Declaration

I hereby declare that this project is a record of research work that was undertaken and written by me. It has not been presented before, for any degree and diploma or certificate at any university or institution. Information derived from personal communications, internet, published and unpublished works were duly referenced in the text.

________________________ ________________________

Osuonda, Manasseh Adah Date

CERTIFICATION

"This is to certify the project entitled Production of Black-soap Gel with *Aloe-vera* and *Edza* Concentrates" by Osuonda, Manasseh adah meets the regulation s governing the award of the degree of Bachelor of Engineering (B. ENG.) of the Federal University of Technology, Minna and it is approved for its contribution to scientific knowledge and literary presentation.

27th Feb. 2012

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27/02/2012

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Date

22-02-2012

External Examiner

Date

Dedication

I dedicate this master piece of research work to the glory of God Almighty for the gift of life and my parent for the parental guidance throughout my moments of joy and discouragement.

PRODUCTION OF BLACK-SOAP GEL WITH *ALOE-VERA* AND *EDZA* EXTRACTS.

BY

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FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA

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Abstract

African Black soap is indigenous to black continent and is much sought after on account of local lore surrounding its efficacious effects on the skin. The colour of this type of soap ranges from light brown to deep black, depending on indigenous ingredients and method of production. Considerable amount of unripe plantain peels, maize cobs, pawpaw leaves, and shear bark were sourced, and oven dried to 100^0c to a constant weight, which were ashed and use to obtain the various potassium hydrioxide used in producing the saop. Ingredients used in the soaps include; honey, egg albumen, camwood, *aloe vera*, flavours and water. The soap production process starts from extraction of alkali, to the extraction of aloe vera, down to processing of the camwood, to the production of the soap using the hot process, and then the characterization of the soap. The produced soap has pH value of 11, foamability of 39mm, and corrosiveness value of 1.54%, which indicates that the produced soap is within the standard values, thus harmless to the skin. Nigeria should try to tap into recycling of wastes to generate revenue and job for a large number of the populace, as this can be a highly lucrative business, if ventured into.

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CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

African Black soap is indigenous to black continent and is much sought after on account of local lore surrounding its efficacious effects on the skin. It is known by many names, these includes 'Ose Dudu', as it is called among the Yorubas of Western Nigeria, 'Sabulun solo', as it is called among the Hausas in the Northern Nigeria, 'Oshapuru Ugi', as it called among the Afos in Nasarawa state of Nigeria, 'Eko Zhiko', as it is called among the Nupes in North-central of Nigeria, a term which literally means "black soap." Black soap is said to have been used throughout the African diaspora. (http://www.soapmakingfun.com, wikipedia, March 23, 2007).

The colour of this type of soap ranges from light brown to deep black, depending on indigenous ingredients and method of production. Palm oil, palm kernel oil, cocoa butter and shea butter are commonly used as base oil, while the lye component, usually in the form of potash (potassium hydroxide), is derived from the ashes of plantain peels, cocoa pods, shea tree bark and the by-products of shea production. It is mild and good for sensitive skin. It is well known for its healing or dermatological properties. Partly because of the plantain skins used in its production, the soap is rich in vitamins A and E, and is considered a treatment for skin diseases like eczema, rashes, acne etc. It also provides relief to children suffering from ring worms and measles. African Black soap is also a natural shampoo for the hair, and has been prescribed for dry, itchy scalp. This beneficial effect on the scalp is attributed to the lubricating property of palm kernel oil (http://www.soapmakingfun.com, wikipedia, march 23, 2007).

1.1.2 History of Soap Making

The earliest recorded evidence of the production of soap-like materials dates back to 2800 BC in Ancient Babylon. A formula for soap consisting of water, alkali and cassia oil was written on a Babylonian clay tablet around 2200 BC.The Ebers Papyrus (Egypt, 1550 BC) indicates that ancient Egyptians combined animal and vegetable oils with alkaline salts to produce a soap-like substance. Egyptian documents mention that a soap-like substance was used in the washing wools ready for weaving (Wikipedia, june 14, 2010).

Finer soaps were later produced in Europe around the 16th century, using vegetable oils (such as olive oil) against the animal fats. Many of these soaps are still produced, both industrially and on small scale basis. Castile soap is a popular example of the vegetable-only soaps derived by the oldest "white soap" of Italy. In modern times, the use of soap has become universal in industrialized nations due to a better understanding of the role of hygiene in reducing the population size of pathogenic microorganisms. Industrially manufactured bar soaps first became available in the late eighteenth century, as advertising campaigns in Europe and the United States promoted popular awareness of the relationship between cleanliness and health (Wikipedia, june 14, 2010).

1.1.3 Cleansing Property of Soap

Soaps are useful for cleaning because soap molecules have both a hydrophilic end (which dissolves in water) and hydrophobic end (which is able to dissolve non-polar grease molecules). Although grease will normally adhere to skin or clothing, the soap molecules can form micelles which surround the grease particles which enables it to be dissolved in water. Applied to a soiled surface, soapy water effectively holds particles in colloidal suspension so it can be rinsed off with clean water. The hydrophobic portion (made up of a long hydrocarbon chain) dissolves dirt and oils, while the ionic end dissolves in water. Therefore, it allows water to remove normally-insoluble matter by emulsification. In other words, while normally oil and water do not mix, the addition of soap allows oils to dissolve in water, allowing them to be rinsed away (Willcox and Micheal, 2000).

1.2 Statement of problem

The traditional African conventional black-soap is faced with unfavourable features of causing itches on the human body; this depends on the concentration of the constituents and the user's body chemistry. Also, due to the hygroscopic nature of the product, the crude black-soap easily melts on contact with moisture at room temperature, hence becoming less durable. Floors and walls of the bathrooms/toilet are usually stained with lathers from the black-soap. Hence, this often discourages its usage.

1.3 Objectives of the Study

(i) to develop another brand of black-soap with fascinating fragrance which enhanced value addition

(ii) to develop a value-chain analysis from production to finished product of the black-soap

1.4 Justification of the study

This study is aimed at the production of improved black-soap capable of relieving acne scarring, reducing oily skin, clearing blemishes on the skin, eliminating skin irritation like rashes, reducing the discomforts associated with eczema, most especially on children's skin. This also has the ability of thorough cleansing of the body and keeping the body fresh always, as skin diseases that give the body a bad look are cleaned up by the soap. The improved black is also economical in usage as wastage is greatly reduced.

1.5 Scope of the study

This study covers the production of the new era black soap, value-addition techniques and value-chain analysis for economic enhancement and entrepreneurial skills and development.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Soap Production using Ash Derived Alkali

The productions of soaps from ash-derived alkalis have an old-age craft in Nigeria and many West African countries (Nwoko, 1982). Ash-derived alkalis offer cheap alternatives to imported ones. According to Irvine (1965), agricultural waste materials contain a good percentage of potash. These materials include palm bunch waste, cocoa pod, plantain peels, banana leaves, maize cob, shear butter tree, sugar beet waste and many others. When these materials are burnt in air, the resulting ashes contain oxides of potassium and sodium which when dissolved in water yields the corresponding hydroxides according to the equations;

$$K_2O + H_2O \rightarrow 2KOH \qquad (2.1)$$

Or

$$Na_2O + H_2O \rightarrow 2NaOH \qquad (2.2)$$

The Romans first produced soap nearly 5000 years ago from wood ashes and animal fat (Kirk and Othmer, 1969). Large-scale commercial production did not start however until the early eighteenth century. Then, soap was produced by the kettle process, which involves boiling fats and oils with caustic soda. By 1938, several commercial feasible continuous processes had been developed. These have largely replaced the kettle process. Soap comprises sodium and potassium salts of various fatty acids, but chiefly of oleic, stearic, palmitic, lauric and myristic acids; i.e. the alkali metal salts of long chain monocarboxylic acids.

Generally, soap makings are based on alkaline hydrolysis reaction, saponification, according to the equation:

$C_3H_5(OOCR)_3 + 3KOH \rightarrow 3KOOCR + C_3H_5OH$ (2.3)

Fat potassium hydroxide salt glycerol

Or

$C_3H_5(OOCR)_3 + 3NaOH \rightarrow 3NaOOCR + C_3H_5OH$ (2.4)

Fat sodium hydroxide salt glycerol

Where R represent the hydrocarbon chain or alkyl group.

Commercially, the fat is gotten from tallow, lard, palm oil, palm kernel oil, coconut oil, marine oil, etc. Potassium hydroxide is obtained from the electrolysis of potassium chloride using a mercury cathodic cell (Kirk and Othmer, 1969); sodium hydroxide is obtained from a similar electrolytic decomposition of sodium chloride. Although at present, palm oil and palm kernel oil for the local soap making in Nigeria are readily available, nearly all the alkali for soap making are imported. Furthermore, Nigeria at present lacks the resources to build a modern alkali plant. Following the call by the federal government of Nigeria, for industries to as much as possible source their raw materials locally, a need has risen for local supply of the alkali needed in soap making. Sourcing of the alkali from agricultural waste to replace imported ones has therefore become attractive (Onyegbado, 2002).

Moreover, Edowor (1984) estimated on annual availability of over 30,000 tonnes of potassium hydroxide derivable from cocoa pod wastes alone, in Nigeria; which more than necessary met the importation requirements of potassium hydroxide and sodium hydroxide of 26,000 tonnes in 1985. Also Onifade (1994) asserted that the dumping of cocoa pod waste in concentrated heaps on the farms can cause adverse effect to soil fertility and that hogs and other livestock could not completely remove the total waste available, as fodder. Thus the mentioned agricultural wastes needed to be removed from the farms and were indeed potential viable resources which should be harnessed (Onifade 1994, and Edowor 1984).

Unfortunately, the soaps which had been made when such alkalis derived from vegetable matter ashes were reacted with palm oil in Nigeria and indeed in the entire West African sub region, had always been "soft'', black and smelly, although they have good lathering abilities and good cleansing properties. As a result, they had found limited uses in the modern sector. Analysis of the extract by Nwoko (1980) and others (Onyekwere, 1996 and Kuye, 1990) showed that the extract was chiefly potassium hydroxide with some quantities of sodium hydroxide. Other metallic ions present constituting as whole about 2% of the metallic ions present, were Ca^{2+}, Cr^{2+}, B^{3+}, Zn^{2+}, Fe^{3+}, Pb^{2+} and Ni^{2+}. The ''softness'' of the soap made from the extract could therefore be attributable to its large content of potassium hydroxide, as potassium hydroxide soap are known to be softer than the ones made from sodium hydroxide and have found uses in various areas as liquid soaps; as shampoos; shaving creams; cleaning of dirty floors and kitchen utensils; in emulsion polymerization processes used in rubber and plastic industries and in such other similar uses. In West Africa, ash-derived alkali soaps have been used as medicinal soaps for body cleansing (Nwoko, 1980).

2.2 Properties of Soap

The properties of the soap are governed by the nature of the fatty acids from which they are derived, and to a lesser extent, by the nature of cation with which the fatty acids are combined.

2.2.1 Solubility Property of Soap

Chemically, a soap is a sodium or potassium salt of a fatty acid. The negatively charged carboxylate group is hydrophilic (attracted to water) and the long hydrocarbon chain is hydrophobic (repelled by water) and lipophilic (attracted to oils). In water, soap forms a cloudy solution of micelle clusters of about 100 to 200 soap molecules with their polar ''heads'' (the carboxylate groups) on the surface of the cluster and their hydrophobic '' tails'' (the hydrocarbon chain) enclosed within. The micelle is an energetically stable particle because the hydrophilic groups are hydrogen bonded to the surrounding water, while the hydrophobic groups are shielded within the interior of the micelle, interacting with other hydrophobic groups (George, 1984).

2.2.2 Foaming Property of Soap

Foam consists of a mass of gas bubbles dispersed in a liquid. Thin films of liquid separate the bubbles from each other and most of the volume in the gas phase. Factors that affect foaming properties are the extent of absorption from solution at liquid-gas interphases, the rheological characteristics of the absorbed films, gaseous diffusion, bubble size distribution and temperature (Bennett and Edward, 1986).

Usually calcium and magnesium are precipitated from solutions of sodium soap in hard water, but they do not have additional surface effect as foam breakers. A few exceptions appear among calcium soap. For example, the foam of sodium oleate solutions is destroyed in the presence of calcium salts (Kirk-Othmer, 1969).

2.2.3 Cleansing Property of Soap

Dirt has been defined as matter in wrong place. When soap is used for cleaning, soap serves as surfactant in conjunction with water. The cleaning action of this mixture is attributed to the action of micelles, tiny spheres coated on the outside with polar carboxylate groups, encasing a hydrophobic (lipophilic) pocket that can surround the grease particles, allowing them to dissolve in water. The hydrophobic portion is made up of long hydrocarbon chain from the fatty acid. In other words, whereas normally oil and water do not mix, the addition of soap allows oils to dissolve in water, allowing them to be rinsed away. Synthetic detergent operates by similar mechanisms to soap (Wikipedia, 2010).

2.3 Raw Materials for this Project

2.3.1 Ash Concentrate (KOH)

The chemical compound potassium hydroxide (KOH), sometimes known as caustic potash, potassa, potash lye, and potassium hydrate, is metallic base. It is a toxic, corrosive, water soluble, white solid, melting at 360^0C; used to make soap and matches, and as an analytical reagent and chemical intermediate. It is very alkaline, along with sodium hydroxide, lithium hydroxide, calcium hydroxide, barium hydroxide and strontium hydroxide (Sybil, 1986).

2.3.1.1 Properties of Ash Concentrate (KOH)

Pure potassium hydroxide is a colourless, highly hygroscopic, solid crystalline compound, having density of about $2.04g/cm^3$, readily soluble in water (1g KOH dissolves in 0.5g water) and lower alcohols (methanol, ethanol, propanols; solubility in ethanol), as well as other polar solvents. The dissolution in water is strongly exothermic, producing substantial amount of energy in form of heat, leading to temperature rise, sometimes up to boiling point and over; concentrated aqueous solutions are called potassium lye. Potassium hydroxide forms solid hydrates, namely the monohydrate $KOH \cdot H_2O$, the dihydrate $KOH \cdot 2H_2O$, and the tetrahydrate $KOH \cdot 4H_2O$; it used therefore as a highly intensive desiccant agent, e.g. for drying liquid amines or their solutions in different non-polar solvents (such as hydrocarbons). It is a highly basic compound, forming strongly alkali solutions in water and other polar solvents, capable of deprotonating many acids, even weak ones, and decompose some inorganic as well as organic materials, e.g. dissolution and hydrolysis of fats in concentrated KOH solutions (Schumann and Siekmann, 2005).

Potassium hydroxide is also an important industrial chemical, used to manufacture many industrial as well as commercial goods and products, for example, most potassium salts; it's also an important laboratory chemical and reagent, again, used to prepare potassium salt, to neutralize acids, further as basic standard in analytics and many more applications. As a very strong base/alkali, potassium hydroxide is strongly corrosive, both towards inorganic as well as organic materials, including living tissues; care must be therefore taken, when handling the substance and its solutions. Its corrosive nature is sometimes used in cleaning and disinfection of resistance surfaces and materials (Schumann and Siekmann, 2005).

2.3.1.2 Uses of Potassium Hydroxide

2.3.1.2.1 Agricultural uses: The agricultural uses of KOH include the correction of the pH of acidic soils, as fungicide and as herbicide.

2.3.1.2.2 Biological and Medical Tests and Diagnostics: Here, potassium hydroxide can serve the following functions: KOH test (to diagnose fungal infections), Whiff test (to diagnose bacterial vaginosis). In botany and mycology, an aqueous solution (typically 10% or less) of KOH hydroxide is used to rehydrate dried herbarium material in preparation for microscopy. Also in palynology, an aqueous solution of KOH is used to deflocculate soil particles aggregated onto pollen grains. It is also used in medical therapeutics (human and veterinary medicine) disbudding calves horns; dissolving scales and hairs.

2.3.1.2.3 Manufacturing and Commercial Chemical Processes of Potassium Hydroxide

KOH is a major industrial chemical because it is used as a base in a wide variety of chemical processes. Some uses of KOH includes: the acrylate ester copolymer coating, the anti-foaming agent used in the manufacture of paper, the saponifying oil for liquid oils for liquid soap, the formulation aid for food. It also used as a pH control agent (raises pH by neutralizing acids), in the making of polyethylene resins, in textile processing and as a catalyst in reactions like the production of biodiesel. Others includes the manufacture of many cleaning product, such as: washing powders, cleansers (for tubes, tile, etc), some dentures cleaners, non-phosphate detergents, drain or pipe cleaners (clog dissolvers) and widely used in carpet cleaning degreasers.

2.3.2 *Aloe-Vera*

2.3.2.1 Origin of *Aloe Vera*

Aloe vera also known as the true or medicinal aloe is a species of succulent plant that takes it origin in the southern half of the Arabian Peninsula, Northern Africa, the Canary Islands and Cape Verde. *Aloe vera* grows in arid climates and is widely distributed in Africa, India and other arid areas. The species is frequently cited as being used in herbal medicine (Ernst and Marshall, 2000).

Aloe vera is a stemless or very short-stemmed succulent plant growing to 60–100 cm (24–39 in) tall, spreading by offsets. The leaves are thick and fleshy, green to grey-green, with some varieties showing white flecks on the upper and lower stem surfaces. The margin of the leaf is serrated and has small white teeth. The flowers are produced in summer on a spike up to 90 cm (35 in) tall, each flower pendulous, with a yellow tubular corolla 2–3 cm (0.8–

1.2 in) long. Like other *Aloe* species, *Aloe Vera* forms arbuscular mycorrhiza, a symbiosis that allows the plant better access to mineral nutrients in soil (Yates, 2002).

2.3.2.2 Cultivation of *Aloe vera*

The plant *aloe vera* has been widely grown as an ornamental plant. The species is popular with modern gardeners as a putatively medicinal plant and due to its interesting flowers, form and succulence (Yates, 2002). This succulence enables the species to survive in areas of low natural rainfall, making it ideal for rockeries and other low-water use gardens. It is intolerant of very heavy frost or snow. The species is relatively resistant to most insect pests, though spider mites, mealy bugs, scale insects and aphid species may cause a decline in plant health. In pots, the species requires well-drained sandy potting soil and bright sunny conditions; however, in very hot and humid tropical or subtropical climates, aloe plants should be protected from direct sun and rain, as they will burn and/or turn mushy easily under these conditions. The use of a good quality commercial propagation mix or pre-packaged "cacti and succulent mix" is recommended as they allow good drainage. Terracotta pots are preferable as they are porous. Potted plants should be allowed to completely dry prior to re-watering (Coleby-Williams, 2008). When potted aloes become crowded with "pups" growing from the sides of the "mother plant," they should be divided and re-potted to allow room for further growth and help prevent pest infestations. During winter, *Aloe Vera* may become dormant, during which little moisture is required. In areas that receive frost or snow the species is best kept indoors or in heated glasshouses (Wikipedia, 27 August, 2010).

2.3.2.3 Uses of *Aloe Vera*

Scientific evidence for the cosmetic and therapeutic effectiveness of *Aloe Vera* is limited and when present is frequently contradictory (Ernst, 2000). Despite this, the cosmetic and alternative medicine industries regularly make claims regarding the soothing, moisturising and healing properties of *Aloe Vera*, especially via Internet advertising. *Aloe Vera gel* is used as an ingredient in commercially available lotion, yogurt, beverages and some desserts. *Aloe vera* juice is used for consumption and relief of digestive issues such as heartburn and irritable bowel syndrome (Reynolds, 2004). It is common practice for cosmetic companies to add sap or other derivatives from *Aloe Vera* to products such as makeup, tissues, moisturizers, soaps, sunscreens, incense, razors and shampoos. Other uses for extracts of *Aloe Vera* include the dilution of semen for the artificial fertilization of sheep, use as fresh food preservative, and use in water conservation in small farms (Wikipedia, 27 August, 2010).

The *Aloe vera* plant has a long association with herbal medicine, although it is not known when its medical applications were first discovered. Early records of *Aloe Vera* use appear in the Ebers Papyrus from 16th century BCE (Barcroft and Myskja, 2003), in both Dioscorides' *De Materia Medica* and Pliny the Elder's *Natural History* written in the mid-first century CE along with the *Juliana Anicia Codex* produced in 512 CE (Reynolds, 2004). *Aloe Vera* is non-toxic, with no known side effects, provided the aloin has been removed by processing. Taking *Aloe Vera* that contains aloin in excess amounts has been associated with various side effects. However, the species is used widely in the traditional herbal medicine of China, Japan, Russia, South Africa, the United States, Jamaica and India (Wikipedia, 27 August, 2010).

The *Aloe vera* extract is alleged to be effective in treatment of wounds (Vogler and Ernst, 1999). Evidence on the effects of *Aloe vera* sap on wound healing, however, is limited and contradictory. Some studies, for example, show that *Aloe vera* promotes the rates of healing, while in contrast, other studies show that wounds to which *Aloe Vera* gel was applied were significantly slower to heal than those treated with conventional medical preparations. A more recent review (2007) concludes that the cumulative evidence supports the use of *Aloe vera* for the healing of first to second degree burns (Maenthaisong et al, 2007). In addition to topical use in wound or burn healing, internal intake of *Aloe vera* has been linked with improved blood glucose levels in diabetics, and with lower blood lipids in hyperlipidaemic patients, but also with acute hepatitis (liver disease). In other diseases, preliminary studies have suggested oral *Aloe vera* gel may reduce symptoms and inflammation in patients with ulcerative colitis (Langmead et al, 2004). Compounds extracted from *Aloe vera* have been used as an immunostimulant that aids in fighting cancers in cats and dogs; however, this treatment has not been scientifically tested in humans (Wikipedia, 27 August, 2010).

2.3.3 Camwood (*Edza*)

2.3.3.1 Origin of Camwood

Camwood (*Baphia nitida*), also known as African sandalwood, is a shrubby, hard-wooded tree with it origin from Africa (West Africa). Its wood is commonly used to make a red dye. The earliest dye wood (Camwood) was from West Africa. Camwood is very common amongst the Nupe land in Niger state, Nigeria. They process it into a powdery form which they refer to as 'edza', and used intensively by them in bathing new born babies, and mixed with locally produced black soap for bathing by adults, which works very well in the curing of skin diseases. The source of the dye, which is soluble in alkali, is the bark and heart of the tree. Camwood is a red dye-wood imported from tropical West Africa, and obtained from the Baphia nifida, a leguminous tree, of the suborder Caesalpinieae. This wood is of a very fine colour, and is used in turnery for making knife handles and other similar articles. The dye obtained from it is brilliant, but not permanent. It is called sometimes Bar-wood, though this name belongs also to another tree (Wikipedia,13 May, 2010).

2.3.3.2 Cultivation of Camwood

Camwood is easy to cultivate and can be propagated by seeds and cuttings. For best results cuttings should be taken from rather young parts. Often grows as an understorey tree in wetter parts of coastal regions, in rainforest, in secondary forest and on abandoned farmland, from sea-level up to 600 m altitude (Burkill, 1995).

2.3.3.3 Uses of camwood

Camwood has many uses, most especially here in Africa. Camwood and its leaves are used to cure parasitic skin diseases. It is pounded, and the juice of the leaves extracted, mixed, and applied against parasitic skin, and a leaf infusion is drunk to cure enteritis and other gastrointestinal problems. In Ghana, Côte d'Ivoire and Nigeria the leaves and bark are considered haemostatic and anti-inflammatory, and are used for healing sores and wounds. In Côte d'Ivoire powdered leaves are taken with palm wine or food to cure venereal diseases, and leaf sap is applied as eye drops against jaundice. An extract of young leaves of camwood with some salt and red pepper is used as nose drops against headache (Onwukaeme and Lot, 1992).

In Nigeria powdered heartwood is made into an ointment with Shea butter (obtained from the seeds of *Vitellaria paradoxa* C.F.Gaertn.) which is applied against stiff and swollen joints, sprains and rheumatic complaints. In Sierra Leone a bark decoction is drunk to cure cardial pain and bark and leaves are prepared as an enema to treat constipation. In Nigeria and Ghana the pounded dried root, mixed with water and oil, is applied to a ringworm-like fungus attacking the feet. Finely ground root bark, mixed with honey, is taken against asthma.

In Côte d'Ivoire a leaf extract of camwood and *Senna occidentalis* (L.) Link is drunk against asthma. In Benin a decoction of the leaves is taken against jaundice and diabetes; in combination with leaves of *Morinda lucida* Benth. it is a treatment against female sterility and painful menstruation. Externally it is applied, together with *Cissus quadrangularis* L., against bone fractures. A decoction of the bark is drunk against epilepsy. (Burkill, 1995)

2.3.4 Egg (Albumen)

Egg lay by females of different species of birds, including fishes, have probably been eaten by mankind for millennia. Eggs of birds consist of a protective eggshell, albumen (egg white), and vitellus (egg yolk), contained within various thin membranes. Popular choices for egg consumption are chicken, duck, roe, and caviar; but by a wide margin the egg most often humanly consumed is the chicken egg (Howe et al, 2004).

Egg yolks and whole eggs store a lot of protein and choline, and are widely used in cookery. Due to their protein content, the USDA (United States Department of Agriculture) categorizes eggs as *Meats* within the Food Guide Pyramid. Despite the nutritional value of eggs, there are some potential health issues arising out of egg quality, storage, and individual allergies (USDA).

Chickens and other egg-laying creatures are widely kept throughout the world, and mass production of chicken eggs is a global industry. There are issues of regional variation in demand and expectation, as well as current debates concerning methods of mass production (Wikipedia, 18 April, 2011).

2.3.4.1 Varieties of Egg

Bird eggs are a common food and one of the most versatile ingredients used in cooking. They are important in many branches of the modern food industry (Montagne, 2001). The most commonly used bird eggs are those from the chicken. Duck and goose eggs, and smaller eggs such as quail eggs are occasionally used as a gourmet ingredient, as are the largest bird eggs, from ostriches. Gull eggs are considered a delicacy in England (Roux et al, 2006), as well as in some Scandinavian countries, particularly in Norway. In some African countries, guineafowl eggs are commonly seen in marketplaces, especially in the spring of each year (Stadelman, 1995). Pheasant eggs and emu eggs are perfectly edible but less widely available. Sometimes they are obtainable from farmers, poulterers, or luxury grocery stores. Most wild birds' eggs are protected by laws in many countries, which prohibit collecting or selling them, or permit these only during specific periods of the year (Wikipedia, 18 April, 2011).

2.3.4.2 Nutritional value of Egg

Eggs add protein to a person's diet, as well as various other nutrients. Chicken eggs are the most commonly eaten eggs. They supply all essential amino acids for humans, and provide several vitamins and minerals, including vitamin A, riboflavin (vitamin B_2), folic acid (vitamin B_9), vitamin B_6, vitamin B_{12}, choline, iron, calcium, phosphorus and potassium. They are also a single-food source of protein (Wikipedia, 18 April, 2011).

All of the egg's vitamin A, D, and E are in the egg yolk. The egg is one of the few foods that naturally contain vitamin D. A large egg yolk contains approximately 60 Calories (250 kilojoules); the egg white contains about 15 Calories (60 kilojoules). A large yolk contains more than two-thirds of the recommended daily intake of 300 mg of cholesterol (although one study indicates that the human body may not absorb much cholesterol from eggs). The yolk makes up about 33% of the liquid weight of the egg. It contains all of the fat, slightly less than half of the protein, and most of the other nutrients. It also contains all of the choline, and one yolk contains approximately half of the recommended daily intake. Choline is an important nutrient for development of the brain, and is said to be important for pregnant and nursing women to ensure healthy fetal brain development (Wikipedia, 18 April 2011).

2.3.5 Honey

Honey is the accumulation of the nectar gathered by bees during their frequent visits to different flowers as the bee look for food. It a sweet and viscous fluid produced by honeybees and other insects from the nectar of flowers (Root A.I. and Root E.R., 2005).

2.3.5.1 Honey Production

Honey is laid down by bees as a food source. In cold weather or when food sources are scarce, bees use their stored Honey as their source of energy. (National Honey Board 2 September, 2007). By contriving for the bee swarm to make it home, in a hive there are three types of Bee: The single queen bee, a seasonally variable number of drone Bees to fertilize new queens, and some 20,000 to 40,000 worker bees. The worker bees raise larva and collect the nectar that will become Honey in the hive (Val Whitmore, 2007). They go out, collect the nectar that will become honey in the hive. They go out, collect the sugar-rich flower nectar, release vasonove pheromones and return to the hive, and these pheromones enable other bees to find their way to the site by smell. Honey bees also release Masonry pheromones at the entrance to the live which enable returning bees to return to the proper hive (Roger Hoopgarner, 1990). In the hive the bees use their "Honey Stomach" to ingest and regurgitate the nectar a number of times until it is partially digested (Standifer, 2007). It is then stored in the Honey comb. Nectar is high in both water content and natural yeasts which unchecked should cause the sugars in the nectar to ferment (National Honey board 2 September, 2007).

After, the final regurgitation, the honeycomb is left unsealed Bees inside the hive fan their wings, creating a strong draft across the Honey comb which enhances evaporation of much of the water from the nectar (National Honey Board 14 April, 2007). The reduction in water content, which raises the sugar concentration, is as a result of fermentation. Ripe Honey, as removed from the hive by the beekeeper, has a long shelf life and will not ferment (National Honey Board, 2007).

2.3.5.1 Nutritional Value of Honey

Honey is a mixture of sugars and other compounds with respect to carbohydrates, honey is mainly fructose (about 38.5%) and glucose (about 31.0% (National Honey Board, 5 May, 2008), making it similar to the synthetically produced inverted sugar syrup which is approximately 48% fructose, 47% glucose and 5% sucrose. Honey's remaining carbohydrates include maltose, sucrose and other complex carbohydrates (National Honey Board, 5 May, 2010).

Honey contains trace amounts of several vitamins and minerals (USDA Nutrient Data laboratory, 24 August, 2007). It's with all nutritive sweeteners; honey is mostly sugars and is not a significant source of vitamins or minerals (American sugar Alliance, 1997).

Honey also contains tiny amounts of several compounds thought to function as antioxidants, including chrysin, pinobaksin, vitamin c, caalase pinocembrin. (Martos, 2000 & Ghedolf, 2002)

The specific composition of any batch of honey will depend largely on the mix of flowers available to the bees that produced the honey (American sugar Alliance, 1997).

Honey has a density of 1.36Kg/Litre (36% denser than water) (Rainer kell, food & Agricultural Organisation of the UN (FA ISBN 92-5-103819-8)

Table 2.1 Nutritional Value per 100g of Honey

Nutrition	Unit	percentage
Energy 300Kcal	1270KJ	
Carbohydrates	82.4g	
Sugars	82.12g	
Dietary fiber	0.2g	
Fat	0g	
Protein	0.3g	
Riboflavin (Vit.B2)	0.039mg	3%
Niacin (Vit.B3)	0.121mg	1%
Pantothenic acid (B5)	0.068mg	1%
Vitamin B6	0.024mg	5%
Folate (Vit. B9)	2μg	1%
Vitamin C	0.5mg	1%
Calcium	6mg	1%
Iron	0.42mg	3%
Magnesium	2mg	1%
Phosphorus	4mg	1%
Potassium	52mg	1%
Sodium	4mg	0%
Zinc	0.22mg	2%

The data shown in table 2.1 represent the different class of food in Honey

2.3.6 Palm Kernel Oil (P.K.O)

Palm kernel oil is obtained from the dried empty kernels of palm fruits. It is nowadays used extensively in making cosmetic products around the world.

Palm kernel oil characteristics resemble those of coconut oil and the oils are used more or less interchangeable with coconut oil. Palm kernel oil is used principally in soap and edible products such as confectionery items. Non-hydrogenated palm kernel is much different than palm oil. Palm kernel oil is made from the kernel of the palm fruit, rather than the flesh. It has good saturation and low molecular weight, which makes it a good addition for hard soaps that leather well in all types of water (Wikipedia, 2009).

2.4 Value Chain

The value chain, also known as value chain analysis, is a concept from business management that was first described and popularized by Michael Porter in 1985. This business tool is new approach taken by many management strategists. Value chain analysis is not only a means of identifying poverty reduction strategies (Mitchell, 2009), but also has been successfully in large Petrochemical Plant Maintenance Organizations to show how Work Selection, Work Planning, Work Scheduling and finally Work Execution can (when considered as elements of chains) help drive Lean approaches to Maintenance. The Maintenance Value Chain approach is particularly successful when used as a tool for helping Change Management as it is seen as more user friendly than other business process tools (Microlinks, 2009).

2.4.2 Concept of Value Chain

A value chain is a chain of activities for a firm operating in a specific industry. The business unit is the appropriate level for construction of a value chain, not the divisional level or corporate level. Products pass through all activities of the chain in order, and at each activity the product gains some value. The chain of activities gives the products more added value than the sum of added values of all activities. It is important not to mix the concept of the value chain with the costs occurring throughout the activities (Wikipedia, 2010).

The value chain categorizes the generic value-adding activities of an organization. The "primary activities" include: inbound logistics, operations (production), outbound logistics, marketing and sales (demand), and services (maintenance). The "support activities" include: administrative infrastructure management, human resource management, technology and procurement. The costs and value drivers are identified for each value activity.

2.4.3 Significance of Value Chain

The value chain framework quickly made its way to the forefront of management thought as a powerful analysis tool for strategic planning. The value-chain concept has been extended beyond individual firms. It can apply to whole supply chains and distribution networks. The delivery of a mix of products and services to the end customer will mobilize different economic factors, each managing its own value chain. The industry wide synchronized interactions of those local value chains create an extended value chain, sometimes global in extent. Porter terms this larger interconnected system of value chains the "value system." A value system includes the value chains of a firm's supplier (and their suppliers all the way back), the firm itself, the firm distribution channels, and the firm's buyers (Porter, 1996).

2.4.4 Theory of Value Chain Analysis

Porter (1985) developed a generic value chain model that comprised of a sequence of activities found to be common to a wide range of firms. To better understand this model, it is useful to separate the business system into a series of value-generating activities referred to as the value chain.

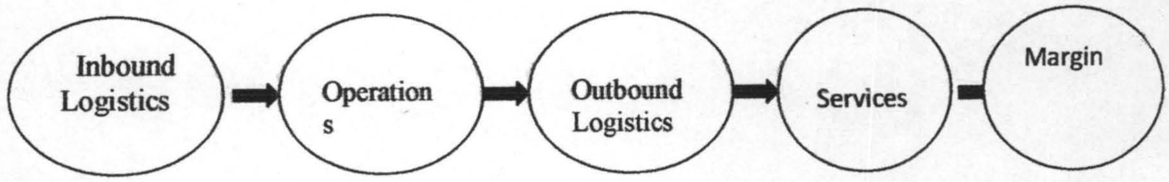

Fig. 2.1 Porter's Generic Value Chain Model

The goal of these activities is to offer the customer a level of value that exceeds the cost of the activities, thereby resulting in a profit margin.

2.4.5 The primary value chain activities are:

i Inbound Logistics: the receiving and warehousing of raw materials and their distribution to manufacturing as they are required.

ii Operations: the processes of transforming inputs into finished products and services.

iii Outbound Logistics: the warehousing and distribution of finished goods.

Iv Marketing and Sales: the identification of customer needs and the generation of sales.

V Service: the support of customers after the products and services are sold to them.

2.4.6 The primary activities are supported by:

i The infrastructure of the firm: organizational structure, control systems, company culture.

ii Human resource management: employee recruiting, hiring, training, development, and compensation.

iii Technology development: technologies to support value-creating activities.

iv Procurement: purchasing inputs such as materials, supplies, and equipment.

The firm's margin or profit then depends on its effectiveness in performing these activities efficiently, so that the amount that the customer is willing to pay for the products exceeds the cost of the activities in the value chain. It is in these activities that a firm has the opportunity to generate superior value. A competitive advantage may be achieved by reconfiguring the value chain to provide lower cost or better differentiation.

The value chain model is a useful analysis tool for defining a firm's core competencies and the activities in which it can pursue a competitive advantage.

2.4.7 Functions of Value Chain

The following are the basic functions of Value Chain:

i. Research and Development
ii. Design of Products, Services, or Processes
iii. Production
iv. Marketing & Sales
v. Distribution

vi. Customer Service

CHAPTER THREE

3.0 MATERIALS AND METHODS

3.1 Materials

The materials used in this study includes: oven, furnace, weighing balance, pH meter, a sieve set, a perforated container and laboratory glassware. Reagents used are: Concentrated hydrochloric acid (HCl), Phenolphthalein indicator, Potassium Hydroxide, *Aloe Vera* Extract, flavour, Granulated Camwood (*edza*), Honey, Potassium Hydroxide, Palm Kernel Oil (*edin*), and Distilled water.

3.2 Methods

The experiment is sub-divided into five stages namely:

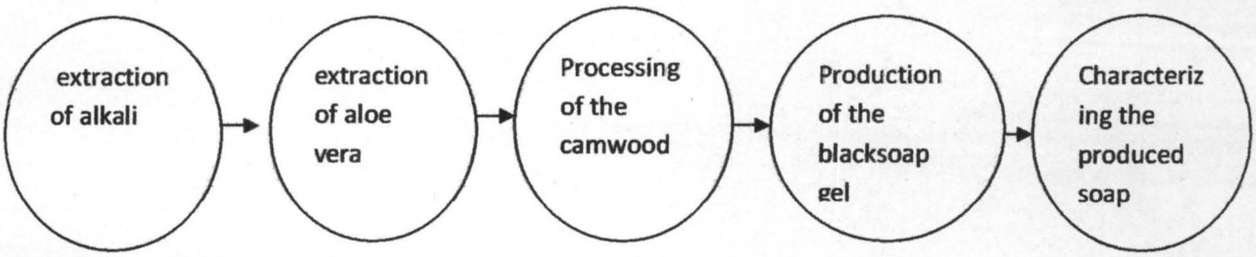

Fig 3.1 Stages in the Soap Production.

3.2.1 The Extraction of Alkali

Considerable amount of unripe plantain peels, maize cobs, pawpaw leaves, and shear bark were sourced, and oven dried to 100^0c to a constant weight. The agricultural wastes were individually kept in an open combustion pan and heated, until the agricultural waste products ignite. A metallic rod with a wooden handle was used to turn the burning agricultural waste products ensuring a uniform combustion. The ash sample of each of material was homogenized by crushing by hand and then sized to remove large particles. Slurry of the ash sample was then made with distilled water in a perforated container covered with sieve at the bottom, and then left until the water drained out of the container through the perforated holes beneath the container. This is referred to as ash-alkali extract. This is shown as follows;

57.91g of pawpaw leaves ash was dissolved in 500ml of distilled water

58.15g of plantain peels ash was dissolved in 500ml of distilled water

66.08g of maize cobs ash was dissolved in 500ml of distilled water

62.52g of shear bark ash was dissolved in 500ml of distilled water

Therefore; 255.66g of ash dissolves in 2000ml of distilled water.

A **B** **C** **D**

Plate 3.1 Extracted Alkali

A= Maize Cob Alkali

B= Shea bark alkali

C= Plantain peels Alkali

D= Pawpaw Leaves Alkali

3.2.2 The Extraction of Aloe Vera Extract from Aloe Vera Plant.

The aloe vera leaves were first of all soaked in a container containing water in other to remove dirt on them. This was followed by hand washing of each individual leaf, and then sanitizing rinse to sterilize leaves. Each leaf of the aloe vera plant was then trimmed to remove the ends and sides, after which filleting of the leaves was done to remove the gel. The gel was then grinded to liquefy it, which was then followed by heating of the gel to about 100^0c(in other to get the concentrates). Finally, it was stabilized to achieve microbial protection, by ensuring that it was not exposed to air for more than four hours to avoid oxidation.

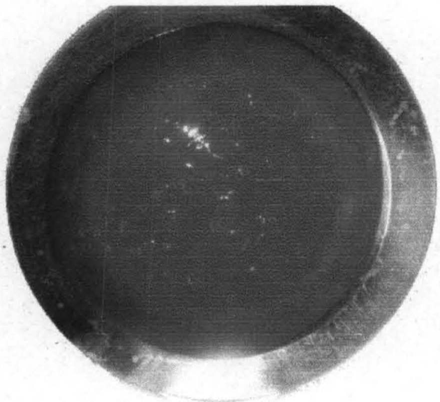

Plate 3.2 *Aloe vera* Concentrate

3.2.3 Processing of Camwood

The camwood was cut into logs and sun-dried for a period of three months to excessively remove the water content in the logs of the camwood. The logs were then pounded into smaller pieces, and also pounded for the second time to get smaller particles of the camwood.

The smaller particles gotten were then sun-dried for a minimum of five hours, after which it was grinded via a grinding stone into a powdery form. Grinding machine could also be used for the grinding of the small particles of the camwood. The grounded camwood was finally sieved to get a smoother powder, which was used as one of the concentrate in the production of the soap.

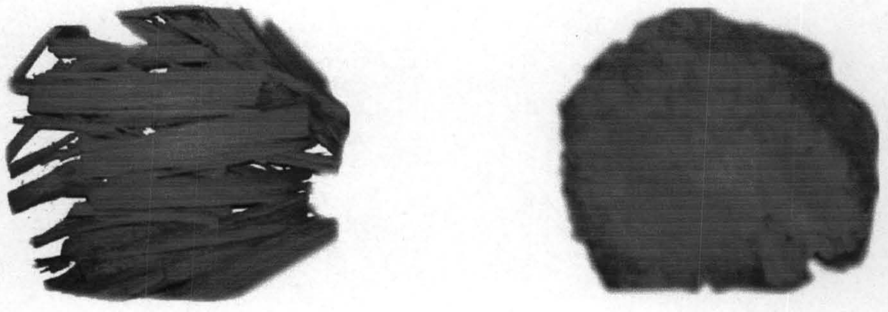

Plate 3.3 Left: Camwood sticks, Right: Granulated Camwood

3.2.4 Production of the Black-soap gel

Using a measuring cylinder, 500ml of palm kernel oil purchased from the gwari traders in minna market, Nigeria, was measured and poured in a stainless steel pot, and kept on a hot plate regulated to a temperature range of 90 to 95^{0}c. The palm kernel oil was heated to 50 to 55^{0}C. 116.5ml of ash concentrate was then poured into the palm kernel oil and stirred thoroughly for 2 to 3 minutes to ensure proper mixing. The mixture was cooked for two hours with interval of fifteen minutes stirring. The mixture was then dropped and stirred thoroughly. Distilled water was boiled and 248.3ml was measured and poured into the soap with a thorough stirring of the soap about ten minutes. 45g of aloe vera, 40g of camwood (*edza*), 40g of honey, and 40g of egg (albumen) were added to the liquid soap and stirred. The liquid soap was then closed and kept for twenty four hours, stirring at intervals, after which glycerine remains at the topmost layer of the mixture was removed using a spatula. A pH test was conducted with a pH test strip, after which 35ml of ethyl butyrate (pineapple flavour) was added and stirred. Details of this is shown below

3.2.4.1 Determination of the quantity of Reagent Used for the Soap Production

The saponification reaction for this experiment, which is between palm kernel oil and potassium hydroxide, is as shown below:

$C_3H_5[OC_{13}H_{27}CO]_3$ +	$3KOH$ →	$3C_{14}H_{27}O_2K$ +	$C_3H_5(OH)_3$	3.1
Myristin (P.K.O)	Caustic →	Potassium	Glycerol	
	Potash →	Myristate		
722g	168.3g →	798g	92g	

3.2.4.2 Determination of the quantity of Potassium Hydroxide required

From the Stoichiometric equation 3.1:

722ml of palm kernel oil require 168.3g KOH

1ml of palm kernel require 168.3/722 = 0.233g KOH

500ml of palm kernel oil will require 500 x 168.3/722 = 116.5g KOH

3.2.4.3 Determination of the quantity of Soap Produced from Palm Kernel Oil

From the stoichiometric equation 3.1:

722g of palm kernel oil yield 798g anhydrous soap

1g palm kernel oil yields 798/722 = 1.1053g anhydrous soap

100g of palm kernel will yield 100 x 798/722 = 110.53g anhydrous soap

Therefore;

500g of palm kernel oil will yield 500 x 798/722 = 552.65g i.e. 552.65g anhydrous soap

Note; soap is not sold in anhydrous form (i.e. water free). Analysis shows that commercial soap will be sold containing 31g water and 69g anhydrous soap. Hence,

69g anhydrous soap yield 100g commercial soap

552.65g anhydrous soap yielded 552.65 x 100/69 = 800.94g commercial soap

3.2.4.4 Determination of Glycerine produced from Palm Kernel Oil

From the stoichiometric equation:

722ml palm kernel oil produce 92ml glycerine

1ml palm kernel oil produce 92/722 = 0.127ml glycerine

500ml palm kernel oil will produce 500 x 92/722 = 63.7ml glycerine

3.3.5 Characterizing the Produced Soap

In characterizing the produced soap, the physical and chemical properties are observed. The properties includes pH, foamability, and corrosive test.

3.3.5.1 Determination of pH

The pH of the soap sample was determined using a pH meter (with glass electrode) standardized using pH buffer solutions and distilled water.

3.3.5.2 Determination of Foamability

About 2g of the soap produced from the palm kernel oil sample was weighed and transferred into a 500ml measuring cylinder containing 150ml of distilled water. Foams were generated by continuously shaking the cylinder for about 20 seconds and allowing the cylinder to stand for about 5 minutes after which the remaining height of foam was taken and recorded.

3.3.5.3 Corrosiveness Test

This test is based on calculating the percentage of unconverted potassium hydroxide (KOH) present in the produced soap. The soap produced can have different reactiveness to the human skin, plastics and metal surfaces. The test determines how mild or hazardous the soap sample is. The test is carried out by dissolving 0.5g of the soap in 150ml of hot distilled water. After proper dissolution, 3 to 4 drops of phenolphthalein was added to produce a pink colour. 0.01M of HCL was titrated against the soap solution until the end point was reached. The end point here changed to orange, and the volume of the acid was read from the burette.

CHAPTER FOUR

4.0 EXPERIMENTAL RESULTS AND DISCUSSION

4.1 Experimental Results

An outline of the results obtained from the experimental work is recorded. These include the weight of the plantain peels, pawpaw leaves, maize cob, and shea bark when originally acquired, the weight after oven drying, the weight after it has been ashed, determination of the concentration of the extracted KOH solution using flame photometer, characterization of the properties of the produced soap

During the drying period of the plantain peels, maize cobs, pawpaw leaves, shea tree, changes in their weight were recorded as follows:

Table 4.1: The Drying Period of Plantain Peels, Pawpaw Leaves, Maize Cobs and Shea bark to a Constant Weight.

Day	Weight of plantain peels(g)	Weight of pawpaw leaves(g)	Weight of maize cobs(g)	Weight of shea bark(g)
1	3887.1	2981.7	4207.3	9247.8
2	2844.8	1807.1	2611.9	6917.5
3	1284.9	1007.3	1506.2	3796.7
4	1000.6	903.4	1251.9	3272.3
5	1000.6	903.4	1251.9	3272.3

Table 4.2: The Concentration of the Various Potassium Hydroxides (KOH)

Potassium hydroxide (KOH)	Concentration (mg/l)
Plantain peels	16415
Pawpaw leaves	3953
Maize cobs	5092
Shea bark	3417

Table 4.3: Physical properties of the characterized palm kernel oil

Physical Property	Value	Attribute	Units
Melting point	27.3	-	°C
Odour	-	Nutty flavour	-
Colour	-	Yellow	-
Taste	-	Palm kernel oil taste	-
Density	2.3	-	kg/m^3

Table 4.4: Properties of the produced soap

Property	Value	Attribute	Units
PH	11.48	_	-
Corrosiveness	1.54275	_	%
Foamability	39	_	mm
Density	1.03955	_	kg/m^3
Odour	_	Pineapple	_
Colour	_	Brown	_

4.2 Discussion of Results

From table 4.1, it can be deduced that the plantain peels, pawpaw leaves, maize cobs, shea bark were completely dried because a constant weight was attained for the four samples after oven drying. Each of the samples was subjected to a high temperature in a furnace to produce ash, which was used to produce the potassium concentrate.

After the leaching of the different ash samples, the concentration of the different extract were obtained using flame photometer. The individual concentration of the different samples were different as shown in table 4.2, with the concentrate from plantain peels higher, followed by maize cobs, then pawpaw leaves and the least which is potassium hydroxide from shea bark.

The pH of 11.48 indicates that the soap produced can be used to clean greasy and oily stains. A pH of about 11 portrays the fact that the soap is made from lye. The produced soap also has a foamability of 39mm which shows that it falls within the standard foamability of soap (ranging from 35 to 45mm).

The corrosiveness test performed showed that the soap acquired cannot be injurious to the individual using it as the corrosiveness test shows a moderate value of 1.54275% with 27.5cm^3 of acid used which is within the specified range of 25 to 45cm^3

4.3 Cost Analysis

Cost Analysis is a systematic process for calculating and comparing benefits and costs of a project for two purposes: which are, to determine if it is a sound investment (justification/feasibility) and to see how it compares with alternate projects (ranking/priority assignment). It involves comparing the total expected cost of each option against the total expected benefits, to see whether the benefits outweigh the costs, and by how much. At the most basic level, **cost** allocation is simply part of good program budgeting and accounting practices, which allow managers to determine the true cost of providing a given unit of service. At the most ambitious level, well-publicized cost-benefit studies of early intervention programs have claimed to show substantial long-term social gains for participants and cost savings for the public.

There are different methods which are used in evaluation of cost analysis, these are: cost allocation, cost effectiveness and cost benefit analysis.

4.3.1 Cost Analysis of the Produced Soup

Table 4.5 Concentrates used for Soap Production and Prices

Concentrates	Amount(₦)
Palm kernel oil	350
Potassium hydroxide	200
Aloe vera	150
Camwood	100
Distilled water	100
Honey	150
Egg	120
Lime	10
Miscellaneous	1000
Total	= N 2180

Quantity of soap produced = 800.94ml

Cost of production = N 2180

$$\text{Price per ml of the produced soap} = \frac{\text{Cost of production}}{\text{Quantity of soap produced}}$$

$$= \frac{N\,2180}{800.94ml}$$

= N 2.7 per ml

CHAPTER FIVE

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusion

To conclude this project, the method of producing black soap gel from plantain peels, maize cobs, pawpaw leaves, shea tree and palm kernel oil can be said to be economically viable, as the produced soap has the following values which are within the standard values; pH of 11, foamability of 39mm, and corrosiveness value of 1.54%. The produced soap from agricultural waste serves as a cleansing agent used for cleaning purposes which helps to enhance waste management in the society.

The use of waste vegetable matter to generate a base used in soap making cannot be over-emphasized as this can be used to develop cheaper substitutes for the industrial base which is expensive.

5.2 Recommendations

The benefits of cheap and easily available alkali sources for a developing nation like our country Nigeria are immense.

1. The country should try to tap into recycling of Agricultural wastes to generate revenue and job for a large number of the populace, as this can be a highly lucrative business, if ventured into. This could help to stabilize the economy of the country if the production of potassium hydroxide from agricultural wastes is properly harnessed.
2. Efficient designs in the unit operations of the soap making process, as well as in the saponification reaction stage, to bring about a reasonable substitution of locally derived potassium hydroxide alkali, for imported ones, should be pursued.

3. Further studies should be carried out in relation to the clinical aspect, and supervised by a dermatologist

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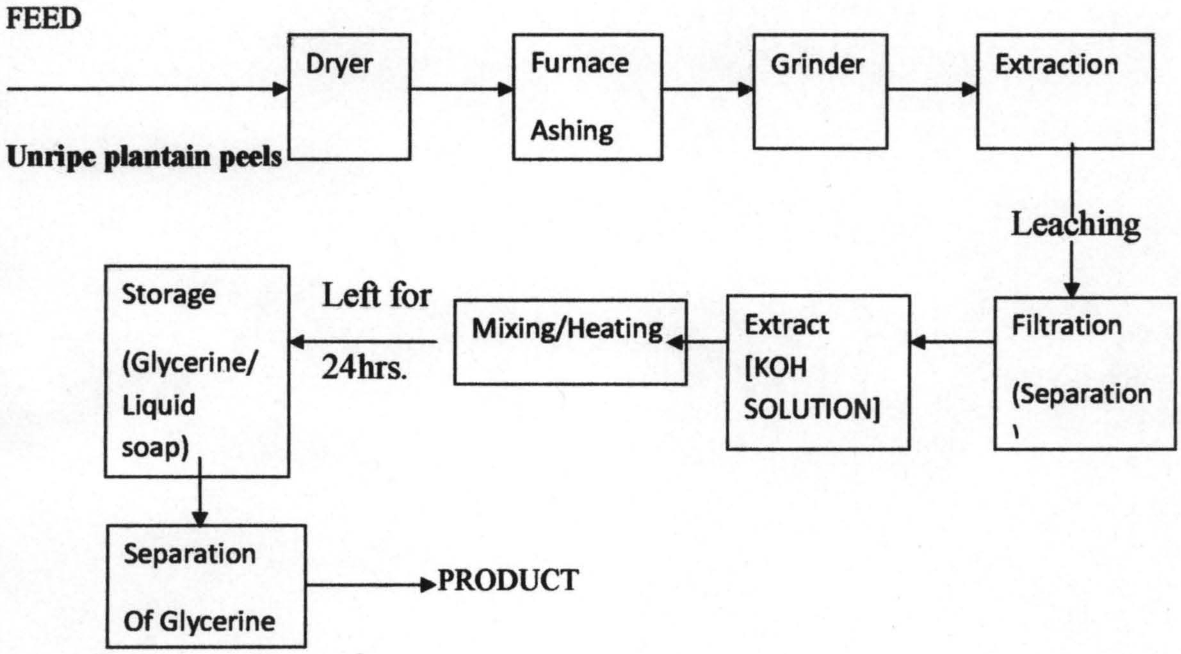
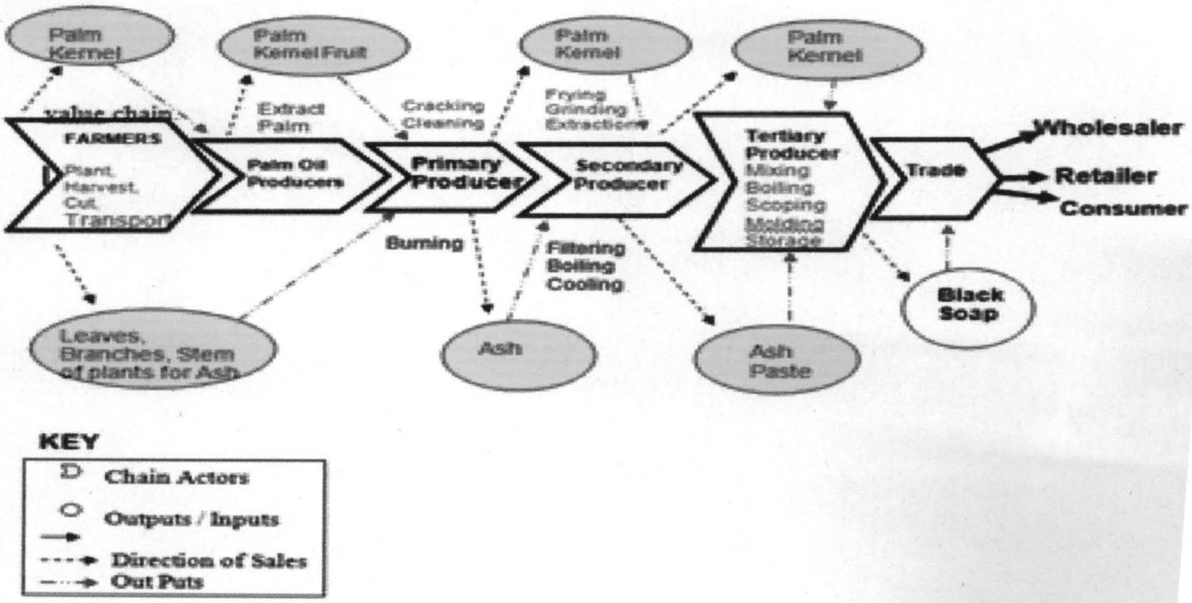
APPENDIX

PROCESS FLOW CHART





Black-Soap Value Chain

Corrosiveness Value

Corrosivity test is performed as follows;

The formula given below was used to calculate the free alkali content of the soap.

$$\%KOH = T_1 \times M_W \times M / (W_g \times 20)$$

Where

T_1 = Volume of acid used

M_w = Molecular weight of KOH

M = Molecularity of acid

W_g = Weight of soap sample dissolved

$$\%KOH = \frac{27.5 \times 56.1 \times 0.01}{0.5 \times 20}$$

$$= 1.54\%$$