# TVET CERTIFICATE V in FOOD PROCESSING

**Module Title:** **PERFORM COFFEE ROASTING**

**Code: FOPPC501** Make Roasted coffee

*Competence*

**Credits: 6**

**Learning hours**

**Sector: Agriculture and Food processing**

**60Hrs**

**Sub-sector: Food Processing**

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## Purpose statement

Coffee is the main Rwandan export commodity and the Rwandan government has been actively promoting coffee growing and processing through its various awarded coffee competitions. Coffee roasting adds more value to coffee but coffee roasting facilities are still very few in Rwanda. One of the reasons is insufficiency of skilled personnel in coffee roasting. The module on coffee roasting focuses on equipping the learners with practical skills in roasting coffee. The module is intended for learners who have successfully completed the certificate IV in food processing. At the end of the module, learners will be able to

Prepare materials and equipment, Receive parchment coffee, Perform green coffee bean hulling and polishing, Roast coffee beans, Grade and grind roasted coffee beans, Check the quality of coffee and Package coffee

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# Learning Unit 1 – Prepare tools, utensils, instruments and equipment

## LO 1.1 – Identify tools, utensils instruments and equipment materials for roasting

- **Topic 1 : Tools,utensils,instruments,equipments and materials**

✓ **Racks (Pallet Racking):** structural racks used for storing parchment coffee after reception.

✓ **Plucking tables:** is a table used to pull out the unwanted materials from the parchment coffee

✓ **Balances** (mechanical/electrical): used for weighing the parchment coffee

✓ **Conveyor:** is mechanical handling equipment that moves coffee beans quickly from one location to another.

✓ **Conveyor belts:** A belt conveyor system is powered types of convey systems with one or two rotating pulley (like drum) that transports coffee beans.

✓ **Hygrometer**: is an instrument used for measuring the relative humidity

✓ **Storage bins:** used for storage of parchment coffee after reception.

✓ **Dustless catador:** machine used for cleaning coffee after hulling by removing husk, coffee dust and other impurities.

✓ **Fan:** a device used for winnowing coffee beans by separating green coffee beans and chaff or other unwanted materials.

✓ **Picking table:** is a table used for hand picking during sorting of coffee beans.

✓ **Densimetric table:** Densimetric tables are designed to separate coffee beans based on density and are typically used for grading.

✓ **Smout peeler polisher: There are** used for polishing coffee beans

✓ **Destoner:** used for removing stones in coffee beans

✓ **Aspiration channel:** The aspiration channel is used in green coffee beans cleaning applications for separating specifically lighter particles from granular products. The aspiration air flowing remove specifically lighter particles such as straw, dust, or hull fragments.

✓ **Screen:** device used to separate smaller coffee beans from larger ones.

✓ **Strainers:** A device that is used to strain /sift fine chaff, husk etc away from larger

ingredients (green coffee beans).

- ✓ **Cyclone:** A cyclone separator is used to separate particulates, such as chaff, from roaster exhaust.
- ✓ **Colour sorter**: It is used for sorting green coffee beans by removing no green beans like yellow beans, black beans etc
- ✓ **Roaster: it is** used for roasting green coffee beans
- ✓ **Grinder**: It is a machine used for grinding roasted coffee beans in order to get coffee powder
- ✓ **Thermometer:** It is used for measuring the temperature during roasting.
- ✓ **Ventilators**: They are used to provide ventilation in work area and storage room
- ✓ **Pallets:** used to support packed ground coffee in storage room.
- ✓ **Packaging machines:** used to pack the coffee powder in packaging materials.
- ✓ **Paper bags**: They are used as packaging materials of coffee powder
- ✓ **Corrugated paper box:** Those are packaging materials of coffee powder
- ✓ **Vacuum sealer:** It is used for sealing the packaging materials after packing
- ✓ **Label:** It is a piece of paper which shows characteristics of a product it is representing. It contains information like name of the product, name of the company and its address, list of ingredients normally in descending order.

- **Topic 2 : Types of coffee roasters**

In total, there are five main kinds of coffee roasters, which coffee processors have used to deliver unique roasting tastes in coffee.

**These roasters include**:

- ✓ **Hot Air Roasters**
- ✓ **Drum Roasters**
- ✓ **Tangential Roasters**
- ✓ **Centrifugal Roasters**
- ✓ **Packed Bed Roasters**

**Hot air coffee roaster** :The hot-air type bake bean machine uses the blower to inhale the air, let the air rise through a heating coil to increase the temperature, and uses hot air as a heating source to roast the coffee beans. The hot air not only can provide the required temperature for baking, but also can utilize the airflow.

The power churns the coffee beans and kills two birds with one stone. **Advantages:** high thermal efficiency, fast heating, raw beans more uniform heating, easy to control. **Disadvantages:** Because the heating efficiency is high, it is easy to cause the heating up too fast, resulting in beans "cracking", and the heating is too high, it is easy to make the caramelization reaction is not enough.

**Flavour characteristics:** The acidity is obvious, the taste is relatively clean and simple, but the richness of the taste is not enough and the depth is lacking, and deep baking tends to produce a pungent taste.

**Drum roaster:** A drum roaster is a horizontal spinning drum through which heat is transferred either directly under the drum or through a conduit running through the centre. This method is a mix of conduction and convection. While it is easier to scorch beans this way, the drum capacity can be larger than in a fluid bed roaster, so this is a preferred machine for coffee shops. It is also a slower method Compared to air roasters, drum roasters roast more slowly, more like commercial machines and manual methods. Roast times will be in the range of 14 to 20 minutes. These machines offer great control over the time, temperature and roasting profiles. Generally speaking, the more expensive the machine is, the more features and control you get.

Depending on the machine, these machines will produce about 8 to 12 oz of roasted coffee per batch. Drum roasters tend to develop the body of a coffee while maintaining the brightness. They are also more durable then air roasters, as they do not require the high fan speeds that small air roasters do. Replacement parts are usually available from the manufacturers as well.

Fig1: **Drum roaster**

**Tangential roaster**: **Tangential roaster**: Specially developed, rotating shovels move and mix the coffee beans around the drum. The flow of hot incoming air transmits the heat onto the beans through convection. The combination of controlled roasting air and mechanically mixed coffee beans creates the perfect transition between the temperature of the bean's surface and its core. The flow of incoming air can be reduced to a minimum without affecting the movement of the coffee. The addition of water systematically ends the roasting process while simultaneously pre-cooling the roasted coffee.

The roasting times of the tangential roasters lie between 1.5 and 18 minutes. Also within shortest roasting periods perfect and reproducible results are achieved. Its flexibility makes the tangential roaster an all-rounder that roasts every coffee with the desired profile.

**The tangential roasters offer these and many other benefits:**

- Perfect roast of both whole beans and crushed coffee
- Uniform bean appearance and homogeneous roast through the application of heat via convection
- Reliable production from light to extremely dark roast colours
- Maximum range of density and volume for the produced roasted coffee
- The flexible adjustment of various key parameters makes it possible to systematically affect the coffee's flavour
- Rapid recipe changes
- Short heating-up time
- Emptying into the cooler in a matter of seconds
- Extremely rapid and uniform cooling, even with short roasting times
- Highly uniform colour and moisture level

**Centrifugal roaster**: In the centrifugal roasting technology, the beans aren't mechanically moved. The rotating roasting bowl creates a centrifugal force moving the beans upwards in the dish and positioning them into the main hot air stream. The roasted goods are well blended in a gentle and uniform manner thanks to the vertical rotational movement combined with an outer lamellar ring.

The centrifugal roaster achieves unique roasting results in the middle roasting time range. On the one hand, it offers a number of ways to influence the flavour, density and degree of extraction from the roasted coffee. On the other hand the thermal equilibrium which is reached quickly ensures that the bean-roasting process proceeds extremely gently.

The centrifugal roaster minimizes heat losses, saves a great degree of energy and is friendly to the environment while also automatically regulating the cooling time. The air volume can be reduced to a minimum, while the integrated roasting air circulation ensures an optimum balance of energy. The compact system also provides another advantage: small spatial requirement.

The distinguishing characteristic of the centrifugal roaster is the rotation of the roasting bowl which is equipped with a lamellar ring around the vertical axis. In this manner, the green coffee is mixed gently during the roasting process. Hot air is guided into the roaster through the centre of the bowl, and as a result, the heat is transferred evenly and the beans are roasted homogeneously. The result is a particularly uniform bean appearance.

In this context, the quantity of air needed for the roasting process can be reduced to an absolute minimum. The addition of water systematically ends the roasting process while simultaneously pre-cooling the roasted coffee.

**The centrifugal roasters offer these and many other benefits:**

- The special design of the roasting bowl ensures processing of a high range of coffee qualities
- The unique design of the roaster allows for unique roasting results in the medium roasting range
- Safe production from light to extremely dark roast colours

- Uniform bean appearance and homogeneous roast
- Gentle product handling during the roasting process
- Consistently reproducible coffee quality
- Maximum range of density and volume for the produced roasted coffee
- Rapid and flavour-preserving cooling.

**The packed –bed Roaster**: the coffee bed is pushed by the roasting air in a horizontal circle. This bed is kept tightly packed by centrifugal force throughout the roasting cycle. It is the centrifugal force acting in opposition to the air drag forces trying to fluidize the bed that permits air speeds to be increased within the bed. Increasing air velocity causes the bed to move faster, which then generates greater opposition to the increasing drag force. This, in turn keeps the coffee in its tightly packed bed.

The unique and critical important benefit deriving from this roasting method is that t he movement of coffee beans inside the roaster can be controlled. The packed bed is fairly thin (30 to 50mm) with a height and diameter determined by the required batch capacity. At the bottom, the packed bed has a smaller diameter so that as it spins it moves up the roasting chamber wall. When it reaches the top of the roasting chamber wall, it is redirected to the bottom of the chamber from where it resumes its upward course.

All of the coffee follows this path throughout the roasting cycle, repeating its course approximately every four seconds. The result is very controlled coffee movement achieving a uniquely even exposure of each bean to the roasting air.

In addition, the fluidised bed roaster is also used for large scale roasting of coffee beans for making instant coffee. The advantages of fluidised bed roasters are uniformity of product and better control of process parameters. However, these units pose problems when handling medium and small batches.

This has special advantages relative to the fluidised bed roaster when the particles to be roasted are large (about 5 mm) and tend to develop unstable fluidisation (slugging). Very good solids mixing and effective gas particle contact makes it possible to use higher temperature heating air for short periods (HTST) and to provide a clean, uniform roasted product.

- **Topic 3 : Source of Energy**

The heat source can be supplied by natural gas, liquefied petroleum gas (LPG), electricity, or even wood. The most common employ indirectly heated drums where the heat source is under the drum. Direct-fired roasters are roasters in which a flame contacts the beans inside the drum; very few of these machines are still in operation.

Hot-air roasters force heated air through a screen or perforated plate under the coffee beans with sufficient force to lift the beans. Heat is transferred to the beans as they tumble and circulate within this fluidized bed.

## LO 1.2 – Assembly equipment according to the catalogue

- **Topic 1: User manual**

✓ **Steps by steps**

The user manual of roasting machine steps by steps is found on the figure below

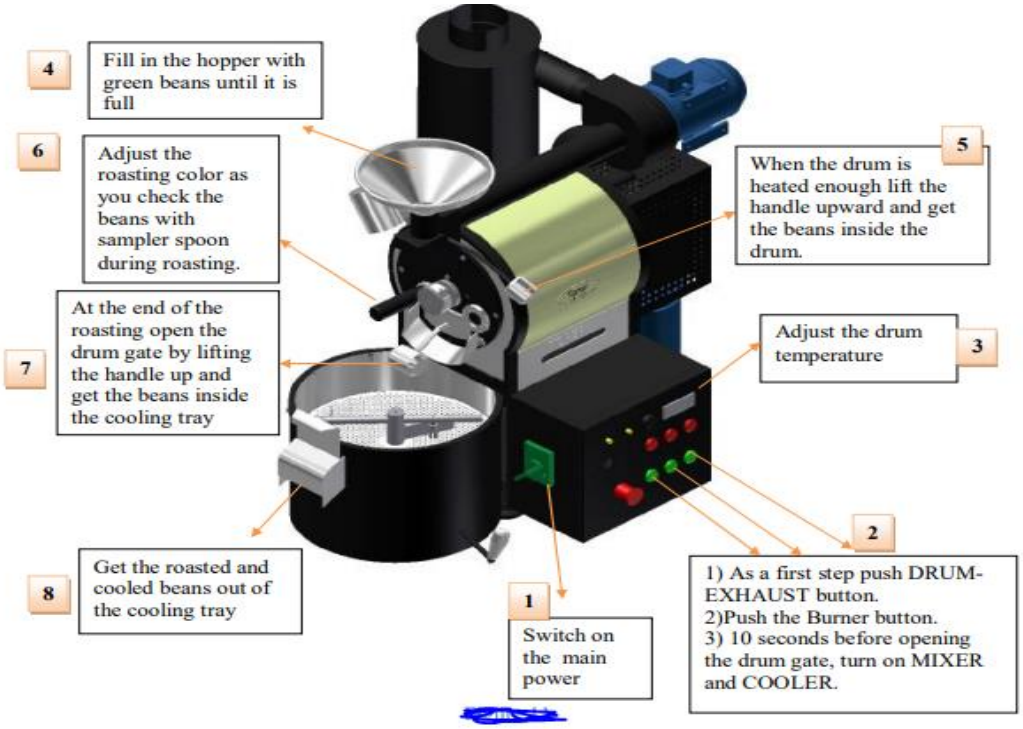

Fig2:**Machine desembling steps**

✓ **Adjustment of machine.**

The adjustment of roasting machine is found on the figure below

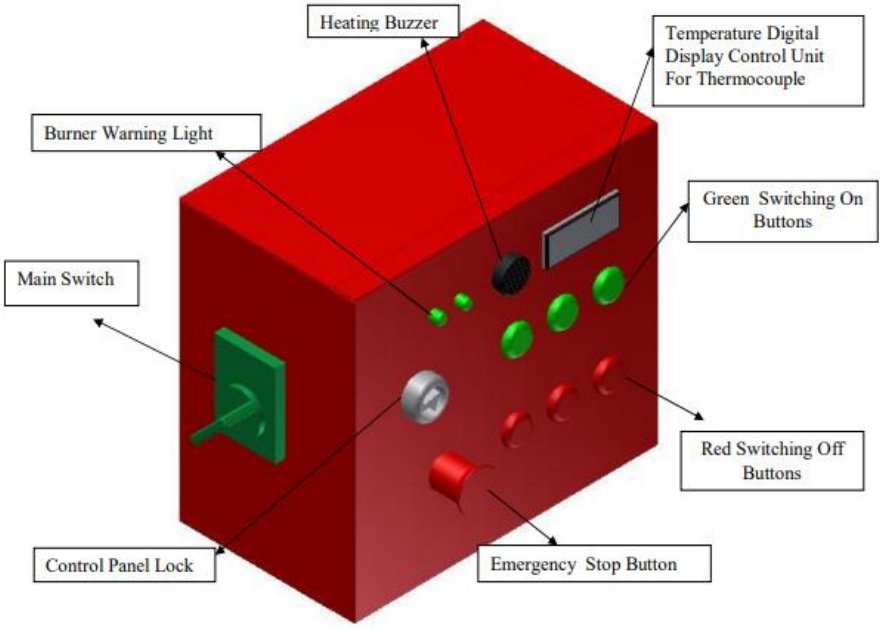


Fig3:**Machine adjustment**

- **Main Switch:** This is main switch for Control Panel. It's used for making on / off the Machine.
- **Emergency Stop Button:** When you push this button in case of an emergency all the activities will be stopped automatically on time.
- **Red Switching off Buttons**: They are used for switching off Drum, Exhaust, Burner and Cooler in order when you push any of them you would like to stop.
- **Green Switching on Buttons:** They are used for switching on Drum, Exhaust, Burner and Cooler in order when you push any of them you would like to start.
- **Digital Display Control Unit for Thermocouple**: It's used to set up a temperature which is also trying to keep it on the same level as you programmed.
- **Heating Buzzer**: It gives you beeping alert when the temperature reaches the value which you set up.
- **Burner Warning Light**: When the burner is on mode these light shows that the burner has temperature

- Topic 2 : Different parts of roasting machine

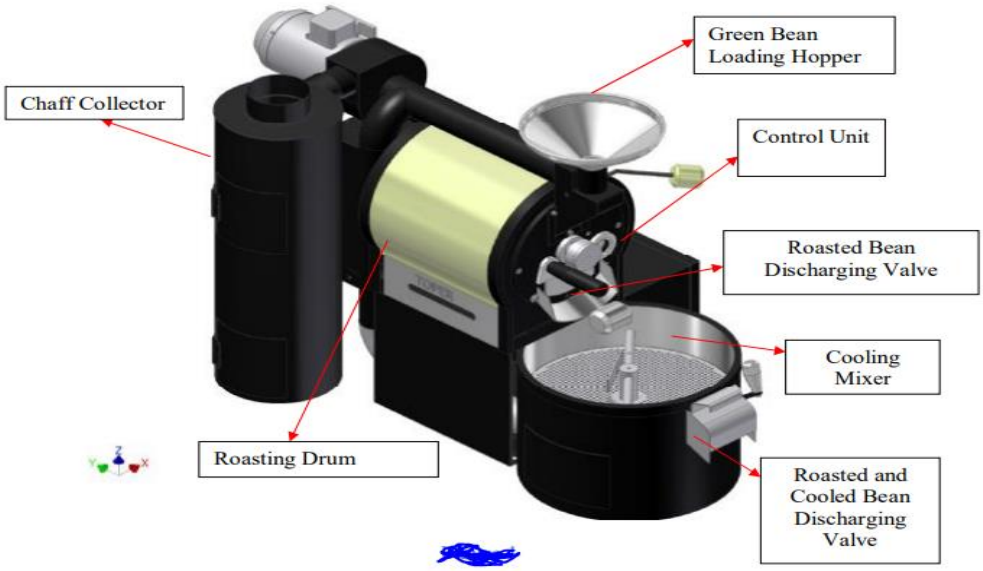


Fig4:**Roaster paarts**

- **Bean insertion**: Green beans are inserted through the loading Hopper.
- **Roasting chamber**: it is supplied with a green coffee feed hopper. It holds one batch of green coffee for charging into the roast chamber at the start of each roast cycle. The hopper is equipped with a receiver for connection to a coffee air conveyor pipe and vent for conveying air.
- **Cooling part**: A water tank is supplied for holding one charge of water for quenching and cooling coffee at the end of the roast cycle. The tank has an adjustable level switch for setting the amount of water that will be charged into the tank.

  The advantages deriving from roasting at lower temperatures have actually been acknowledged for a very long time: less "tipping," more even roasting, and better bean development. High performance roasting (i.e., operating with extremely low temperatures and very short roast times) minimizes thermal destruction and loss of valuable volatiles.

# Learning Unit2:Prepare green coffee beans

## LO 2.1 – Receive parchment coffee

- Topic 1 :Quality parameters

✓ **Moisture content**:

The ideal moisture content of green coffee beans for roasting ranges between 9 and 12% of moisture content

If green coffee has humidity greater than 12%, it's an indicator that it wasn't properly dried or stored.

Moisture content can not only affect the development of mould and presence of pests, but can also impact roasting and sensory profile of the final coffee. Even if a bag appears to have the right level of moisture, without using a meter to test a representative sample.

- ✓ **Defect**: **Quakers**:

Coffee seeds that don't properly react during the Mallard stage of roasting. Even at a relatively dark roast, quakers will stand out with their pale orange or khaki appearance, and when ground emit a rancid toasted peanut aroma. These pesky defects are acknowledged to be predominantly the result of under ripe coffee.

Under ripe green seeds will often curl at the edges giving them a "boat-shaped" appearance. While it's possible to eliminate some underdeveloped seeds in floatation tanks prior to pulping or in grading channels after fermentation, it's far more effective to remove under ripe cherries while it is visibly apparent, before processing begins.

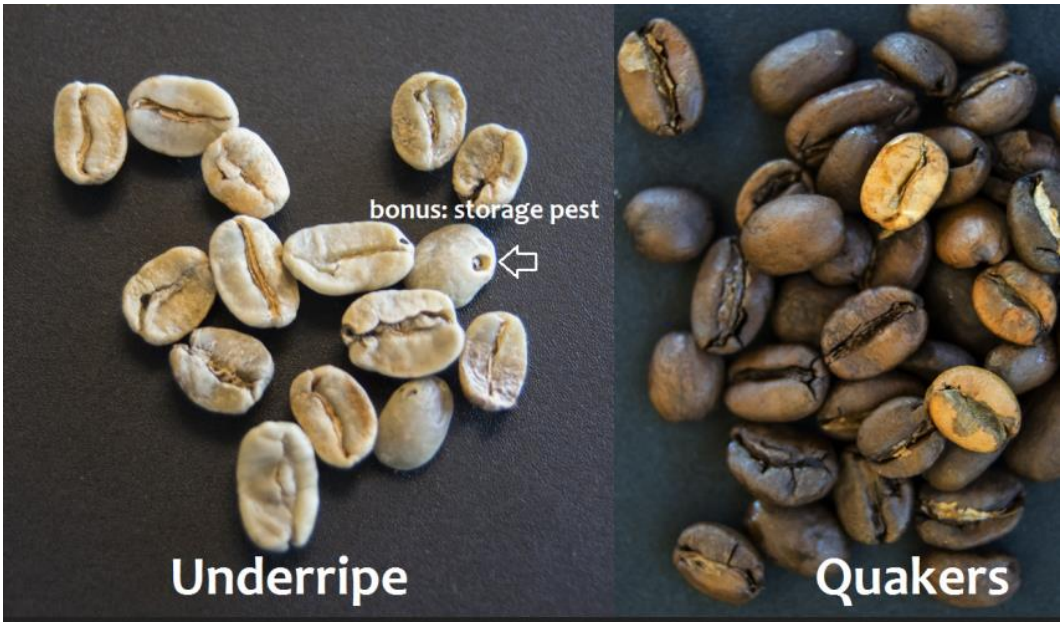

Fig5:**Different characteristic of cofee**

- **Topic 3 : Corrective measure**

Re-drying: coffee whether wet or dry processed, arriving from farms and activities for hulling is not always sufficiently dry, and it is often necessary to dry certain batches further. Apart from providing storage stability, a uniform moisture content of 11% enables husk and parchment to be removed more easily.

## LO 2.2 – Hull and polish parchment coffee

- **Topic 1: Purpose of hulling and polishing**

Hulling is the process which is done after receiving the parchment coffee in order to remove the thin tough parchment layer from the coffee beans.

The dried coffee beans are surrounded by film known as “parchment”. Once the grains are dry, we make them last in a machine to be peeled to withdraw the parchment and to release the green grain of coffee.

In the wet method the dried coffee beans have a parchment covering while in the dry method, the beans are covered with the husk. These are removed in a mechanical operation known as hulling. The hullers usually rotate at a speed of 450 – 800 rpm. Higher speeds result into a polished appearance but also increase the breakages. Hulling is done with the help of machines, which can range from simple millstones to sophisticated machines that gently whack at the coffee.

Coffee hulling is an optional step in coffee production because some coffee beans are sold "in parchment" (or "en pergamino"). It occurs in the late stages of coffee processing. The coffee milling process is of different steps including hulling, polishing, cleaning and sorting, and grading.

**Coffee hulling aims at:**

- ✓ Removing the parchment skin (also called "pergamino") from the coffee bean
- ✓ Transforming dry fruits into green coffee
- ✓ Ensuring the best possible flavor

Coffee polishing is an optional process in which any silver skin that remains on the beans after hulling is removed in a polishing machine

**Coffee polishing aims at:**

- Improving the appearance of green coffee beans
- Eliminating a by product of roasting called chaff.
- It is described by some to be detrimental to the taste. By raising the temperature of the bean through friction which changes the chemical makeup of the bean.

- **Topic 2 : Hulling and polishing process and techniques**

✓ **Coffee hulling process**

After drying the coffee should be rested for 8 hours in a well ventilated place. The thin parchment around the coffee is removed either by hand, in a pestle and mortar or in a huller. Hulling may or may not remove a final layer closest to the beans, called the silver skin. If removal of silver skin is required, it may require separate equipment following hulling, called polishers.

The mechanism used by the huller machine is simple, with the coffee being fed through the hulling cylinder and filtered through the perforated screen using cross beaters. This helps to reduce the friction between beans and to restrict the generation of dust, thus resulting in minimum loss of product due to breakage

- **Hulling techniques**

The two basic types of coffee hulling consist of wet and dry hulling. Each process is the same, but also can be very different.

✓ **Wet hulling**:

The parchment layer of the coffee, which is also known as the endocarp, is removed when the coffee is wet.

✓ **Dry hulling**:

This is a process that entails removing the husk once it is dried.

- **Coffee polishing process**

Polishing is an optional process where any silver skin that remains on the beans after hulling is removed by machine. Polished beans are considered superior to

unpolished ones. The polishing process is carried out in order to bring forth the beautiful deep colour of the roasted coffee bean.

- **Topic3 : Husk separation methods**

✓ **Sieving**:

Sieving is a centuries-old method of separating coarse particles from finer particles as they pass through a fine screen.

**The sieving machine is found on the figure below**

Fig 6:**Cofee husker**

✓ **Aspiration**:

After hulling and polishing, the remaining residues or chaff are removed by using some machine like Fan for winnowing, Aspiration channel by flowing air into green coffee in order to remove specifically lighter particles such as straw, dust, or hull fragments. Aspiration is thus one of method used for husk separation.

- **Topic 4 : Characteristics of hulled green coffee beans**

✓ **Appearance**:

The appearance of hulled coffee beans is concerned with their different colours but the acceptable hulled coffee beans fall into one of the colour categories.

- Grayish-blue
- Grayish-green
- Brownish-gray-green
- Brownish-green
- Brown

✓ **Smell**:

The hulled green coffee beans have the greenish smell. It can either be sensed nasally via smelling the coffee through the nose.

- ✓ **Density**:

  The scientific community is fond of observing density in terms of lbs/ft$^3$ (pounds per cubic foot) or kg/m$^3$ (kilograms per cubic meter), It is widely expressed in g/l. Density is a measurement of the amount of something (coffee, in our case) that can fit in a given 3-dimensional space, mathematically expressed as mass divided by volume.

  There are a number of ways to measure density; the simplest is to use a graduated cylinder. The density measurement of a coffee at 0.64 g/mL is relatively low density, while my measurements of 0.67 g/mL are fairly average and anything above 0.69 g/mL it is considered to be pretty dense.

  Graduated cylinder on the figure measure the density

  Fig7: **Graduated cylinder for mraesuring density**

- ✓ **Moisture**:

  Ideal moisture content of hulled green coffee beans ranges between 9% and 12percent.

  If it falls below 9% moisture content, the hulled coffee beans will lose its weight whereas if the moisture content is above 13%, the hulled coffee beans will require further drying.

  Green coffee that is high in moisture (greater than 12 percent wet basis) can deteriorate due to bacteria, mould, or yeast, especially if the seed is killed. If the

seed remains alive in any case, the parchment coffee moisture level should be lowered to below 12 percent soon after harvest. When the ambient relative humidity is about 70 percent, coffee beans will gradually equilibrate to about 12 percent moisture.

Thus green bean coffee is generally dried to 12 percent, and bought and sold at this moisture percentage. If the bean dries to below 9 percent moisture, it will shrink enough to become distorted or deformed, which will give the appearance of low-quality coffee.


Fig8:Moistermeter

## Learning Unit 3 – Roast green coffee beans

### LO 3.1 – Sort green coffee beans

**Coffee beans sorting aims at:**

- ✓ Elimination of defective beans and the foreign bodies: stones, end of wood, fragments of husks and parchment etc
- ✓ Regulating the homogeneity of the coffee beans before it is roasted

- **Topic 1 : Sorting parameters**

- ✓ **Defects**: **Main Defects of Green Coffee.**

**1. Colour defects**

**1.1. Black beans***: Any* bean which is at least half-black on the outside or inside is called a black bean. This is considered to be the main defect of green coffee, and is used as a standard in inspection tests. Recently, however, stinker (see aroma defects), beans have become more common in batches of certain origins, depreciating their value considerably.

Black beans make the beverage taste bitter, disagreeable, and render it generally undrinkable.

The reason for this defect is attributed to prolonged fermentation of cherries picked from the ground, which then undergo a poor drying process with intermittent periods of wetting. The presence of black beans is rare in wet processing, except where the cherry has been harvested from the ground, or if there are still some beans left from previous operations in the fermentation tanks and poorly cleaned washing channels.

**1.2. Greyish or dark grey beans***:* There are several reasons for this colour: harvesting before the beans are ripe, initial fermentation of cherries in the heap, poor drying or repeated spells of wetting if stored under poor conditions, etc. Beans of this colour are classified as undesirable.

**1.3. Foxy beans:** These have red colouring which is essentially due to artificial drying which has been overdone. Reasons for this include high drying temperature, drying period extended over a long time, or the beans not having been sufficiently mixed. It may affect the tissues to varying depths. If the colouring is very superficial, it could be the result of excess fermentation coupled with loose pulp. In some cases it has been attributed to the adherence of a thin film of reddish soil from the drying area during hulling, if the soil has high clay content.

**1.4. Coated or murram-coloured beans:** this colouring is imparted to the bean by the presence, either wholly or partially, of the skin. It is a defect of minor importance, except for extremely high quality Arabicas.

**1.5. White, opalescent, and glassy beans***:* these are generally beans that have been insufficiently dried or have reabsorbed some moisture, within which internal enzyme reactions often appear. These beans are less dense than a healthy bean of the same volume. Glassy beans are the result of artificial drying using too high a temperature at the beginning, resulting in a rapid release of water vapour. They are considered undesirable.

***1.6.*** **Blotchy and spotted beans***:* Blotchy beans have spots of various colours due to incomplete or irregular drying. Spots appear on the beans due to the effect of oxidising agents, which are present on the surface tissues following injuries. These

develop particularly during the preparation of beans, often during hulling, but certain lesions are induced by pest or disease infections.

Poor fermentation or the use of water with high iron content (formation of black precipitates with the tannin from beans) for wet processing can also give rise to spots. The presence of whitish spots reveals poor drying or the initiation of germination resulting in enzymatic reactions.

**2. Defects in the aroma and taste**

**2.1. Stinkers:** When these beans are cut, they release a putrid, nauseating odour, which is also rather volatile and this odour will have disappeared after a few hours. As the appearance of these beans is no different or only slightly different from that of healthy beans, it is very difficult to distinguish them. Unfortunately, their bad odour becomes apparent during roasting and the presence of a single stinker in a cylinder is enough to contaminate its entire contents. The taste comes through in the beverage and produces undrinkable coffee.

It has now been established that stinkers are caused either by excessively long fermentation or the use of unclean water. If it is a matter of only a few beans in batch, the reason may be that the fermentation tanks or washing channels have been poorly cleaned and all the beans from the preceding operation were not removed.

**2.2. Rancid or acid beans:** These beans have a rather dark brown colour and give off a disagreeable odour when cut. They are the result of poorly managed, excessively long fermentation and their defects are discernible in the beverage.

**2.3. Musty beans:** These beans are either partially or totally covered with mould. They give off a characteristic odour, which does not disappear after roasting and is transmitted to the beverage. The presence of a few musty beans in a batch is enough to contaminate the total contents. It is usually the result of incomplete drying, or the re-absorption of moisture in the storage areas or during transport (wet bags).

***2.4.*** **Rio flavoured coffee***: A* slightly medicinal aroma is characteristic of certain coffees from the regions of Rio and Victoria in Brazil, due to the metabolic activity of bacteria in the soil, which produce an iodised substance which is absorbed by

and transported within the coffee tree by the sap. However, it is not always regarded as a defect, as this very specific flavour is appreciated by some consumers, mainly in regions of Northern France.

**3. Other abnormalities**

**3.1. Broken beans:** The beans become broken due to inadequate adjustment of the pulping equipment or hullers, or an excessively rapid rotation of the cylinders during pulping. Breakages most frequently occur during hulling when the coffee is too dry. Broken beans adversely affect the appearance of the batch, but more importantly they roast faster than whole beans, and tend to become charred. Their presence therefore has a negative effect on the quality of the beverage.

**3.2. Crushed beans:** These are rather flat beans, the median furrow of which has been laid open. Unlike broken beans, crushed beans are the result of processing insufficiently dried coffee.

***3.3.*** **Pitted beans:** The surfaces of beans which have been infested by insects are more or less riddled with small, round holes such as those produced by the berry borer. Cutting them open reveals the pores bored by the insect.

**3.4. Elephant beans:** These are large, deformed beans, consisting of several embryos enveloping the endosperm. Within a batch, they upset the uniformity of the bean size and are also a problem during roasting.

✓ **Foreign matter***:* Impurities such as twigs, leaf debris and wood fragments are very rarely found in well-prepared coffees. Mostly encountered is:

- Soil and dust (transported by the wind during drying);
- Small stones (careless harvesting, drying on packed earth);
- Pulp (poorly executed pulping) or parchment debris (incorrect adjustment of the huller's fan)
- Beans are still in parchment (faulty huller operation) or dry cherries are presented (great variation in the size of the cherry, huller poorly adjusted).
- Twigs and pieces of branches are also common.
- The presence of soil and other related debris is revealed by handling the beans and observing the marks that they leave on the skin. It is easy to eliminate these impurities by passing the beans through a winnowing machine.

Pulp debris (skins) depreciates the value of the coffee, especially Arabica. The skins resemble large, dark brown fragments and give the beverage a bad taste.

Parchment debris is mostly small and very fragmented and eliminated by use of a winnowing machine.

- Presence of whole parchment coffee beans or whole dry cherries is considered as a major defect because they give the green coffee a disagreeable appearance and are harmful to the roasting process.

✓ **Maturity level of green beans**: Droughted beans are an abnormality related to processing of immature coffee cherry. These arise from cherries that have been harvested several weeks before they are ripe. Amongst the many known reasons for the deterioration of the quality of coffee, the high percentage of unripe beans in the batches is a major factor. Farmers should be discouraged from harvesting unripe beans.

- **Topic 2 : Sorting methods and techniques**

The green coffee obtained is then sorted according to size, density and colour. However there are two methods of sorting green coffee beans that are sieving and hand-picking or manual sorting.

✓ T**he Bean size sorting**

**The bean size classifications are because of the following reasons:**

- roasting should be carried out with beans of the same size, otherwise the smallest are burned while the larger beans are insufficiently roasted,
- subsequent sorting operations are simplified
- a higher price is paid for large beans
- Finally, defects are concentrated in inferior grades.

✓ **Density sorting**

Green coffee at this stage will still include dust and other light particles, together with beans of light density, or which are deformed, discoloured or insect-attacked. Separation is carried out by use of vibrating screens or a Catador. The Catador is

based on the principle of pneumatic separation by the use of an upward current of air created by a radial blade fan rotating at about 550rpm within a vertical chamber and can separate the beans into two categories, heavy and medium heavy, from other material.

✓ **Electronic colour sorting**

This final sorting operation is to separate beans with an undesirable colour, such as black, white or brown beans.

Manual sorting which is tedious and labour intensive is being increasingly replaced by electronic sorting using photoelectric cells.

**Electronic sorters are capable of eliminating:**

- Black beans, which give a bitter, unclean and pungent taste,
- Foxy beans with a rum, sour, unpleasantly fruity taste,
- White beans with a flat, woody, sometimes sour and grassy taste.
- Stinker beans

- **Topic 3 : Centrifugation**

Centrifugation is the technique which involves the application of centrifugal force to separate particles from a solution according to their size, shape, density, viscosity of the medium and rotor speed. Most fine coffee goes through a battery of machines that sort the coffee by density of bean and by bean size, all the while removing sticks, rocks, nails, and miscellaneous debris that may have become mixed with the coffee during drying.

First machines blow the beans into the air; those that fall into bins closest to the air source are heaviest and biggest; the lightest (and likely defective) beans plus chaff are blown in the farthest bin. Other machines shake the beans through a series of sieves, sorting them by size. Finally, an ingenious machine called a gravity separator shakes the sized beans on a tilted table, so that the heaviest, densest and best vibrate to one side of the pulsating table, and the lightest to the other.

## LO 3.2 – Grade green coffee beans

- **Topic 1: Method of grading**

- ✓ **SCAA: Specialty Coffee Association of America. Speciality Coffee Association of America (SCAA) Green Coffee Classification**

  The green coffee classification standard provided by the SCAA is an excellent method to classify coffees. It is superior over some systems in that it better accounts for the relationship between defect and cup quality. However, it leaves out a few of the important defects that can occur in coffee.

  To classify a coffee, 300 grams of properly hulled coffee is classified according to the standards given below. 100 grams of this coffee is sorted using screens 14, 15, 16, 17, and 18. The coffee remaining in each screen is weighed and the percentage is recorded. Since classifying 300 grams of coffee is very time consuming, 100 grams of coffee is typically used. It is recommend that if the coffee is of high quality with few defects to use 300 grams. If the coffee is of a lower quality with many defects 100 grams will often suffice in a correct classification as either Below Standard Grade or Off Grade. The coffees then must be roasted and cupped to evaluate cup characteristics.

- **Speciality Grade (1):** Not more than 5 full defects in 300 grams of coffee. No primary defects allowed. A maximum of 5% above or below screen size indicated is tolerated. It must possess at least one distinctive attribute in the body, flavour, aroma, or acidity. It must be free of faults and taints. No Quakers are permitted. Moisture content is between 9-13%.
- **Premium Grade (2):** No more than 8 full defects in 300 grams. Primary defects are permitted. A maximum of 5% above or below screen size indicated is tolerated. It must possess at least one distinctive attribute in the body, flavour, aroma, or acidity. It must be free of faults and may contain only 3 quakers. Moisture content is between 9-13%.
- **Exchange Grade (3):** 9-23 full defects in 300 grams. It must have 50% by weight above screen size 15 with no more than 5% of screen size below 14. No cup faults are permitted and a maximum of 5 quakers are allowed. Moisture content is between 9-13%.
- **Below Standard Grade (4):** 24-86 defects in 300 grams.
- **Off Grade (5):** More than 86 defects in 300 grams.

**Primary Defects**

| Primary Defect | Number of occurrences equal to one full defect. |
|---|---|
| Full Black | 1 |
| Full Sour | 1 |
| Pod/Cherry | 1 |
| Large Stones | 2 |
| Medium Stones | 5 |
| Large Sticks | 2 |
| Medium Sticks | 5 |

**Secondary Defects**

| Secondary Defects | Number of occurrences equal to one full defect |
|---|---|
| Parchment | 2-3 |
| Hull/Husk | 2-3 |

| | |
|---|---|
| Broken/Chipped | 5 |
| Insect Damage | 2-5 |
| Partial Black | 2-3 |
| Partial Sour | 2-3 |
| Floater | 5 |
| Shell | 5 |
| Small Stones | 1 |
| Small sticks | 1 |
| Water Damage | 2-5 |

✓ **Brazil/ New York method**

In the Brazilian method 300 grams of coffee is classified. The number of beans equivalent to one full defect is given below. For example every three shells counts as one full defect. On the other hand one large rock counts as five full defects. If a bean has more than one defect the highest defect is counted. For example an insect damaged black bean counts as one full defect. The table is split up into two since Brazilian legislation allows a maximum of 1% of foreign defects. After counting the number of defects uses the third chart to classify the type and its point rating.

| **Intrinsic Defect** | **Number** | **Full Defects** |
|---|---|---|
| Black bean | 1 | 1 |
| Sour (Including | 1 | 1 |

| | | |
|---|---|---|
| stinker beans) | | |
| Shells | 3 | 1 |
| Green | 5 | 1 |
| Broken | 5 | 1 |
| Insect Damage | 5 | 1 |
| Mal-formed | 5 | 1 |

| **Foreign Defect** | **Number** | **Full Defects** |
|---|---|---|
| Dried Cherry | 1 | 1 |
| Floater | 2 | 1 |
| Large Rock or Stick | 1 | 5 |
| Medium Rock or Stick | 1 | 2 |
| Small Rock or Stick | 1 | 1 |
| Large Skin or husk | 1 | 1 |

| | | |
|---|---|---|
| Medium Skin or husk | 3 | 1 |
| Small Skin or husk | 5 | 1 |

- **Topic 2 : Grades specification**

**Grading** is the separation of beans according to size, shape and density. The coffee bean has three dimensions: length, width, and thickness. It is usually oblong, fairly flat, and boat shaped. However, peaberry has an elongated oval shape. Although round perforations are sufficient to separate most beans, peaberry requires oblong slots.

A flat bed grader and a drum grader separate the beans according to size, and pneumatic separators, often called catadors, grade the beans by density.

The hulled coffee beans are separated according to size with mechanical graders. The peaberry type beans are also separated from the flat beans. Grading by size will indirectly determine the quality, because the most imperfections are found in the smaller grades.

To raise the quality of size-graded green coffee, various procedures are used to separate out the imperfections. Various types of machines are used to cull out the lighter and heavier beans, but air separators are most common. Imperfections such as sour beans and black beans cannot be separated by specific gravity differences, but electronic optical sorters can separate the coffee according to colour.

After hulling and grading the coffee, it is bagged and shipped. Coffee is usually not roasted before long-distance shipping, because roasted coffee will not store as long as green coffee. However, one-way gas valves on foil bags have greatly increased the shelf life of roasted coffee. Green coffee can be stored for several years if storage conditions are cool and dry.

- **Density**: Coffee is graded based on size and weight. They are also sorted pneumatically by using an air jet to separate heavy from light beans.
- **Size**: Beans are sized by being passed through a series of screens with holes that only allow a certain size of beans to pass through.

  There are 5 grades determined by bean size:

| | |
|---|---|
| Grade0: | beans held back by screen No. 18 (7mm holes) |
| GradeI: | beans passing through screen No. 18 and held back by screen No. 16 (6.3 mm holes) |
| GradeII: | beans passing through screen No. 16 and held back by |

| | |
|---|---|
| | screen No. 14 (5.5 mm holes) |
| GradeIII: | beans passing through screen No. 14 and held back by screen No. 12 (4.7 mm holes) |
| GradeIV: | beans passing through screen No. 12 and held back by screen No. 10 (4mm holes) |

- **Topic 3 : Coffee blending**

**Purpose of coffee blending**

To reduce costs, to provide a consistent cup profile and to create unique, signature coffees.

This is done by blending superior beans of different origins and characteristics, and the greatest homogeneity in taste and aroma is reached if blending is performed before roasting.

In blending, the taste is a matter of personal preference; this is certainly true when it comes to coffee.

Economically, blending coffees makes sense for large commercial roasters, who frequently combine cheaper coffees with more expensive specialty beans to reduce the cost of their offerings. Consistency is also of particular importance to large roasters and distributors. Customers expect a brand of coffee to taste the same from one cup to the next. Since qualities like body and flavour can differ markedly between farms, regions and even harvests from the same farms, the only way to ensure consistent flavour is to blend coffees from several different regions in order to minimize the differences among them.

**a) Blending for a stable taste**

To produce the desired flavour, various coffee varieties are blended together. The principal aim in blending coffee is to arrive at a flavour and aroma which can be continually reproduced. The blender uses recipes which have already proven that they meet the taste criteria of a certain region. Coffee is a natural product, and given that the quality of the harvest is unstable, the recipes for blends must be regularly adjusted.

**b) First blend, then roast**

As a rule, different coffees are combined while still raw; to produce what is referred to in the trade as 'blends'. A very small number of roasters prefer to blend their coffees after roasting. Four or more different varieties are necessary in order to achieve the particular flavour required because only by blending can the natural fluctuations in quality amongst the different varieties be compensated for.

## LO 3.3 – Roast green coffee beans

The green coffee beans must be roasted to develop the typical coffee aroma and flavour.

- **Topic 1 : Roasting conditions**

✓ **Temperature**: Temperature must be recorded to prevent the over roasting or under roasting of green coffee beans. It is measured by using thermometer. The dry coffee beans are heated to temperature of 200-250$^0$C.

✓ **Time**: This is measured by the timer or chronometer. The roasting time is also crucial in coffee processing. The roasting time of dry coffee beans ranges between 15-20 minutes. The duration of roasting depends on the taste and the source of the grains.

- Topic 2 : Roasting parameters

✓ **Colour:** The colour of coffee beans changes to yellow which gradually deepens in colour as the cooking process go on.

✓ **Flavour:** The colour and flavour of the coffee beans will be influenced by the length of roasting, for example, light brown beans ( a light roast) will have a weaker flavour than brown/ black beans ( a dark roast).

✓ **Size**: As the coffee is heated they shrivel until half cooked, then swell, and begin to open out as they increase in size.

Furthermore, Roasting coffee makes the chemical and physical properties of green coffee beans into roasted coffee products as the green coffee beans are quickly brought to high temperatures.

The main physical changes in coffee beans during roasting are:

The loss of weight mainly due to the water evaporation and release of certain heavy gases as $CO_2$, which causes the beans to swell, increasing its volume by about 60%.

Increased volume is accompanied by the change in structure of the bean, which become more elastic more brittle (which make it easier to grind).

Its colour changes from green to brown through the caramerization of sugar and other carbohydrates and the formation of certain pigments substances produced by chemical reactions known as Strecker's reactions.

The main chemical changes during coffee roasting are:

The chemical changes concerning the presence of some groups of substances that vary before and after roasting and the formation of new compounds.

The explosion of a limited number of cells causes rather popping sounds when the coffee is thus said to be squeaking

When the cell wall splits through too much pressure, gas is released as well as volatile aromas, this explains why, when increasing of the final temperature of the roast, up to a certain point the aromas increase and then diminish.

Not only does the aroma vary according with the temperature but also the corresponding degree of bitter and acid taste: bitterness increases with the temperature whereas the acidity diminishes

The most delicate stage in roasting process is the final stage: Above $200^0$C the chemical reactions, higher to endothermic (heat absorbing) become exothermic (heat producing). The increase in temperature of coffee therefore becomes more rapid.

- Topic 3 : Roasting methods and techniques

✓ **Manual coffee beans roasting**: Coffee beans can be roasted in a saucepan as long as they are continually stirred. A small improvement is made by roasting the coffee in sand, as this provides a more even heat.

✓ **Automated coffee beans roasting**: Coffee beans can be roasted in a roaster which will produce a higher quality product. The simplest roaster is basically a tin can with a handle so that it can be rotated slowly over a fire. There are various other roasters suitable for larger scale units

- Topic 4: Characteristics of roasted coffee beans

The different types of roasts include the light roast, the medium roast and the dark roast.

**Very light roasts**: Light brown in colour. There will be no oil on the surface of these beans because they are not roasted long enough for the oils to break through the surface. Roasting at $200^0$C, lose 11-12% weight and contain acid taste and less aroma.

These are

✓ Light City

✓ Half City

✓ Cinnamon

**Light roasts**: This is medium is brown in colour with stronger flavour and a non-oily surface. It is often referred to as American roast because it is generally preferred in the United States. Roasting at $220^0$C, lose 14-15% weight of weight, it has better aroma, less astringent and acidic cup.

- ✓ City
- ✓ American
- ✓ Breakfast

**Medium dark roast**: It is of rich, dark colour. This roast has some oil on the surface and with a slight bitter sweet after taste. This has an optimal quality. Roasting at $230^0$C, lose 16-20% weight.

- ✓ Full City

**Dark roast**: This roast produces shiny black beans with an oily on the surface and a pronounced bitterness. The darker the roaster, less acidity will found in the coffee beverage. Roasting at $240^0$C, lose 21-23% weight. It has a dark colour and good taste.

- ✓ High
- ✓ Continental
- ✓ New Orleans
- ✓ European
- ✓ Espresso
- ✓ Viennese
- ✓ Italian
- ✓ French

The table below summarizes the different types of coffee roasts

| **Temperature $^0$C** | **Roast** | **Weight loss %** | **Cup quality** |
|---|---|---|---|
| 200 | Very light | 11-12 | Acid taste, less aroma |

| | | | |
|---|---|---|---|
| 220 | Light | 14-15 | Better aroma, less astringent, acidic cup |
| 230 | Medium | 16-20 | Optimal quality |
| 240 | Dark | 21-23 | Dark colour, good taste |

## Learning Unit 4 – Coffee cupping and packaging

The objective of a proper grind is for efficient extraction of the roasted coffee soluble, volatiles and to get the most flavor and aroma in a cup.

### LO 4.1– Grind roasted coffee beans

- **Topic1: Grinding methods**

✓ **Manual grinding:** Manual grinding is performed by the manual grinders which are preferred by a lot of folks who want to get more intimate with the coffee-making experience. The manual coffee grinding is found on the figure below:

Fig9:**Coffee grinder**

There are a few benefits to hand grinders over electric units:

- ✓ **Ground control:** Coffee grind size is imperative to the quality of the brew. It is just known that with a manual grinder, the grinding size is personally controlled.
- ✓ **Price range:** Manual grinders are *cheap* and effective as can be.
- ✓ **Versatility:** These are ultra-portable, so they can be brought with you on a camping trip if you need that fresh coffee when you wake up. They can also be brought when travelling and staying in hotels
- ✓ **Reduced Noise:** The grinders go off and it sounds like it is in a plane hangar.
- ✓ **Electrical grinding:** They are responsible for that great-tasting cup of coffee you get each morning on your way to work and save immense amounts of time if you're brewing at home. **The electrical coffee grinding is found on the figure below:**


Fig10: **Electrical coffee grinder**

**The mains benefits of electrical grinder.**

- ✓ **Save time:** It takes an average of seven seconds for an electric grinder to produce a full brew basket of coffee grinds (3.30 oz), but it can take up to thirty seconds to get a good grind with a manual coffee maker.
- ✓ **Less cleaning:** electric grinder is cleaned out once a month to retain optimal performance, but manual grinders need daily cleaning.
- ✓ **Lasts longer than manual units:** manual units undergo varying amounts of physical stress. An electric grinder could last in a whole decade, but it should be hard-pressed to find a manual unit that will last that long without needing burr replacements every six to twelve months.

- Topic2: Specification of coffee powder

There two main of coffee powder specifications that are coarse and fine


Fig11:**Cofee powder specification**

- ✓ **Coarse**: coarse grinds are better for filter methods. Dark roasts, however, always yield more "fines" than lighter roasts.
- ✓ **Fine**: fine coffee powder and **coarse** coffee powder is coffee grind size matters. The length of time the grounds will be in contact with water determines the ideal grade of grind generally, the finer the grind, the more quickly the coffee should be prepared.

  **In addition, the size of the grind is hugely important to the taste of the coffee:** If the coffee tastes bitter, it may be over-extracted, or ground too fine. On the other hand, if the coffee tastes flat, it may be under-extracted, meaning grind is too coarse.

- **Topic: Types of grinders**

- ✓ **Blade grinder**: with a blade in the centre of the grinder that looks like a propeller, similar to a blender blade. Blade grinder is inexpensive but produces a very inconsistent particle size. The fineness of the grind is determined by how long the grinder is operating via a built in timer. The longer it grinds the finer the coffee becomes.

Fig12: **Blade grinder**

- ✓ **Burr grinder:** it is made up of two revolving abrasive surfaces called burrs, in between which the coffee is ground, a few beans at a time. It is a manual coffee grinder. They are **flat** burr grinder and **conical** burr grinder but they do the same thing. The burr grinder is an excellent device.

Fig13: **Burr grinder**

However, Conical Burr Grinders have two cone shaped burrs with ridges that grind/crush the coffee whereas Flat Plate Burr Grinders have two identical and parallel rings that are serrated on the side that faces the other. Both burr grinders have one stationary burr while the motor turns the other. The beans are drawn in between the two burrs and crushed into a uniform size. Both types of grinders are known for their flexibility and quality.

## LO.4.2. Check the quality of roasted coffee

- Topic1:Brewing steps

- ✓ **Water boiling**: The use of water is very important to the quality of the coffee. It is better to use filtered or bottled water as the tap water is not good or has a strong odour or taste, such as chlorine.

When brewing coffee with water, it is avoided to use distilled or softened water as the distilled water is water that has been boiled to remove impurities, but also

beneficial minerals. It is not a great choice for coffee as the minerals can enhance the flavour.

Water temperature should maintain at water boiling point. Colder water will result in flat, under-extracted coffee, while water that is too hot will also cause a loss of quality in the taste of the coffee.

- ✓ **Steeping:** a process of creating coffee by adding ground coffee to hot water. It is one way to experience immersion brewing.

Steeped coffee offers complexity in flavours as the coffee grounds remain in the hot water for more extended periods compared to the other coffee preparation methods. For a cup of hot coffee, just under five minutes as appropriate for steeping.

To make the coffee using a French Press, the contact time should be 2-4 minutes while making Espresso coffee has an especially brief brew time: the coffee is in contact with the water for only 20-30 seconds. It is also possible to create a cold brew while steeping coffee. However, to accomplish this you will need to leave the coffee grounds in the water for around 12-24 hours.

For the best results, coarsely ground coffee should be used. Coarsely ground coffee is preferred to avoid having a cup of coffee that has coffee dust suspended within the liquid. This could lead to coffee dust settling at the bottom of the cup.

Steeping can affect the coffee taste. The coffee with an undesirable taste of the final product is likely either:

- ✓ **Over-extracting** - the brew time is too long
- ✓ **Under-extracting** - the brew time is too short

- **Topic2: Extraction**

- ✓ **Strength**: coffee strength is the amount of caffeine contained in a coffee, then the largest single influence is the amount of coffee dosed compared to the amount of water to make a cup of coffee. In this regard the coffee makers the coffee has the most influence, as they will determine the ratio of coffee grinds to water during the brewing process.

- ✓ The coffee strength can also mean the 'flavour' or how much 'bite' the coffee has. Each individual type of coffee requires its own depth of roasting to bring out its best flavours.
- ✓ Therefore one particular bean may only require a medium roast, whereas another bean may require a darker roast in order to bring out its best and unique flavour notes.
- ✓ This is where the skill and experience of the roaster comes in.

**Strength / Roast Profile Guide**

| **Rating** | **Description** |
|---|---|
| 1 | Light to Medium Roast |
| 2 | Medium Roast |
| 3 | Medium to Dark Roast |
| 4 | Dark Roast |
| 5 | Very Dark Roast |

- ✓ **Brew ration:** Coffee-to-Water Ratio: 15gr of ground coffee are dissolved in 225 ml of boiled water**.**
- ✓ **Dark roast coffee**: This produces shiny black beans with an oily on the surface and well-defined bitterness. The darker the roaster, less acidity will found in the coffee beverage as acidity relates to the degree of roast. The lighter the roast, the brighter the cup, the more acidity. A dark roast will have less acidity but more body. A medium bodied cup will have a balance of acidity and body. It has a dark colour and this may give the impression of a stronger tasting coffee; good taste.

- Topic3.Brewing methods

- ✓ **Decoction:** it is extraction of water soluble substances of coffee by boiling. It refers to brewed coffee that is usually later mixed with milk and sugar. Decoction is act of boiling coffee to extract the coffee flavours.
- ✓ **Infusion:** Infused coffee is the process of extracting flavours from coffee grounds, similar to steeping tea leaves. The infusion coffee method is a simple process

illustrated below. For flavoured coffee, try adding cardamom pods, cinnamon sticks or vanilla beans to the infuser.


Fig14:**Infusion coffee method**

- ✓ **Espresso**: is a coffee making method of Italian origin, in which a small amount of nearly boiling water is forced under pressure through finely-ground coffee beans. Espresso coffee can be made with a wide variety of coffee beans and roast levels. It is generally thicker than coffee brewed by other methods, has a higher concentration of suspended and dissolved solids, and has crema on top foam with a creamy consistency). As a result of the pressurized brewing process, the flavours and chemicals in a typical cup of espresso are very concentrated.

  Espresso is also the base for various coffee drink including caffè latte, cappuccino, caffè macchiato, caffè mocha, flat white, and caffè Americano

  The figure below shows the expresso machine

Fig 15: **Expresso machine**

- Topic 4: Cupping (develop and rank a score sheet)

✓ **Fragrance**: Aromatic aspects of dry ground coffee beans. One can evaluate this at three distinct steps in the cupping process:

- Sniffing the grounds placed into the cup before pouring water onto the coffee;
- Sniffing the aromas released while breaking the crust; and
- Sniffing the aromas released as the coffee steeps.

✓ **Aroma**: Aromatic aspects of ground coffee beans when infused in hot water

✓ **Acidity:** Brightness and or sourness of the coffee. Acidity is often described as "brightness" when favourable or “sour” when unfavourable. At its best, acidity contributes to a coffee's liveliness, sweetness, and fresh-fruit character and is almost immediately experienced and evaluated when the coffee is first slurped into the mouth. Acidity that is overly intense or dominating may be unpleasant, however, and excessive acidity may not be appropriate to the flavour profile of the sample.

✓ **Flavour:** It is defined as taste and aroma, mild-tones of coffee. It is a combined impression of all the gustatory (taste bud) sensations and retro-nasal aromas that go from the mouth to nose.

Coffee flavour profiles consist of:

✓ **Mild:** Coffee with a mild body is not sharp, pungent or strong. Many light roast coffees normally possess a mild flavour profile.

- ✓ **Bold:** Coffee with a bold body has a strong and noticeable flavour. Coffees from medium to dark roast levels normally possess a bold flavour profile.
- ✓ **Extra Bold**: Coffee with an extra bold body has flavours that are extremely strong and pronounced. Dark roast coffees normally possess an extra bold flavour profile.
- ✓ **Sweetness:** Subtle pleasant sweetness in coffee. Sweetness refers to a pleasing fullness of flavour as well as any obvious sweetness and its perception is the result of the presence of certain carbohydrates. The opposite of sweetness in this context is sour, astringency or "green" flavours.
- ✓ **Body:** Mouth feel or heaviness perceived on the surface of the tongue. The quality of body is based upon the tactile feeling of the liquid in the mouth, especially as perceived between the tongue and roof of the mouth.
- ✓ **Balance**: Overall rating of coffee, no one parameter should dominate. How all the various aspects of Flavour, Aftertaste, Acidity and Body of the sample work together and complement or contrast to each other is Balance. If the sample is lacking in certain aroma or taste attributes or if some attributes are overpowering, the Balance score would be reduced.
- ✓ **Crema**: is the term for the layer of foam found on the surface of a shot of espresso coffee. Generally golden to dark in colour, this foam is a result of several factors in the brewing of the espresso, from the type of bean to the pressure employed by the espresso machine. While the crema does not contribute to the taste of the coffee, it is often considered an indicator of the espresso's quality.
- ✓ **Clean Cup**: Transparency in the cup should be free of off-flavours and defects. It refers to a lack of interfering negative impressions from first ingestion to final aftertaste, a transparency" of cup. In evaluating this attribute, notice the total flavour experience from the time of the initial ingestion to final swallowing or expectoration.
- ✓ **Uniformity**: It refers to consistency of flavour of the different cups of the sample tasted. If the cups taste different, the rating of this aspect would not be as high.
- ✓ **Aftertaste:** Aftertaste is defined as the length of positive flavour (taste and aroma) qualities emanating from the back of the palate and remaining after the coffee is

expectorated or swallowed. If the aftertaste were short or unpleasant, a lower score would be given.

- ✓ **Overall**: Overall score of rating any coffee. The "overall" scoring aspect is meant to reflect the holistically integrated rating of the sample as perceived by the individual panellist. A sample with many highly pleasant aspects, but not quite "measuring up" would receive a lower rating.

## L. O.4.3: Package coffee powder

Coffee packaging must attract consumers for purchase. In addition, coffee packaging has the specific requirements of keeping its contents fresh.

Ground coffee goes stale rapidly and loses flavour, probably due to oxidation of certain oils. Packaging ground coffee in air-tight containers will help to reduce flavour loss. However, the best quality brew is obtained when using freshly ground beans. Ground coffee is Vacuum packed.

- **Topic1: Types of packaging methods**

- ✓ **Vacuum packaging**: It is a form of modified atmosphere packaging. The overall goal of vacuum packaging is to eliminate some or all oxygen, which commonly contributes to degradation. Vacuum packaging refers to the technique of removing air from a pack prior to sealing and it predates the use of gases as a means of food preservation. Its principal purpose is to remove oxygen by pulling the packaging material into intimate contact with the product.

  Vacuum packaging involves the evacuation of air from the packs prior to sealing and is also extensively used for the packaging of coffee powder to increase its shelf life. It has discovered that for every 24 hours that coffee was in room temperature; there was a decrease in shelf life of ten percent due to exposure to $O_2$.

- ✓ **Sealing**: It is a process of using an adhesive agent to close or to secure the food product i.e. Coffee powder. However the seal is a device or material that is used

to close off or fasten an opening or connection especially to prevent the escape or entry of a liquid or gas. Coffee powder sealing is done by the coffee powder vacuum sealing machine which is multifunctional high speed full automatic machine, speciality designed for liquid or semi-liquid including coffee powder, tea powder and cocoa powder.

The machine applied with world famous electrical and pneumatic components. It is of the high quality, high stability and long service life.

Fig16:**Sealer**

**The benefits of vacuum sealing are:**

- **Shelf life extension**: Reducing oxygen levels from packaged food products limits the growth of bacteria and fungi, thus extending the expected life of the product. Replacing oxygen with the appropriate gas may further extend shelf life.
- **Space and volume reductions:** Vacuum sealing removes excess air from a package and reduces overall volume, which may save on storage space requirements and shipping costs.
- **Product protection**: Products are often vacuum packed to prevent them from shifting or moving in transit, thus reducing the possibility of damage.
- **Rust & corrosion protection**: Vacuum sealing can help prevent rust and corrosion when used in conjunction with a desiccant. By removing the oxygen from the bag, contaminants (including moisture), are no longer in contact with electronic components, precision parts and precious metals. The contents are protected from potentially damaging exposure.

- **Topic 2: Types of packaging materials**

✓ **Aluminium**: Aluminium is widely used in food contact materials. Aluminium and its various alloys are highly resistant to corrosion. Aluminium as shown above, serves as a complete $O_2$ barrier; however, this is only the case when the material is in perfect condition.

✓ **Low density polyethylene (LDPE):** Low-density polyethylene (LDPE) is heat sealable, inert, odour free and shrinks when heated. It is a good moisture barrier but is relatively permeable to oxygen and is a poor odour barrier. It is less expensive than most films and is therefore widely used for bags, for coating papers or boards and as a component in laminates.

✓ **Polyethylene terephhalate (PET):** is a plastic material which has found increasing applications within the packaging field. It is a simple long-chain polymer. Its chemical inertness, together with other physical properties, has made it particularly suitable for food packaging applications.

Fig17: **PET**

✓ **Polypropylene:** Packaging of coffee especially if it is ground requires polypropylene. Polythene cannot be used as the flavour components diffuse through it. The use of laminates is popular but more expensive.

- **Topic 3: Packaging machines**

Packaging operations can be designed for variable package sizes and forms or for handling only uniform packages, where the machinery or packaging line is adjustable between production runs. Certainly slow manual operations allow workers to be flexible to package variation but also some automated lines can handle significant random variation

Efforts at packaging line automation increasingly use programmable logic controllers (PLC) and robotics. However there are two types of packaging machines that are automatic and semi-automatic machines

- ✓ **Automatic**: The Automatic Packaging Machine system is a combination of electronic, electrical and mechanical parts. Automation is to use control systems and information technologies to reduce the need for human work in production of goods and services. Automation plays an increasingly important role in the world economy and in daily experience.
- ✓ **Semi-automatic**:is a cost-efficient, secondary or end-of-line packaging solution for a wide range of applications. It is designed for reduced throughput rates and requires operator loading of product and activation of each wrapping sequence. This versatile system can be quickly and easily integrated into existing production lines.

Semi-automatic equipment, including tabletop machinery, will require operator assistance for each cycle run. Choosing to automate one task in the process can free up an operator to focus on other tasks where labour is limited.

**Machinery packaging plays increasingly important roles such as:**

- Improve labour productivity. Sliding blister sealing machine packaging machinery is much faster than manual packaging. One good example of this is the candy packing machine. Ensure packaging quality. Mechanical packaging is particularly important for exported goods to achieve consistent packaging.
- Handle specialized requirements, such as vacuum packaging, inflatable packaging and pressure filling.
- Reduce labour and improve working conditions for bulky/heavy products.
- Protect workers from health effects brought by dust, toxic/hazardous products and prevent environmental contamination.
- Reduce packaging costs and save storage costs for loose products including coffee powder by simply using compression packaging.
- Reliably ensure product hygiene by eliminating hand contact with food.

- **Topic 4 : Storage conditions of coffee powder**

Cool, dark and dry location far away from light, heat and moisture is best for coffee storage. Avoid putting them in fridges and freezers because they are moist and long exposure to cool temperature can affect the flavour. The room temperature and Relative humidity of 60% are good for storing the coffee powder.

**However the following are elements to be avoided during coffee powder storage:**

- ✓ **Direct sun light**: Lighting has the most significant effect on coffee directly after roasting. Direct light actually causes roasted coffee beans to go stale. It is extremely important to store coffee beans in dark areas or in opaque containers (in clear containers) so that the coffee does not spoil.
- ✓ **Moisture:** Humidity plays a large role in the overall state of roasted coffee beans. When a roasted coffee bean is exposed to moisture, the beans can go bad almost instantly. That is why it is crucial to store roasted coffee beans in dry, dark place. This exposure to moisture can once again make the beans go bad.
- ✓ **Oxygen:** The biggest coffee killer is oxygen. When roasted beans are exposed to air, they can go bad just a matter of days. When coffee beans oxidize, the favourite cup will taste stale.
- ✓ **Heat:** Another coffee killer is heat. Roasted coffee beans should be kept away from heat until they are ground and ready to lose flavour. Coffee is just another food product that requires cool storage for freshness.

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