WOLKITE UNIVERSITY

COLLEGE OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF CHEMICAL ENGINEERING

PRODUCTION OF SHAMPOO FROM AVOCADO SEED OIL

Final year project submitted to Department of Chemical Engineering in partial Fulfillment of the Requirements for the Degree of Bachelor of Science in Chemical Engineering.

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APPROVAL

This is to certify that the project prepared by Abdilu Worku, Rameto Mohammed, Hikma Akmel, Faiza Umer and Abdurezak Ahmed entitled "Production of Shampoo From Avocado seed Oil", which is submitted in partial fulfilment of the requirement for the degree of bachelor of science in chemical engineering complies with the regulation of the university and meets the accepted standards with respect to originality and quality.

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DECLARATION

We, the undersigned, declare that this project is our original work, has not been presented for a degree in any other university and that all sources of material used for the project are duly acknowledged.

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Acknowledgment

First of all we would thank our almighty Allah to give us wisdom and strength to finish this project. Following to this, we would like to express our deep gratitude to Dr. Gebre project advisor for his end-ever, and great effort to assist, and guided us throughout our project activities. It would be grateful to thank Chemical Engineering department head Dr. Gebr. For his Corporation in writing letters for other departments in order to get materials that we lack. We would also like to thank chemical engineering Lab technicians Mr.Yanas and Mr. Meseret. For their great corporation and, always assisting us in the time of the whole experimental work. At the last we would like to give special thanks our parents and other members of our family for their unlimited support and for their being in faith for the success of our completion.

ABSTRACT

The variety of avocado fruit was peeled destoned and underwent through oven dryer and has dried at 110^0c for 2hrs. After which it was dried, ground and accurately were measured to 25grams per experimental run. The experiment was conducted to formulate shampoo using avocado seed oil as ingredient in the formulation. Hexane solvent extraction method was used to extract oil from avocado seed at 69^0c for 3(hr.) and particle size of avocado powder (0.5mm) was examined to define optimum avocado seed oil (28% yields). The oil was characterized and its values were calculated as 14.2% and 0% moisture content. In addition to this, acid value, and pH value were recorded as 0.84%, and PH of 7.2 respectively. From 25gm sample powder avocado 7ml of oil was found.

The extracted avocado seed oil and 1ml of formaldehyde were kept together in first beaker and Sodium hydroxide and de-mineralized water were kept together in second beaker then heated at 65^oc for 20 minutes, then immediately mix using stirrer in order to form a uniform solution. The solution was cooled down at room temperature. The thickness of the solution was adjusted using 3gm fine sodium chloride. Perfume and color were added in to the solution respectively. Finally, citric acid was added to the formulated shampoo to adjust PH to 7.2. Eventually 195.8ml of shampoo was found.

The produced shampoo was characterized and calculated it`s physical property such as foam ability and stability, visual inspection, and detergence ability. The other characteristics were good foaming capacity, moderate dirt dispersion, yellowish color, fine and smooth texture and nature of hair after wash was soft and manageable.

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Lists of acronyms

AD: Administrative Cost

CTFA: Cosmetic, Toiletry, and Fragrance Association

DC: Direct Cost

DP: The percentage of detergency power

DSC: Distribution and Selling Cost

FCI: Fixed Cost Investment

ID: Indirect Cost

INCI: International Nomenclature of Cosmetic Ingredients

NPV: Net Present Value

PEC: Purchased Equipment Cost

POC: Plant Overhead Cost

TCI: Total Capital Investment

TPC: Total Production Cost

NaOH: Sodium hydroxide

KOH: Potassium hydroxide

CHAPTER ONE

INTRODUCTION

1.1. Background

Washing the hair and scalp has become a near-universal practice. The method of doing so varies depending on both geographic and economic factors. Shampoos assumed importance as a product category with the advent of synthetic detergents. These were developed in the 1930s, became widely used in laundry markets by the mid-1940s and appeared in a shampoo format during the 1950s. Shampoos are probably the most widely used hair products today; based on synthetic detergents they are relatively insensitive to water hardness, thus allowing for efficient rinsing since there are no scum residues. (Knowlton, 1993.). Shampoos are cleaning formulations used for a wide range of applications, including personal care, pet use, and carpets. Most are manufactured in roughly the same manner. They are composed primarily of chemicals called surfactants that have the special ability to surround oily materials on surfaces and allow them to be rinsed away by water. Most commonly, shampoos are used for personal care, especially for washing the hair. New shampoos are initially created by cosmetic chemists in the laboratory. These scientists begin by determining what characteristics the shampoo formula will have. They must decide on aesthetic features such as how thick it should be, what color it will be, and what it will smell like. They also consider performance attributes, such as how well it cleans, what the foam looks like, and how irritating it will be. Consumer testing often helps determine what these characteristics should be. Once the features of the shampoo are identified, a formula is created in the laboratory. These initial batches are made in small beakers using various ingredients. In the personal care industry, nearly all of the ingredients that can be used are classified by the Cosmetic, Toiletry, and Fragrance Association (CTFA) in the governmentally approved collection known as the International Nomenclature of Cosmetic Ingredients (INCI).The more important ingredients in shampoo formulations are water, detergents, and foam boosters, thickeners, conditioning agents, preservatives, modifiers and special additives. (Knowlton, 1993.).

The primary ingredient in all shampoos is water, typically making up about 50-60% of the entire formula. Deionized water, which is specially treated to remove various particles and ions, is used in shampoos. The source of the water can be underground wells, lakes, or rivers. The next most abundant ingredients in shampoos are the primary detergents. These materials, also known as surfactants, are the cleansing ingredients in shampoos. Surfactants are surface active ingredients, meaning they can interact with a surface. The chemical nature of a surfactant allows it to surround and trap oily materials from surfaces. One portion of the molecule is oil compatible (soluble) while the other is water soluble. When a shampoo is applied to hair or textiles, the oil soluble portion aligns with the oily materials while the water-soluble portion aligns in the water layer. When a number of surfactant molecules line up like this, they form a structure known as a micelle. This micelle has oil trapped in the middle and can be washed away with water, thus giving the shampoo its cleansing power. Surfactants are derived from compounds known as fatty acids. Fatty acids are naturally occurring materials which are found in various plant and animal sources. The materials used most often to make the surfactants used in shampoos are extracted from coconut oil, palm kernel oil, and soy bean oil. Some common primary detergents used in shampoos are ammonium lauryl sulfate, sodium lauryl sulfate, and sodium lauryl ether sulfate. (Kentish, October1995).

1. 2. Statement of the problem

Now a days there are many types of shampoos which are available in the market, even if they possess some qualities, they couldn't afford adequate qualities which customer anticipate. Besides this, there is high demand of shampoo in Ethiopia, and hence imported from abroad, because there is no value added ingredients of shampoo like avocado seed oil which is extracted in Ethiopia. Shampoo which has avocado seed oil as its ingredients, can overcome those problem, because of the following special ability;

- Avocado shampoos have the ability to penetrate the skin and deliver adequate amount of minerals in to the skin.
- Avocado shampoos have the ability to filter out and protect skin from UV when they exposed to high sun light.
- A shampoo which has avocado seed oil has the highest concentration of vitamin E. Not only does it help repair damaged hair, but it also helps keep the scalp healthy and flake-free. In addition to vitamin E the oil also contains different types of abundant minerals, which can contribute value added to shampoo.

1.3. Objective of the study

1.3.1. General objective;

- Our general objective is production of shampoo from avocado seed oil

1.3.2. Specific objectives;

- To extracting oil from avocado seed.
- To characterize produced oil.
- To characterize the produced shampoo.
- To see the project feasibility

1.4. Significance of the research

With the raise in the standard of living & health consciousness of people the demand for cosmetics is growing very fast. In Ethiopia it was helps to reduce import, to satisfy customers and to share market business. There are many types of shampoos which are available in the market, some contains synthetic minerals others may or may not. Even though they contain some minerals that helps for hair to gain little amount of food and moisture, those things are not adequate. Because of this, customers are not satisfied in terms of quality. Shampoos which have avocado seed oil as its ingredient, it enjoys a great advantage over other.

1.5. Limitations of the study

The limitations of this project paper includes:

During this project we have faced a lot of challenges that affects our laboratory results like there was insufficient laboratory equipment's (like oven, sieve, grinder (miller)….)

Again we have faced challenges that affects our laboratory results like there was insufficient laboratory chemicals like distilled water, sodium laury sulfate so due to this reason inability to gain pure shampoo which full fill all criteria like market shampoo

CHAPTER TWO

LITERATURE REVIEW

2.1. General Overview of avocado

Avocado (Persea Americana Miller) which is native to the high lands of Mexico and center America is cultivated in tropical and sub-tropical regions from 40ºN and 40ºS (Samson, 1986). It contains eleven vitamins, fourteen minerals and high percentage of seed oil (up to 30%) with no cholesterol (Currier, 1991). Avocado is by itself a complete food containing nine essential amino acids even though not in balanced proportion (Bergh, 1991). Avocado is also processed into oil for human consumption and used as ingredient in various cosmetics and health products ((Gaillard etal, 1995). Avocado seed oil is the major avocado product but here in Ethiopia there may be few peoples that even know oil can be produced from avocado seed. Only a few countries are actually involved in the production of oil namely Mexico (34%), USA (8%), Israel (4%), South Africa (<2%) and New Zealand (<1%) and these are also the countries involved in growing and trading of the fruit. Avocado seed oil was predominantly processed by the traditional producing countries and sold to the cosmetics and pharmaceutical industry to be used in cosmetic and health care products and as a lubricant. A new method has recently been developed in New Zealand which produces avocado seed oil that is comparable in quality to olive oil the industry's finest or premium cooking oil. The emerging market for it should be acknowledged and taken advantage of as it presents many opportunities for using surplus seed and producing a value added product (, Eyre set al, and 2006).

2.2 Factors influencing the oil content of avocado seed

Avocado seed with high oil content must be used in the production of oil. Various factors however are known to affect the oil content of seed and they are:

- **Cultivar**: -Different cultivars vary in oil content upon maturity and only those with high oil content should be considered. Because the oil is contained in the, cultivars with high proportion seed should be selected. Many studies have confirmed the Hass cultivar to be superior in quality with all the favorable attributes.
- **Maturity stage: -** The time at which the fruits of any given cultivar are harvested was noted by Apria in 2006 to have the greatest impact on the oil content of the fruits. Maturity is when the fruit is most suitable for human consumption and not for processing. Some cultivars mature early while others mature much later and understanding this becomes very important for choosing when to harvest. However it is

understood that when avocado seed mature their moisture content lower while their oil increases and leaving the fruits on the trees much longer after maturity tend to increase oil content (Apria, Avocado Post harvest Quality, 2006.).

- **Location and growth conditions**: - The same study of avocado postharvest quality by Apria etal. (2006) also noted differences in oil content for the same cultivar due to different locations and growth conditions such as soil fertility. Sun exposed fruits were also found by Woolf et al. (1999) to yield higher levels of oil than those fruits in the shade.

2.3. Biochemical Composition

Understanding the biochemical composition of the oil help to explain its functional properties and uses. Most of the beneficial attributes associated with eating avocados are mostly preserved in the oil and for this reason is very valuable. The composition and in particular properties of the oil varies according to how it is produced whether it be crude, or refined according to the method and number of successive operations involved in its production (Simmental & Escalona, 2004). Various analysis have been done on the composition of avocado seed oil and table1 lists typical results according to Eyreset al. (2006). The Vitamin E, Beta-sistosterol and alphatocopherol levels however are higher in avocado seed oil, the micronutrients with significant proof of health benefits. The flash or smoke point of avocado seed oil is another noticeable feature. This makes the oil highly applicable for high temperature cooking as it will not burn until it reaches temperatures well above 150^{0}C. The oil is also free of cholesterol and carbohydrate. (Eyreset al., 2006)

Table: 1 typical analysis results of avocado seed oil composition composition

Parameter	Avocado seed oil
Acidity Value (as oleic) (%)	2.0 – 0.08
Peroxide value	3.3-0.1
Iodine value	43.86
Color (chlorophyll)	40-70
Specific Gravity	0.912- 0.916
Beta-sistosterol (%)	0.45 -1.0
Total Vitamin E (mg/kg)	112 -200
Alpha-tocopherol (mg/kg)	130
Beta/Gamma-tocopherol	15
Delta-tocopherol	5

2.4. Oil Utilization

A **Cosmetic Industry: -** Avocado seed oil is well known for its anti-bacterial, anti-wrinkle and healing properties. The multiple properties of avocado seed oil namely stability, emollient skin, penetration, softening and moisturizing results in its wide applicability for cosmetic products. The high penetration ability of the oil in particular makes it very successful in its use as a natural and effective beauty aid. It is used in a wide variety of creams and oils for skin application as it acts as an effective carrier of other supplements incapable of permeating the skin (Human, 1987).

2.5. Extraction method of avocado seed Oil

The main point of extraction is the separation of the oil from the oil-bearing material with subsequent purification of the raw oil, but looking at the oil production as a whole not only the oil processing is important for the production of high-quality oil, but also the harvest, the pretreatment of the harvested material, and the storage conditions until processing have to be taken into consideration. The aim of the extraction method is to optimize the oil yield with simultaneous maintenance of the oil quality (Gupta, 2012). It has been observed that mechanical pressing and solvent extraction are the most commonly used methods for commercial oil extraction (Arabian et al., 2013).

2.5.1. Mechanical oil extraction

Prior to the discovery of any other oil extraction method oil was extracted mechanically or cold pressed. It is the simple process of heating the plant material to low temperatures and then physically pressing the oil out. Today mechanical expression is used mainly for citrus peels and is unpopular due to the low extraction yield. A manual ram press or an engine driven screw press can be used (Jahirul, et al, 2013). It has been found that engine driven screw press can extract 68– 80% of the available oil while the ram presses only achieved 60–65% (Bhuiya et al., 2015). According to literature, oil extraction efficiencies calculated from data reported in more recent studies are found to generally correspond to these ranges, although the efficiency range of engine driven screw presses can be broadened to 70–80% (Atabani et al., 2012, 2013; Bhuiya et al., 2015). The oil extracted by mechanical presses needs further treatment of filtration and degumming in order to produce a purer raw material (Atabani et al., 2013; Loganathan & K, 2013). An additional problem associated with conventional mechanical presses is that the design of mechanical extractor is suited for some seeds, and therefore, the oil yield is affected if that mechanical extractor is used for other seeds (Atabani et al., 2012, 2013; Bhuiya et al., 2015; Lokanatham & K, 2013).

2.5.2. Solvent extraction

The solvent extraction is chemical oil extraction method which is the most popular method of extraction of oil because of its high percentage of oil recovery from the seeds. Solvent extraction bridges the gap between mechanical extraction which produces oil with high turbidity metal and water content and supercritical fluid extraction which is very costly to build and maintain its facilities. Solvent extraction is the process in which the oil is removed from a solid by means of a liquid solvent, it is also known as leaching (Bhuiya,et al., 2016). Solvents are compounds that are generally liquid at room temperature and atmospheric pressure; they are able to dissolve other substances without chemically changing them. Extraction of oil using solvents is the most effective method for oil recovery of almost 98%, especially with materials having low oil content. Common solvent extraction uses a pure organic or mixed organics to extract the valuable extracts from the plant material. Typical solvents include ethyl acetate, diethyl ether, methanol, ethanol, petroleum ether, isopropyl alcohol, carbon tetrachloride and n-hexane. The liquid mixture formed on dissolving a substance (solute) in a solvent is termed a solution. The oil is then distilled and the solvent evaporated leaving the oil behind. This process leaves minimum oil residual in the cake compared to mechanical. Solvent extraction is a continuous solid/ liquid extraction. A solid which contains the material to be extracted is placed in what is called a thimble. A thimble is made out of a material which will contain the solid but allow liquids to pass through. A lot like filter paper. The thimble containing the material is placed in the solvent extractor (soxhlet). An organic solvent is then heated at reflux. As it boils its vapors rise up and are condensed by condenser. The condensed solvent then fills up the thimble. After it fills with enough solvent it automatically siphons back down into the container of organic solvent. This process takes place over and over again until all the material to be extracted into the organic solvent.

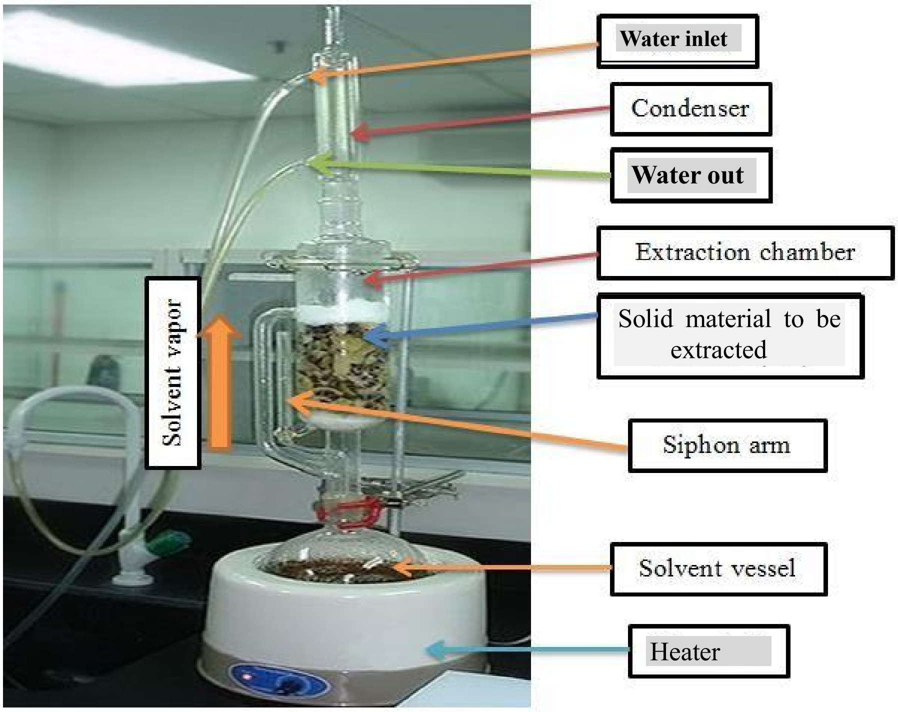


Figure: 1 soxhlet extractor

Soxhlet extractor is a piece of laboratory apparatus, it is not limited to the extraction of lipids. Typically, a soxhlet extraction is only required where the desired compound has a limited solubility in a solvent, and the impurity is insoluble in that solvent. If the desired compound has a significant solubility in a solvent, then a simple filtration can be used to separate the compound from the insoluble substance. Normally a solid material containing some of the desired compound is placed inside a thimble made from thick filter paper, which is loaded into the main chamber of the soxhlet extractor. The soxhlet extractor is placed onto a flask containing the extraction solvent. The soxhlet is then equipped with a condenser. The solvent is heated to reflux. The solvent vapor travels up a distillation arm, and floods into the chamber housing the thimble of solid. The condenser ensures that any solvent vapor cools, and drips back down into the chamber housing the solid material. The chamber containing the solid material slowly fills with warm solvent. When the soxhlet chamber is almost full, the chamber is automatically emptied by siphon side arm, with the solvent running back down to the distillation flask. This cycle may be allowed to repeat many times, over hours or days (Atabani et al., 2012).

2.6. Factors that affect solvent Extraction

It has been observed that there are many factors affecting the rate of solvent extraction such as particle size, the type of solvent used, temperature, time and agitation speed (Atabani et al., 2012, 2013). The oil yield from avocado seeds depends on the nature of the solvent, the temperature of extraction, seed particle size, contact (residence) time between the solvent and the seed and pre-treatment conditions (Sayyar, Abidin, Yuns, & Muhammad, 2009).

Particle size

Particle size influences the extraction rate in a number of ways. The smaller the size, the greater is the interfacial area between the solid and liquid, and therefore the higher is the rate of transfer of material and the smaller is the distance the solute must diffuse within the solid as already indicated. On the other hand, the surface may not be so effectively used with a very fine material if the circulation of the liquid is impeded, and separation of the particles from the liquid and drainage of the solid residue are made more difficult (Richardson et al., 2002).

Solvent type

The solvent has to be selected in such a way that it would be a good selective solvent and its viscosity would be sufficiently low to circulate freely. Generally, a relatively pure solvent will be used initially, although as the extraction proceeds the concentration of solute will increase and the rate of extraction will progressively decrease, first because the concentration gradient will be reduced, and secondly because the solution will generally become more viscous. The most commonly used solvents for food processing are water, aqueous solutions of acids and nontoxic salts, commercial hexane, and in some cases other alkanes, ethanol and to a lesser extent the other lower alcohols, methylene chloride, methyl ethyl ketone, and acetone. In the extraction of olive oil using organic solvents like hexane, ethanol, petroleum ether, isopropyl alcohol and carbon tetrachloride by a Soxhlet extractor, (Banat, et al., 2013) did also obtain the highest oil yield (43.7%) by n-hexane. However, it has been observed that this method consumes much more time compared to other techniques. The solvent extraction is only economical attractive at a large-scale of production (Atabani et al., 2012).

Temperature

Temperature generally affects both the equilibrium and mass transfer rate of the extraction process. In the former, higher temperature results in greater solubility of compounds in the solvent, resulting in a larger K value (equilibrium constant). In the latter, the higher the temperature, the higher will be the D (diffusion coefficient), hence increasing the rate of extraction. In conventional solid-liquid (solvent) extraction processes, the temperature is limited by the boiling point of the solvent. Thus, an optimized balance has to be determined when selecting the extraction temperature. Oil solubility in solvent increases with extraction temperature, High temperature also has a positive effect on viscosity and diffusivity of oil.

Viscosity decreases while diffusivity increases as the extraction temperature increases, resulting in shorter extraction times. The energy required for solvent recovery decreases when the higher operating temperature is used for extraction. However, high temperatures may cause deterioration and denaturation of some oil and meal components. Hence, temperature selection is based on the type of oil and required specifications of the final product.

Extraction Time

In general, a prolonged extraction time results in an increased yield of the oil until equilibrium is reached. Thereafter, the concentration of compound will not increase further but there will have greater liability for degradation. Prolonged extraction time is also not desirable from an economic standpoint of labor and energy requirements. Therefore, it is essential to find an optimum extraction time.

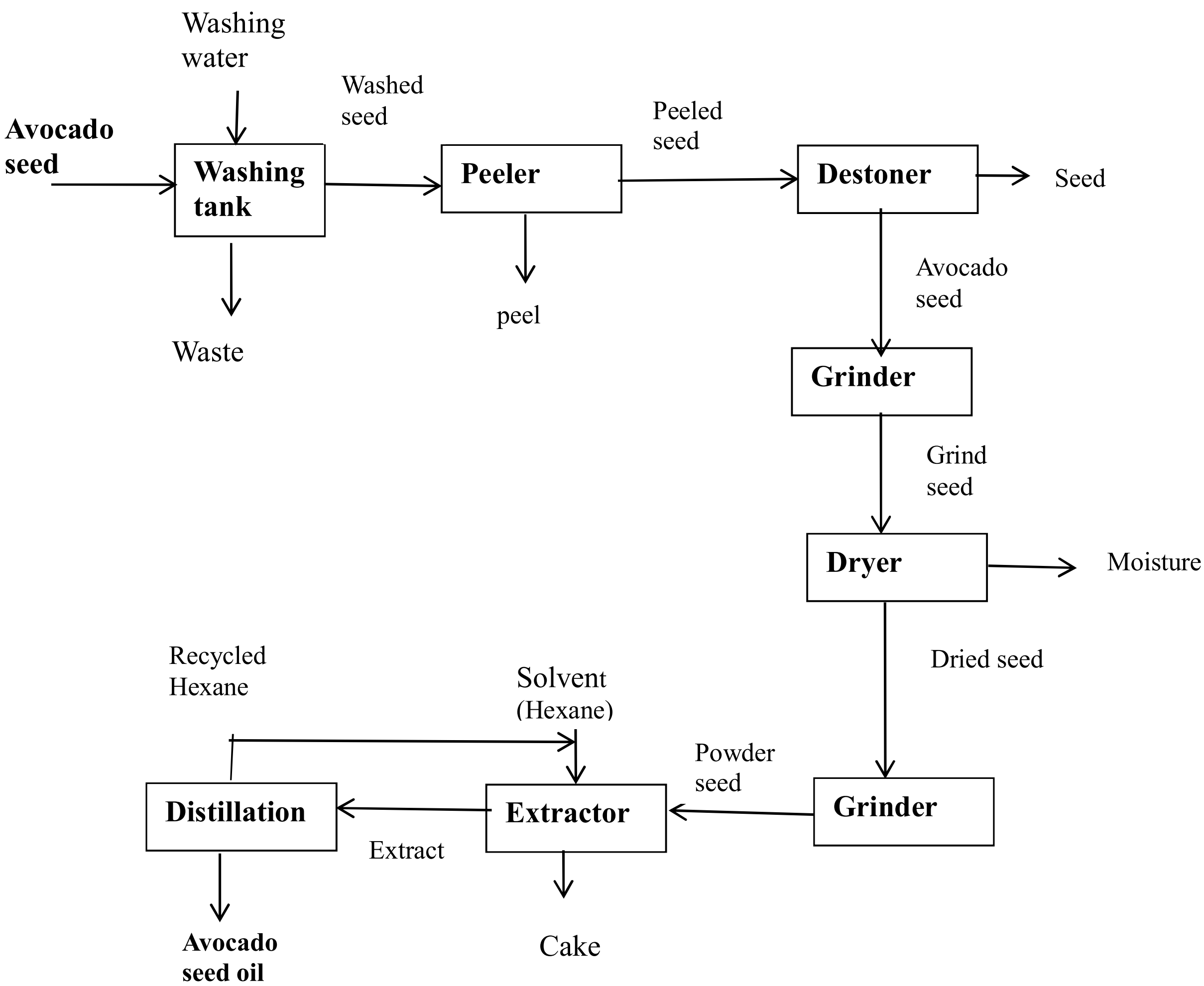


Figure: 2 block flow diagram of extraction process

2.7 .Shampoo

Shampoo is defined as a preparation of a surfactant in suitable form liquid, solid or powder which when used under the conditions specified will remove surface grease, dirt and skin debris from the hair shaft and scalp without affecting adversely the hair, scalp or health of the user. Shampoos are of various types and forms on the basis of physical appearances, constituents and properties (Martin M. Rieger, 1985).

2.7.1. Raw Materials

The more important ingredients in shampoo formulations are water, detergents, foam boosters, thickeners, conditioning agents, preservatives, modifiers, and special additives.

1. Water:-The primary ingredient in all shampoos is water, typically making up about 70-80% of the entire formula. Deionized water, which is specially treated to remove surfactant allows it to surround and trap oily materials from surfaces. One portion of the molecule is oil compatible (soluble) while the other is water soluble. When a shampoo is applied to hair or textiles, the oil soluble portion aligns with the oily materials while the water-soluble portion aligns in the water layer.

When a number of particles and ions, is used in shampoos. It helps dilute the detergents, makes the formula easier to spread and reduces irritation. It also keeps the formula inexpensive. (Natural Cosmetic Formulating Element by, Perry Romanowski, 2015).

2. Detergents: -The next most abundant ingredients in shampoos are the primary detergents. These materials, also known as surfactants, are the cleansing ingredients in shampoos. Surfactants are surface active ingredients, meaning they can interact with a surface. The chemical nature of a surfactant molecules line up like this, they form a structure known as a micelle. This micelle has oil trapped in the middle and can be washed away with water, thus giving the shampoo its cleansing power. (Element by, Perry Romanowski, 2015).

3. Foam boosters: - In addition to cleansing surfactants, other types of surfactants are added to shampoos to improve the foaming characteristics of the formulation. These materials, called alkanol amides, help increase the amount of foam and the size of the bubbles. Like primary detergents, they are also derived from fatty acids and have both water soluble and oil soluble characteristics. Typical materials include lauramide DEA orcocamide DEA. (Natural cosmetic formulating element by, perry Romano ski, 2015).

4. Thickeners:-To some extent, the alkanolamines that make shampoos foam also make the formulations thicker. However, other materials are also used to increase the viscosity. Methylcellulose, derived from plant cellulose, is included in shampoos to make them thicker.

Sodium chloride (salt) also can be used to increase shampoo thickness. (Natural Cosmetic Formulating Element by, Perry Romano ski, 2015).

5. Conditioning agents: - Some materials are also added to shampoos to offset the sometimes-harsh effect of surfactants on hair and fabrics. Typical conditioning agents include polymers, silicones, and quaternary agents. Each of these compounds deposit on the surface of the hair and improve its feel, softness, and comb ability, while reducing static charge. (Natural cosmetic formulating elements by, Perry romanowski).

6. Preservatives: - Since shampoos are made from water and organic compounds, contamination from bacteria and other microbes is possible. Preservatives are added to prevent such growth. Two of the most common preservatives used in shampoos are Formaldehyde and methyl. (Natural Cosmetic Formulating Elements by, Perry Romano ski, 2015)

7. Modifiers: - Other ingredients are added to shampoo formulas to modify specific characteristics. Opacifiers are added to make the formula opaque and give it a pearly look materials known as sequestering agents are added to offset the dulling effects of hard water. Acids or bases such as citric acid added to adjust the pH of a shampoo so the detergents will provide optimal cleaning. (Natural cosmetic formulating element by, perrybromanowski, 2015).

8. Special additives: - One of the primary factors that influence the purchase of a shampoo is its color and odor. Additives such as zinc pyrithione are included to address the problem of dandruff. Other additives are dyes which can color the hair. (Natural Cosmetic Formulating Element by, Perry Romanowski, 2015).

2.7.2. Production of shampoo

Active Ingredients (AIs) and other raw materials are dispensed for processing. Initially, active ingredients and other raw materials have taken into a vessel known as 'Mixing Vessel'. In this vessel the raw materials was mixed with hot water. For preparing liquid shampoo, sodium hydroxide and water are heated to about 65^0C. Avocado seed oil & preservatives are also heated to 65^0C. The water used for this process should be De-mineralized and free from any kind of impurities. The two solutions are mixed in mixer; the mixing process is carried out at a specific temperature. Subsequent, after that the solution should cool to at room temperature. The solution is taken to another vessel and other ingredients like Fragrances, Pigments, etc. are added. The mixture is agitated for about 20-30 minutes to form a homogenous solution. Eventually Citric Acid is used to adjust pH between 6.7 PH finally, the solution was back to room- temperature and is ready for packing. (Sharma, 1998).

2.7.3. Types of shampoo

1. Basic shampoos

A. Normal hair shampoos:-They achieve good cleansing with minimum conditioning.

B. Oily hair shampoos:-They give excellent cleansing and very minimal conditioning

C. Dry hair shampoos: - They cause mild cleansing and good conditioning. They reduce static electricity and make the hair more manageable.

D. Damaged hair shampoos: - Meant for hair which have been chemically treated with hair color, bleaching agents or hair straightening agents. They have mild detergents and more conditioner in order to temporarily repair the hair surface defects.

2. Baby shampoos: - These are formulated with amphoteric surfactants which causes little or no irritation. They are mild and can also be used by adults who wish to wash their hair every day.

3. Medicated shampoos

Anti-Dandruff shampoos: - In addition to the regular ingredients, also contains additives such as anti-fungal, anti-bacterial, selenium sulphide and tar derivatives. They remove sebum, oil, scalp scales and the anti- fungal acts on fungus pityrosporum ovale which is usually the cause of dandruff.

4. Conditioning shampoos: - They are a combination of shampoos and conditioner. These products may be self-defeating since the shampoos removes sebum, the body's natural conditioner and replace it with an artificial conditioner.

2.7.4. Requirements of a Shampoo

- It should effectively and completely remove dust or soil, excessive sebum or other fatty substances and loose corneal cells from hair.
- It should produce good amount of foam to satisfy the psychological requirement of the user. It should be easily remove d on rinsing with water.
- It should have the hair non-dry; soft, lustrous with good manageability and minimum fly away.
- It should not cause any side effect or irritation to skin or eye.
- It should not make the hand rough and chapped.

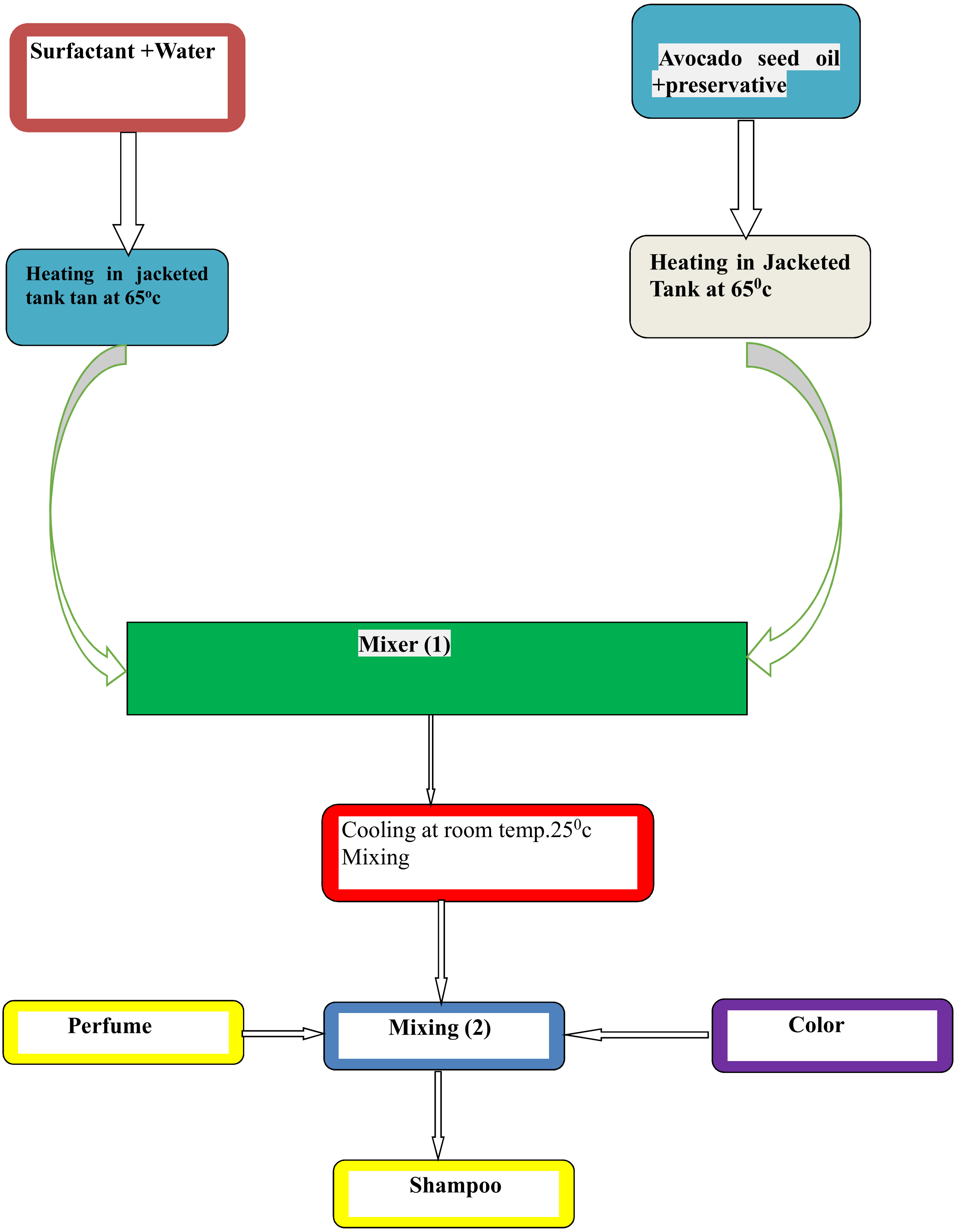


Figure: 3. process flow diagram of shampoo

CHAPTER THREE

MATERIALS AND METHODS

The experimental work has been done in the laboratory of Department of Chemical Engineering, Wolkite University, wolkite, Ethiopia.

3.1. Equipment's used in laboratory

- Miller
- Simple Distillation
- Measuring cylinder
- Beaker
- Soxhlet extractor
- Volumetric round bottom flask
- Thimble
- Digital balance
- Heater
- Thermometer
- Oven
- Knife
- Digital PH meter

3.2. Raw materials and chemicals used in laboratory

- Potassium hydroxide
- Toluene
- Ethanol
- Phenolphthalein indicator
- Deionized Water
- Surfactants (Sodium hydroxide)
- Conditioners (Avocado seed oil)
- Hexane
- Viscosity modifier (sodium chloride)
- Citric acid
- Preservative (Formaldehyde or methyl)
- Color (white)
- Fragrance (perfume)

3.3. Methodologies

We used solvent extraction method to extract the avocado seed oil by using hexane.

3.3.1. Determination of moisture content of the seed of avocado

Two cleaned and sliced samples were weighed and dried in an oven at 110°C for 2 hrs. Then the weight was measured. The percentage moisture in the avocado seed was calculated using the following:

$$\%m_x\ (wb) = \frac{(m_1 - m_2)}{m_1} \times 100\%$$

Where: -m_1 = mass of sample weight before drying

m_2 = mass of sample weight after drying

3.4. Laboratory Procedures for oil extraction from avocado

Avocado was obtained from gubre town. It was first washed and then parts to be removed like peel and other unwanted materials were removed by hand and finally weighted with electronic balance.

Figure: 4. avocado

- The avocado seed chopped with knife & dried on direct sunlight &then at oven with temperature of 110^0C.

Figure: 5. dried avocado seed

- The dried avocado seed was then grounded by using coffee miller.

Figure: 6. Grinded seed

- The powder of avocado seed was inserted to the thimble & here the required measurements were taken before going to the next step.
- Then it was inserted into the Soxhlet apparatus & the heating mantel adjusted at the boiling point of the solvent. The condenser was attached to the water tank at the top and the Soxhlet apparatus at the bottom. The round bottom flask that contains the solvent will be also attached to the bottom of the Soxhlet apparatus.

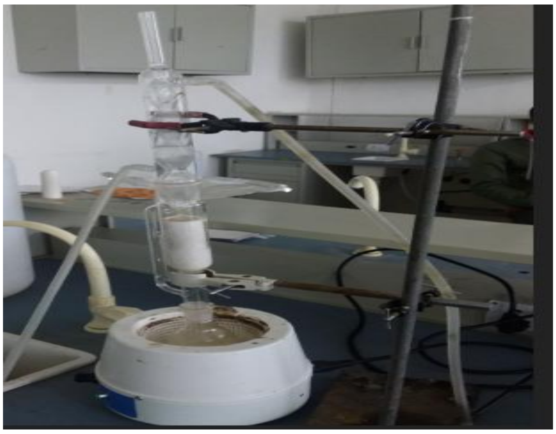


Figure: 7 .soxhlet apparatus

- The extraction time ranges at 3 hours because the optimum extraction and efficiency of extraction is better at 3hour.
- The solvent recovery process was conducted by using simple distillation until the boiling point of the solvent hexane at 69 ^{0}c. The solvent was recovered and the extracted oil was gained.

Figure: 8. Simple distillation

3.5. Avocado seed oil analysis

A. Determination of the yield

25 g (W_1) of the sample was placed in the thimble and about 100ml of n-hexane was poured into the round bottom flask. The apparatus was heated at 69°C and allowed for 3hrs for extraction process. At the end, the cake was weighed and dried in the oven at 80°C until the constant weight (W_2) is attained and the percentage of oil extracted was determined as:

$$\%yield = \left[\frac{w1-w2}{w1}\right]\times 100\%$$

Where;

W1 =weight of sample before extraction

W2 = weight of sample after extraction

(Saxena, et al., 2011)

B. Determination of PH Value

2g of the sample was poured into a clean dry 25ml beaker and 13ml of hot distilled water was added to the sample in the beaker and stirred slowly. It was then cooled. The pH electrode immersed into the sample and the pH value was read and recorded.

C. Determination of Acid Value

25ml of Toluene and 25ml of ethanol was mixed in a 250ml beaker. The resulting mixture was added to 2g of oil in a 250ml conical flask and few drops of phenolphthalein were added to the mixture. The mixture was titrated 3ml with 0.1M KOH to the end point with consistent shaking for which a dark pink color was observed.

The Acid value was calculated as:

Acid value = [(v*C*56.11)/ M]. (Kardash tetal. 2005)

3.6. Laboratory procedure to formulate Liquid Shampoo

A. Water: -De-mineralized water is used to ensure bacterial degradation is minimized, and it should be free from any kind of impurities. 110ml pure water is prepared in beaker.

B. Surfactant (sodium hydroxide):-Preparation of NaOH is extremely caustic and can cause skin burns therefore; carefully 60ml solution sodium hydroxide with 0.1 molar concentrations is prepared

C. Conditioner (avocado seed oil) 20ml was prepared.

The prepared avocado seed oil and 1ml of formaldehyde were kept together in first beaker and sodium hydroxide and de-mineralized water were kept together in second beaker then heated at 65°c for 20 minutes, then immediately mix using stirrer in order to form a uniform solution. The solution was cooled down at room temperature.

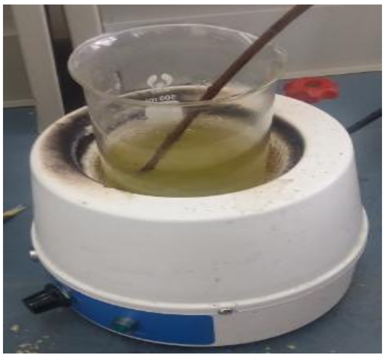


Figure: 9. heating and stirring the solution

D. Viscosity modifier (sodium chloride)

3gm of fine sodium chloride is added in to the prepared solution, and stirred using stirrer this make the formulations thicker and enhance the viscosity to increase.

Finally 1.4ml and 0.4ml perfume and color is added respectively in to the prepared solution, and stirred continuously for 30 minutes in order to get uniform product of shampoo. Eventually using citric acid of 3ml the PH value is adjusted to 6.7 PH. (Ernest W. Flick, 1992).

Figure: 10. shampoo

3.7. Evaluation of liquid Shampoos

To evaluate the prepared formulations, quality control tests including visual assessment and physicochemical controls such as pH, density and viscosity were performed. Also, to assure the quality of products, specific tests for shampoo formulations including the determination of dry residue and moisture content, total surfactant activity, and detergency test is carried out.

1. Physical appearance/visual inspection:-

The formulations prepared were evaluated in terms of their clarity and foam producing ability.

2. Determination of pH:-The pH of 10% shampoo solution in distilled water is determined at room temperature 25°C. The pH is measured by using digital pH Meter

3. Cleaning action:-

5grams soiled human hair is placed at $35^{O}C$ of water containing 10 ml of shampoo in a flask. The flask is shaken for 4 minutes. Then it is washed once again with sufficient amount of water, then after filter the hair dried and weighed. The amount of soil removed is calculated using the following formula.

DP = (1-T/ C)*100% In which, DP is the percentage of detergency power, C is the weight of hair before washing in the control sample and T is the weight of hair after washed in the test sample.

4. Foaming ability and foam stability: -

Cylinder shake method was used for determining foaming ability. 40 ml of the shampoo solution was put into a 250 ml graduated cylinder and covered the cylinder with hand and shaken. The total volumes of the foam contents after shaking will be recorded. The foam volume was calculated only.

CHAPTER FOUR

RESULT AND DISCUSSION

4.1. Laboratory Result for avocado seed oil extraction

1. Moisture content

Table: 2 moistuer content measurment trial data

Trial	m_1	m_1
1	125.6	107.8
2	107.8	107.8

$$\%m_x\,(wb) = \frac{(m1-m2)}{m1}*100\%$$

Trial 1

$$\%mx\,(wb) = \frac{(125.6 - 107.8)}{125.6}\times 100\%$$

$$= 14.2\%$$

Trial 2

$$\%mx\,(wb) = \frac{(107.8 - 107.8)}{107.8}\times 100\%$$

$$= 0\%$$

Table: 3 the effect of particle size on yield of extracted oil

Particle size(mm)	avocado Powder (gm.)	Hexane(ml)	Time(hr.)	Extracted oil(ml)
1	25	100	3	4.8
0.5	25	100	3	7

The sample that has 0.5mm in size extracts higher amount of oil as compared to the sample that has 1mm particle size. The reason behind this is the surface area contact of solvent has increased in case of 0.5mm and whereas in case of 1mm contact surface are between powder avocado and solvent is minimum. The maximum amount of oil percentage obtained by reducing the particle size of the sample because; the surface contact area of solvent with powder avocado was increased.

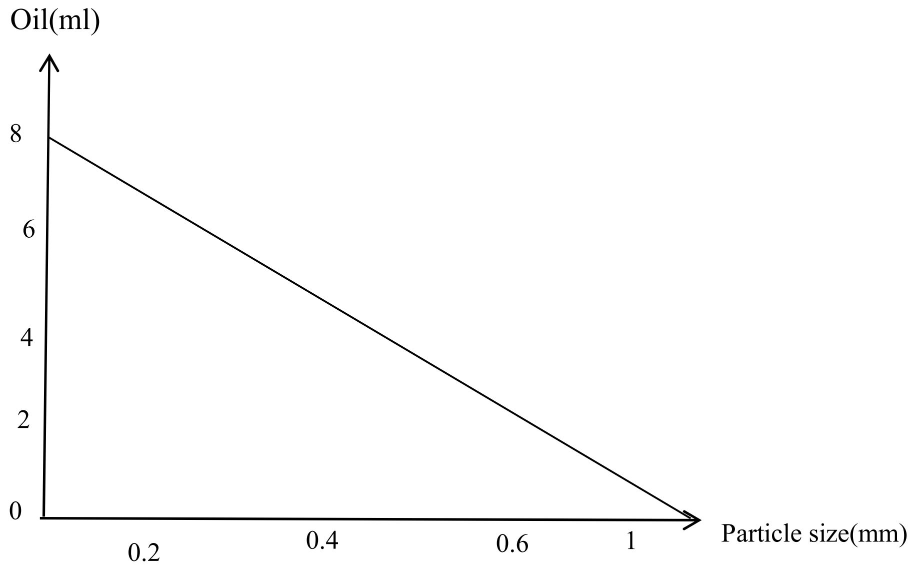


Figure: 11 particle size vs. yield of oil

1. Percent yield

%yield = $\left[\frac{w1-w2}{w1}\right]\times 100\%$

Percent yield for the oil extracted using hexane

W1 =weight of sample before extraction = 25g

W2 = weight of sample after extraction (residue) = 9.8g

%yield = $\frac{(25 - 18)}{25} \times 100\%$

= 28%

Note:-Amount of oil extracted from 25g in ml was found 28%x25g= 7ml for one batch extraction 25g dried and grinded avocado seed oil was used. Since we have run 4 trials the total avocado seed powder used and oil extracted was 100g and 28ml respectively.

2. PH value

Using the PH meter the PH of the oil was determined as 7.2 which indicates the neutrality of the oil.

3. Acid value

Acid Value (AV) = $\left[\frac{v*c*56.11}{M}\right]*100\%$

V= volume of added KOH = 3ml=0.003liter

C= concentration of KOH=0.1mol/liter

M=mass of sample= 2g

Molecular weight of KOH=56.11g/mol

$$AV = \left[\frac{0.003*0.1*56.11}{2}\right] \times 100\%$$

$=0.84\%$

Oil produced using n-hexane as solvent

As shown in the figure the oil is transparent. It has good quality which makes it unique among other types of oils.

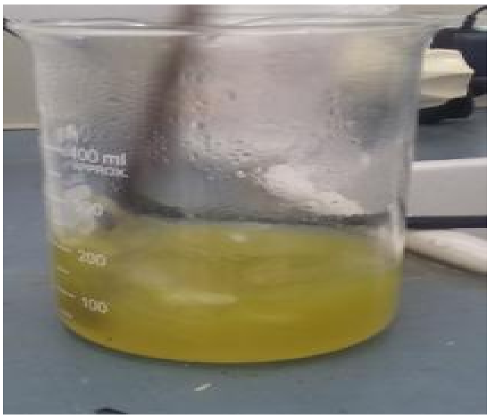


Figure: 12. production of oil using hexane as solvent

4.2. Laboratory results for formulation of shampoo

Using purified avocado seed oil in shampoo formulation as ingredient, to made appropriate formulation of shampoo.

Formulation = 110ml of water, 60ml of NaOH, 20ml of avocado seed oil, 3gm of NaCl, 1.4ml of perfume, 0.4ml of color and 1ml of formaldehyde.

1. Physical appearance/visual inspection

Physical appearance was evaluated just using our common sense eyes. The results of visual inspection of series of formulations are listed in table 4.3 as can be seen, formulations had the good characteristics with respect to foaming. The current trend to promote shampoos of lower pH is one of the ways to minimize damage to the hair. Mild acidity prevents swelling and promotes tightening of the scales, there by inducing shine. The shampoos were acid and base balanced and were ranged 6.7 to 7.2, the pH 7.2 which was good PH value for shampoo

2. Detergency ability

Although cleaning or soil/sebum removal is the primary aim of a shampoo, experimental detergency evaluation has been difficult to standardize, as there is no real agreement on a standard soil, a reproducible soiling process or the amount of soil a shampoo should ideally remove. Shampoos F1, showed moderate detergency.

3. Foam ability and stability

Although foam generation has little to do with the cleansing ability of shampoos, it is of paramount importance to the consumer and is therefore an important criterion in evaluating shampoos.

Table: 4 Evaluation of Formulation for physical appearance, PH, and detergency and foam stability

NO	Formulation	Physical Appearance	pH	Detergency %	Foam volume (ml)
1	F1	Deep yellow, which has good foaming	7.2	56	45

Physiochemical properties of produced liquid shampoo

Table: 5 physiochemical properties of produced liquid shampoo

NO	Physiochemical evaluations	Result
1	pH	7.2
2	Wash ability	Easily washable
3	Foaming capacity	Good foaming
4	Dirt dispersion	Moderate
5	Color	Yellowish
6	Texture	Fine and smooth
7	Nature of hair after washes	Soft manageable

Note: - the above table indicates the summarized results of chemical and physical characteristics of produced shampoo after formulation was carried out at the laboratory.

CHAPTER FIVE

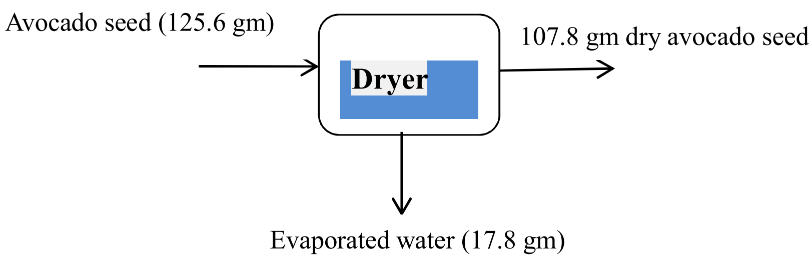
Material and Energy Balance

Material quantities, as they pass through processing operations, can be described by material balances. Such balances are statements on the conservation of mass. Similarly, energy quantities can be described by energy balances, which are statements on the conservation of energy. If there is no accumulation, what goes into a process must come out. This is true for batch operation. It is equally true for continuous operation over any chosen time interval. Material and energy balances are very important in an industry. Material balances are fundamental to the control of processing, particularly in the control of yields of the products.

5.1. Material and Energy Balance for oil laboratory experiment

5.1.1. Material balance for oil extraction

Material Balance on dryer



Mass in + ~~generation~~ = mass out +~~consumption~~ +~~accumulation~~

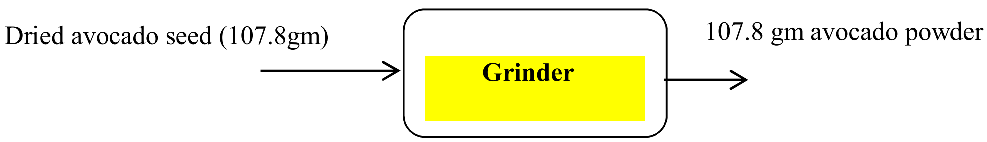
Mass in = mass out

Mass of Avocado seed = Mass of dry avocado + Mass of evaporated water

125.6gm = 107.8gm + 17.8gm

125.6gm = 125.6gm

Material Balance on Grinder



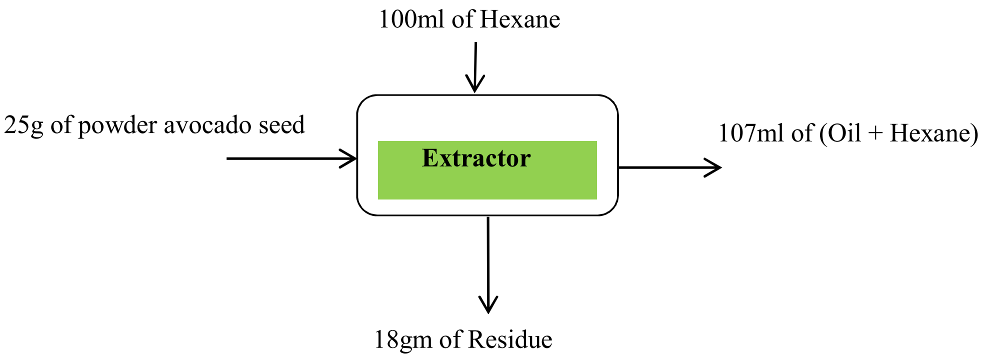
Mass in + ~~generation~~ = mass out +~~consumption~~ +~~accumulation~~

Mass in = mass out

Mass of dried Avocado = Mass of powdered avocado

107.8 gm. = 107.8 gm.

Material Balance on Soxelat extraction



Mass in + ~~generation~~ = mass out +~~consumption~~ +~~accumulation~~

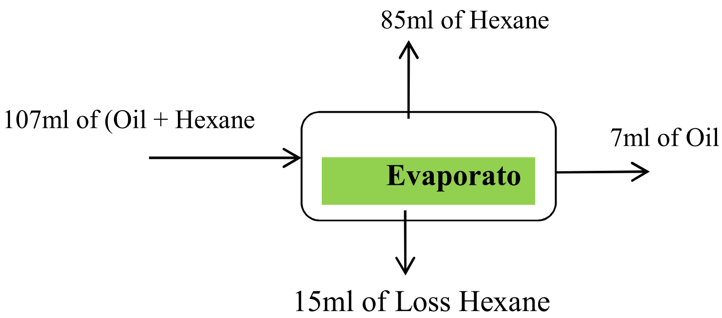
Mass in = mass out

Mass of sample powder Avocado + mass of Hexane = Mass of (oil +Hexane) +mass of residue

25 gm. +100 gm. = 107 gm. + 18 gm.

125 gm. = 125 gm.

Material Balance on Distillation



Mass in + ~~generation~~ = mass out +~~consumption~~ +~~accumulation~~

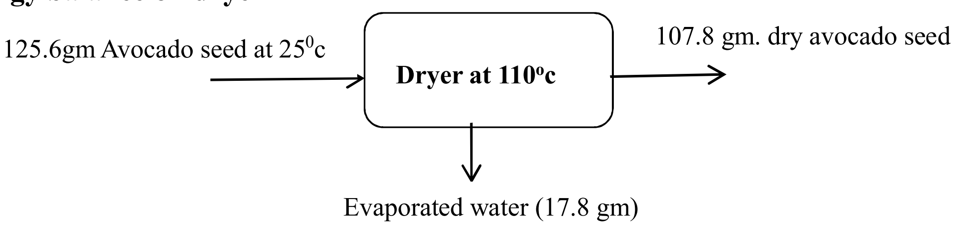
Mass in = mass out

Mass of (Oil + Hexane) = Mass of Hexane + Mass of Oil + mass of loss Hexane 107gm = 85 gm. + 7 gm. + 15 gm.

107 gm. = 107 gm.

5.1.2. Energy Balance for oil in laboratory experiment

Energy balance on dryer



From conservation of energy,

Energy in+ energy ~~generation~~ = energy out + ~~energy~~ consumption + ~~accumulation~~

Energy in = energy out

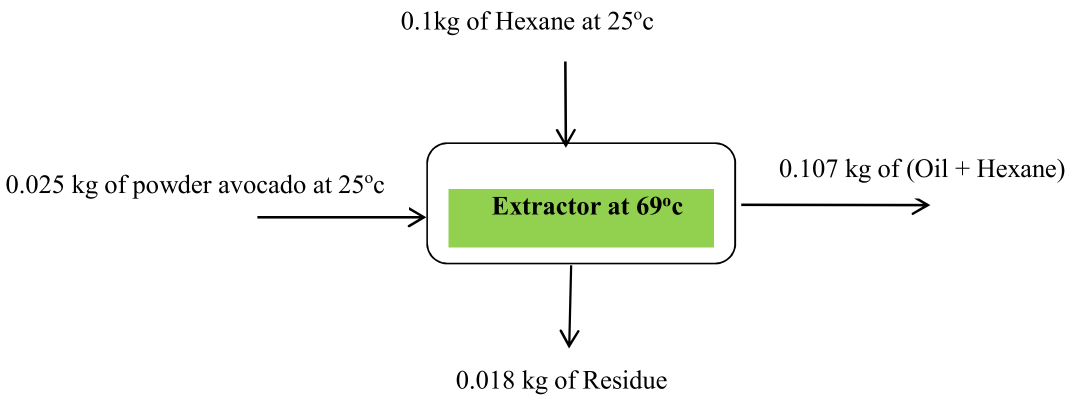
Tin= Temperature in=25ºC

Tout= Temperature out=110ºC

Q= MCP ΔT = (125.6 gm.)*(2.26KJ/Kg.ºC) *(110-25)ºC

Q = 24.127KJ

Energy Balance on soxelat extraction



From conservation of energy

Energy in+ energy ~~generation~~ = energy out + energy ~~consumption~~ + ~~accumulation~~

Energy in = energy out

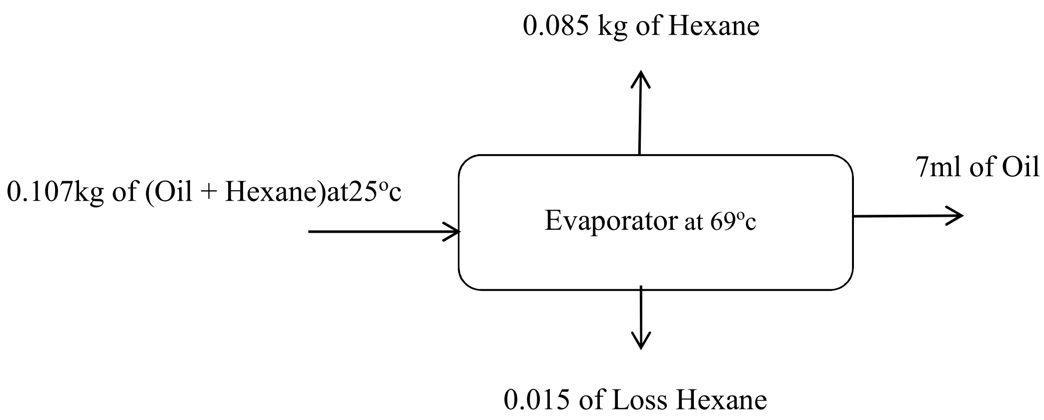
Tin= Temperature in=25ºC

Tout= Temperature out=69ºC

Q= MCP ΔT = (0.025 kg+0.1 kg)*((2.26KJ/Kg.ºC +1.55KJ/Kg.ºC)/2) *(69-25) ºC

Q =10.05KJ

Energy Balance on Distillation



From conservation of energy,

Energy in+ energy ~~generation~~ = energy out + energy ~~consumption~~ + ~~accumulation~~

Energy in = energy out

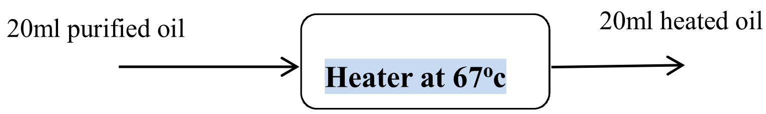
Q= MCP ΔT = (0.107kg)*((2.26KJ/Kg.ºC +1.55KJ/Kg.ºC)/2) *(69-25)ºC

Q =8.96 KJ

5.2. Material and Energy Balance for shampoo production in laboratory experiment

5.2.1. Material Balance for shampoo in laboratory

Material Balance on heater



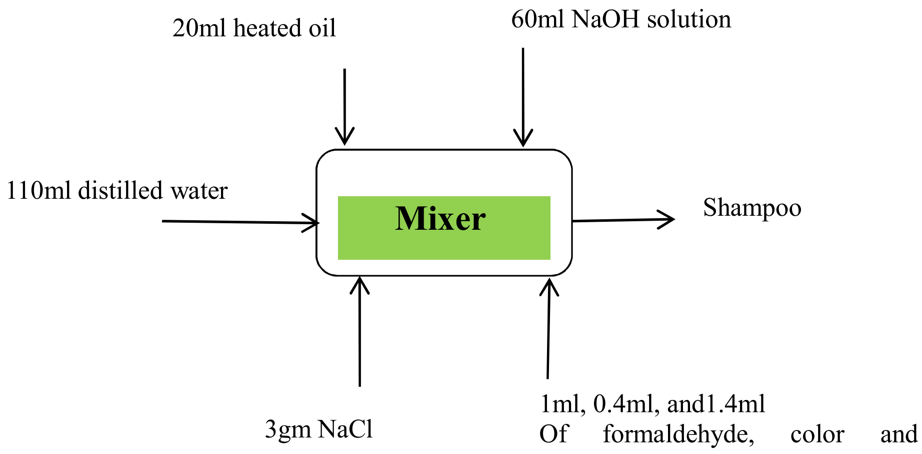
Mass in + ~~generation~~ = mass out +~~consumption~~ +~~accumulation~~

Mass in = mass out

Mass of purified oil = Mass of heated oil

20 gm. = 20 gm.

Material balance on mixer



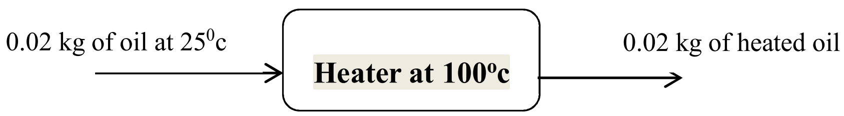
Mass in + ~~generation~~ = mass out +~~consumption~~ +~~accumulation~~

Mass in = mass out

110 gm. distilled water + 20 gm. of heated oil +60 gm. of NaOH of solution +3 gm. of NaCl+ 1gm of formaldehayde+0.4 gm. of color+1.4 gm. of perfume =195.8 gm. of shampoo or 195.8ml of shampoo.

5.2.2 Energy Balance for shampoo production in laboratory

Energy Balance on Heater



From conservation of energy,

Energy in+ energy ~~generation~~ = energy out + energy ~~consumption~~ + ~~accumulation~~

Energy in = energy out

Q= MCP ΔT = (0.02 kg)*(2.26KJ/Kg ºC) *(100-25)ºC

Q =3.39 KJ

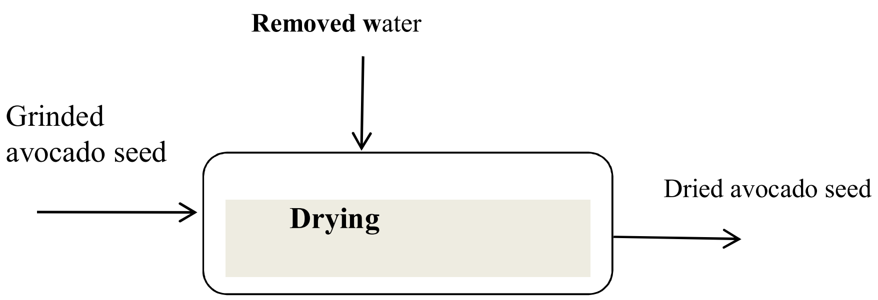
5.3. Material and Energy balance of oil extraction in Industrial Scale

5.3.1. Material balance for oil production in industrial scale up for three main equipments

Assume the oil production capacity is 432tone/year which equals to 60kg/hour and the annual working time is 300 days. To achieve this goal, we have expected to do material and energy balance at each stages of the process. Here we are trying to do the material and energy balance calculation for main equipment's. □

- Plant capacity 432tone/year=60kg/hr.
- Raw material required 245kg/hr.
- The seed contain 12% moisture in wet base
- Recovery of the seed on grinding5% over sizing
- The ratio of solute to solvent 1:10
- The factory works for 300 days/year

Mass balance at drying

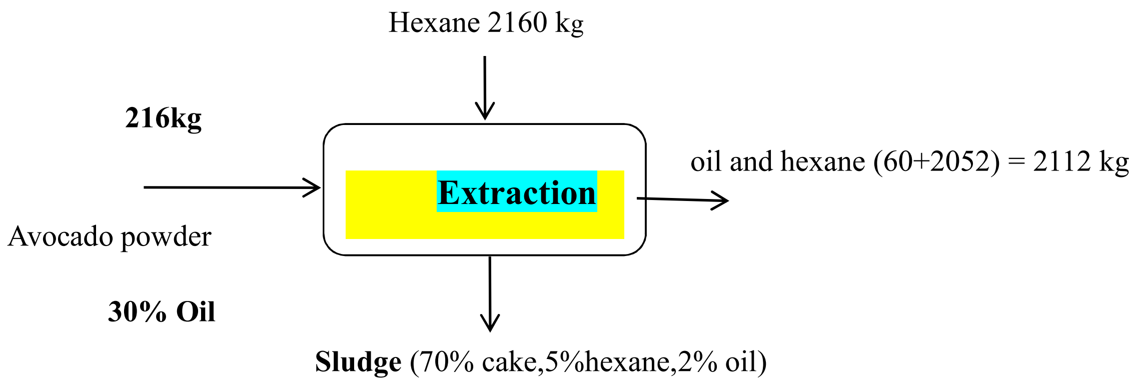


Mass in +~~generation~~ – ~~consumption~~ – mass out = ~~accumulation~~

Mass in = mass out

245 kg = 245 kg*0.12 +dried Avocado seed

Mass balance on extraction



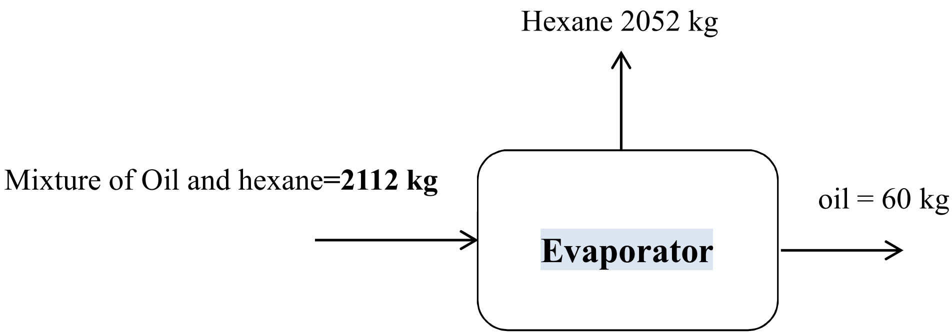
Sludge = 151.2+108 +4.32 = 264 kg

Mass in + generation – consumption -mass out = accumulation

Mass in = mass out

216 kg +2160 kg = 2112 kg+264 kg

Assume hexane recovery is 100%



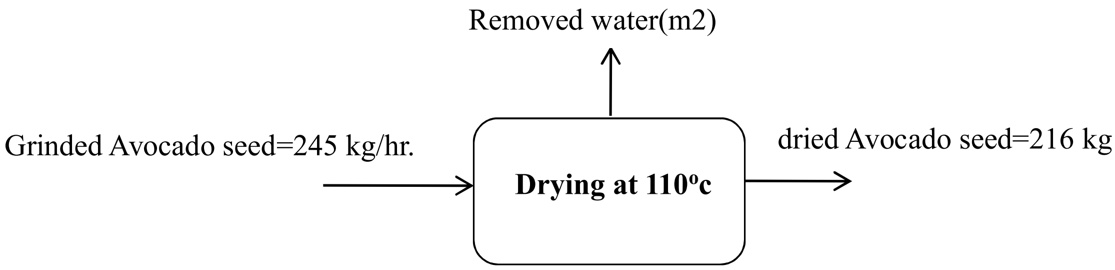
Mass in + generation – consumption -mass out = accumulation

Mass in = mass out

2112 kg =2052 kg + 60 kg

5.3.2. Energy balance of oil extraction in industrial scale up for three main equipments

Energy Balance on drying



From conservation energy

Energy in+ ~~energy generation~~ = energy out + ~~energy consumption~~ + ~~energy accumulation~~

Energy in = energy out

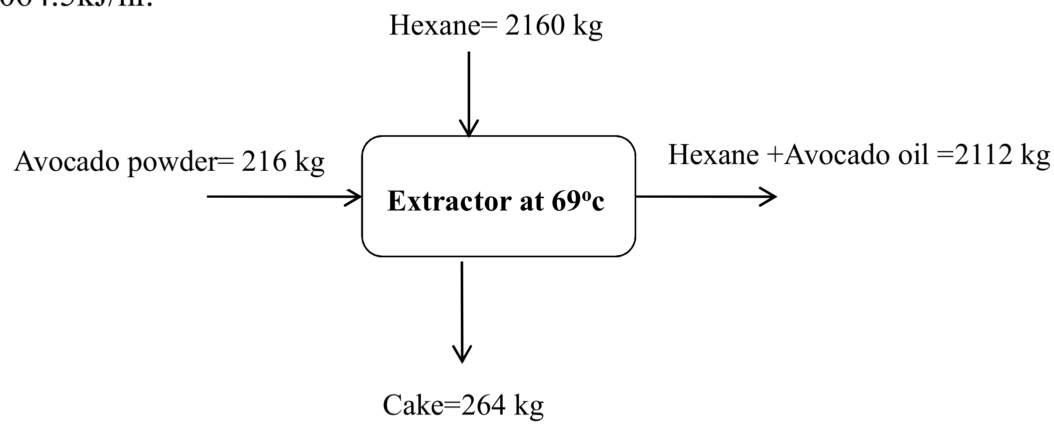
Assumption, The temperature in put=25°c

The temperature of drying is kept 110°c

$Q = mcp\Delta T$

$Q=245\ kg/hr \times 2.26 kJ/kg.^{o}c(110-25)^{o}C$

$Q=47064.5 kJ/hr.$



From conservation of energy,

Energy in+ ~~energy generation~~ = energy out + ~~energy consumption~~ + ~~energy accumulation~~

Energy in = energy out

Tin= Temperature in=25°C

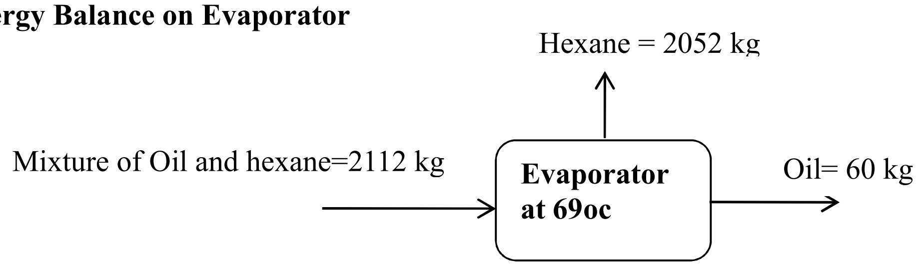
Tout= Temperature out=69°C

$Q= MCP\ \Delta T$

$Q= MCP\ \Delta T = (216+2160)\ kg/hr.*((2.26 KJ/Kg.oC +1.55 KJ/Kg.^{o}C)/2) *(69-25)^{o}C$

$Q= 199156.32 kJ/hr.$

Energy Balance on Evaporator



From conservation of energy,

Energy in+ ~~energy generation~~ = energy out + ~~energy consumption~~ + ~~accumulation~~

Energy in = energy out

Tin= Temperature in=25°C

Tout= Temperature out=69°C

Q= MCP ΔT = (2112 kg/hr.)*((2.26KJ/Kg.oC +1.55KJ/Kg.oC)/2) *(69-25)°C

Q = 177027.84kJ/hr

5.4. Material and Energy balance of shampoo production in Industrial Scale

Since there is no disaggregated data on the amount of powdered and liquid detergents, the views of knowledgeable people in the area have been collected. Accordingly, it was learnt that about 85% of the total volume of imported detergents constitute powdered and the remaining 15% liquid. Taking this as a base, the current demand for liquid detergent is estimated at 138 tons

Table: 6 estimation of market demand amount of liquid detergent in ethiopia

Demand Forecast for liquid detergents (tons)

Year	Quality
2013	146
2014	154
2015	164
2016	174
2017	185
2018	196
2019	207
2020	220

Hence, in order to analyze the unsatisfied demand for detergents the data obtained from the Ethiopian Revenues and Customs Authority on the import of detergents have summarized in the above table.

Note Taking this as a base, the current demand for liquid detergent is estimated at 164tons per year in 2015, for our project. Assume the manufacturing capacity of our factory covers half percent of imported liquid detergent market share in Ethiopia which is 50% i.e. 82 tones /year or 82,000kg/year shampoo.

5.4.1. Main equipment sizing

- **Mixing unit**

Mixing Volume of shampoo is 100,000L (including safety factor)

Working volume 82,000L

Operation time = 300 days/year

One batch feed to the mixer is every six hour=6hr

Total batches per day = 24/6= 4 batches

In one batch = 82,000L/4 =20500L/six hour

From the laboratory result the composition of liquid shampoo is tabulated as follows:

Table: 7 raw material mixing in laboratory scale

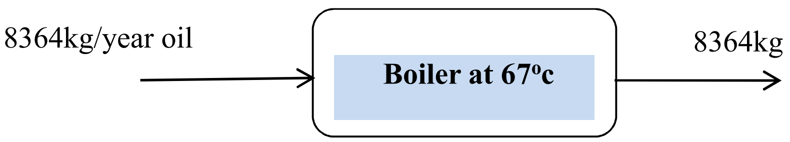
Raw materials	Amount in liter, L	Composition in Percentage (%)
Water	0.11	56.18
Sodium hydroxide	0.06	30.8
Avocado oil	0.02	10.2
Salt	0.003	1.53
Perfume	0.0014	0.71
Formal aldehyde	0.001	0.51
color	0.0004	0.20
Total	0.1958	100%

To get the same proportion in industrial level, 82,000 L of total volume should be fractionated in to components

Raw materials	Amount in liter, L	Composition in Percentage (%)
Distilled water	0.5618x82,000=46067.6L	56.18
Sodium hydroxide	0.308x82,000=25256L	30.8
Avocado oil	0.102x82,000= 8364L	10.2
Sodium chloride	0.0153x82,000=1254.6L	1.53
Perfume	0.0071X82,000=582.2L	0.71
Formal aldehyde	0.0051X82,000=418.2L	0.51
color	0.002X82,000=164L	0.20
Total	82,000L	100%

5.4.2 Material Balance for shampoo production in industrial scale

Material balance on boiler



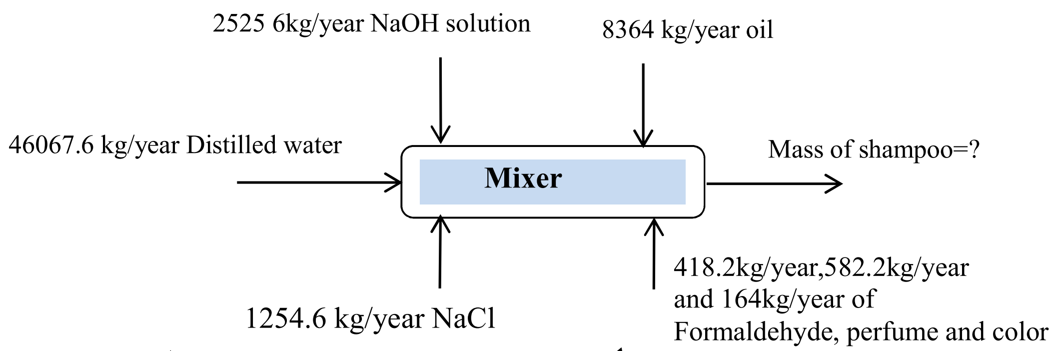
Mass in + ~~generation~~ = mass out +~~consumption~~ +~~accumulation~~

Mass in = mass out

Mass oil = mass of heated oil

8364 kg/year=8364 kg/year

Material balance on mixer



Mass in + ~~generation~~ = mass out +~~consumption~~ +~~accumulation~~

Mass in = mass out

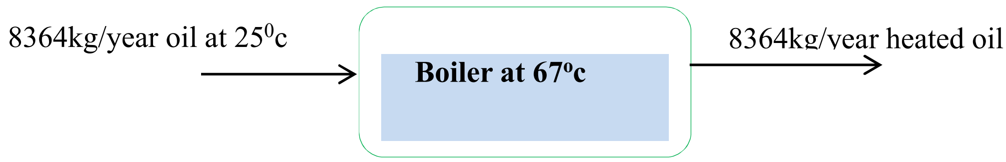
Mass of distilled water + mass of heated oil +mass of NaOH of solution +mass of NaCl+ mass of formaldehyde +mass of color + mass of perfume =mass of shampoo.

46067.6kg/year+8364kg/year+25256kg/year+1254.6kg/year+418.2kg/year+582.2kg/year+ 164 kg/year=mass of shampoo

Mass of shampoo = 82000 kg/year

5.4.3 Energy Balance for shampoo production industrial scale up

Energy balance on boiler



From conservation of energy,

Energy in+ energy ~~generation~~ = energy out + energy ~~consumption~~ + energy ~~accumulation~~

Energy in = energy out

Tin= Temperature in=25°C

Tout= Temperature out=67°C

Q = MCP ΔT

Q = 8364 kg/year)*(2.26kJ/kg.°C)*(67-25)°C

Q = 793910.88 kJ/year

CHAPTER SIX

ECONOMIC COST ANALYSIS

6.1. Equipment cost with specific capacity

Table: 8 list of equipment cost list

No	Name of equipment	No of equipment	Capacity or size	Cost ($)/equipment	Cost for total equipment
1	Horizontal storage tank	1	100,000L	59500	59500
2	Pump	3	0.0508m(di a	3900	7800
3	Vertical storage tank	3	100,000L	59500	59500
4	Mixer	1	500kg/h	90000	90000
5	Grinder	2	2ft	42,652.46s	85,304.93
6	Agitator	1	61.11 rpm	800	800
7	Purifier	1	0.6096m(dia)	24,171.11	24,171.11
8	Washing	1	150kg/hr	3344.48	3344.48
9	Extraction	2	1875L/Day	639,513	1,279,026
10	Evaporator	1	150kg/hr.	81,700	81,700
11	Dryer	1	100ft2	47600	47,600
12	Centrifuge	1	0.508m(dia)	11,900	11,900
13	Packaging	1	0.1016m	3300	3300
14	Heater	1	150L	200	200
15	Conveyer	1	0.9144m	31100	31100
16	Peeler	1	0.6096m	49300	49,300
17	Destoner	1	0.4064m	27990.68	27,990.68
18	Shampoo packing bottles	580,000pice /year	150ml	0.08	1,773,197.2

6.2. Estimation of total product cost

Fixed Capital Investment (FCI) Estimation Direct cost (DC)

Fixed capital: - refers to buildings, industrial plants machinery, and tools, motor, vehicles, office equipment's(max .etal, 1973).the cost of machine and equipment is estimated at about FCI(Fixed capital investment)

A. Cost of equipment + Installation +Instrumentation +Piping +Electricity (50 -60% of FCI)

- Purchased equipment cost (PEC) =1,773,197.2$
- Installation including painting (8-9%PEC) = 8% PEC=141855.776$
- Instrumentation and control (6 % PEC) = 106391.832$
- Piping (80%PCE) = 141855.776$
- Electricity (40% PEC) = 709278.88$

B. Building process including services (10% PEC) = 177319.72$

C. Service utilities (20-80% PEC) = 354639.44$

D. Land (4-8% PEC) = 70927.88$

E. Yard (10-20% PEC) = 177319.72$

Direct cost (DC) = A+B+C+D+E =3652786.142$

Indirect Cost

A. Eng'g and supervision (20% of DC) = 730557.2284$

B. Construction expense and construction fee (18% of DC) =657501.5$

C. Contingency (10% of FCI)

FCI = Direct cost +Indirect cost

FCI= $5040844.87+0.1FCI

FCI=$ 5600938.744

Working capital investment (WCI) = 15% of TCI = 0.15 TCI

Working Capital: -Is mostly referred to us circulating capital which is nonrenewable goods such as raw materials and fund require to pay wages and other claims against the company (Bauman, 1984, Urich, 1986).

Total capital investment (TCI) = FCI + WCI

TCI = $ 5600938.744 + 0.15TCI

TCI =$ 6589339.69

WCI = 0.15 TCI = 0.15*$ 6589339.69= $988400.95

Fixed charges

A. Depreciation (10 % of FCI) = $560093.8744

B. Local taxes (1-2% of FCI) = $56009.38744

C. Insurances (0.4-1% FCI) =$22403.75

D. Rent (8-12% of FCI) = $448075.09

Total fixed charge (TFC) = $1086582.107

Total production cost (TPC) = WC/0.3 = $988400.95 /0.3= $3294669.83

Plant overhead cost (POC) = (5-15% of TPC) = $164733.49

Manufacturing cost = TFC +TPC +POC=$4545985.399

General expense

General expense = Administrative + Distribution and selling cost + Research and development cost + financing (interest) cost

- Administrative costs (2-6% of TPC) = $65893.3966
- Distribution and selling(2-20 %TPC) =$65893.3966
- Research and development(5%TPC) =$164734.99
- Financing (interest)(5% of TCI) = $329466.98
- General expense = $625988.75
- Working day = 300 day/year

Annual shampoo production = 164,000L/year*0.5 = 82,000L/year. Operation time =300 days/year for 24 hrs.

Daily shampoo production =82,000 L/year/ (300day/year) = 273.33L/day

Unit sell price =0.2L=18$ that is 90$/L

Total selling price is = 90$X82, 000L/year= $7,380,000$

Profitability analysis

Gross profit = product sales revenue–total product cost

Gross profit = $7,380,000$/year - $3,294,669.83 /year= $ 4085330.17/year

Therefore depreciation cost = Depreciation=10%fixed capital + 2.5% building

Depreciation = 0.1X$ 5600938.744+0.025X177319.72= $56452

Gross profit including depreciation (Gross Profit - depreciation cost)

= $ 4085330.17/year- $564526.86 = $352080.85/year

Net profit = gross profit with depreciation (1-Ø), where, Ø= income tax of rate Ethiopia =30%

= $352080.85/year *(1-0.3) = $2,464,562.695/year

Minimum acceptable rate of return (mar) for new capacity with established corporate with low Minimum acceptable rate of return (Mar) levels of risk=12%

Rate of Return an Initial Investment (ROI)

$$ROI = \frac{\text{Net Profit}}{\text{Total Capital Investment}} = \frac{\$2{,}464{,}562.695\ /year}{\$6589339.69}$$

$= 0.37*100\% = 37\%$

ROI ≥ Mar (12%), 37% > 12%, so the Project is feasible

6.3 Payback period

$$\text{Pay Back Period} = \frac{FCI - Salvage}{\text{Net profit} + \text{Depreciation}}$$

$$= \frac{\$5600938.744 - 0}{\$2{,}464{,}562.695/year + 564526.86/year}$$

$$\frac{\$5600938.744}{3{,}029089.55}$$

= **1.85year**

Pay Back Reference

Pbref = 0.85/ (mar + 0.85/n) = 0.85/ (0.12 + 0.85/1 0) = 4years,

PBP < PBref, so the Project is Feasible

CHAPTER SEVEN

SITE SELECTION AND ENVIRONMENT EFFECT

7.1 Site Selection

The site selection is decided based on the raw material availability, infrastructure, and other related facilities. Hence taking these things in to consideration the site for Plant erection could be around southern part of Ethiopia specifically Arbaminch, Wolaita, Dilla and around these areas. In these particular areas there is enormous amount of avocado plantation with abundant source of avocado fruit. In addition to this, selecting this area also provide additional geographical advantage, because land is cheap compare to other areas especially around Addis Ababa. Generally, this area has selected based on factors which enhance us to maximize feature targeted profit and to achieve our project without any obstacles.

The consideration relevant to this Study includes:

- Easily availability of raw material (Avocado seed)
- Depend on the market location and transportation service.
- Good infrastructure, high availability and low cost of labor force.
- Amount of area required for the plant

7.2. Environmental effect

Our production process is environmental friendly. Both the oil extraction and formulation of shampoo using this extracted avocado oil as ingredient do not affect the environment, because it does not generate toxic wastes. Since Production of shampoo not involves any complex process, it will not lead to generation of toxics substances. Prepared row materials inter in to mixer and all inputs will out in the form of product, so there is no generation of waste which can affect or hurt surrounding environment. Actually there is some residues which generate during oil extraction process, but this by product will not throw away like other by product, instead it utilized for animal feed stocks, therefore it enhance us to generate some money from our by product. Generally extraction of avocado oil and formulation of shampoo using this extracted oil totally has no any significant impact on environment, so establishing this plant and starting production is absolutely safe and effective

7.3 Plant layout for shampoo manufacturing process

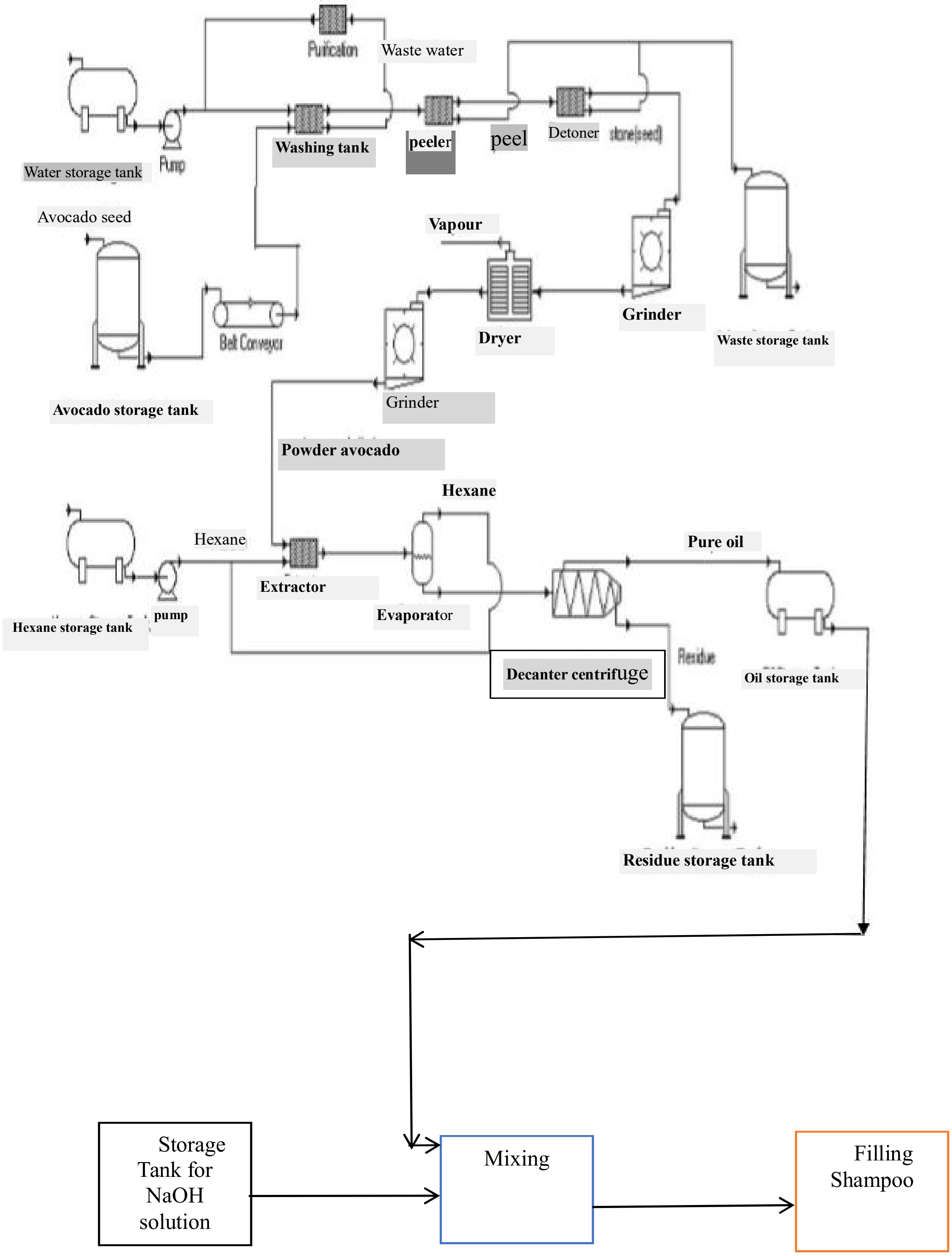


Figure: 13. process flow diagram for liquid shampoo production

CHAPTER EIGHT

CONCLUSION AND RECOMMENDATION

8.1. Conclusion

A lot of trials and investigations were carried out to extract oil from avocado seed. As we observed from lab results, particle size have great effects on percentage yields of the oil. From 25gm of mass which has 1mm avocado powder and extraction time of 3hr the yield of oil found was 4.8ml and for the same mass and 0.5mm avocado powder the yield found was 7ml. From this result we conclude that as particle size decreases the yield of oil content increases. In lab we have used this formulation = 110ml of water , 60ml of NaOH, 20ml of avocado oil, 3gm of NaCl, 1.4ml of perfume, 0.4ml of color and 1ml of formaldehyde, Generally this project study presents a number of flourished abundant minerals which found in avocado seed oil. This oil plays a great role in the produced shampoo, because of its unique minerals, and therefore gives good quality for the produced shampoo. Since this shampoo has good quality, it can satisfy consumer anticipation demand and can be packed for use.

8.2. Recommendation

- During this project we have faced a lot of challenges that affects our laboratory results like there was insufficient laboratory equipment's and chemicals (like oven, distilled water, SLS, perfume…). So we recommend that there should have be appropriate and sufficient equipment's and chemicals to do laboratory experiments.
- Further study shall be conducted at the impurity, besides that we recommend that the detergent and cosmetics factories that imports carrier oil from aboard, it is better to produce thus domestically. Because there is cheap raw material, farming land with suitable climate and cheap labor force. So that government and other stockholders has to encourage and attracting investors to participate in this sectors.
- In addition to this we recommend other types of formulations to investigate or to find a way of other production mechanism to enhance change in phase such as solid or powder other than liquid shampoo. Since our shampoo has unique quality for treatment of damaged hair, we recommend for those who has such problem to choose our product.

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APPENDIX

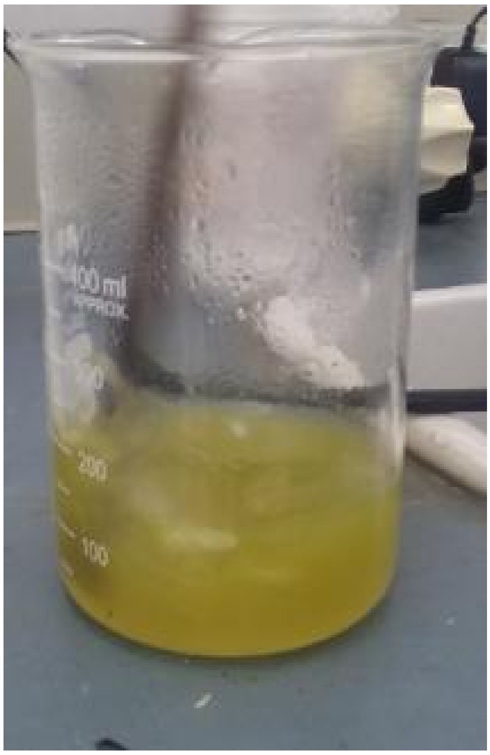
Appendix 1: Some photos taken during working in laboratory

Avocado

Dried avocado seed

Soxhlet apparatus

Grinded seed



Simple distillation   Oil produced using n-hexane as solvent

Heating and stirring of the solution   Shampoo

Appendix2: Typical values for some measurement

Measurements	**Unit**
Boiling Point of Hexane	69^0c
Boiling Point of Oil	271^0c
Specific Heat Capacity of oil	2.26KJ/kg 0C
Specific Heat Capacity of Hexane	1.55KJ/kg 0C
Density of Water	1000kg/m3
PH of Water	7
PH of oil	7.2
PH of shampoo	6.7