Coffee and Tea Processing level II

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Module Title: - Demonstrating Knowledge of Coffee Roasting & Grounding and tea processing Principles

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LG 25 LO1: Identify substance purpose of Coffee product

Instruction sheet 1

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- Identifying target varieties of green coffee bean
- Identifying production purpose of coffee
- Desire the range of products

Identifying coffee bean size, quality and other factors affecting tastiness

- Identifying impact of coffee on customers taste and preference

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to

- Identify target varieties of green coffee bean
- Determine production purpose of coffee
- Desire the range of products
- Identify coffee bean size, quality and other factors affecting tastiness
- Identify impact of coffee on customers taste and preference

Learning Instructions

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the “Information Sheets”. Try to understand what being discussed. Ask your trainer for assistance if you have hard time understan them.
4. Accomplish the “Self-checks” which are placed following all information sheets.
5. Ask from your trainer the key to correction (key answers) or you can request your tr to correct your work. (You are to get the key answer only after you finished answerin Self-checks).

If your performance is satisfactory proceed to the next learning guide

Information sheet 1 Identifying target varieties of green coffee bean

1. Introduction

The coffee tree or shrub belongs to the family Rubiaceae and the genus Coffee. There are more than 70 species of coffee. However, only two of these species are commercially. explored worldwide: Coffee Arabica (Arabica), considered as the noblest of all coffee plants and providing 70% of world's production; and (Robusta), considered to be more acid but more resistant to plagues, and provides 30% of world's production. Coffee Arabica is a bush originally from Ethiopia. Coffee production in Ethiopia is mainly concentrated in the south, southwest and east of the country. Coffee is produced in Ethiopia in different areas like Jimma, Iluabor, Kaffa, Hararghe, Wellega, Sidamo, Yirgachafe and other. Coffee production in under Ethiopia condition is the critical to Ethiopian economy.

1.1 **Target varieties of green coffee bean**

A) Arabica coffee When roasted, Arabica beans provide a sweet, fruit, and berries yet soft taste with low acidity levels. This type of coffee beans needs a cool, subtropical climate where lots of sun, rich soil, and moisture are present, as a location in a high elevation. Since Arabica beans are difficult to grow and cultivate, they are more expensive compared to Robusta beans, and have a higher cost of production. Arabica, which need several years to come to maturity, and they yield more crop per tree. Most Arabica beans are grown in Africa (Ethiopia) and Latin America mild caffeine content (1% to 2%). That makes Arabica most consumed coffee kind today. Nearly 70% of the world coffee production falls upon Arabica.

1.1.1 **Main coffee Arabica production region in Ethiopia**:-

- The potential of coffee production in the country is comes from .
- Oromia region :- Jimma zone , Illubabor ,West wollega, East wollega Brenna ,Bale , Arsi, west Arsi,Guje ,East &west harrge
- SNNPR ,Gedeo ,Wolyita, Gamogofa, South Omo, Bench Maji, Kaffa ,Sheka , KAT (Amaro)
- Sidama region

- Gambella,:- Mejenger zone is the main coffee production area and few but not least are produced in
- Amhara and Tigray region, but it is not well known at Market.Coffee growing area of Ethiopian

❖ .**Unique characteristics of coffees/flavors**

- Lekempti - Fruity
- Sidamo - Sweet
- Harar - Mocha
- Yirgachefe - Flora
- Limmu - Winey

N.B: Mocha = strong Arabian coffee: a dark brown strong-tasting coffee from Yemen and some other countries on the Arabian

B) Robusta is more productive than Arabica and more resistant to diseases and pests, which is why it was named “Robusta”. Robusta beans have considerably more caffeine than Arabica beans (2% to 4,5%) and have a higher acid content. The taste is strong but less aromatic, sometimes slightly bitter. Around 30% of the world coffee production is allotted to Robusta, which is mainly used for espresso roasting

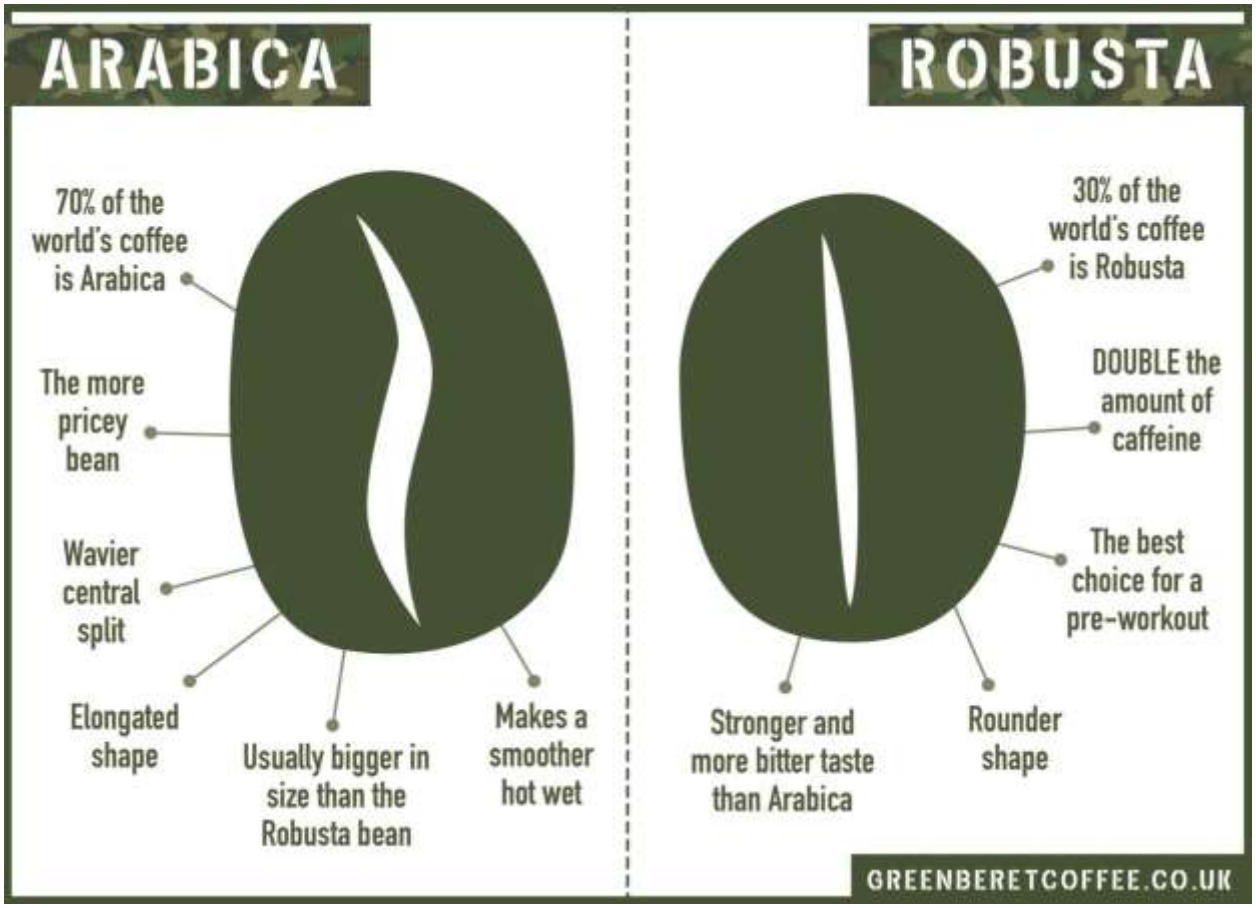

Figure 1:The difference between c.Arabica and c.Robusta

Self-check 1: Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

PART1: write short answer for the following question (3 pt. for each)

1. Explain the difference between coffee Arabica and coffee Robusta**?**
2. Write the Unique characteristics of coffee flavors in Ethiopia?
3. Mention at list three main currently green coffee bean producer region in Ethiopia?

Note: **Satisfactory rating - >6 points** **Unsatisfactory - <3 points**

You can ask you teacher for the copy of the correct answers.

Information sheet 2 : Production purpose of coffee

2.1 Production purpose of coffee

Coffee production is the industrial process of converting the raw fruit of the coffee plant into the finished coffee. The coffee cherry has the fruit or pulp removed leaving the seed or bean which is then dried. While all green coffee is processed, the method that is used varies and can have a significant effect on the flavor of roasted and brewed coffee.

- **Importance of coffee production**
  - ✓ To change widely consumed beverages
  - ✓ To impart coffee based aromatic compounds
  - ✓ Substitution in to food formula
  - ✓ Coffee is important to increase the economy of Ethiopia by exporting and brewing in locale market
- **Health benefits of coffee**
  - ✓ Coffee has antioxidant and antitoxic properties at cellular level.
  - ✓ Coffee reduces the risk of hepatic cirrhosis and prevents the formation of gallstones. Coffee provides protection against degenerative brain diseases like Alzheimer's and Parkinson is disease.
  - ✓ Coffee provides protection against colon and skin cancers.
  - ✓ Coffee combats caries and has anti-inflammatory properties.
  - ✓ Coffee has a moderate slimming effect and improves performance in sports.
  - ✓ Coffee helps to alleviate asthma symptoms and helps to calm hyperactive children

2.2. Desire the range of products

Instantcoffee

Instant coffee production typically involves treating ground-roast coffee with hot water and high pressure to extract the water-soluble compounds. This soluble material is then cooled and sometimes centrifuged, concentrated by heating, and dried through freeze drying to reduce moisture to approximately 5%.

Cold Brew Coffee–A **method** of brewing that doesn't use hot water. Instead, cold water and a longer period of time is used to create the finished cold coffee beverage.

Filtered or Drip Coffee–A method of brewing where coffee is placed into a paper filter and hot water is poured onto it allowing it to drip into the carafe below.

French Press Coffee–Coffee made with a French press brewer that uses a plunger to press the coffee to separate the finished drink from the coffee grounds.

Iced Coffee–Slightly different from cold brew coffee, iced coffee is prepared using a hot brew method and then cooled before serving.

Moka–Coffee brewed in a **moka pot**, which passes water through the coffee using pressurized steam.

Percolated Coffee–A brew method where hot water is cycled through the coffee grounds using gravity to reach the desired strength

Ground coffee is not processed beyond the usual steps of washing and roasting before being packaged and shipped to a coffee shop where it begins its natural deterioration process. Coffee grounds, by comparison, have a much higher capacity for pleasant acidity, a wider range of bodies, and more flavor compounds to be extracted. Ground coffee will take effort to pour and extract the intended flavors.

Coffee extract is the compound extracted from coffee beans and spring water, with high content of aromas, intense, balanced flavor, and excellent quality. These are some of the characteristics.

Self-check 2: Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Part 1:SayTiru or false the following question(2 pt for each)

1. Ground coffee is not processed beyond the usual steps of washing and roasting before being packaged and shipped to a coffee shop where it begins its natural deterioration process.
2. Coffee is not important to increase the economy of Ethiopian.
3. Spray-drying process uses high temperature under high pressure to volatilize the aqueous extract during instant coffee processing.
4. Coffee is not provides protection against colon and skin cancers.

Note: **Satisfactory rating - >4 points** **Unsatisfactory - <4points**

You can ask you teacher for the copy of the correct answers

Information sheet 3: Identify coffee bean size, quality and factors affecting tastiness

3.1 **Coffee Quality**

Quality is defined as "the degree to which a set of inherent characteristics fulfills requirements"**.** (ISO 9000:2005)

- Quality is about making organizations perform for their stakeholders from improving products, services, systems and processes, to making sure that the whole.
- Quality is about meeting the needs and expectations of customers. **Customers** want quality that is appropriate to the price that they are prepared to pay and the level of competition in the market.

3.2 Quality attributes

- Moisture content
- Color
- Size
- Acidity
- Aroma
- Flavor

Coffee is flavors. Therefore, the most important quality criterion. It is the sum of different parameters all coming into play during primary production of green coffee bean. Criteria used to measure quality of green beans are bean size, shape of bean, density, color and the bean chemistry of the raw bean. These criteria are influenced by a wide range of factors like plant genetics, orchard practices and postharvest treatment. All the downstream operations (storage, roasting, brewing) can only preserve cup quality. Besides its flavour characteristics, other factors such as environmental impact, purity and safety are becoming important for the global evaluation of coffee quality. The most important quality parameters are ripeness of cherry and time to processing.

The coffee may give an astringent or impure cup, if harvested immature or kept too long before processing. Careful picking, collecting, and storing of cherries should be précised

to produce high quality coffee. Analytical (moisture content and defective bean count) and organoleptic (taste testing) criteria are generally used by the coffee roaster to determine the choice of the green coffee beans. Moreover, quality evaluation for the roaster requires reliability of supply, uniform low moisture and agreed defect count, regular roasting characteristics and of course the cupping quality

3.3 Factors affecting coffee Quality and tastiness

- Effect of bean size on coffee quality**:** bean size sorting is an important operation during coffee processing which also facilitates to carry out roasting. Roasting is carried out with beans of similar size, if not done; the beans with smaller size get burned earlier while the larger ones get insufficiently roasted. Larger beans also fetch premium price in the market and ultimately beans with higher percentage of defects get concentrated in low grade coffee .The green beans are sorted according to size, density and colour.

- Manual sorting, which is tedious and labour intensive, is practiced in Ethiopia. Machine sorting is also used by some trading companies. Machines for size sorting use the sieving principle which is either one using screens mounted in the drums or the vibrating flat bed of rectangular shape. Electronic colour sorting is used to separate beans with an undesirable colour, such as black, white or brown beans

- Quality coffee is a product that has desirable characteristics such as clean raw and roasted appearance, attractive aroma and good cup taste .Quality of coffee is a combination both genetic makeup of the plant and environmental condition including human involvement in production and processing, finally affects flavor and aroma of the cup quality. These come from the chemical constituents of the coffee beans. The chemical reaction takes place during processing, particularly in the fermentation stage of wet processing, which maintain the desired chemicals. The quality of cherries influence the quality of product; under ripe, over ripe, diseased and damage cherries reduces quality.

In addition to the botanical species to which the coffee plant belongs, there are other factors that can influence the intensity and the quality of coffee

- ✓ The geographical region of the plantation
- ✓ The type of soil

- ✓ Sun exposure
- ✓ Harvesting method
- ✓ The processing method and the storage conditions
- ✓ The roaster's skills
- ✓ The packaging of the roasted coffee

- **Common coffee defect**
  - ✓ Hull/Husk
  - ✓ Broken/Chipped
  - ✓ Insect Damage
  - ✓ Partial Black
  - ✓ Partial Sour
  - ✓ Floater
  - ✓ Shell
  - ✓ Small Stones
  - ✓ Small sticks
  - ✓ Water Damage

Figure 2: common coffee defect

3.4 Coffee Grading

Grading: A device for controlling the quality of an agricultural commodity so that the buyer & seller can do business without personally examining every lot sold.

Grading. Although coffee beans are of fairly uniform size and proportion, they are graded first by size and then by density. The elephant bean is the only exception to this. Beans are sized into different grades by running the beans through sieves and screens with specifically-sized holes.

- **Coffee Grade:** Grade statement is based on
    - ✓ Size (High grades)
    - ✓ Moisture (9.0 to 12.2%)
    - ✓ Defects
    - ✓ Roast/Cup (for defects only, not character)

Self-check3: written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Part 1: Multiple choose (2 pt. for each)

1. One of the following is not quality attributes of coffee

A. Moisture content B. Color

C. Size D. Acidity

E. Concentration

2. Which one of the following is common green coffee bean defect?

A. Broken/Chipped B. Insect Damage

C. Partial Black D. Partial Sour

E. all is the answer

Part2: write short answer (3 pt. for each)

1. Explain coffee grading?
2. Write the Effect of bean size on coffee quality?

Note: **Satisfactory rating - >8 points** **Unsatisfactory - <6 points**

You can ask you teacher for the copy of the correct answers

Information sheet 4: Impact of coffee on customers taste and preference

4.1 Definition:

- **Consumer**: the final user of the product. It can be an individual or an organization that finally used the product to satisfy a particular need or want In general, a consumer is a person or organization unit that plays a role in the consummation of a transaction with the marketer or an entity.
- **Perceptions** are influenced by motivational push factors, e.g. socio-demographics, familiarity, security, social norms, prestige and peer pressure.

4.2. positive impacts of coffee on customers taste and preference:

1. A clean coffee maker is essential for making great-tasting coffee.
2. Regularly clean the coffee maker as specified in the cleaning and maintenance section .Always use fresh, cold water in the coffee maker.
3. Store unused coffee grounds in a cool, dry place. After opening a package of coffee grounds, reseal it tightly and store it in a refrigerator to maintain its freshness.
4. For an optimum coffee taste, buy whole coffee beans and finely grind them just before brewing.
5. Do not reuse coffee grounds since this will greatly reduce the coffee flavor. Reheating coffee is not recommended as coffee is at its peak flavor immediately after brewing. Clean the coffee maker when over-extraction causes oiliness. Small oil droplets on the surface of brewed, black coffee are due to the extraction of oil from the coffee grounds.
6. Oiliness may occur more frequently if heavily roasted coffees are used
   Negative effects of coffee on customers test.

4.3. Negative impacts of coffee on customers taste and preference:

1. Coffee contains caffeine which may raise blood pressure
2. Coffee may cause insomnia
3. Caffeine withdrawal leads to negative side effects such as headaches
4. Coffee may worsen acid reflux and heartburn symptoms
5. Coffee may increase the risk of miscarriage in pregnancy
6. Some coffee drinks contain large amounts of sugar and fat
7. Some people are seriously allergic/intolerant to coffee

4.4. Other factors affecting coffee on customers taste and preference

- Social Influence: 4 sources of social influence; family, social class, culture and reference groups social status and social approval the term value- expressive, is the need for psychological association with a person or group.
- Branding: the brand is a powerful tool that attracts positive consumer behavior, influencing perceptions and choice. Brand carries an assurance about the characteristics that make the product or service unique. A strong brand is a means of making people aware of what the company represents and what its offerings are.to a consumer, brand means and signifies:
    - ✓ Source of product
    - ✓ Delegating responsibility to the manufacturer of product
    - ✓ Lower risk
    - ✓ Less search cost
    - ✓ Quality symbol
    - ✓ Deal or pact with the product manufacturer
    - ✓ Symbolic device

- Variety

Even before the plant that bears the coffee fruit has begun to grow, there's a very important factor that will influence the crop - the variety.It's not as simple as Arabica vs. Robusta (we'd generally recommend staying away from the latter). Within the *species* Arabica, there are dozens of known varieties and more being discovered and created with time.

- Terroir that are responsible for the impact on coffee flavour / tastiness are numerous and complex, but here are some of the important ones:
    - ✓ Altitude
    - ✓ Climate
    - ✓ Soil type
    - ✓ Soil micro-biome
    - ✓ Topography

- Farming Practices

The practices of the farm where the coffee is grown will have a huge impact on the taste of the coffee. Everything from the use of chemicals to planting patterns &pruning regimen are ultimately going to affect the nature of the crop/green coffee bean. One

particularly important farming practice is *picking*. Coffee is best when it is picked at optimal ripeness.

- Processing

A washed or wet-processed coffee is more modern style of processing involves briefly fermenting the coffee cherries and then removing the seeds from the fruit or pulp - 'washing'. This method has an advantage in that with the outer, fruity layer, some of the risk of spoilage is removed. Washed coffees tend to have higher acidity and more clarity.

- Roast Profile: The roaster helps to realize the full potential of the coffee by carefully crafting a roast profile that will suit that set of beans. This isn't as simple as light or dark - on the contrary, roast colour can be pretty misleading. The roaster has to fine tune variables like roast time, charge temperature, rate of rise, drum speed, air flow & cooling speed, while responding to data like temperature logs, first and second crack timing, and most importantly sensory experience. It helps us to experience the influences of all the steps that came before that roast.
- Blending**:** Blending can be a masterful craft in its own right. In its basic forms, it can ensure a more consistent flavour experience throughout the year as the inputs to that blend change with the season. At its best, a blend can be a unique taste experience, whose flavour is more than just a sum of those of its component parts.
- Brewing: is the final stage in the process from soil to palate, which can also have an important influence on coffee taste.

Self-check 4: Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Part1: write short answer for the fowling Question (4 pt. for each)

1. Brand is a powerful tool that attracts positive consumer behavior, influencing perceptions and choice How to affect customer perception?----------

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2.How to affect bean size, shape, color on quality of roasted coffee?----------

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3. Describe the positive and negative impact of coffee on customer tastes?----------

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Note: **Satisfactory rating - >10 points** **Unsatisfactory - <8 points**

You can ask you teacher for the copy of the correct answers

LG-26 LO2: Identify key quality factors affecting coffee production performance

Instruction sheet 2

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- Identifying coffee safety requirements for target varieties
- Identifying type of raw materials for coffee production
- Identifying Effects of coffee processing on coffee quality
- Substitution guidelines and the effect of substitution on coffee production performance

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to

- Identify Coffee safety requirements for target varieties
- Identify Type of raw materials in ***coffee production***
- Identify Effects of coffee processing on coffee quality and customers taste and preference.
- Determine the effect of substitution on coffee production performance.

Learning Instruction

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6. If your performance is satisfactory proceed to the next learning guide

Information sheet 1: Identify coffee safety requirements for target varieties

1.1. Introduction

Food Safety deals with disease producing (hazards) that are accidentally introduced into food supplies. *Pesticides, herbicides, chemical additives,* and spoilage are all of concern. But, food scientists, food processors, and consumers focus most on microbiological quality. Microorganisms pose a challenge to the food industry and most food processes are designed with microbial quality.

1. 2. Legal Safty requirements coffee

A. **Food safety**: Traceability, hygiene and control Food products such as coffee. The main focus of European Union's legislation is food safety. The **General Food Law** (European Commission Regulation 178/2002) is the legislative framework for this subject Food products must be traceable throughout the entire supply chain to guarantee food safety, to allow appropriate action in cases of unsafe food and to limit risks of contamination. An important aspect to control food safety hazards is defining critical control points (HACCP) by implementing food management principles. Subjecting food products to official controls is another important aspect.

B. Avoid contamination to ensure food safety

Contaminants are substances that may be present as a result of the various stages of growing, processing, packaging, transport or storage. Threshold limits for several contaminants force to avoid negative impact on the quality of food and risks to human health. The different forms of contamination are:

- **Pesticides:** The presence of pesticides is one of the most common reasons for border authorities to reject coffee coming from producing countries. European Union's legislation on Maximum Residue Levels (MRLs) of pesticides establishes the MRLs of pesticides permitted in products of animal and vegetable origin which are intended for human consumption. MRLs are relevant to many natural ingredients, including coffee.
- **Mycotoxins**: Molds and fungi are another important reason for border rejections for coffee. OchratoxinA (OTA) levels are an specific point of attention;

nonetheless, there are no specific limits for green coffee beans since the product is roasted or goes through other types of processing before reaching consumers. For roasted coffee beans and ground roasted coffee, the maximum level of OchratoxinA (OTA) is set at 5 µg /kg while the maximum is set at 10 µg/kg for soluble coffee (instant coffee).

- **Salmonella:** It is a very serious form of contamination and occurs occasionally as a result of incorrect harvesting and drying techniques. Coffee beans are considered low-risk commodities regarding salmonella contamination.
- **Extraction solvents:** Solvents can be used for decaffeination of coffee. There are maximum residue limits restrictions for the extraction solvents such as methyl acetate (20 mg/kg in the coffee), dichloromethane (2 mg/kg in the roasted coffee) and ethylmethylketone (20 mg/kg in the coffee).
- **General requirements on packaging and labeling**

Food labeling legislation does not apply to bulk products such as green coffee. However, there are specific industry practices for coffee labeling to ensure product identification and traceability:

- ✓ Product name
- ✓ International Coffee Organization (ICO) identification code
- ✓ Country of origin
- ✓ Grade
- ✓ Net weight in kilograms
- ✓ *For certified coffee*: name/code of the inspection body and certification number

For Example Green coffee is traditionally shipped in woven bags made from natural fibers, such as jute or burlap. These bags typically hold 60 or 70 kilogram of green coffee. However, jute and burlap bags do not protect against moisture. As such, plastic big bags and plastic container liners are increasingly used, although they may still let some moisture in. These plastic bags range in size from 60 kilogram to full container-sized bags of 20 tones. Also have high-barrier packaging (in all sizes, including container-size). This type of material keeps out both oxygen and moisture. The most exclusive specialty coffees are often vacuum-packed to preserve the green coffee quality.

Self-check 1: Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Part1: write short answer for each question (10 pt.)

1. What is a contaminant affects coffee verities?
2. Define Food safety, Traceability, hygiene and control according to coffee Safty requirement

Note: **Satisfactory rating - >6 points** **Unsatisfactory - <5 points**

You can ask you teacher for the copy of the correct answers

Information sheet 2 : Identifying type of raw materials for coffee production

2.1. Selection and quality of coffee beans

There is no perfect processing method. Among coffee beans there may be soil residue, stones, twigs, etc. and the beans could be in part removed, treated, unripe or effected by molds etc. For this reason, great care is used in the selection of healthy beans and in the removal of dirt or other material. In fact transport can also substantially affect the quality of coffee beans. Transport by ship-container and the possible contaminations and deterioration of quality. The beans of raw coffee are packed in bags, placed on pallets and then into containers. Transport is one of the most frequent causes of quality decay-broke bags high humidity percentage in containers with subsequent building of condensation, if not suitably insulated.

2.2.Elements /compounds of Green coffee bean

- **Caffeine**: This white powder is why the world produces more than sixteen billion pounds of coffee beans per year.
- It's actually an alkaloid plant toxin (like nicotine and cocaine); plants use it to kill bugs. It stimulates us by blocking neurons receptors for the sleep chemical adenosine
- **Wate**r: Hot H2O is a super solvent, leaching flavors and oils out of the coffee bean.
- **A good cup of Joe** is 98.75 percent water and 1.25 percent soluble plant matter.
- **2-Ethylphenol**: This substance creates a tarlike, medicinal odor in your morning wakeup..
- **QuinicAci:** That "sour coffee" burn in the pit of your stomach? This stuff. On the plus side, it's one of the starter chemicals in the formulation of flu-fighter Tamiflu.
- **3,5DicaffeoylquinicAcid**

  When scientists pretreat neurons with this acid in the lab, the cells are

significantly (though not completely) protected from free-radical damage. Yup: coffee is a good source of antioxidants.

- **DimethylDisulfide**

  A natural product of roasting the green coffee bean, this compound is just at the threshold of detectability in brewed java. Good thing, too, as it's one of the compounds that gives human feces its odor.

- **Acetylmethylcarbinol**

  That rich, buttery taste in your daily jolt comes in part from this flammable yellow liquid, which helps give real butter its flavor and is a component of artificial flavoring in microwave popcorn.

- **Putrescine**

  Ever wonder what makes spoiled meat so poisonous? Here you go. Ptomaines like putrescine are produced when E. coli bacteria in the meat break down amino acids. Naturally present in coffee beans, it smells, as you might guess from the name, like Satan’s outhouse.

- **Trigonelline**

  chemically, it's a molecule of niacin with a methyl group attached. It breaks down into pyridines, which give coffee its sweet, earthy taste and also prevent the tooth-eating bacterium Streptococcus mutans from attaching to your teeth. Is there anything coffee can't do? It even fights the Cavity Creeps.

- **Niacin**

  vitamin B3.Trigonelline is unstable above 160 degrees Fahrenheit; at that temperature, the methyl group detaches, unleashing the niacin into your cup. Two or three espressos can provide half your recommended daily allowance.

- **Theophylline**

  one of the many chemical cousins of caffeine, this mild stimulant and muscle relaxant is used to relieve the symptoms of asthma, bronchitis, and emphysema.

2.3 Coffee Roasting Process

The aromatic qualities of coffee only become apparent once the beans have been exposed to high temperature during pyrolysis, which is still referred to as 'roasting' or grilling. In addition to changes in its external appearance (colour, size and texture) during the course of this operation, the product is the Centre of complex chemical changes, some of which generate the particular aroma and taste of coffee.

- **Green Coffee**

Though quality & "defects" are relative to any given varietal or cultivar of coffee, care should be taken to choose the most defect free coffee available for roasting. Limit the use of green that has a high number of blackjacks, sticks, hulls, broken, etc.

Bean size, also relative to the type of coffee, needs to be uniform for each batch. This will allow for even roasting. The moisture content of green coffee needs to be maintained at 10% to 12%. Generally speaking, this may be accomplished by storing the green at or below 72oF and 55% to 70% humidity. These parameters will vary from location to location based on ambient condition.

- **Unroasted bean:** 22°C (72°F), green beans Green coffee as it arrives at the dock. The beans can be stored for approximately 12–18 months in a climate controlled environment before quality loss is noticeable.165°C (329°F), drying During the drying phase the beans are undergoing an endothermic process until their moisture content is evaporated, signifying first crack.

Figure 2.1: unroasted bean

2.4. Roasting Equipment and Techniques

There are two roasting techniques

1. Heating by convection in which the coffee is in contact with hot gases.

2. Heating by conduction there is in direct contact between coffee beans and a hot surface. During the industrial roasting process a small quantity of sugar molasses, or various other products is sometimes added, to 'coat' the berries. This coating, which is permissible by law, gives the berries a better color and more shiny appearance, prevents the loss of aroma and has the further advantage for the merchant of increasing the weight. Specialty coffees, on the other hand, are generally roasted in small batches.

2.5. The Two Common Roasting Methods

1) Drum Roasting

Drum-type roasting machines roast the coffee beans as they tumble in a rotating drum that is typically heated by gas or wood. When the desired roast is achieved, the beans are poured into a cooling hopper to keep them from overcooking.

There are three main parts in a traditional drum roasting machine: a heat generator, a vessel, where coffee is continuously agitated by rotation of the vessel or by forced heated air, and a cooler where the coffee temperature is reduced.

Drum roasted beans are roasted "to color". This means that the beans are considered done when they reach a certain color designated by the roaster. This causes inconsistency between batches, because color is a subjective measurement of the "doneness" of a coffee bean.

The drum method does not have a mechanism to remove "chaff", or skin, which falls from the beans during the roasting process. This debris remains in the batch as it is roasted, and becomes burnt and often begins to smoke. This changes the overall flavor dynamic of the coffee, especially with dark roasted beans.

Depending on the positioning of the coffee bean and distance from the heat source, the coffee beans reach the perfect temperature at different times. This creates a batch with inconsistently roasted coffee beans, affecting the overall flavor and quality of the coffee.

2) Hot Air roasting

the hot-air roaster, also known as a fluid bed roaster, roasts the coffee beans as they lift and tumble on a current of hot air. Most green coffee is roasted at approximately 400oC. The roasting process causes the coffee beans to swell and increase in size by over 50%, while at the same time greatly reducing their weight. Once the beans have left the roasting machines they must be cooled immediately to prevent auto combustion from modifying the proper grade of toasting that has been achieved. Air roasting can provide better control over the roasting process, but many still prefer the classic drum method for roasting coffee beans. Air roasted beans are roasted “to temperature”, which is a much more precise technique for knowing when a batch has finished roasting. That way, the roaster can easily duplicate batches of coffee beans, recreating the same color, flavor profiles, and aroma of the coffee beans.

Air roasters have a special chamber that collects the chaff, preventing the material from smoking and affecting the batch’s flavor. An air roaster, the coffee beans float on a bed of hot air inside of the roasting chamber, keeping the beans at a consistent temperature throughout the process

Fig. 2.2 Coffee roaster machine

2.6. Three Ways Of Cooling Roasted Beans:

A. Water cooling: a shower of water chills the hot roasted beans. Coffee absorbs water so this process increases the specific weight.

B. Cooling in normal air.

C. Cooling in forced air.

A lightly roasted bean may range in color from cinnamon to a light chocolate tan. Lighter roasts are generally not used for espresso since they produce a sharper, more acidic taste than do darker roasts.

- Darker roasts, in contrast, have a fuller flavor approaching a bitter sweet tang. As the roast darkens, caffeine and acidity decrease proportionately. Dark roasts can range in color from a medium-chocolate brown, to an almost black bean with an oily appearance.

As a result of this, extremely dark roasts will tend to have a smoky flavor and are better suited for brewed coffee rather than espresso. The amount of oil drawn to the surface of the bean increase proportionately to the length of roasting time. After roasting, coffee does not keep its aroma for long; it is, therefore, better not to roast or not to buy coffee exceeding current needs. It is advisable to keep it in airtight pack-aging to prevent light, heat and moisture ingress.

You should always start with a pre-heated roaster. Allow the roaster and burner to idle for 20-30 minutes before dropping your first batch. Creating a stable starting point for the coffee, especially if you are doing multiple roasts. After the equipment is pre-heated, green coffee beans are placed in the roaster. As the roast heats up, the beans are tumbled allowing the coffee to heat evenly. The temperature slowly rises and moisture is driven off. As the process continues the sugars are caramelized and the roast is completed.

- **Stalling:** After the coffee is roasted, the beans should rest for 24 hours to allow carbon dioxide (CO2) to dissipate from the coffee before being brewed. This can be done as whole bean or grounding.

Unroasted			
	22°C (72°F), green beans Green coffee as it arrives at the dock. The beans can be stored for approximately 12–18 months in a climate controlled environment before quality loss is noticeable.		165°C (329°F), drying During the drying phase the beans are undergoing an endothermic process until their moisture content is evaporated, signifying first crack.
Light roast			
	196°C (385°F), cinnamon roast A very light roast level which is immediately at first crack. Sweetness is underdeveloped, with		205°C (401°F), light roast Moderate light brown, but still mottled in appearance. A preferred roast for some specialty roasters, highlights origin

	prominent toasted grain, grassy flavors, and sharp acidity prominent.		characteristics as well as complex acidity.
Medium roast			
	210°C (410°F), American roast Medium light brown, developed during first crack. Acidity is slightly muted, but origin character is still preserved.		219°C (426°F), city roast Medium brown, common for most specialty coffee. Good for tasting origin character, although roast character is noticeable.
Dark roast			
	225°C (437°F), full city roast Medium dark brown with occasional oil sheen, roast character is prominent. At the beginning of second crack.		230°C (446°F), Vienna roast Moderate dark brown with light surface oil, more bittersweet, caramel flavor, acidity muted. In the middle of second crack. Any origin characteristics have become eclipsed by roast at this level.
	240°C (464°F), French roast Dark brown, shiny with oil, burnt undertones, acidity diminished. At the end of second crack. Roast character is dominant, none of the inherent aroma or flavors of the coffee remain		245°C (473°F), Italian roast Nearly black and shiny, burnt tones become more distinct, acidity nearly eliminated thin body.

Coffee Roast Color's.

Figure 3.different coffee roast color

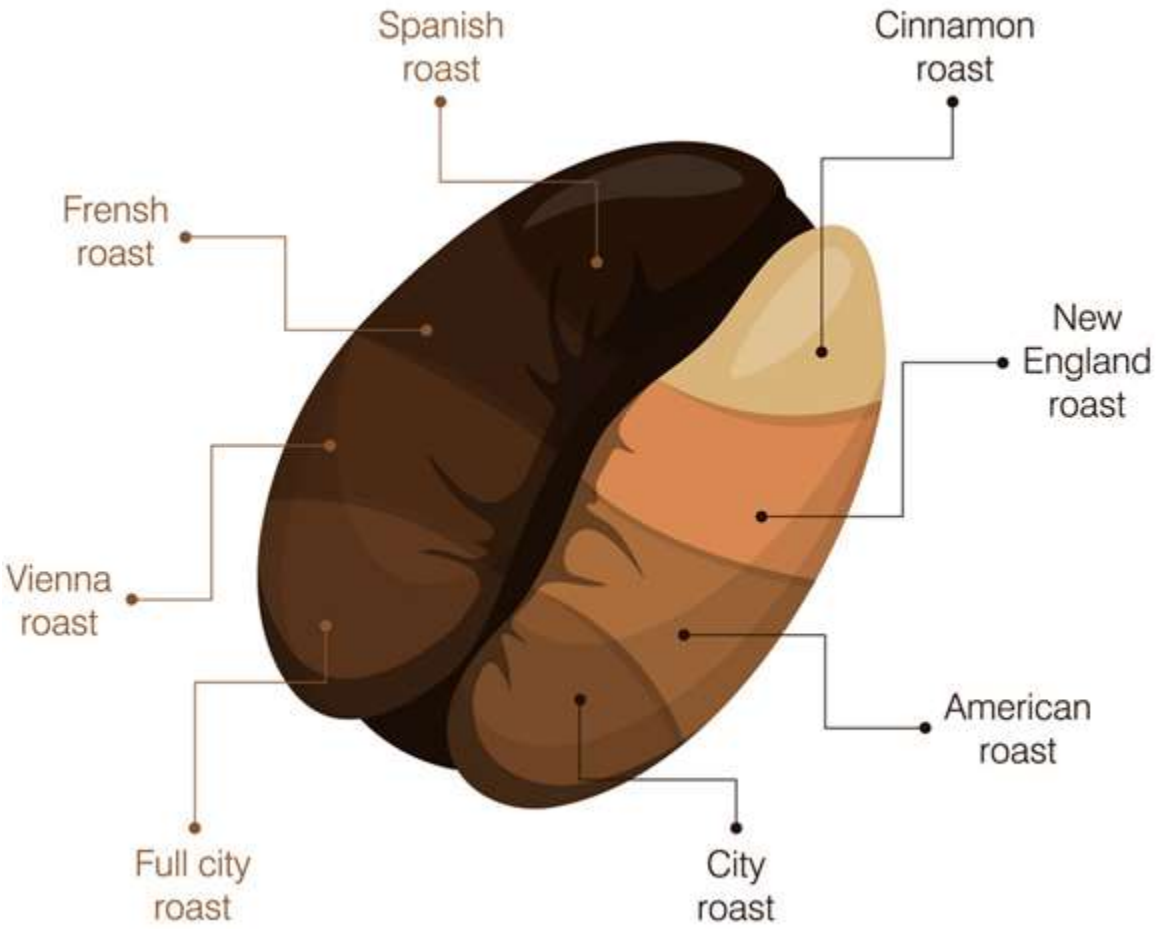

Figure. 4. Coffee roasting Degree

2.7. Changes During Roasting Process

At the ending the roast stopping the roast is critical. Once the desired color has been reached, whether it is at the first or second crack, the coffee must be removed from the heat. It may be evacuated to a cooling pan or quenched with water to stop the roasting process. If the later is chosen, care must be taken that the coffee is not moistened to the point it will stale or mold

- **Color Change**

  As the green coffee loses its moisture; you'll notice the color changing from green to a pale yellow. As the roasting process continues the yellow will develop into a tan or light brown.

- **Firs Crack**

  when the coffee has reached a temperature of 390oF to 400oF the coffee beans will increase in size significantly. Soon thereafter, a loud cracking noise will be heard as the remaining moisture bursts out of the coffee beans. At this point, the sugars in the coffee have begun to **caramelize**. This would generally be the lightest roast anyone would use. **Caramelizing** After the first crack, the coffee begins to roast more quickly. During this phase, the color darkens rapidly and requires a close eye and quick timing to achieve precise roast levels.

- **Second Crack**

  many roasters stop the roast before the second crack, however excellent coffee can be found at or beyond this level, if so desired. The second crack may be harder to identify than the first crack, if it occurs at all. If you have reached this stage, you should remain focused on the roast, as the color may change in a fraction of a second.

- **Physical changes**
  - ✓ Increase in bean volume is related to the release of bean tension
  - ✓ During the roasting process, weight loss usually varies between 14-23% depending on the
  - ✓ water evaporation increase
  - ✓ the bean volume increase
  - ✓ the disruption of the endosperm, bean cracking occurs.

- ✓ During the roasting process, weight loss usually varies between 14-23% depending on the
  botanical origin, green coffee moisture, storage conditions, and the roasting method.
- ✓ Weight loss results mainly from water and volatile substances release from the beans as well as of silver skin detachment.
- ✓ The increase in bean volume is related to the release of bean tension
- ✓ At the end of roasting, the apparent density of green coffee beans also decrease, cracks and fissures are formed, and pressure resistance sharply declines.

- **Chemical changes**
  - ✓ Tissue structure of coffee beans starts changing
  - ✓ With a continued temperature elevation protein denaturation.
  - ✓ Above 100 °C, beans undergo browning related to a series of reactions (Maillard and Strecker mechanisms) giving rise to various substances, including melanoidins).
  - ✓ Gaseous substances (water vapors, carbon dioxide, and carbon monoxide) are released.
  - ✓ At 180-200 °C, with the disruption of the endosperm, bluish smoke and aroma appears, and caramelization develops.
  - ✓ Volatile substances release from the beans as well as of silver skin detachment.
  - ✓ Gases expansion in the endosperm (which implies cell swelling), stretching of cellular
  - ✓ membranes, and partial destruction of polyoses, cellulose, and lignin
  - ✓ Decline complex chemical transformations, namely, Maillard and Strecker reactions.

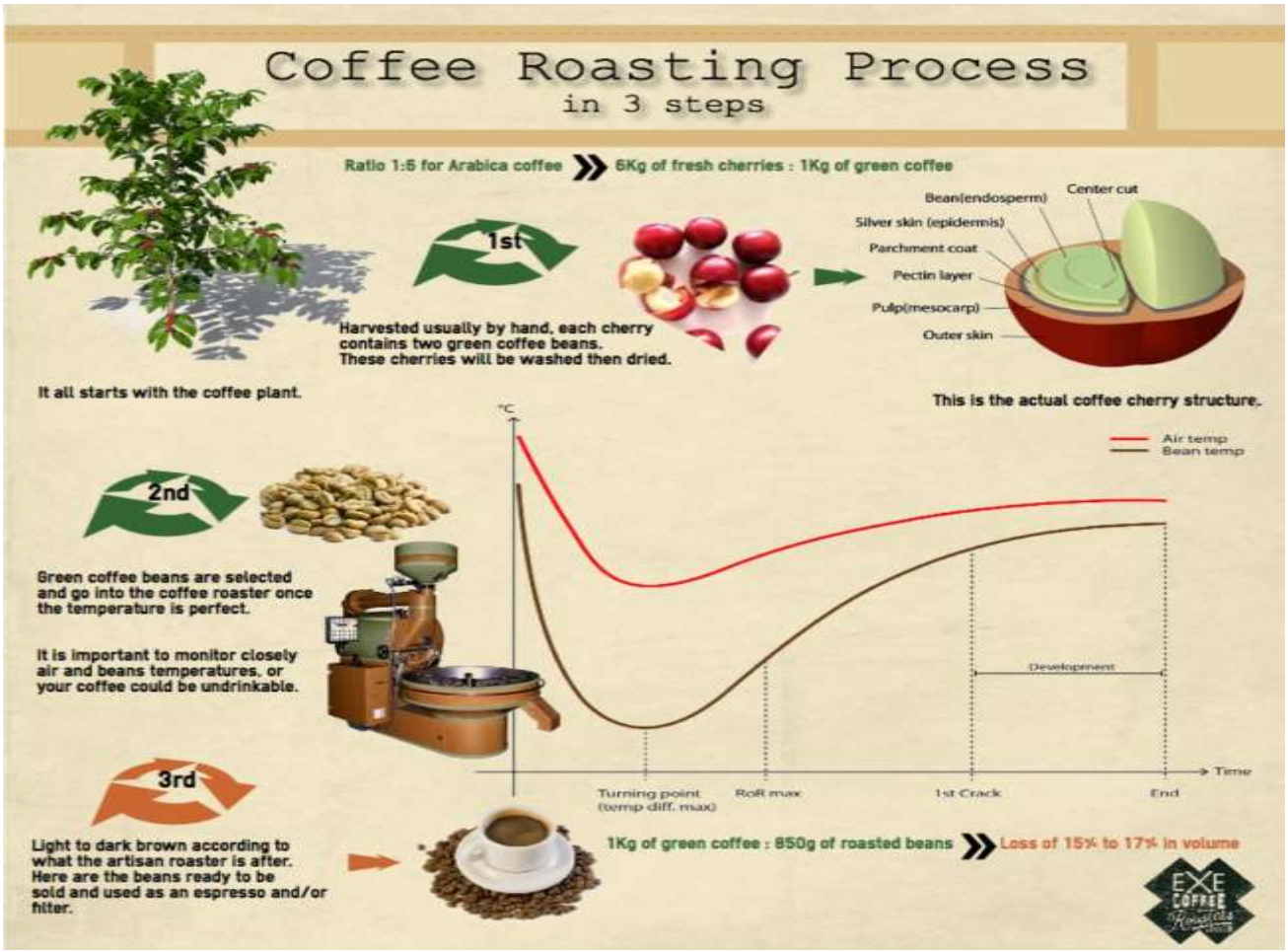

Fig.5.coffee roasting process

2.8. Pounding/Grinding

Pounding should be done just before it is wanted to make coffee liquor. However, if storing is required it should be packed immediately in air tight and moisture proof package and containers like composite plastic packages or Jars. Polyethene is not suitable because of its low barrier to air and moisture leading to the loss of aroma and moisture pick up .The finer the ground coffee, the less amounts of flavor and aroma. This is because of soluble constituents are more accessible since every cell is broken the volatiles escape before water come into contact. So all cells should not be broken but ground sufficiently to permit efficient extraction. Thus, coarse grinding is better.

-Grinding is the last operation through which coffee has to go before being actually made into a drinkable product. Ideally, coffee should be ground immediately before being brewed, as ground coffee quickly loses its aroma. In the past, coffee was ground in wooden or marble mortars with a pestle; then came different kinds of crank and

drawer coffee grinders, and finally the modern-day electric ones. The old coffee grinders differ from the modern-day electric ones, because coffee is 'ground' by the wheel and not 'minced', as happens with the various electric-blade coffee-grinders. These also heat the coffee, further roasting it causing some loss in flavors.

Figure: 6.Coffee Grinder

2.9. **Rolling :** The damp tea leaves are then rolled to be formed into wrinkled strips, by hand or using a rolling machine which causes the tea to wrap around itself. This rolling action also causes some of the sap, essential oils, and juices inside the leaves to ooze out, which further enhances the taste of the tea. The strips of tea can then be formed into other shapes, such as being rolled into spirals, kneaded and rolled into pellets, or tied into balls, cones and other elaborate shapes. In many type of oolong, the rolled strips of tea leaf are then rolled to spheres or half spheres and are typically done by placing the damp leaves in large cloth bags, which are then kneaded by hand or machine in a specific manner.

Figure 7: Tea Rolling Machine

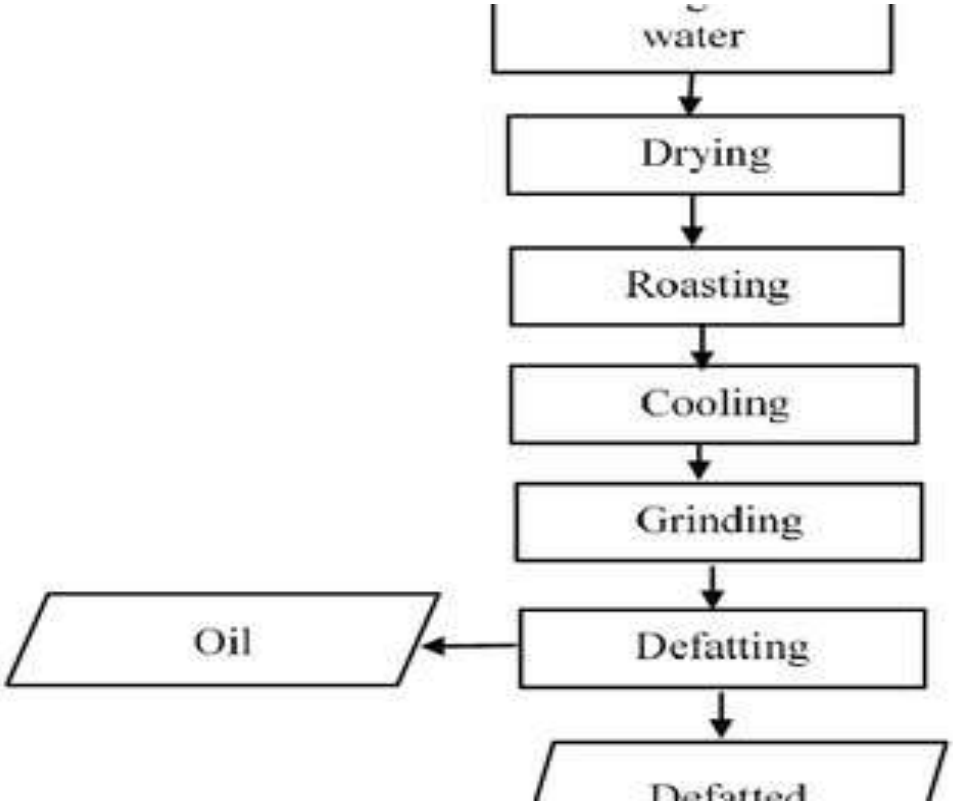

Figure 7: Coffee Roasting Flow Sheet

Self-check 2: Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Part 1: write short answer for the following question (3 pt. for each)

1. List at list 5 physical and chemical changes during roasting?

1 . ----------

2 .----------

3 . ----------

4 . ----------

5 . ----------

2.Write the three ways of cooling roasted beans and purpose of cooling after roasting?-

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3. Differentiate the two roasting technics ?----------

-

4. Briefly elaborate traditional grinder and modern grinder? ----------

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5. List five elements of green coffee bean? ----------

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6. Explain Tea rolling process?

Note: **Satisfactory rating - >15 points** **Unsatisfactory - <12 points**

You can ask you teacher for the copy of the correct answers

Information sheet 3: Identifying Effects of coffee processing on coffee quality

3.1 Introduction

Choosing the right coffee roasting technique is the heart of the roasting process. The roasting machines have various sizes, with a wide range of capacity from a few kilograms to several hundreds, highly computerized or fully manual. Therefore, the processing stages affect the coffee quality.

3.2 Factors Affecting Roasting Process

1.Varation on process

- Variation in the coffee itself – degree of moisture content makeup of the bean hard or softy type small, large or thin in size.
- Variation in the amount of coffee used – although this can be controlled more easily than the other two factors.
- Variation in the heating of the different cylinders – even of one roasting machine even the position of the cylinder, inner or outer can make a difference.

2. Heat Types

A. Conductive Heat in Coffee Roasting

Conductive heat transfer is straightforward: it is the transfer of heat between two objects that are directly touching. In coffee roasting, conduction occurs “if any type of heating element (say flames) touch the drum, when beans come into contact with the surface of the drum, paddles or faceplate, and even when the beans touch each other inside the roaster,”.

B. Convective Heat in Coffee Roasting

Convective heat is the transfer of heat through a liquid or gas. There are two types of convection: natural and forced. Natural convection describes the natural tendency of hot air to rise and cool air to fall. Forced convection is the forcing of air via a fan or pump to transfer heat. Almost every roaster uses a fan to some degree to pull air through their

roaster. However, natural convection also takes place to a certain extent in drum roasters, where the air in the top of the barrel will tend to be warmer than the air near the bottom.

C. Radiation in Coffee Roasting

Radiation is the release of energy via a process of electromagnetic radiation because of the vibrational and rotational movement of their molecules and atoms. Probably the most well-known example of radiation is the heat of the sun traveling through the vacuum of space to heat our planet. With current technology, radioactive heat is difficult to measure and almost impossible to control in coffee roasting. Even roasters equipped with infrared burners are using infrared heat to heat a barrel (conduction) and air (convection), not directly applying radioactive heat.

3. *Batch Size*

At a certain point, the beans themselves become their own source of conductive heat. This means that larger batch sizes will carry more heat and be less responsive. To effect changes in the batch, you will need more energy.

4. Airflow

The amount of airflow in the drum isn't directly correlated to the amount of convective heat energy. However, as the beans enter the Maillard reaction and then caramelize ahead of first crack, they release water and carbon dioxide. The water released has a cooling effect on the atmosphere inside the drum.

5. Drum Speed

For roasters with variable drum speed settings, an increase in drum speed means lifting the beans into the hot air accumulated at the top of the drum, increasing their exposure to convective heat. As with charge temperature and batch size, going too high or too low can cause problems. If the drum speed is too high, the risk roasting inconsistently, and, as cellulose matter is eroded through pyrolysis, actually damaging and smashing the beans. If the drum speed is too slow, as more of the bean mass will stay in contact longer with the walls of the drum. This leads to beans that will potentially suffer from scorching or facing.

6. Drum

The thickness of the drum also plays a big role in heat retention. The more heat the roaster drum can store, the more lag there will be when you make an adjustment to the flame setting.

7. Exhaust Fan

Some larger roasters are designed with a damper on the exhaust air pipe that isn't really meant to be adjusted during the roast. The idea is to set it at the appropriate setting and use the flame height to effect changes in the roast. On some smaller roasters, the fan can actually be strong enough to cool the barrel. This can stall the roast.

Self-check 3: Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

PART I: Multiple Choose (2 pt. for each)

1. Witch one of the following is factors affecting roasting process

A. *Airflow* *B. Durum speed*

C. batch size *C. Exhaust Fan* E. none of the above

2. Heat Types refers to ----------

A. *Conductive Heat* *B. Convective Heat*

C. *Radiation* *D. all of the above*

3. During coffee roasting variation also affect the process Except----------

A. Variation in the coffee itself B. Variation in the amount of coffee used

C. Variation in the heating of the different cylinders D. Aroma

Part2: write short answer for the following question (4pt.)

1. How to Minimize the Factors during Roasting Process?

Note: **Satisfactory rating - >10 points** **Unsatisfactory - <8 points**

You can ask you teacher for the copy of the correct answers

Information sheet 4: Substitution guidelines and the effect of substitution on coffee production performance

4.1. **Coffee substitutes**

The number of products, which aim at replacing coffee, is considerable, done in order to reduce the price of coffee. Various grains and roots have been used, all for adulterating purposes. Apart from chicory, the most important adulterants are fig, acorn (mildly astringent), malt, barley and other roasted cereals, often flavored with steam passed through coffee.. This is by no means a complete list. These products, which have a remote resemblance to that of real coffee, are harmless, though undesirable

Self-check 4: Written test

Name…… ID……. Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Part 2: write short answer for the following question (3pt)

1. Explain briefly effect of coffee substitution on coffee production performance?

Note: **Satisfactory rating - >2 points** **Unsatisfactory - <1 points**

You can ask you teacher for the copy of the correct answers

Operation sheet 1: Operate Roasting process for coffee production

In Roastingis appling heat process that turns coffee into the fragrant, dark brown beans with which we are most familiar but they are defferent roasting color and pyhesico-chemical changes during roasting.

1) First, sorting activity is separation of coffee beans from coffee defects or foreign objects, black coffee beans and to separate broken coffee with whole coffee so it will be easier to uniform the quality of roasted coffee produced

2) Adjust coffee roaster machine with roasting temperatures of 225°C- 250°C for 10, 15 and 20 minutes

3) Check the roasting machine to worm with properly. Wait until temperature heat arises. Put the sample using the sample spear to heated cylinder

4) The first stage of roasting is endothermic (beans absorb heat) where the green beans are slowly dried to become a yellow color and the beans begin to smell like toast or popcorn.

5) The second stage, often called the first crack occurs at approximately 205^{o}c (400^{o}F) in which the bean doubles in size becomes light brown color, and experiences a weight loss of approximately 5%.

6) In the next step the temperature raises from 205^{o}c to approximately 220^{o}c the color changes from light brown to medium brown and a weight loss of approximately 13% occurs. The resulting chemical process is called pyrolysis and is characterized by a change in the chemical composition of the beans as well as a release of Co_2.

7) Wait until it roasts properly for cupping purpose at light medium roast level.

8) Pull-up the cylinder and pull out the roasted beans to the cooling trays and stir it using the roasting spoon until it cool.

9) Turned off the heater and other valves

10)Finally, clean disassembling or assembly of roaster properly

11)Shut down the Equipment.

Operation sheet 2: Operate grinding process for coffee production

After coffee roasting Coffee should be ground immediately before being brewed, as ground coffee quickly loses its aroma. In the past, coffee was ground in wooden or marble mortars with a pestle; then came different kinds of crank and drawer coffee grinders, and finally the modern-day electric ones.

1. Adjust grinding machine into fine particle or coarse particle.
2. Grind the roasted coffee in to desired quality.
3. after grinding Turned off the heater /powers and other valves
4. Finally, clean disassembling or assembly of grinder and roaster properly
5. Shute down the Equipment.

Operation sheet 3: Operate Tea Rolling process

1. Adjust tea rolling machine with rolling temperatures
2. Using a rolling machine which causes the tea to wrap around itself.
3. Strips of tea can then be formed into other shapes, such as being rolled into spirals,
4. Rolled in to spirals, kneaded and rolled into pellets, or tied into balls, cones and other elbow shapes
5. after rolling turned off the heater
6. finally, clean disassembling or assembly of tea rolling properly
7. Shut downs the Equipment properly.

LAP TEST: Performance Test

Name……. ID……..

Date…….

Time started: _____ Time finished: _____

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within **2**hour. The project is expected from each student to do it.

Task-1: operate the roasting machine

Task-2: operate the grinder machine

Task-3: operate tea Rolling machine

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