PRODUCTION AND CHARACTERISATION OF POMADE FROM SHEA BUTTER AND PALM KERNEL OIL

By

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2007/2/27991EH

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SCHOOL OF ENGINEERING AND ENGINEERING TECHNOLOLGY
FEDERAL UNIVERSITY OF TECHNOLOGY MINNA

NOVEMBER 2011

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PROJECT SUBMITTED TO THE
DEPARTMENT OF CHEMICAL ENGINEERING
SCHOOL OF ENGINEERING AND ENGINEERING TECHNOLOLGY
FEDERAL UNIVERSITY OF TECHNOLOGY MINNA

IN PARTIAL FULLFILMENT OF THE REQUIREMENT FOR THE
AWARD OF BACHELOR OF ENGINEERING (B.ENG)
DEGREE IN CHEMICAL ENGINEERING

NOVEMBER, 2011

DECLARATION

I hereby declare that the work in the project report entitled **"PRODUCTION AND CHARACTERIZATION OF POMADE FROM SHEA BUTTER AND PALM KERNEL OIL"** has been performed by me under the supervision of **Dr J.O. OKAFOR** of Chemical Engineering. No part of this project report was presented for another degree or diploma elsewhere at any institution to the best of my knowledge.

AWWAL YAHAYA VIASHIMA		01|12|2011.
Name of Student	**Signature**	**Date**

CERTIFICATION

This is to certify that this project report (thesis) entitled, **"PRODUCTION AND CHARACTERISATION OF POMADE FROM SHEA BUTTER AND PALM KERNEL OIL"** by **AWWAL YAHAYA VIASHIMA** with Matriculation Number of **2007/2/27991EH** meets the requirements for the partial fulfillment of the award of Bachelor of Engineering (B.Eng) degree in Chemical Engineering, Federal University of Technology, Minna.

Dr J. O. Okafor Project Supervisor	02/12/2011 **Date**
Dr. M. O. Edoga Head of Department	**Date**
External Examiner	**Date**

DEDICATION

This research project is dedicated to my late mum Arc. Mrs Zainab M. Awwal whom after her labor on earth didn't wait to reap the fruit of her labor.

ACKNOWLEDGEMENT

Firstly, my heartfelt thanks goes to my beloved parents Dr. and Late Arc. Mrs. Y. M. Awwal for their parental care and relentless efforts throughout my life to this level. You are two in a million. May God Almighty reward you abundantly. With deep love, my reverse thanks goes to my elder brother, Ibrahim and my kid sisters Nabilah, Blessing and Gift for their moral support and advice. God bless you all.

With profound gratitude and appreciation, I wish to thank my supervisor, Dr. J. O. Okafor for sparing his time to see to the success of this project. Thanks a million and God bless.

My immersed gratitude goes to my friends, Shittu, Topsy, who have put smiles on my face in one way or the other. May God bless yah all. I cannot fail to register my appreciations to my classmates for their contributions and cooperation as a team. God bless you all

Finally, my outer most thanks goes to almighty God, for his love, mercy and guiding light throughout my academic programme. May my survival under the sun bring you glory in heaven. Amen.

ABSTRACT

This project researched into the production of a semi solid, water-in-oil emulsion type from two natural oil samples, Shea butter and Palm Kernel oil. The extraction of Shea butter and Palm Kernel oil were done using the traditional extraction methods. The Shea Butter and Palm Kernel oil produced were off white and dark brown in colour respectively with both oils having a pleasant smell. The produced oil samples were characterized to determine some of its physical and chemical properties respectively. These includes its saponification values of 179.8 mg/KOH/g and 244.03 mg/KOH/g, acid values of 4.71 mg/KOH/g and 3.086 mg/KOH/g, iodine values of 57.5 mgI_2/g and 17.4 mgI_2/g, free fatty acid of 2.36 and 1.54, specific gravity of 0.09 and 0.92 for Shea butter and Palm Kernel oil respectively. These values depict that those oil are good raw material for the production of pomade. The Shea butter and Palm kernel oil were further processed to produce Shea butter pomade and Palm Kernel oil pomade with the addition of petroleum jelly, vitamin E oil, honey, citric acid, Aloe Vera juice and perfume. The Shea butter and Palm Kernel oil pomade produced was of a consistent texture, had a pleasant smell, glossy appearance, met the dermatological requirement, had a wet moisturizing effect and an acceptable thermal stability.

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Chapter One

1.0 INTRODUCTION

Pomade is any substance, preparation, or treatment applied to a person to cleanse, to alter the appearance, or to promote the attractiveness of the person. The term thus includes all creams, powders, lotions, and coloring agents applied to the face, scalp, hair and hands and many borderline products such as deodorants, depilatories and oral and suntan preparations (Austin, 1984).

The various kinds of cosmetics products are best grouped into three principal classes:

i. For the skin

ii. For the hair

iii. And for the nails

In form they may be dry powders, pastes, solid or liquid emulsions, or aqueous, alcoholic, or oily solution. Pomades generally used on the skin are manufactured by the emulsification of oils, fats or waxes and water. This is activated either by dispensing the fatty material in the water, or by dispensing water in the fatty phase using suitable emulsifier. All creams for the skin fall into three large general classes;

i. Cold creams

ii. Vanishing creams

iii. And water free creams

There are also certain special creams which may be practically any of the above, made in liquid form (Austin, 1984).

Shea butter is a slightly yellowish or ivory-colored natural fat extracted from the nut of the African Shea butter tree by crushing, boiling and stirring. It is widely used in cosmetics as a moisturizer, solvent or lotion. Shea butter is edible and may be used in food preparation. The

main industrial use of Shea butter is in cosmetics, such as moisturizer creams and emulsion and hair conditioners for dry and brittle hair. Shea butter is an emollient and it is used for the manufacture of high quality lotion and creams. It helps makes the skin smooth and is proven to offer natural protection against ultraviolent rays (Austin, 1984).

Palm kernel oil is a versatile and highly saturated oil, provides a rich ingredient in homemade cosmetics and skin care. Semi-solid oil in most climates, palm kernel oil provides a light oil base that adds moisturizing properties to such as lip balms, gives the ability to control the ingredients of one's make-up. Palm kernel oil in the form of palm kernel fruits pulp is found in the form of drops or in cohesion in the external part of the fruit pulp or within the stone kernel. Although palm kernel oil or seed oil is identical to coconut oil, it contains rich amounts of lauric and myristic fatty acid (Austin, 1984).

1.1 Aims and Objectives

The aim of this research work is to produce and characterize pomade from Shea Butter and Palm Kernel Oil.

The aim can be realized through the following objectives:

a. Characterization of the Shea Butter and Palm Kernel Oil to determine some of its physical and chemical properties.
b. Production of the Shea Butter and Palm Kernel oil Pomade.
c. Characterization of the produced Shea Butter and Palm Kernel oil Pomade to determine its conformity with standard requirements.
d. Statistical analysis with the use of questionnaires and comparative analysis of the two products.

1.2 Scope of the Study

This research work is strictly limited to the production and characterization of Pomade from Shea Butter and Palm Kernel Oil.

1.3 Significance of the Study

This research work is to produce and characterize pomade from Shea butter and palm kernel oil, which is one of the roles of a chemical engineer. It enables the transfer of theoretical knowledge into practical work after our academic program in the labour market.

1.4 Justification of the Study

Completion of this research work will go a long way:

a. To aid the replacement of petroleum fractions with natural vegetable fats that has a good moisturizing and healing effect,

b. To promote the investment opportunities in the pomade market,

c. To create employment for the teaming population of unemployed graduate and

d. To contribute to the attainment of Federal Government Vision 2020 (1): Eradication of extreme poverty and hunger.

Chapter Two

2.0 LITERATURE REVIEW

2.1 Historical Background of Cosmetics

The use of balms, unguents, powders and paints for the care and adornment of the body is a practice almost as old as man itself. The development of cosmetics was closely linked with the practice of religion and medicine and in all the great civilizations, as well as among primitive tribes, relies and records tell us that cosmetics were used in some form or another (Grant, 2006).

Ancient Egyptians up to the 5th century B.C knew much about cosmetics without doubt the famed beauty of Cleopatra was largely the result of the cunning use of eye make-up, hair dyes, perfumes and powders. Bathing face make-up and hair waving were also known to Egyptian women (Grant, 2006).

From the 7th century A.D, the Romans, in keeping with their tradition, absorbed cultural knowledge from their subjects and built it into their own culture. Cosmetics flourished throughout their empire in spite of condemnation of the practice as decadent and corrupting. Yellow, blonde dyed hair was indeed by law the uniform of prostitutes in Rome although in later time noble and fashionable women adopted the habit with gold dust and the use of vermillion as rouge was practiced and Galen formulated the forerunner of the modern color cream. The early Christians saints are on record as condemning cosmetics practice at this time. Cosmetics continued to be popular until the middle of the 17th century. Blanching of the teeth was practiced and vegetable dues were used to color the hair-radish and hedge privet for auburn, white wine and rhubarb or honey and gum baric for golden shades. Poppy seed oil and found pigs jaw were used as a face whitener and red ochre for rage (Grant, 2006).

However, when Cromwell assumed powder in England, the scene changed radically, for about 20years strict moral attitudes prevented the use of cosmetics and it was not until 1668, on the restoration of the monarchy that cosmetics again became fashionable. Men, as well as women now indulge in make-up and artificial hair. Herbal portions, lip salves, eye make-up perfumes and wigs bonder encouraged by the royal courts. The usage of cosmetic became so great that, in

England an Act of parliament was passed imposing the same penalties as, those for witchcraft, on women, who deceived a man into marriage with the aid of cosmetic preparation or other artificial acts (Grant, 2006).

By the mid-1920 make-up had become, sophisticated and led to an experimental period in which new colors and textures were developed. As scientific knowledge grew, so the products and variation proliferated (Grant, 2006).

From 1939 onwards, with a slight setback during the Second World War, expansion continued. Scientific knowledge increased and other companies entered the field with a range of products at prices that the poorer costumers could afford; cosmetics because not only respectable, but essential. After the war tremendous expansion occurred and more scientist entered the field, thus in 1956, research in dermatology led to the introduction of hormones into skin care products. Vitamins were incorporated into skin creams and the acid balance of the skin was discovered. Many preparations to preserve this acid balance found their way into the market creams to prevent the damage caused by strong sunlight to produce a sun fan were formulated and the discovery of synthetic detergent revolutionalised the formulation of shampoos (Grant, 2006).

2.2 Definition of Cosmetics

The meaning of cosmetics should be understood as follows; Any substance, preparation, or treatment, applied to the person (a) to cleanse (b) to alter the appearance, or (c) to promote the alter activeness of the person. The term thus includes all creams, powders, lotion and coloring agents applied to the face, scalp, hair, and hands, and many borderline products, such as deodorants, depilatories and oral and sustain preparations (Awwal, 2005).

In the federal food, drug and cosmetic Act, the definition is: "The term cosmetic" means (1) article intended to be rubbed, poured sprinkled, or sprayed on, introduced into, or otherwise applied to the human body, or any part thereof for cleaning, beautifying, promoting attractiveness, or altering the appearance; and (2) articles intended or use as a component of any such articles, except that such term shall not include soap" (Awwal, 2005).

2.2.1 Cosmetology

Is a branch of applied science dealing with the external embellishment of the person through the use of cosmetic products and treatment? As an organized study, cosmetology dates from 1895, when the first school to teach the use of cosmetics in treatments for the skin and hair was established in Chicago. The educational movement spread rapidly, first in private schools, but, after 1922, also in many vocational and industrial high schools (Awwal, 2005).

Cosmetics are the end products of cosmetic chemistry, a not too well defined science that blends the skills of specialists in the chemical, physical, biological and medical fields. Present day practice has evolved from the relatively small cold creams and glycerin-and-rose water formulations to scientific products created by research and development laboratories well staffed with able and creative scientists (Awwal, 2005).

2.3 Types of Cosmetics

i. Creams ii. Lotions iii. Shampoos iv. Sharing lotions v. Deodorants and antiperspirants vi. Depilatories vii. Powders viii. Makeup lotions ix. Lipstick x. Rouge xi. Antioxidants xii. Sequestering Agents xiii. Preservatives (Awwal, 2005).

2.4 Creams and their Classifications

A large variety of cosmetic creams and lotions is available; the major types are briefly described below:

i. Cold Cream; cold cream are general emollient emulsions from which water evaporates on application, producing a cooling effect on the skin. They are used for general skin care and in cleansing the face'

ii. Vanishing Creams; vanishing creams are emulsion which are rub into the skin and leaves a dry fed. Creams of this type are used in general skin care and form the basis of many kind hand, foundation, and moisturizing creams

iii. Hand Creams; are available is two main types those which are used to keep the skin soft and supple and those used to protect the skin from damaging chemical etc, apart from industrial usage, the foregoing creams the most important commercially lotions include opaque emulsions (milks) or clear liquids.

iv. Day Creams; Night creams, emollient creams, nourishing creams, and skin foods, all serve basically the same purpose and are based on the same formula type. They provide emulative and lubrication to the skin, thereby keeping it in soft, smoothes, and supple conditions.

v. All Purpose Creams; All purpose creams, as the name suggest are formulated to meet the major cosmetic requirements is one product. They may be used as foundation, cleansing or emollient creams, as hand cream or as proactive skin creams.

vi. Hormone Creams; are normally emollient creams containing estrogen hormones, i.e chemical components which control glandular function in the female body. Such substances incorporated into cream bases and applied to ageing are claimed to have a beneficial rejuvenating effect.

vii. Vitamin Creams; are emollient creams containing vitamins.

viii. Acid Creams; Are emulsions containing small quantities so mild organic acids the skin surfaces normally acid in nature may become alkaline and more susceptible to damage when subjected to extensive contact with detergents or soaps. Acid creams are used to bring the skin back to its normally acid conditions.

ix. Foundation Creams; are basically vanishing creams with sufficient adhesiveness to retain powder which in applied to the face after application of the creams.

x. Moisturizing Creams; these are emollient creams containing high concentrations of water in addition to humectants. The purpose of these creams is to maintain the natural moisture balance in the skin (Grant, 2006).

2.5 Occurrence of Shea Butter

Shea nut tree a deciduous tree 40 meters high with leaves clustered at the end branches. It is a perennial tropical tree (Parkii specie) found in the semi-arid savannahs of west and Central Africa particularly in northern Nigeria and Ghana (Oyewo, 2010).

Shea butter in solid at room temperature although it quickly liquefies right around body temperature. This Shea Butter in unrefined and since Shea butter in an all-Natural product, if varies widely in quality, appearance and smell depending on where it in produced from and how it in refined or extracted (Oyewo, 2010).

Flowering of the tree varies from place to place. Fruiting begins around May to August in Nigeria when the tree in about 12-15 years age and remains in full bearding of fruits for about 20-25 years. The fruits are yellowish and ellipsoid about two inches long with 1-3 seeds. The kernels are usually stored in dry places before processing begins. They are usually left in well ventilated rooms or packed in sacks are improper storage affects the level of oil produced. It benefits includes dry skin relief, retains elasticity and an aging cell health in the skin and reduces stiffness and swelling in muscles making a useful treatment for rheumatism and arthritis sufferers. Shea butter in basically composed of two fatty acids, stearic and Oleic, which together account for 85 - 90 % of the total fatty acids. The relative proportions of these two fatty acids determine the hardness of the Shea butter. Stearic acid is solid, while Oleic acid is a liquid at room temperature. Therefore, Shea butter with a higher Oleic content will be softer than Shea butter with a low Oleic content (Oyewo, 2010).

The proportions of stearic and Oleic acids in the Shea Kernels and butter differ across the distribution range of the species. Shea butter from Central Africa has constantly high Oleic acid content, and in liquid of warm ambient temperatures the fatty acid proportion of West African. Shea butter, the Oleic content ranges from 37-55 %, while the stearic content can vary from 25-50 %. This means that the hardness of Shea nut butter from West Africa, which is where the vast majority of Shea nut butter and nuts are produced, can vary significantly, virgin Shea butter has a high amount of vitamin A & vitamin E, as well as phytosterols, triterpenes, fatty esters and

phenol acids. The healing and moisturizing ability of Shea butter in not affected by the hardness, since this in determined by the hardness, since this is determined by the ratio of the two main fatty acids (Oyewo, 2010).

2.6 Occurrence of Palm Kernel Oil

Palm Kernel is obtained from the health Kernel of the palm product e.g fruits palm oil is a form of vegetable oil obtained from oil palm tree fruit. The oil palm tree is a tropical palm. Three are 2 species of oil palm; the fruit is reddish about the size if a large palm and grows in large bunches. Each fruits contains a single seed "the palm Kernel" surrounded by a soft oil pump. Oil is extracted from both the pulp of the fruit palm oil edible oil high in olefins a potentially valuable chemical group that can be processed into many non-food products as well. Palm oil contains mainly palmistic and Oleic acids, while palm Kernel oil contains mainly lamic acid. Palm oil is the largest natural source of tocotrunal, part of vitamin E family, palm oil is one of the vegetable oils relatively high in saturated fats through its not as high as the palm Kernel oil (Weiss, 1983).

2.7 Description of Palm Kernel

General gregarious farm palm with separate male and female trees (didecious), growing up to 25 m and sometimes taller. Butter shaped, smooth, straight stem in trees of more than 50 years, the truck has a noticeable swelling above the middle, and this distinguished it from the palm fruit. The terminal crum is a cluster of fan-shaped leaves (Weiss, 1983).

2.7.1 Edible Parts

Fruits, seed Kernels "nut" young unfolded leaves (Weiss, 1983).

2.7.2 Bark

Grey or yellowish bark (Weiss, 1983).

2.7.3 Leaves

Fan-shaped up to 4 cm long including the leaf stalk leaf blade divided to about the middle into numerous linear-lances late folded segments about 3 cm at the base leaf stalk, black with locked spines at the edges (Weiss, 1983).

2.7.4 Fruits

Roundish 15 x 12.5 cm, green –yellow to arrange with the base enclosed in 6-7 hip-shaped bracts, weighing up to 1 kg contain 3 seeds creamy-brown, segments shaped weighting about 100 g (Weiss, 1983).

2.7.5 Distribution

Throughout the savannah of the semi-humid and sub humid tropics in Western Africa from Senegal to Nigeria & belt Southwards from Sudan to Mozambique and Transvaal's (Weiss, 1983).

2.8 Extraction of Oil

2.8.1 Extracting Shea Butter Traditionally

The Shea not seeds are first cleaned to remove accompanying materials such as stones and passed though a magnetic separator to remove pieces of metal. The seeds are then dried to reduce the moisture content of the seeds and then Crisfield to obtain fairly fine grains with less course particles. Shea butter can be recovered by local methods of rendering, with the use of a mechanical press or by the use volatile solvents:

i. Shea nuts are contained in pods or shells
ii. Shell or pods cracked open by hand thus releasing nuts or kernels
iii. Nuts are dried to remove moisture
iv. Roasted nuts are grouped to paste to facilitate oil extraction
v. Nut paste with gradual adding of warm water is kneaded vigorously by hand until oil in coagulated form separate from the water
vi. Released oil in coagulated form is whisked out
vii. Coagulated Shea butter containing traces of nut paste is placed to steam kettles or boiling pots.
viii. Coagulated Shea butter paste is heated in kettles at high heat to release Shea oil.
ix. Shea butter oil is skimmed and stored to solidify into Shea butter (Oyewo, 2010).

2.8.2 Extraction of Palm Kernel Oil Traditionally

The entire process is manual. Dehulling is done by cracking the kernel with stones. Each kernel is place on a stone while a smaller stone is used to hit it against the bigger stone. Once the kernel is cracked, the nut is picked up into a bowl, the stone is cleaned, and another kernel is introduced for cracking (Weiss, 1983).

Next the kernel is place inside a pot, covered, and heated with fire made from fire wood. Heating is followed by a dense fume with characteristic aroma that usually spread to very far places. The heat allows the oil to drain out of the nuts leaving a black fragile charcoal like mass. The dense black oil is separated and stored in small containers like bottles. Palm kernel oil made in this way is used by local African people for pomade and medicine (Weiss, 1983).

2.8.2.1 *Mechanical Extraction of Palm Kernel Oil*

This could be used for small scale or large scale extraction of palm kernel oil. Palm kernels are pre treated by magnetic separators that remove metallic debris that might destroy the device.

Then the kernels are sieved to remove sands, stones, and other impurities before cracking with inbuilt swinging hammers. The nuts are separated from the shells after cracking and prepared by heating before squeezing with a screw press. The nuts are screwed through a metallic path (with pores) that decreases in diameter to the exit so that the oil is forced out of the side while the cake is collected at the tip of the screw (http://www.encyclopedia.com).

Finally, palm kernel oil obtained via mechanical means are usually filled with impurities that must be removed by further processing (http://www.encyclopedia.com).

2.9 Characteristics of Produced Oil

The following are the basic characteristics for most fats and oils;

1. Iodine value
2. Saponification value
3. Refractive index

2.11.4 Uses of mineral oil

Mineral oil is used in cosmetics production medically for the production of laxative dispersant that is diluents in white or colored rubber and plastic compounds, dispersant for reactive compounds such as metal hydrides, catalyst carrier, in food as binder, deforming agent, lubricant, fermentation aid and protective coating (Awwal, 2005).

2.11.5 Lanolin

Lanolin also known, as wool wax is a stiff, soft and consistent solid derived from the wool of sheep. It has a great affinity for water of which it absorbs 25-30 %. Refined wool wax is needed with water to produce a colorless ointment known as hydrous lanolin. Anhydrous lanolin also exists.

Lanolin is used as a base in cream making because of its slight antiseptic effect and high resistance to rancidity. It improves creamy texture and hinders absorption of medication through the skin. Lanolin is a natural moisturizing with powerful emollient and protective properties. Human have valued its well tolerated beneficial qualities for thousands of years. Nowadays, this iunioque, created by nature substance is widely used in many products and various technical applications.

Wool wax is a natural substance design by nature to soften both the skin and the wool fibers against adverse weather conditions. The best known uses of refined wool wax products (lanolin and lanolin derivatives) are in medicine, cosmetics and toiletries which takes advantage of these natural protective qualities.

Because lanolin is hydrogenated, it is composed of lanolin derivatives alcohol, it chemical and physical characteristics is strongly in resemblance to those of lanolin alcohol. It is a white, slightly pasty and virtually odourless solid with an exceptionally low acid and saponification value.

Cholesterol and its derivatives are secreted through the oil glands of the skin to act as a lubricant and protective covering for the hair and skin. Lanolin, a grease extracted from raw sheep wool

and composed largely of cholesterol esters, has a variety of commercial uses in lubricants, leather preservatives, ointments, and cosmetics.

2.11.6 Properties of Lanolin

Hydrous Yellowish to gray semisolid contains from 25-30 % water, slight odour. It is anhydrous brownish to yellow semi-solid containing not more than 0.25 % water. It is non toxic. Anhydrous lanolin is widely used in cosmetic cream since it is readily absorbed by the skin (Austin, 1984).

2.11.7 Uses of Lanolin

Lanolin is well known ingredients of ointments and cosmetic creams. It is also used in soap and as a softener for textile, leather rubber mixture and the like (Austin, 1984).

2.11.8 Water

Water is also very important in pomade production it is a colourless, odourless, tasteless liquid which exist in allotropic forms. Ice (solid) and steam (Awwal, 2005).

2.11.9 Properties of water

Water is a polar liquid with high electric constant (81 – 17 ^{0}C) which largely accounts for its solvent power. It is a weak electrolytic ionizing as H_2O and OH. It has a specific gravity of 1.00 ^{0}C and freezing point of 32 ^{0}C and expands about 10 % on freezing. It has a viscosity of 0.01002 poise, vapour pressure of about 760 mmHg, refractive index of 1.333 and a latent heat of fusion of 80 cal/g (Austin, 1984).

2.11.10 Uses of Water

The uses of water are numerous due to its unique and desirable properties which include universally, as a solvent, availability, cost, low viscosity and chemical greatness to most process equipments (Austin, 1984).

2.11.11 Perfumes

These are pleasant smelling substances obtained from natural or synthetic sources. They are widely used either in the form of alcoholic solution (perfumes, colognes or toilet water) because of their esthetic appeal. They are added to cosmetics, soaps, paper etc to which they impact an agreeable aroma.

A perfume most possesses a high degree of stability for it to be accepted commercially. It must not only give an appreciable aura of fragrance to the wearer when worn, but must keep this character for several hours without changing. This lasting power of perfumes is very difficult to achieve, since the constituent of perfume are highly volatile and evaporates easily (Austin, 1984).

2.11.12 Borax

A large number of emulsifying agents are used in the production of cosmetics creams examples are sodium and potassium serrate borax and other compounds whose basic structure is a paraffin chain terminating in a polar group (Austin, 1984).

Sodium or potassium striate and borax are effective in stabilizing oil in water emulsions in this case, the paraffin chain of these molecules are concentrated in the oil droplet with a charged situated at the interface and the counter ions form a diffuse double larger in the water, thus preventing coal essence. But borax is preferred for the production of cosmetics creams due to its antiseptic and preservative properties (Austin, 1984).

2.11.13 Uses of Borax

Borax is used in the manufacture of creams glass, enamels, and other ceramic products. It also has a high value as mild detergent it can be used in the production of tooth paste and cleaning agent due to its antiseptic effect, mostly it is used as an emulsifier (Austin, 1984).

Chapter Three

3.0 METHODOLOGY

3.1 Instruments, Equipments, Materials and Reagents used

The materials used in the course of this research include apparatus, equipments, and instrument.

Table 3.1 Instruments and Equipments

S/No	Apparatus	Manufacturer	Source
1	Measuring cylinder	Fortuna, Germany	WAFT,Dept.FUT Minna
2	Conical flask and Beaker	Pyrex, England	WAFT,Dept.FUT Minna
3	Water Bottle	Gallenkamp, England	WAFT,Dept.FUT Minna
4	Retort Stand and Burette	Griffens & George Ltd England	WAFT,Dept.FUT Minna
5	Weighing Balance	Gallenkamp, England	WAFT,Dept.FUT Minna
6	Heating Mantle	Gallenkamp, England	WAFT,Dept.FUT Minna
7	Mechanical stirrer	Gallenkamp, England	WAFT,Dept.FUT Minna
8	Density bottle	Pyrex, England	WAFT,Dept.FUT Minna
9	Thermometer	Gallenkamp, England	WAFT,Dept.FUT Minna
10	Rubber spatula	Pyrex, England	WAFT,Dept.FUT Minna
11	Bottles	Pyrex, England	WAFT,Dept.FUT Minna

Table 3.2 List of Material and Chemicals

S/No	Reagent and Materials	Manufacturer	Source
1	Hydrochloric acid	Mi-Swaco, Houston, USA	WAFT,Dept.FUT Minna
2	Potassium iodide	Mi-Swaco, Houston, USA	WAFT,Dept.FUT Minna
3	Ethanol	Mi-Swaco, Houston, USA	WAFT,Dept.FUT Minna
4	Starch solution	Mi-Swaco, Houston, USA	WAFT,Dept.FUT Minna
5	Distilled water	Amazon Services, Jos	WAFT,Dept.FUT Minna
6	Indicator	Mi-Swaco, Houston, USA	WAFT,Dept.FUT Minna
7	Potassium hydroxide	Mi-Swaco, Houston, USA	WAFT,Dept.FUT Minna
8	Sulphuric acid	Mi-Swaco, Houston, USA	WAFT,Dept.FUT Minna
9	Tetrachloromethane	Mi-Swaco, Houston, USA	WAFT,Dept.FUT Minna
10	Shea nut cake	Locally Produced	Bida, Niger State
11	Palm Kernel nuts	Locally Produced	Bida, Niger State
12	Aloe vera gel	Locally Produced	Bida, Niger State
13	Onion	Locally Produced	Bida, Niger State
14	Garlic	Locally Produced	Bida, Niger State
15	Citric acid	Mi-Swaco, Houston, USA	WAFT,Dept.FUT Minna
16	Vitamin E oil	Mi-Swaco, Houston, USA	WAFT,Dept.FUT Minna
17	Honey	Locally Produced	Bida, Niger State
18	Perfume	Mi-Swaco, Houston, USA	WAFT,Dept.FUT Minna
19	Petroleum jelly	Mi-Swaco, Houston, USA	WAFT,Dept.FUT Minna

3.2 Experimental Procedure

This research work was carried out in three stages:

1. The extraction of Shea butter and Palm Kernel oil with the use of solvent (hexane)

2. The refining of the extracted Shea butter and Palm Kernel oil.

3. Further processing of the refined Shea butter and Palm Kernel oil to produce the pomade.

3.2.1 Extraction of Shea butter and Palm Kernel oil

The preparatory stages which were as follows:

1. **Seed picking;** The Shea butter and Palm Kernel oil seed are usually scattered all over the bush. They were gathered and sun dried.

2. **Pre-treatment**: The dried Shea butter and Palm kernel nuts were then decorticated, that is, the shell of the nuts were separated from the kernel. The kernels were then washed to remove impurities.

3. **Drying**: The kernels were then dried in an electric oven to reduce the moisture content. The weight of the kernels before and after drying was noted.

4. **Crushing**: The kernels were then crushed with a local mortar and pestle to obtain fairly fine grains with less coarse particles.

Note, that the shell of the nuts can be used to repel mosquitoes.

3.3 Analysis of oil extracted

3.3.1 Determination of saponification value

3 g of the oil was placed in a conical flask. Then 250 cm^3 of sodium hydroxide (NaOH) was added to the flask. The content was placed on a heater for about 30 minutes, with occasional shaking of the flask (Oyewo, 2010)

The solution was then titrated against a standard 0.5 M hydrochloric acid using phenolphthalein as indicator. Back titration was also carried out in the same way without using the oil. The saponification value was then calculated using the formula below:

$$SV = \frac{b-a\,(28.05)}{M} \qquad 3.1$$

Where b = the volume of acid for blank test

a = the volume of acid used with oil

m = mass of oil used.

3.3.2 Determination of Iodine value

2 dried reagents bottles of 250 cm^3 capacity was obtained. 0.5 g of oil was inserted into one of them, 5 cm^3 of tetrachloromethane was added and the solution mixed with iodine chloride. The bottle and its content were allowed to stand in the dark for about an hour.

10 cm^3 of potassium iodide was added to the sample with distilled water. The mixture was stirred gently and then titrated against an aqueous solution of sodium thiosulphate in the presence of starch as indicator, titration continued until the black colour just disappeared. The iodine value was then calculated using the formula below (Oyewo, 2010).

$$IV = \frac{b-a\,(1.269)}{M} \qquad 3.2$$

Where b = blank titration

a = titration with oil

m = mass of oil used

3.3.3 Determination of acid value

This is a means of determining the amount of sodium hydroxide required to neutralize the free fatty acid in the sample. 25 cm^3 of ethanol and 25 cm^3 of diethyl ether were mixed with an indicator and the mixture was then neutralized with 0.1 M sodium hydroxide. 3 g of the oil was

added to the solution and titrated against 0.1 M aqueous sodium hydroxide until a pink colour was obtained (Oyewo, 2010).

The acid value was then calculated from the formula below:

$$AV = \frac{Titre\ value\ (5.61)}{M} \qquad 3.3$$

Where M = mass of oil used

3.3.4 Refractive Index

This is the rate of the sine of angle of incidence to that of sine of angle of refraction. The oil was rendered optically clear and with the aid of Abbe's refractomer, the refractive index was read and recorded (Oyewo, 2010).

3.3.5 Determination of specific gravity

A density bottle was used for this. It was weighed as W_1 and then filled with oil. A stopper was inserted and then reweighed as W_2. The bottle was then emptied, washed, properly rinsed in water and then dried. The bottle was now filled with water, excess water cleaned off the bottle and reweighed as W_3 (Oyewo, 2010)

The specific gravity was calculated from the formula below:

$$SG = \frac{W_2 - W_1}{W_3 - W_1} \qquad 3.4$$

Where

$W_2 - W_1$ = Density of oil

$W_3 - W_1$ = Density of water

3.3.6 Determination of free fatty acid

This determines the amount of sodium hydroxide needed to neutralize the free acid in 1g of the sample. It is expressed as a percentage (Oyewo, 2010).

Acid value = 2 (FFA)

$$FFA = \frac{Acid\ Value}{2} \quad 3.5$$

Some free fatty acid contents of Shea nut are shown below:

Oleic acid 70 – 78 %

Palmitic acid 6 %

Linoleic acid 6 – 9 %

Stearic acid 8 – 9 %

3.3.7 Boiling point

This is the temperature at which the oil is noticed to start boiling. The oil was placed in a beaker and a thermometer inserted. The sample was carefully heated using a Bunsen burner and the temperature at which boiling started was noted and recorded (Oyewo, 2010).

3.4 Refining of the extracted Shea butter

To meet the primary aim of this research work, the extracted Shea butter was refined to degum, neutralize, bleach and deodorize it.

3.4.1 De-gumming:

This is the process of removing gum formed alongside the fat produced.

Procedure: 30 g of the oil was put into a separating funnel. Distilled water was boiled and added to it. It was shaken for about 2 minutes. The gum was collected along with water at the bottom of the funnel (Oyewo, 2010).

3.4.2 Neutralization:

This is an alkali refining process. The objective is to remove the free fatty acid present in the fat. The type and strength of the alkali influences the efficiency of neutralization and the ability of the process to remove other undesirables, that is residual phosphate and so on (Oyewo, 2010).

Procedure: 0.5 M of sodium hydroxide was added to the degummed oil stirred and filtered off to obtain neutralized oil. The minimum amount of alkali required to neutralize the FFA in the oil is gotten from the formula:

$$\% \text{ NaOH} = \% \text{ FFA} \times 0.142 \qquad 3.6$$

Neutralization is very important, as acidic fats are usually very difficult to bleach and they can also affect the yield of finished product (Oyewo, 2010).

3.4.3 Bleaching:

The clay sample used was tested to be a kaolinite clay with the use of degumming reagent. The clay was dried for 2 hours to eliminate moisture. The clay was then calcinated by further heating. A sieve shaker was used in obtaining different sizes of the clay. For this work, 0.2 mm and 0.5 mm sieve sizes were used.

The sieve samples were then wet with 0.2 M hydrochloric acid and heated to a temperature of 110 °C for about 2 hours. This turned the clay to activated clay (Oyewo, 2010).

Procedure: The bleaching was done in round-bottom flask containing the oil. It was placed on a heater and the temperature kept constant. 5 g of the clay was poured into the flask with a contact time of 20 minutes. The same result was obtained when activated coal was used with no difference in the colour observed (Oyewo, 2010).

3.4.5 Deodourization:

This method was used in removing any odour contained in the fat to make it suitable for use in producing a body lotion. The odour might be a result of the decomposition of the natural pigment in the oil. In this work, two methods were used in the deodourization process (Oyewo, 2010).

- Use of onions
- Use of garlic

Procedure: 50 cm^3 each of extracted oil sample were placed in two separate beakers and heated. When fully heated, 5 g of sliced onions were added to one sample and to the other, 5 g of sliced garlic. There was further heated and then filtered. The odour of the two contents were observed and recorded (Oyewo, 2010).

3.5 Further processing of the refined Shea butter and Palm Kernel oil to produce Pomade.

Pomade has the following requirements:

- Aloe Vera juice: Distilled water forms the base of a body lotion, but for the basis of this experiment, aloe Vera juice was used to replace water as they both have the same consistency. This is done as it makes the lotion last longer. Aloe Vera is a good moisturizer as it alleviates discomfort associated with dry/cracked skin (Oyewo, 2010).
- Vitamin E oil; this served as a tocopherol which is a natural skin anti-oxidant, promoting healthy tissue-healing and rejuvenation.
- Honey: This is a natural humectants and therefore has the ability to attract and retain moisture. It also has significant antioxidant properties.
- Citric acid: This served as a preservative in the body lotion.
- Refined Shea butter and Palm Kernel oil: This served as the major ingredient as they are the main sample of this research work.
- Body lotion bottle: this served as a container for the final product of this research work. A glass bottle is most suitable for storing Shea butter and Palm Kernel body pomade as it hardly alters the composition of the lotion (Oyewo, 2010).

Procedure for Pomade Production

1. In a large Pyrex measuring bowl, **Shea butter or Palm Kernel oil** was melted in a pan (double boiler method) on a heating mantle. Then 100 g of petroleum jelly was added to the melted oil.
2. After melting was achieved, 10 cm^3 of honey, 5 cm^3 of vitamin E oil, 4cm^3 of citric acid, and 10 cm^3 of Aloe Vera juice were added to the melted oil and stirred properly.

3. The Pyrex bowl was removed and set in a large metal bowl filled with ice water. This helped to cool the mixture faster and is much easier than having to keep putting it in the freezer.
4. 5 cm^3 of perfume was added to the mixture. Mixing continued using a hand mixer, whipping the bottle continually for 15 minutes to get air bubbles out.

5. It was finally allowed to properly cool for about 30 minutes. Once the pomade has solidified and had the right whipped texture, it was spooned into jars and then packaged (http://www.murrayspomade.com/history.php)

3.6 Characterization of the Produced Shea Butter and Palm Kernel Pomade

3.6.1 Determination of non volatile matter in creams

Procedure

Weigh about 1 g of cream (m_1) in already weighed crucible (m) and heat in oven for 2 hours at a temperature of 105 °C. after 2 hours, take out the crucible and residue cool in dessicator for 10 minutes (well covered) then weigh again the crucible and residue (m_2). The difference in weight is calculated as non-volatile matter (NIS, 2009).

Calculation

$$\% \text{ Non-volatile matter} = \frac{m_2 - m \times 100}{m_1} \qquad 3.7$$

Where

m = weight of the dried crucible in grams

m_2 = weight of crucible and residue in grams after heating

m_1 = weight of the cream in grams

3.6.2 Determination of Thermal Stability

Apparatus

i. Humidity chamber

ii. Beaker 100ml

Procedure

Spread a stripe from the sample to be tested on the internal wall of the beaker in its total height. Transfer the beaker and its content to the humidity chamber at 60 % to 70 %.Relative humidity and a temperature of 37 ± 1^0 C for 8 hrs. Remove the beaker and make observation for possible oil separation (NIS, 2009).

3.6.3 Dermatological Test

This is a check on the actual cosmetic preparation and identification of the actual ingredient in the cream at fault. Test should be carried out in condition which area close as possible to those in which the cosmetic worn on hands and elsewhere may be conveyed to the eyelid by fingers. The eyelids are notoriously liable to be first sites to be affected in many patients with contact dermatitis (NIS, 2009).

3.6.4 pH Determination

Apparatus- pH meter with glass electrode

Procedure

Oil-in-water Emulsion Type: the sample of the cream is weighed accurately to 5.0 ± 0.01 g in a 100 ml beaker. Add 45 ml of distilled water and 1 ^{0}C. Read the pH on the pH-meter.

Water-in-oil Emulsion type: weigh 10.0 ± 0.01 g of the cream sample and add 90ml of methyl spirit with a ph 6.5 to 7.0. Then warm the solution of the cream sample and the spirit up to 45 ^{0}C and stir thoroughly for 15 minutes. The alcohol layer is filtered off through a filtered off through a filter paper and measure the ph of the filtrate at 27±1 ^{0}C using pH-meter electrode immersed in it (NIS, 2009).

3.6.5 Determination of viscosity

Principle: This is determined by the viscometer set. The permissible limit that shall be accepted for each company products should confirm to a set standard which must have been observed to be communicated with stability of the product (NIS, 2009).

Apparatus

i. Brookfield viscometer

ii. Thermometer

iii. Laboratory jack

iv. 500 ml beaker

Procedure: Pour a quantity of the material into a clean dry 500 ml beaker until three quarter full. Cool to a specified temperature usually 20 ^{0}C without disturbance with the acid of a laboratory jack, put the sample in place and select the appropriate spindle and then insert it into the sample.

Start the instrument after selecting the appropriate speed, and after five minutes takes the dial reading (NIS, 2009).

Calculation

Viscosity (centipoises) = Dial reading × factor 3.8

Centipoises = Centistokes × density 3.9

3.6.6 Determination of specific Gravity

Principle

Relative density is determined by changes in variance in the ingredient of the composite sample against any penalties for quality control or weight and measures.

Apparatus

Specific gravity stainless steel cup 100 ml capacity

Procedure: Clean and dry the stainless steel cup and weigh it (m). fill the cup with water completely at 27 ± 2 ^{0}C and weigh (m_1). Melt approximately 100 g of the material in a porcelain dish or if in the aqueous form, fill the already dried stainless cup with molten cream completely, cool to 27 ± 2 ^{0}C and weigh (m_2) (NIS, 2009).

Calculation

$$\text{Relative density (at 27 }^0\text{C)} = \frac{M_2 - M}{M_1 - M} \quad 3.10$$

Where

M = mass in grams of the stainless steel cup

M_1= mass in grams of the stainless steel cup with water

M_2 = mass in grams of the stainless steel cup with the cream.

Chapter Four

4.0 RESULTS AND DISCUSSION

4.1 Results

Table 4.1 Physical Properties of Shea Butter

S/N	Properties	Experimental Value	NIS Standard
1	Color	Orange-yellow	Orange-yellow
2	Odour	Pleasant	Dependable
3	Boiling point (°C)	65.4	60.0 – 69.0
4	Specific Gravity	0.09	0.01 – 0.10
5	Refractive Index (29 °C)	1.54	1.50 – 1.69
6	Melting Point (°C)	30.7	30.0 – 38.0

Table 4.2 Chemical Properties of Shea Butter

S/N	Properties	Experimental Value	NIS Standard
1	Free fatty acid	2.36	≤ 5 %
2	Acid Value (mg/KOH/g)	4.71	2.30 – 12.6
3	SaponificationValue (mg/KOH/g)	179.8	160 – 184
4	Iodine Value (mgI_2/g)	57.5	55.0 – 71.0

Table 4.3 Physical Properties of Palm Kernel Oil

S/N	Properties	Experimental Value	NIS Standard
1	Color	Yellowish	Yellowish
2	Odour	Pleasant	Dependable
3	Boiling point (°C)	55.2	50.0 – 59.0
4	Specific Gravity	0.92	0.10 – 1.00
5	Refractive Index (29 °C)	1.45	1.40 – 1.69
6	Melting Point (°C)	27.6	20.0 – 29.0

Table 4.4 Chemical Properties of Palm Kernel Oil

S/N	Properties	Experimental Value	NIS Standard
1	Free fatty acid	1.54	≤ 5 %
2	Acid Value (mg/KOH/g)	3.086	2.30 – 12.6
3	Saponification Value (mg/KOH/g)	244.03	180 – 267
4	Iodine Value (mgI_2/g)	17.4	16.2 – 19.2

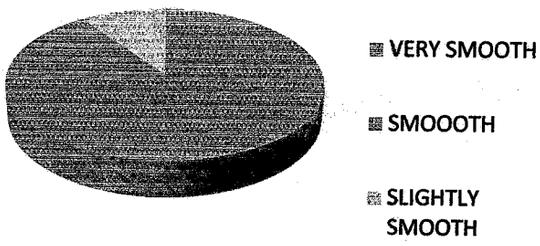
Table 4.5 Quality Characteristic for the Shea Butter Pomade

S/N	Characteristic Test	Value Obtained	NIS Standard
1	Thermal stability at 50 °C for 10 days	No oil separation was observed	No oil separation was observed
2	Free Fatty Acid	0.5	0.2 – 1.4
3	pH Value of 10 % solution at 27 °C	5.99	5.0 – 8.0
4	Specific Gravity (27 °C)	0.83	0.8 – 1.0
5	Acid Value	2.80	
6	Non-volatile matter percentage by mass (105 °C)	26.6	15 – 35
7	Dermatological safety test on development stage	Absence of negative reaction to the skin	Absence of negative reaction to the skin

Table 4.6 Quality Characteristic for the Palm Kernel Oil Pomade

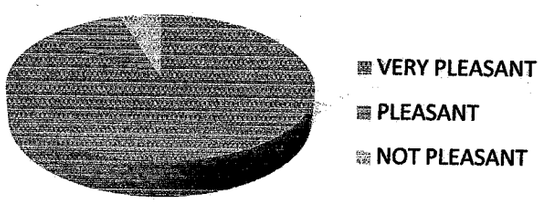
S/N	Characteristic Test	Value Obtained	NIS Standard
1	Thermal stability at 50 °C for 10 days	No oil separation was observed	No oil separation was observed
2	Free Fatty Acid	0.6	0.2 – 1.4
3	pH Value of 10 % solution at 27 °C	6.94	5.0 – 8.0
4	Specific Gravity at 27 °C	0.80	0.8 – 1.0
5	Acid Value	3.37	
6	Non-volatile matter percentage by mass at 105 °C	28.5	15 – 35
7	Dermatological safety test on development stage	Absence of negative reaction to the skin	Absence of negative reaction to the skin

In a case study of twenty people,



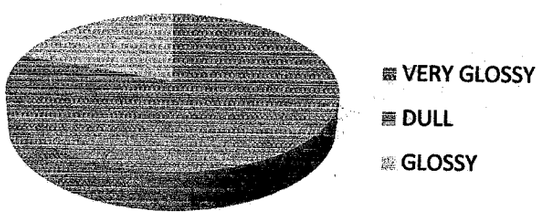
Very Smooth: 15 Smooth: 3 Slightly Smooth: 2

Chart 4.1: Physical Texture of the Shea Butter Pomade



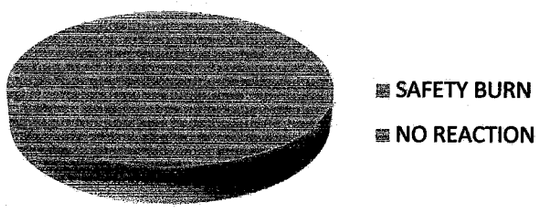
Very Pleasant: 17 Pleasant: 2 Not Pleasant: 1

Chart 4.2: Odour of the Shea Butter Pomade



Very Glossy: 14 Glossy: 4 Dull: 2

Chart 4.3: Appearance of the Shea Butter Pomade

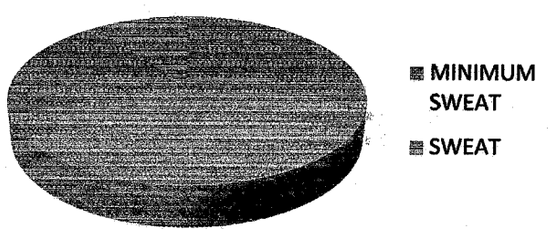


Safety Burn: 0 No Reaction: 20

Chart 4.4: Dermatological Requirement of the Shea Butter Pomade.

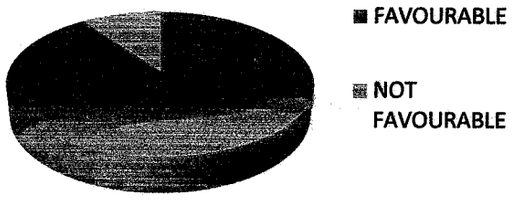
Wet feeling: 20 Dry feeling: 0

Chart 4.5: Moisturizing Effect of the Shea Butter Pomade



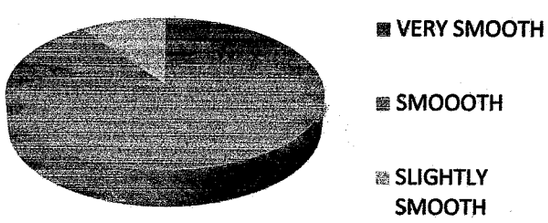
Minimum sweat acceptable: 18 Sweat: 2

Chart 4.6: Thermal Stability of the Shea Butter Pomade



Favourable: 18 Not favourable: 2

Chart 4.7: Overall Assessment Shea Butter of the Pomade

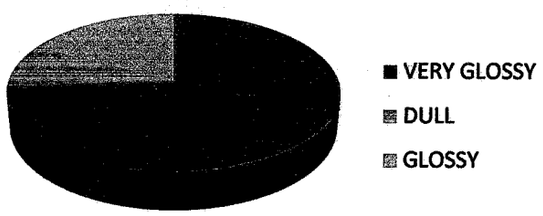


Very Smooth: 16 Smooth: 2 Slightly Smooth: 2

Chart 4.8: Physical Texture of the Palm Kernel Oil Pomade

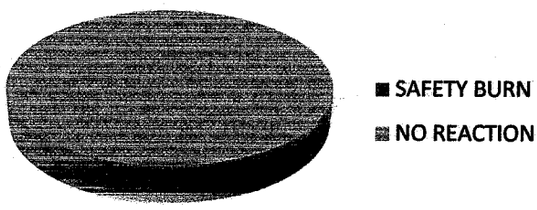
Very Pleasant: 14 Pleasant: 4 Not Pleasant: 2

Chart 4.9: Odour of the Palm Kernel Oil Pomade



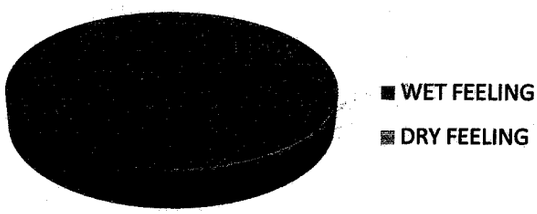
Very Glossy: 17 Glossy: 2 Dull: 1

Chart 4.10: Appearance of the Palm Kernel Oil Pomade



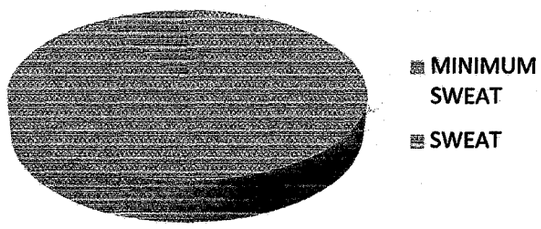
Safety Burn: 0 No Reaction: 20

Chart 4.11: Dermatological Requirement of the Palm Kernel Oil Pomade.



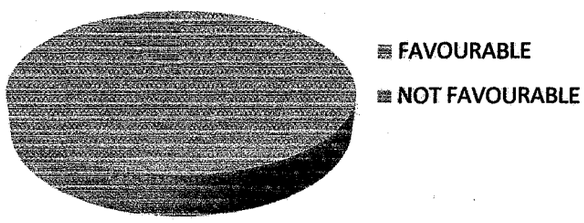
Wet feeling: 20 Dry feeling: 0

Chart 4.12: Moisturizing Effect of the Palm Kernel Oil Pomade



Minimum sweat acceptable: 18 Sweat: 2

Chart 4.13: Thermal Stability of the Palm Kernel Oil Pomade



Favourable: 18 Not favourable: 2

Chart 4.14: Overall Assessment of the Palm Kernel Oil Pomade

4.2 Discussion of Results

To achieve a maximum yield of Shea butter extraction from its nuts, the traditional extraction method was employed in this research work which proved to be cost effective and very productive. Palm kernel oil was extracted from its nuts using the traditional extraction method with 93 % extraction yield. Thus, at optimum conditions, both Shea nuts seeds and palm kerned nuts are good sources of oil used in both small scale and industrial production of pomade after a sequence of filtering of the extracted oil.

Characterization of the Shea butter and palm kernel oil was done in order to determine some of its physical and chemical properties. For Shea butter oil, the iodine value was 57.5 mgI_2/g, saponification value was 179.8 mg/KOH/g, acid value 4.71 mg/KOH/g, free fatty acid 2.36, refractive index 1.54, specific gravity 0.09, while that of the palm kernel oil were obtained as

follows; Iodine value was 17.4 mgI_2/g, saponification value was 244.03 mg/KOH/g, acid value 3.086 mg/KOH/g, free fatty acid value was 1.54, refractive index 1.45, specific gravity 0.92.

The low iodine values for both oil shows that the seeds has a long shelf life. The higher the iodine value the greater the liquidity of the oil. The saponification value indicates that the oil is a good raw material for the production of soap. (Brunner, 1985; Goodarznia and Bikini, 1998) The odour of the produced palm kernel oil was pleasant while that of Shea butter was not pleasant; hence it was deodorized using onion/garlic to improve its smell and texture.

Further processing of the Shea butter oil and Palm Kernel oil into pomade was carried out. Different formulations were used in conformity to standards stating no use of toxic or carcinogenic materials, absence of endocrines disruptors, and absence of artificial colorants. The pomade produced was a semi-solid cold cream made from natural oil, Shea butter and Palm Kernel oil, water-in-oil emulsion type which is a standard emulsion and are used to impact shining to the skin. It is pomade that when diluted with water, it cannot be easily washed from the hand or skin, it is more resistant to water and must be removed with soap or shampoo. Herbs and essential oils were used in the production process rather than alcohol-based perfumes because the latter can change the consistency of the pomade making it rather grainy instead of having a very smooth texture. The results from the characterization tests and the questionnaire analysis of the produced pomade shows that the pomade produced from both oils are favourable and its market appeal will be high.

Further comparison of the two products from the characterization test and the statistical analysis carried out by the use of questionnaires showed that the Shea Butter pomade was more favourable and thus will have an increased market appeal. This can be drawn from the fact that the raw material Shea Butter is more in availability than the Palm Kernel oil. Furthermore, Shea Butter has a lower pH value, acid value, free fatty acid value amongst other. The lower aforementioned values the more favourable the product according to standard requirements.

Chapter Five

5.0 CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

For this research work, a semi-solid, water-in-oil emulsion type pomade was produced from two different oil samples, Shea butter and Palm Kernel oil. Characterization of the extracted Shea butter and Palm kernel oil was carried out to determine some of its physical and chemical properties. Using different formulations, pomade was produced from the above oil samples.

Subsequently, characterization test and questionnaire analysis of the produced pomade was carried out and the values and analysis obtained conformed to standard values and showed that the pomade produced from both oil samples are favorable and indicates no variation in thermal stability, pH value, viscosity, specific gravity, non-volatile matter, free fatty acid and dermatological safety test.

A comparative analysis of the two product shows that the Shea Butter Pomade was economically viable, more favourable and will have a greater market appeal. This can be drawn from the availability of the Shea Butter, lower pH value, lower free fatty acid value of the Shea Butter Pomade.

5.2 Recommendations

a. Students interested in this research work can produce pomade from other different oil samples such as castro oil, jatropha oil, groundnut oil etc
b. It is also recommended that the government should impose laws of deforestation to prevent the falling of Shea butter and Palm Kernel oil trees for fire wood.
c. More should be done in the development and processing of Shea nuts and Palm kernel nuts due to its availability in large quantities in producing pomades, creams and body lotions
d. It is also recommended that interested students should study this research work carefully for the production of pomade from Shea butter and Palm Kernel oil in large quantities for commercial use.

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APPENDIX I

For palm kernel oil pomade

Acid value $= \frac{Titre\ value\ x\ 56.1\ x\ 0.1}{M}$

$= \frac{0.6\ x\ 56.1\ x\ 0.1}{1} = 3.366$

Free fatty acid $= \frac{Acid\ value}{2} = \frac{3.366}{2} = 1.683$

For Shea butter pomade

Acid value $= \frac{Titre\ value\ x\ 56.1\ x\ 0.1}{M}$

$= \frac{0.5\ x\ 56.1\ x\ 0.1}{1} = \mathbf{2.805}$

Free fatty acid $= \frac{Acid\ value}{2} = \frac{2.805}{2} = 1.403$

For Palm kernel oil pomade

Specific gravity $= \frac{w_2 - w_1}{w_3 - w_1} = \frac{45.933 - 25.10}{51.014 - 25.10} = \frac{20.833}{25.914} = 0.80$

For Shea butter pomade

Specific gravity $= \frac{w_2 - w_1}{w_3 - w_1} = \frac{65.738 - 25.10}{74.091 - 25.10} = \frac{40.638}{48.991} = 0.83$

For palm kernel oil pomade

Percentage non-volatile matter $= \frac{m_2 - m}{m_1} \times 100$

Where m = weight of the dried crucible in grammes

m_2 = weight of crucible and residue in grammes after heating

m_1 = weight of the cream in grammes

$= \frac{26.97 - 25.481}{26.590}\ x\ 100 = 40.9$

For Shea butter pomade

$= \frac{28.514 - 27.482}{28.531}\ x\ 100 = 96.2$

APPENDIX II

Quality Characteristics of a Skin Creams

Characteristics	Requirement
Thermal stability a) 40 ^{0}C for 6 week b)50 ^{0}C for 10 days	No oil separation to be observed
pH of 10 % solution at 27 $\pm$ 2 ^{0}C and emulsion type a) Oil in water emulsion b) Water in oil emulsion c) Cold cream (beewaxed borek)	 5.0 – 8.0 5.0 – 8.0 5.0 – 8.0
Total fatty substance % by mass (min)	15
Water content percentage by mass (max) a) Oil in water emulsion b) Water in oil emulsion	 85.0 52.0
Rancidity (for vegetable oil cream)	No pink colouration
Viscosity at 27 $\pm$ 2 ^{0}C centipoises (min) a) Emulsion type oil-in-water b) Emulaion type water-in-oil	 0.14 x 10^6 cPs 0.1 x 10^6 cPs
Specific gravity at 27 $\pm$ 2 ^{0}C a) Oil-in-water emulsion b) Water-in-water emulsion	 0.8 – 1.0 0.8 – 1.0
Non-volatile matter percentage by mass (m/m) at 105 ^{0}C a) Water in oil b) Oil in water	 65 – 80 96 – 99
Percentage oil content by mass (m/m) a) Oil in water b) Water in oil	 15 – 35 35 – 55
Dermatological safety test on development stage	Absence of negative reaction to the skin
Microbial Test Total Microbial count E-coli isolation	= 100 cfu/g Nil

(NIS, 2009)

APPENDIX II

QUESTIONNAIRE I

Department of Chemical Engineering,

Federal University of Technology,

P.M.B. 65,

Minna, Niger State.

Dear Respondent,

QUESTIONNARE ON THE EFFECT OF SHEA BUTTER POMADE PRODUCED IN MY RESEARCH WORK.

I am a final year student of the Department of Chemical Engineering of the Federal University of Technology, Minna, Niger State. I am conducting a research on the effect of the Shea butter pomade produced in my research work. Please kindly answer the questions in this questionnaire after using the pomade. I assure you that all information contained in this questionnaire would be used for the safe purpose stated above.

Thanks for your co-operation,

Yours faithfully,

Awwal Yahaya Viashima

QUESTIONNAIRE II

Department of Chemical Engineering,

Federal University of Technology,

P.M.B. 65,

Minna, Niger State.

Dear Respondent,

QUESTIONNARE ON THE EFFECT OF PALM KERNEL BUTTER POMADE PRODUCED IN MY RESEARCH WORK.

I am a final year student of the Department of Chemical Engineering of the Federal University of Technology, Minna, Niger State. I am conducting a research on the effect of the Palm Kernel oil pomade produced in my research work. Please kindly answer the questions in this questionnaire after using the pomade. I assure you that all information contained in this questionnaire would be used for the safe purpose stated above.

Thanks for your co-operation.

Yours faithfully,

Awwal Yahaya Viashima

QUESTIONS

Gender:	Male □	Female □	
Physical Texture:	Very Smooth □	Smooth □	Slightly Smooth □
Odour:	Very Pleasant □	Pleasant □	Not Pleasant □
Dermatological Safety Requirement:	Burns □	No Reaction □	
Appearance:	Glossy □	Dull □	
Moisturizing Effect:	Dry Feeling □	Wet Feeling □	
Thermal Stability:	Causes Sweat □	Doesn't cause Sweat □	
Overall Assessment:	Favourable □	Not Favourable □	

4. Specific gravity
5. Acid value
6. Free fatty acid
7. Boiling point
8. Meting point

2.9.1 Iodine Value:

The iodine value of oil is related to its unsaturation. It is a measure of unsaturated acid present. The test measures the amount of iodine that can be absorbed by the acid. One major property of unsaturated compounds is the presence of double bonds and the ability to undergo additional reaction especially with halogens (Brunner, 1985; Goodarznia and Bikini, 1998).

2.9.2 Saponification value:

In this process, ester is saponified and then back-titrated to determine the mean molecular weight of fatty acid present in the fat/oil. This is also the hydrolysis of triglycerides into glycerol and potassium salts of fatty acids, using a solution of potassium hydroxide in alcohol. Saponification value gives the actual amount of alkali, required by a fat/oil (Brunner, 1985; Goodarznia and Bikini, 1998).

2.9.3 Refractive index:

This is measure by angle through which light is bent when passing through a thing film of melted fats. The index of each fat falls within a narrow range and can be used in checking the purity of the oil. It is temperature dependent and usually reassured at 40 ^{0}C, temperature at which most fats are liquid (Brunner, 1985; Goodarznia and Bikini, 1998).

2.9.4 Specific gravity:

This is defined as the density of substance relative to that of water. It compares the sample relative to water (Brunner, 1985; Goodarznia and Bikini, 1998).

2.9.5 Acid value:

This is defined as the number of potassium hydroxide or sodium hydroxide that is required to neutralize the free fatty acid in one gram of the sample (Brunner, 1985; Goodarznia and Bikini, 1998).

2.9.6 Free Fatty acid:

This is the amount of sodium hydroxide required to neutralize the free acid in one gram of the sample. It can also be expressed percentage (Brunner, 1985; Goodarznia and Bikini, 1998).

2.10 Refining of the Shea Butter and Palm Kernel Oil Produced

When the fat has been produced, it is necessary to refine it to make it suitable for use which is the primary aim of this research work. The operations involved are:

1. Neutralization
2. Bleaching
3. Degumming
4. Deodorization

2.10.1 Neutralization:

This is the treatment of the fat with dilute caustic soda which removes the fatty acids present. The fat is acidic and neutralized with a base. The type and strength of the alkali, influences the efficiency of neutralization and the ability of the process to remove other undesirables residual phosphate etc (Brunner, 1985; Goodarznia and Bikini, 1998).

2.10.2 Bleaching:

This is mostly referred to as de-colorization of the fat. It is a process of removing colored bodies in the fat. Fats and oils contain coloured matter as natural constituents. Pigments like chlorophyll or carotenes give fats their colours. Some pigments can be made colourless by oxidation. This however, affects glyceroids and destroys natural antioxidants in the fat. Another method in thermal bleaching in which the fat in heated to a very high temperature which makes carotenes pigments colourless. This method also chars the pigments which make it very difficult

to use and is generally not advised in highly coloured fats. Another method is adsorption bleaching which is widely accepted for most edible oils. It is done by the use of bleaching earth which has large surface that has affinity for pigment types. Colour in removed without damage to the oils. Bleaching is usually following by filtration, with the filter being an interwoven metal structure (Brunner, 1985; Goodarznia and Bikini, 1998).

2.10.2 De-gumming:

This is a process whereby gum that is formed during fat production is eliminated. This removes protein compounds, complex carbohydrates if any, and the natural gums of the Shea butter and palm Kernel oil. Degumming also removes calcium, magnesium, iron and copper from the oils. The gum was formed as a result of the presence of thick white latex in the not (Brunner, 1985; Goodarznia and Bikini, 1998).

2.10.3 Deodorization:

This process removes unpleasant smells that are affected to the oil, which in one of the primary aims of this research work. It makes the oil widely accepted for consumption and cosmetic proposes and other use (Richard, 2009).

2.11 Major Ingredients for the Production of Pomade

The major ingredients used in the manufacturing of pomade are as follows;

1. Shea butter or Palm kernel oil
2. Mineral oil
3. Borax
4. Lanolin
5. Distilled water
6. Perfume

2.11.1 Shea butter

It is a slightly yellowish or ivory-colored natural fat extracted from the nut of the African Shea butter tree by crushing, boiling and stirring. It is widely used in cosmetics as a moisturizer, solvent or lotion. Shea butter is edible and may be used in food preparation. The main industrial use of Shea butter is in cosmetics, such as moisturizer creams and emulsion and hair conditioners for dry and brittle hair. Shea butter is an emollient and it is used for the manufacture of high quality lotion and creams. It helps makes the skin smooth and is proven to offer natural protection against ultraviolent rays (Oyewo, 2010).

2.11.2 Palm kernel oil

It is a versatile and highly saturated oil, provides a rich ingredient in homemade cosmetics and skin care. Semi-solid oil in most climates, palm kernel oil provides a light oil base that adds moisturizing properties to such as lip balms, gives the ability to control the ingredients of one's make-up. Palm kernel oil in the form of palm kernel fruits pulp is found in the form of drops or in cohesion in the external part of the fruit pulp or within the stone kernel. Although palm kernel oil or seed oil is identical to coconut oil, it contains rich amounts of lauric and myristic fatty acid (http://www.encyclopedia.com/palm kernel).

2.11.3 Mineral oil

It is a colourless, transparent oil liquid, a mixture of liquid hydrocarbon, almost tasteless, and odourless. Specific gravity (0.860 – 0.903) soluble in either chloroform, carbon disulphide, benzene, boiling alcohol and volatile oils, insoluble in water cold alcohol and glycerol, combustible and non-toxic (Awwal, 2005).

Paraffin oil or liquid petroleum is either pressed or dry-distilled from paraffin distillate, used for superficial oiliness of the cream. It is of different colors basically white and brown and graded according to these colors (Awwal, 2005).