most economic method to obtain soluble coffee which is free-flowing and agglomerated/granulated powders. The dried powder has about 3.0% moisture.

Spray drying features the spraying (atomization) of concentrated extract into hot drying air. The spray droplets dry to form a non-agglomerated, free-flowing powder consisting of large individual spherical bead-shaped particles. An agglomerated powder with low fines content can be produced by combining spray drying with powder fluidization in an integrated fluid bed built into the spray drying cone base. Powders consisting of very large agglomerates are produced in a separate agglomeration process, in which spray dried powder is rewetted by steam, agglomerated, and dried using fluidization and cascading powder principles.

Spray drying produces spherical particles about 300 μm (0.012 in) size with a density of 0.22 g/cm^3. To achieve this, nozzle atomization is used. High speed rotating wheels operating at speeds of about 20,000 rpm may be used. The use of spray wheels requires that the drying towers have a wide radius to avoid the atomized droplets collecting onto the drying chamber walls. The drying is completed in 5–30 sec. (dependent on factors such as heat, size of particle, and diameter of chamber). The inlet and outlet air temperature are typically 270°C and 110°C respectively. The moisture content of the feed and powder is 75-85% and 3-3.5% respectively.

Spray drying is preferred to freeze drying in some cases because of its economy, short drying time, usefulness when dealing with heat-sensitive product, and the fine, rounded particles it produces.

One drawback with spray drying is that the particles it produces are too fine to be used effectively by the consumer; they must first be either steam-fused in towers similar to spray dryers or by belt agglomeration to produce particles of suitable size.

33.4.1.1 Nozzle tower spray dryer

It gives a free-flow powder with average particle size of 100-250 μm; however the residence time in dryer is longer.

33.4.1.2 Fluidized spray dryer

It gives a free flow agglomerated/granulated coffee. The powder has average particle size of 100-300 μm. Lower drying temperatures are employed with improved aroma in powder.

33.4.1.3 Filtermat spray dryer

This employs even lower temperature and longer drying times. It yields coarse, agglomerated/granulated, free-flowing and dustless powder with particle size of 250-1000 m and with increased aroma retention.

Nozzle tower, Fluidized spray dryer, Filtermat spray dryer, Freeze dryers may be utilized for drying purpose.

Certain important criterion that needs to be controlled in drying technology includes:

- Colour (brightness) of the final soluble coffee powder
- Particle size distribution and powder structure / morphology
- Bulk density
- Residual moisture content
- Aroma retention
- Flowability
- Solubility
- Mechanical stability

The latest technology in vogue in spray dryers are the air disperser and drying chamber designs that enable production of powder having the desired particle morphology and taste through enhanced retention of desirable aromatic volatiles.

The Spray dryer coupled with extract concentrate gas injection and dosing unit installed on the high pressure side of the spray dryer feed line represents the latest design concept in the important area of powder bulk density control and coffee powder brightness.

33.4.2 Agglomerated Powder

Powder is processed in Rewet Agglomerator to obtain dustless powder and customized granules. The average particle size obtained is > 1000 .

33.5 Freeze Drying

Freeze drying gives a premium product. It preserves all the desirable aspects of the concentrated coffee extract. Actual freezing can take place on a continuous Air blast belt freezer or for smaller capacities on Rota drum freezer. Granulation of frozen coffee slabs is done to get the right granule size and size distribution.

Quality parameters include colour, density and solubility.

Freeze drying includes pre-freezing, foaming and freezing of the concentrated extract followed by granulation - sieving of the frozen granules, which are dried in trays (batch processing) or on a moving conveyer belt (continuous processing).

On freezing, the water in the concentrated extract forms ice crystals, which sublime under

the influence of vacuum and applied heat to leave a dry granular product. Sublimation is the direct phase transition from solid state (ice) to gas phase (vapour). The conveyer belt permits much shorter drying times, promoting improved aroma retention as the coffee granules are exposed only for a relatively short time, to the vacuum conditions inside the freeze drying sublimation chamber.