Instant coffee production

Business, Industries

Introduction

Instant coffee is an aromatic beverage, consisting of water with additional compounds extracted from coffee beans during brewing, which have then been dehydrated into a soluble coffee form. Coffee beans are seeds from coffee fruit, selected from different sources (location and seasons). The blend could give a particular taste of the brand and also help to reduce the risk of shortage or price fluctuation from a single raw material supplier. Coffee arabica produces the finest coffee, while coffee robusta produces a strong but inferior coffee.

Processing

There are two main primary processing methods: the unwashed or dry process, which produces naturals, and the washed or wet process, which produces washed coffees. In the dry process the ripe cherries are dried in their entirety after which they are mechanically decorticated to produce the green bean. In the washed or wet process the ripe cherries are pulped and fermented to remove the sticky sugary coating called mucilage that adheres to the beans (this can also be done mechanically), and the beans are then washed and dried. This lactic fermentation involves the action of Leuc. mesenteroids, L. berivs and Streptococcus faecalis. In all procedures the parchment skin is later removed mechanically after drying. Better flavour is achieved if the beans are processed by the wet method rather than the dry method when removing the hull, Wet processing helps in developing ‘ soft buttery notes’ in the cup, unlike the thick ‘ robust’ notes that are observed in the average robusta cup.

Beans are mixed by weight portion and no special arrangement of mixing is required. Many imported beans are shipped green, as can be stored in the state with little loss of quality, before roasting.

The roasting operation develops the characteristic flavour and headspace aroma. There are two stages of transformation in which the 12% of moisture is driven off and pyrolysis occurs, with the swelling of the beans. Roasting time determines classification as a light, medium or dark roast. The first stage take up about 80% of the roasting time with green beans gradually changing from a straw colour to a pale brown. The second stage of roasting leads to the rapid darkening, emission of oily smoke and crackling sounds, with the chemical composition of the beans rapidly changing. A porous microstructure is formed and the density of coffee bean is almost halved after roasting (from ca. 1. 3 g. ml-1 to ca. 0. 7 g. ml-1). The degree of roasting is key for quality consistency of the final product. This can be measured by the colour or density of the roasted beans. Roasting time can be set for predetermined roasting degree. The roasters currently available for roasting operations include vertical rotating bowl roasters, vertical static drum roasters, horizontal rotating drum roasters, fluidized bed roasters and pressure roasters. Horizontal roasting drum roasters are the most popular, with either a perforated wall or a solid wall.

Grinding reduces the size of the coffee bean to small particles. A multi-roller can be used, where the coffee beans pass through up to four stages of size reduction, with the gap between rollers decreasing with each stage.

Extraction involves the separation of the soluble solids and volatile aroma/flavour compounds are extracted from ground coffee granules, using hot water as the solvent. An example of such an extractor is a percolation battery extraction device, or a counter-current continuous screw extractor, where a pressurized water feeding system can be used to enhance extraction efficiency.

Solvent extraction is not a single stage operation but involves loading the coffee, spraying with solvent (water) until the solute content is reduced to the economical minimum, and excavated. In the production of instant coffee, a series of extraction tanks are linked together to form an extraction battery. Hot water is fed into the take containing roasted granules that are almost extracted and then flows through the various tanks in series before it is withdrawn from the freshly charged tank.

Both spray drying and freeze drying are commonly used for instant coffee manufacturing. Spray drying operates at a high temperature, providing an efficient and economic method for the dehydration of coffee solution. However freeze drying has a much better retention of flavour/aroma compounds, but at a relatively higher cost.

Freeze drying depends on low temperatures (below -20oC) and the absence of drying air during the dehydration process. The complete process includes freezing, granulation, and then freeze-drying. The slower the highly concentrated coffee is frozen, the larger the ice crystals formed, essential in preserving the best possible colour as well as increasing the solubility of the final product. A band freezer is commonly used, where the band is divided

into four to six temperature zones, each of which are cooled by to the required temperature. The coffee extract is then transported through the temperature zones for controlled freezing, leaving the band as flakes at a temperature of approximately -40oC. These frozen flakes are then ground up and fed into a granulator with a built-in perforated plate. The flakes are granulated and passed through holes in the plate, sorting the granules into various sizes. The correctly sized granules are passed though a vacuum lock and a gate lock into the freeze-drying cabinet, and emptied into a hopper. Below the pressure of 4. 6mm Hg, the ice in the coffee goes directly from a solid to vapour without melting. This kind of evaporation is called sublimation.

Dried coffee has little or no aroma, therefore, manufacturers usually recover the aromatic volatiles during the bean grinding or extraction processes, and spray them back onto the product just before the final filling operation. This will provide a coffee-like fragrance when the pack is opened.

Packaging and shelflife

The freeze-dried coffee enters the packaging section via a hopper and is automatically weighted, filled into polyethylene bags, and packed into cardboard cartons for bulk export, or filled into glass jars and labelled. As coffee oil is usually used as a carrier for the aromatic volatiles, it is necessary to fill the packs under a blanket of inert gas such as CO2 to reduce the risk of oxidation. Sealed packaging is necessary for volatile compound retention and to prevent moisture pick-up.

High moisture content reduces coffee’s shelf life. At 7% moisture content, instant coffee may start to ‘ cake’. Glass bottles or metal tins often used as containers for instant coffee. Beans that are at equilibrium and are inactive would have a moisture content of well below 12. 5%. Beans with a high moisture content could be very actively respiring, giving up moisture and undergoing changes both physically and intrinsically. Physically, there would be a fading in colour and, depending on the moisture content, the temperature and the humidity of the surrounding area, this could result in bleaching and mould growth. Intrinsically, the cup quality could fade from a clean, strong and neutral cup to a ‘ woody’, ‘ aged’ and ‘ musty’ cup.

Safety and microbiological aspects

A particularfoodsafety issue for coffee is concern over the presence of ochratoxin A (OTA), a mycotoxin that can cause kidney damage, and is a possible human renal carcinogen. In coffee, OTA is produced by fungi of the Aspergillus genus (A. ochraceus, A. carbonarius, A. niger). It is mostly concentrated in the husk, which suggests that naturals (coffees dried in the fruit) are most at risk of contamination. In the European Union the following maximum limits apply to finished coffee products, effective 1st March 2007: roasted coffee – 5 ppb (parts per billion); soluble coffee – 10 ppb. The HACCP process can be used to establish where OTA enters the system and where the fungi causing OTA first appears. HACCP is a management system in which food safety is addressed through the analysis and control of biological, chemical and physical hazards from raw food material production to manufacturing and consumption.

Careful inspection of visual appearance and any mouldy or earthy smells can be a useful tool for checking for the presence of OTA.? The monitoring of ? Pesticide residues in coffee is also a vital aspect of an HACCP system. Furthermore, coffee growers maintain chemical registers that detail, in chronological order, the type and quantities of all chemicals used and the timing of their application. Hydrocarbon contamination is usually caused by jute coffee bags because of the ‘ batching oil’ used to soften the jute fibres before spinning. There have been instances of contaminated oil being used (old engine oil for example), leading toThe International Jute Organizationhas established specifications (IJO Standard 98/01) for the manufacture of jute bags to be used in the food industry.

Quality control

The supplier must meet the contract specification of the buyer. The seller and buyer jointly established the quality parameters, which the seller is expected torespectcontinuously, shipment after shipment. Instant coffee produced must be suitable for human consumption, free from extraneous matter such as live pests and moulds, fully conform to the contract description or selling sample, with uniform quality, and be clean ‘ in the cup’ i. e. free from abhorrent flavours.

Instant coffee is graded according to quality. For the United States market, undergrade coffee is any type of coffee that grades below GCA type 6 (120 defects per 370 grams The US market prohibits imports below this grade, however most other markets do not normally specify that particular grades of coffee should not be imported, relying instead on general food and

hygiene regulations. However, the ICO has introduced a set of worldwide minimum export standards in an attempt to remove the lowest coffees from the market altogether. The higher risk of mould and therefore OTA occurring in lowgrades is also likely to reduce the demand for such coffee.

Improper processing techniques, including use of incorrect equipment and poor handling, contribute to defects in quality. Major off-tastes can occur as a result, including raw/green, fruity, overripe, fermented, chemical, earthy, and oily flavours.

Problems that may occur include:

The picking of overripe beans lowers cup quality leading to a fermented and ‘ medicinal’ flavour, due to the deterioration of the fruit.
A putrid, rotting off-taste may be caused due to microorganisms entering damaged beans if the coffee beans are not sorted on size, leading to the beans being cut during pulping. Black beans or ‘ stinkers’ may be formed affecting quality.
The water used for washing, as for all the stages of processing, should be clean to ensure the quality of the end product. Unclean water or water contaminated with fine silt, and recirculated water with a high solid content, could cause earthy, fruity or fermented and other off-tastes.
During the preparation of the robusta beans, spreading the fruit in thick layers with inadequate stirring and raking could result in mould formation. This can adversely affect the visual appearance and the cup quality of the cherry beans. Lack of protection from rain and night dew during drying can also cause mould growth.

Spicy and chemical off-tastes could be due to packaging in poor quality bags or bags in which spices or fertilizers have been packed earlier. Storing coffee with spices, chemicals, fertilizers or fungicides could also cause these off-tastes. Coffee beans easily absorb odours that could lower their aromatic quality.

Based on visual quality, robusta beans could be categorized into three grades: above FAQ (fair average quality), FAQ (average) and below FAQ.

Based on liquor quality, robusta beans could be classified as follows:

Fineandspecial, where the liquor quality is soft, smooth and buttery, with good body, hardly any bitterness, and clean. This quality can be seen in robusta coffees which are washed and processed with care, in robusta beans which are grown at high altitudes and under shade, and in plant strains which have the inherent characteristics of lower caffeine content, softness and mellow flavour notes.

Good, where the liquor quality could be described as good body, neutral, light bitterness, clean, with a hint of chocolate notes.

Average, with a cup quality of fair body, fair neutrality, average bitterness, and clean.

Below average, where the liquor, though of fair body, has harsh notes of the robusta fruit, is bitter though clean, and is flat with no flavour notes.

Poor, a cup which is unclean, having medicinal, phenolic or rioy off notes, or strong harsh robusta notes, with or without body, bitter and unpleasant to the taste.

What has been said above is not a universal methodology followed by all robusta producing origins. It is only a means to explain the quality attributes that could be encountered in a robusta cup and the manner in which these attributes could be classified. Individual buyers have their own classification and evaluation methods, but usually the attributes and ratings will be comparable to those above.

ISO 9001 is a process-based quality management system that organizations can use to demonstrate theconsistent qualityof their products to customers and concerned regulatory institutions.

When an organization’s quality management system complies with ISO 9001 and when the coffee is processed in accordance with these procedures, then the quality management system (not the product) can be ISO 9001 certified.

Spoilage

Physical and sensory properties

Robusta beans have robust but clean strong and fruity flavours, and are often used in instant coffee preparation. Arabica coffee may also be used, and generally produce good liquors with acidity and flavour. However, these organoleptic properties can be affected by a number of factors.

Poor visual colour in instant coffee, such as a whitish appearance could result in a low value. This indicates a poor processing technique, which could result in a fruity or fermented off-taste. Broken beans, on the other hand, could result not only in a high roasting loss, but also in charring of the beans and a poor cup quality, leading to off-tastes being produced, affecting the final soluble coffee product. The defect count is the measured presence or absence of defects such as blacks, browns, greens, faded and bleached beans, insect damaged beans, sour beans and extraneous matter such as twigs, sticks or stones.

Maillard browning is desirable in the manufacture of coffee, causing beneficial sensory changes, as well as antimutagenic (??) and antioxidative properties (?). This enzymatic browning is catalysed by the enzyme polyphenol oxidase and can contribute to the overall acceptability of coffee. Products of enzymatic browning play a number of physiological roles i. e. melanonins produced may exhibit antibacterial and antifungal properties(?).

Added ingredients: chicory added “ French” coffee, fig added “ Viennese” coffee??

Volatile components give coffee its characteristic fragrance. There are more than 600 classified flavour compounds in instant coffee. Heat vaporises them into the air. Instability of the volatile compounds can cause flavour of roasted coffee to deteriorate quickly as it cools, or if it is kept hot too long, evaporation causes the loss of many of these compounds and their flavours. Bitter substances – organic acids which give a bitter, slightly sour taste to

coffee. Chlorogenic acid equals about 4% of roasted coffee beans, along with caffeine and polyphenols compounds.

Coffee should never be boiled as these temperatures increase the solubility of the bitter compounds, resulting in unpalatable coffee.

Coffee contains Methylxanthines such as caffeine and theobromine. These are compounds which stimulate the central nervous system, and have either positive or negative effects, depending upon the individual, including increased exercise performance, temporarily increased heartbeat, metabolism, stomach acid, sleep disturbance, and dilation and/or constriction of certain blood vessels. Diuretic effects, causing increased urination. Withdrawal symptoms include headaches, fatigue, moodiness anddepression.

Legal aspects

The ICO council passedResolution 420(May 2004) which recommends voluntary targets for the minimum quality export standards for both arabica and robusta. The ICO’s Coffee Quality-Improvement Programme calls on producing members to endeavour to restrict the export of arabica coffee with more than 86 defects per 300 g sample or robusta coffee with more than 150 defects per 300 g. The Programme also asks members to endeavour not to allow arabica or robusta of any grade to be exported whosemoisture contentis below 8% or above 12. 5%.

For the coffee year October 2009 – September 2010 the ICO reported that 24 exporting members, accounting for nearly 59 million bags or nearly 60% of

all 2009/10 exports, provided information on the quality of the coffee they exported. Of these exports over 57 million bags (96%) were classified as being within the Resolution’s defects and moisture targets. The split arabica/robusta was 92% arabica and 8% robusta.

Coffee can be decaffeinated by the use of a solvent, water, or super-critical cardon dioxide.

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