PRODUCTION OF ANTISEPTIC SOAP FROM *PSIDIUM GUAJAVA LINN* LEAF EXTRACT

BY

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A RESEARCH PROJECT SUBMITTED TO THE SCHOOL OF SCIENCE AND INFORMATION SCIENCES IN IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF SCIENCE DEGREE IN CHEMISTRY OF MAASAI MARA UNIVERSITY.

DECEMBER, 2017

DECLARATION

Declaration by the student

I declare that this is my original work and has not been presented for a degree in any other university or for any other award.

SIGNATURE…………………………….. DATE……………..

ELIZABETH MWENDE BS01/048/2013

Declaration by the supervisor

We confirm that the work presented in this proposal was carried out by the candidate under our supervision.

Signature**………………………………** Date **…………………………… ……….**

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Department of Chemistry

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Signature**...**

Date**...**

Mr. John Mining.

Department of Chemistry

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DEDICATION

To my mother Christine Mwikali, all Brothers and Sisters, my husband Julius Moyi and my daughter Josephine Ayako.

ACKNOWLEDGEMENT

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ABSTRACT;

Amritphala *(psidium guajava l*) is a small size tree in myrtaceae family, traditionally used in treatment of several diseases such as inflammation, diabetes, hypertension, wounds, pain and fever. When it comes to skin care, the astringents of guava enhance the skin texture and tighten loosened skin. The guava leaves works more effectively than any other skin nourishing lotions in the market. Decoction of immature leaves and fruits can be applied on the skin to prevent tightening and toning effects. Being packed with antioxidant, antibacterial and anti-inflammatory agents and beneficial tannins, fresh guava leaves are considered as a natural pain reliever. These leaves contain chemicals such as polyphenols, carotenoids, flavonoids and tannins which are extremely effective in treating various diseases. In conjunction to these guava leaves importance, I have come up with a project in which an antiseptic soap was prepared out of it, which is ethnic and of dermatological importance and then explored the chemical and physical properties of the prepared soap. Extract from guava leaves was obtained using maceration extraction method with water as solvent since water has higher polarity compared to other solvents and can show presence of all the physicochemical properties needed. The phytochemical properties of guava extract were carried out which showed that guava extract had both medical and physiological activities. The tests carried revealed the presence of tannins, terpenoids, flavonoids, saponins, phenols and glycosides. The chemical and physical properties determine the quality and how efficiency the soap is to washing, bathing and even cleaning; and they include moisture content, pH, caustic alkalinity, total fat matter, percentage chloride and the total alkali of the soap made. The physicochemical properties of guava soap were done in comparison with Jamaa, Shujaa and Ndume as control soaps. The values of moisture content ranged between 11.03% to 22.14% with guava soap having 11.18%, pH ranged between 10.63 to 11.43 with guava soap having 11.36 , total fat matter ranged between 52.47% to 58.36% with guava soap having 54.27%, total alkali ranged between 0.00% to 0.55% with guava soap having 0.00%, free caustic alkali ranged between 0.00% to 0.04% with guava soap having 0.00% and finally percentage chloride which ranged between 0.14 %to 0.84% with guava soap having 0.41%. This study analysis showed that the free caustic alkalinity and total alkali for the four soaps were below the KEBs set standards hence no adverse effects on skin or cloth. In addition, the pH values were within the KEBs limit hence the soaps cannot have skin irritation effects.

Keywords: Extract, Terpenoids, Saponins, Phenol and Tannins Soap, pH, Total fat matter, Moisture content, free caustic alkalinity, percentage chloride, and Total alkali.

CHAPTER 1

INTRODUCTION

1.1 Background of the study

Soap may be defined as a chemical compound or a mixture of chemical compounds resulting from the interaction of fatty acids or fatty glycosides with a metal radical or organic base. The metals commonly used in soap making are Sodium and potassium which produce water soluble soaps that are used for laundry and cleaning purposes. The qualities of soap can be determined by identity, purity, content and other chemical, physical and biological properties, or by the manufacturing processes. For the quality control of the traditional medicine, the traditional methods are procured and studied and documented and the traditional information about the identity and quality assessment is interpreted in terms of modern assessment.

Psidium guajava is a small tree up to 20 feet high with spreading branches. Guava tree is easy to identify because it is thin, smooth, copper colored back that flakes off showing the greenish layer beneath and also because of the attractive body aspect of the trunk. *Psidium guava* is considered native to Mexico, South America, Europe, Africa and Asia. It is mainly found in tropical and subtropical regions. (Smith et al, 1992).

The leaves are ever green, opposite, short-petiole oval or oblong-elliptic, somewhat irregular in outline; leathery with conspicuous parallel veins and more or less downy on the outside. Flowers are white, borne singly or in small clusters in the leaf axils. The fruit exuding a strong, sweet, musky odor. When ripe may be round, ovoid or pear- shaped. (Jimenez et al, 2001)

More recent Ethropharmacological studies show that *psidium guajava* is used in many parts of the world for the treatment of a number of diseases such as diabetes, anti-inflammatory, hypertension, caries, wounds, pain relief and reducing fever. Some countries with long history of traditional medicinal use of guava include Mexico and other Central American countries including the Caribbean, Africa and Asia. (Garcia et al, 2003).

Moreover it is known that guava has a high content of vitamin A, vitamin C and potassium, which are characterized by their antioxidant functions. These nutrients normally carry out detoxification processes and keep the skin health and wrinkle-free (Suntornsuk et al, 2002). Guava leaves have benefits in making soap because they have great properties that can make the skin look good and even protect the skin especially when used in bathing or give a shining property to utensils on washing.

1.2 Taxonomic classification of guava;

Kingdom	**Plantae**
Subkingdom	Tracheobionta
Super division	Spermatophyte
Division	Magnoliopsida
Class	Magnoliopsida
Subclass	Rosidae
Order	Myrtaceae
Genus	Psidium l
Species	Guajava l

1.3 Problem statement

Production of antiseptic soap at a cheaper rate has been a hitch to many soap producers and this has led to the production of soaps with poor qualities which are less effective to diseases and amounting to high cost in purchasing. Also the steady and high exposure from dirt, dust, pollution and many agents produce skin reactions and form pimples and acne. This research work focuses on producing medicinal soap out of locally available plant, that is, from psidium guajava leaf, which will be more effective in bathing, washing and even cleaning, and at a minimized cost of buying. On bathing it has good effect in healing wounds, acnes and clearing out pimples.

1.4 Justification

Guava leaf extract is very good in the production of cheap and effective antiseptic soap that is firm to touch with high skin healing action. The soap is also excellent in both hard and soft water because it lathers easily. The soap is also more on natural profanes that can cure skin infections like skin allergies, rashes and skin itchiness. Furthermore the homemade soaps are of high quality, healthy and environmentally friendly because the fats and oils used are biodegradable (Viorica et al, 2011). Also, glycerin a core product of Trans esterification has both medicinal and industrial application such as soap and cosmetics (Chalmers and Bathe, 1978)

1.5 Broad Objectives

To prepare soap at a cheaper from locally available guava leaf extract.

1.7 Specific Objectives

i. To determine the phytochemical constituents of guava extract.

ii. To prepare antiseptic soap from guava leaf extract.

iii. To determine the physical and chemical parameters of the soap made and compare it with commercial soaps such as Ndume, Shujaa and Jamaa basing the results to the KEBs.

1.8 Research Questions

i. Can soap be prepared from extract made from guava leaves?

ii. How is the guava soap effective to diseases?

iii. Will the antiseptic soap meet both the Industrial Chemical standards and Kenya Bureau of Standards respectively?

1.6 Hypothesis

i. Extract from guava will produce antiseptic soap that meets both the Encyclopedia of Industrial Chemical standards and KEBs standards respectively.

ii. The antiseptic soap produced from guava leaf extract will cure diseases such as skin infections, wounds and even pimples.

CHAPTER TWO

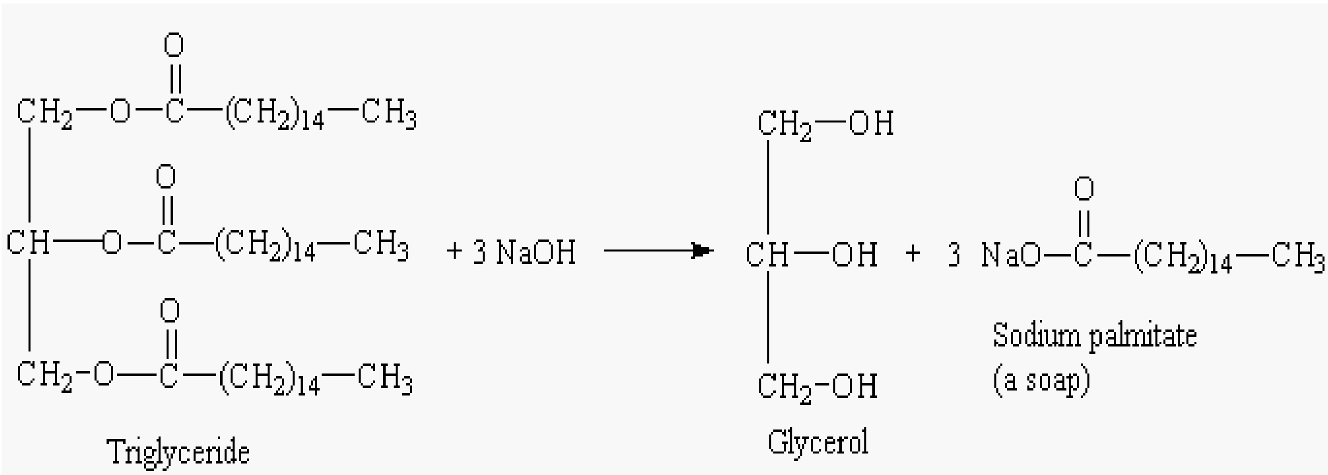
LITERATURE SURVEY

2.1 Soap

Soaps are anionic surfactants used in conjunction with water for washing cleaning and bathing in homes. In industries, it is used for spinning and textiles and also it is an important component of some lubricants .All soaps are made from fats and alkaline solutions. (Cavitch, 1994). There are many kinds of fats both animals and vegetables. Animal fats are usually solid at room temperature but many vegetable fats are liquids at room temperature. As with all the fats, soap contains positive ion, usually Na^+ or k^+ and negative ion, usually the anions of long- chained carboxylic acid obtained by the hydrolysis of animals or vegetables fats. There is also even numbered-chains resulting from the fats that are synthesized in cells by polymerization of a 2-carbon acetate unit. The vegetable fats are relatively unsaturated and liquids under ordinary conditions while animal fats are relatively more saturated (Childers, 2000).

Soaps are obtained by treating vegetables or animals' oils and fats with a strong base such as sodium hydroxide and potassium hydroxide in aqueous solutions. Fats are made up of triglycerides; 3-molecules of fatty acids attached to a single molecule of glycerol. The alkaline solution (lye) brings about the chemical reaction known as the saponification. In this reaction, the triglyceride fats first hydrolyze into free fatty acids and then combine with the alkali to form crude soap. Glycerol (glycerin) is liberated and either left in or washed out and recovered as a useful by product (Tafadzwa et al, 2012). This will depend on the process employed. For example; saponification reaction below.

Fat + lye→ Glycerol + Soap



Soaps molecules have both a hydrophilic end which dissolves in water as well as hydrophobic end which is able to dissolve non polar grease molecules, hence its usefulness for cleaning. For instance, when applied to soiled surface, soapy water effectively holds particles in colloidal suspension hence it can be easily rinsed off with clean water. The resultant round structures formed are known as micelles (Francion and Calling, 2002).

2.2 Guava

Guava is a common shade tree or shrub in door yard gardens in the tropics, also called guayaba in Spanish speaking countries and goiyaba in Brazil. The guava fruits can either be eaten fresh or made into drinks ice cream and preservatives. Guava fruits often grow well on well branched trees or shrubs reaching up to 20metres high in the richness of the Amazon. The tree can be easily identified by its distinctive thin smooth copper colored bark that flakes off thus showing a greenish layer beneath. (H.Burkill, 1997). The guava has spread widely throughout because it thrives quickly in a variety of soils, propagates easily and bears fruits quickly. The fruit contains numerous s seeds that can produce mature fruit- bearing plant within four years. The fruits are much enjoyed by the birds and the monkeys that disperse guava seeds in their seeds in their droppings and cause spontaneous clamps of guava trees to grow throughout the Amazon rain forest (J.Morton, 1987).

Since 1950s, guava particularly its leaves, have been a subject for diverse research in both its physical and chemical identity of its constituents, pharmacological properties and history in fork medicine. For example, from preliminary medicinal research in laboratory models, extract from guava leaves are implicated in therapeutic mechanisms against cancer, bacterial infections, inflammation, and pain and skin disorder. Essential oils from guava leaves have shown strong ant-cancer in *vitro (A.Sofowora, 1993)*. Nowadays guava leaves are considered minor in terms of its commercial and health benefits by millions of people; but this research work focus on these physical and chemical components of guava leaves that can be obtained or achieved when applied or used in form of soap.

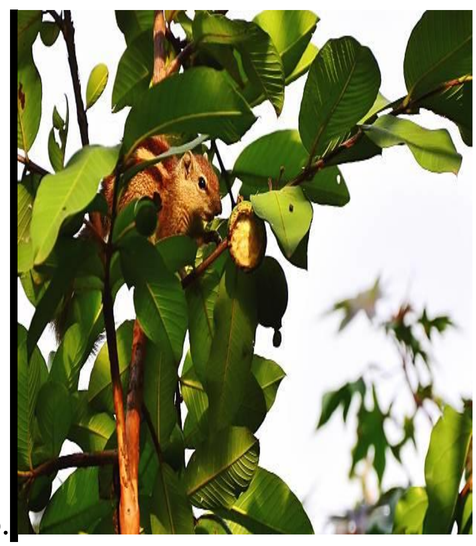


Figure 2.2: Guava leaf pictures

2.3 Saponification

Saponification is the chemical process of making soap. It involves an exothermic reaction between lye and a fat usually oils. An array of saponifiable oils and fats may be used in the process such as olive, coconut, cocoa butter and palm to provide different qualities. For example coconut oil provides lots of lather; olive oil provides mildness while coconut and palm oils provide hardness. Smaller amounts of unsaponifiable oils and fats that do not yield soap are sometimes added for further benefits.

2.4 Raw materials used in Soap making

The raw materials to use in soap making include;

2.4.1 Fats and Oils;

All animal fats and vegetable oils intended for soap making should be as free as possible from unsaponifiable matter of a good color appearance and in sweet, fresh condition (Simmons and Appleton, 2007). In the past, animal fat was obtained directly from a slaughter house but nowadays soap makers use fat that has been processed into fatty acid. This eliminates many impurities and it produces water as a by-product instead of glycerin. Many vegetables fats including olive oil, coconut oil, palm kernel oil can also be used in the soap making. Each offer quite different fatty acid content and hence results in soaps of distinct feel. Soap can be made using only one type of fat or oil by blending animals and vegetable or blending more than one vegetable oil. Soap made only from vegetable oils lathers easily but does not harden properly while soap made from animal fats are hard, tends to be grainy and lathers poorly. A mixture of the two or more types of fats or oils brings out the best qualities of both. Coconut and palm oils are very good for soap making (Francion and callings, 2002). Some vegetable oils such as palm kernel oil, jojoba seed oil, cocoa butter, beeswax, animal and others are rich in minerals and vitamins and are very good when used in bathing soap, for it nourishes the skin and cures many skin diseases and infections.

2.4.2 Alkali

The type of alkali metal determines the kind of soap product. The alkali most commonly used is sodium hydroxide or potassium hydroxide. Potassium-based soap creates a more water-soluble product than sodium –based and hence it is known as soft soap, which is often liquid while sodium-based soaps are firm (Shoge, 2011). The soft soap alone or in combination with sodium-based soap is commonly used in shaving products. Lithium metal can also be used as an alkali to form lithium soaps which also tend to be hard and are exclusively used in greases. The alkalis to use in soap making can be from two different sources. These sources are;

- Lye, caustic soda or potash purchased from the market.
- Lye obtained by leaching or washing water through the ashes of plant.

2.4.3 Other soap ingredients

Additives can be used to enhance the color, texture and scent of the soap. Fragrances and perfumes are added to the soap mixture to cover the odor of dirt and leave behind the fresh smelling scent. Either essential oils or artificial perfumes can be used abrasives are also used to enhance the texture of the soap and they include; talc, silica and marble pumice (volcanic ash). Modern manufacturers color soap to make it more enticing to the consumers as compared to the past where soap was made without dye hence a dull grey or brown color (Francion and Callings, 2002).

2.5 Soap making processes

There is several different soap making processes that allows easy production of soap products.

2.5.1 Cold process soap making

The cold process method is one of the most common ways to produce soap even at home. This process gets its name from the general low temperature used to mill the type of the soap. The low temperature or sufficient temperature is to ensure the liquefaction of the fat used. This soap making process requires exact measurements of alkali and fat amounts and computing their ratio, using saponification charts to ensure that the finished product mild and skin friendly.(Donkor,1997)

2.4.2 Hot process;

In the hot process method, alkali and fat are boiled together at 80-100 degrees until saponification occurs, which the soap maker can determine by taste or by eye. After saponification has occurred, the soap is precipitated from the solution by adding salt and the excess liquid drained off. The hot-soft soap is then spooned into a mold (Mittelbachet al,, 1996)

CHAPTER THREE.

MATERIALS AND METHODS

3.1 Introduction

This small- scale production of soap involved the cold process whereby small test batches of soap were first made. In this process, the reaction took place substantially at room temperature and the glycerin remained in the soap and the reaction continued for 28 hours after the soap had been poured into the mold.

3.2 Collection and Preparation of Plant Extract

130g fresh guava leaf samples were collected from guava trees growing in ukambani, Machakos a popular place called Masinga. Random leaf samples were collected into a well transparent polythene paper with appropriate labeling and stored in an ice cooler until being transported to the Maasai Mara laboratory for extraction.

3.3 Extraction Method used on guava leaves

A more modified method was used. The leaf samples were washed in distilled water, air-dried and then placed into a mortar to be ground into powder. Boiling distilled water was used for the maceration extraction procedure. The leaf powder was added to 520 ml of boiling distilled water to make a 20% concentration. The mixture was made in sterile 125ml Erlenmeyer flask wrapped in aluminium foil to avoid evaporation and exposure to light for 3 days at room temperature. The flask was placed on a platform shaker at 70 rpm. After 3 days of soaking in solvent, the mixture was centrifuged for 10 minutes at 2800 rpm at 25^{o}c to remove solids. The supernatant was collected and stored at 4^{o}c to avoid degradation until use. (Kimberly Rogers, Dr.Anand. K, 2013)

3.4 Phytochemical Analysis of Guava Extract

Chemical tests for the identification of bioactive chemical constituents in the guava were carried out using a standard procedure as shown below;

3.4.1 Test for phenols and Tannins

2 ml of the extract was mixed with 3ml of 2% solution of $FeCl_3$. A black coloration indicated the presence of phenol and tannins.

3.4.2 Test for terpenoids (Salkowski's Test)

2 ml of the extract was mixed with 3 ml of chloroform. Then 3 ml of concentrated sulfuric acid was added carefully and shaken gently. A reddish brown coloration formed at the interphase showed positive results for the presence of terpenoids.

3.4.3 Test for glycosides

2 ml of the extract was mixed with 3ml of glacial acetic acid containing 3 drops of 2% $FeCl_3$. To another tube containing 3 ml of concentrated sulfuric acid, the mixture was poured into it. A brown ring at the interphase indicated the presence of glycosides.

3.4.4 Test for flavonoids (Shinoda test)

2 ml of the extract was mixed with 5 pieces of magnesium ribbons and concentrated hydrochloric acid was added drop wise noting the color change. Pink or orange coloration indicated the presence of flavonoids.

3.4.5 Test for saponins

4 ml of the solvent extract was placed in a test tube and shaken vigorously noting down the observations. The formation of stable foam indicated the presence of saponins.

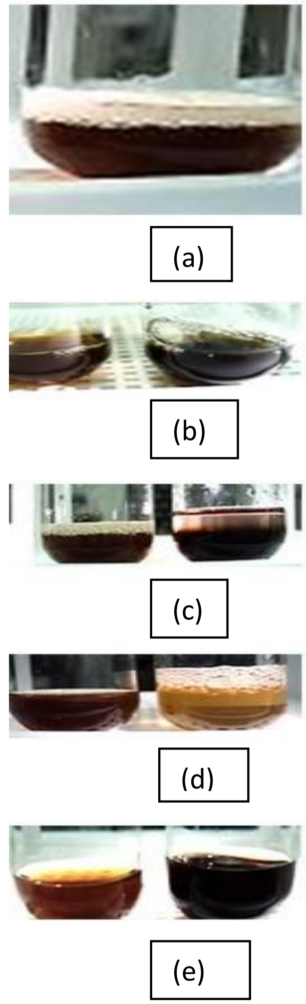


Figure 2: (a) Existence of saponin, (b) Existence of phenols, (c) Existence of terpenoids, (d) Existence of flavonoids, (e) Existence of glycosides

3.5 Soap Preparation

3.5.1 Determination of Lye and the Amount of Water

The amount of lye in the recipe depends on the mass of the fat or oil (Childers, 2000)

Mass of lye= Mass of fat or oil* Sodium factor or

i. (Amount of Fat) ×(Saponification Value of the Fat) =(Amount of Lye)

ii. (Amount of Lye)÷0.3 =(Total Weight of Lye Water Solution)

iii. (Total Weight of Lye Water Solution) – (Amount of Lye) =(Amount of Water)

TABLE OF CASTOR AND COCONUT OIL FOR SOAP PREPARATION

Table 1: First trial

OIL	**AMOUNT**	**SAP VALUE**	**AMOUNT OF LYE USED**	**AMOUNT OF LYE WATER SOLUTION**	**AMOUNT OF WATER SOLUTION**
Castor	20 ml	0.1286	2.57 ml	8.57 ml	6.00 ml
Coconut	50 ml	0.1910	9.56 ml	31.85 ml	22.29 ml

Table 2: Final experiment

OIL	AMOUNT	SAP VALUE	AMOUNT OF LYE USED	AMOUNT OF LYE WATER SOLUTION	AMOUNT OF WATER SOLUTION
Castor	116.67 g	0.1286	15.00 g	50.00g	35.00g
Coconut	233.33g	0.1910	44.57g	148.56g	103.99

3.5.2 Cold Process Soap making procedure

***Step 1*:**

The lye solution was prepared by mixing carefully weighed dry lye with appropriate amount of distilled water. The dry lye was measured in a container with a lid for sealing (On mixing the lye will be poured into to the water not water into the lye). The lye and water mixture were continuously mixed until all the lye is dissolved. One of the soap making thermometers was inserted into the liquid and the mixture was set aside for later use after labeling it.

***Step 2*:**

The acid was prepared by pouring appropriate weights of coconut and castor oils into the large soap making pot. The second thermometer was also inserted into the concoction and the mixture was set aside for future use after labeling it.

Step 3:

Both mixtures were waited to drop to 105 degrees Fahrenheit (41°C) in temperature but did not hit the desired temperatures at the same time, the acid mixture was warmed by inserting the container into a hot water in the hot plate to adjust the temperature right.

Step 4:

After the desired temperatures had been met, the lye was slowly poured into the oils mixture while stirring constantly and vigorously in order for all the necessary molecules to interact. The soap mixture was ready when it started to saponify. The mixture was tested by drizzling some soap onto the surface of the liquid to see if the reaction was occurring. Saponification had taken place when the soap stayed on top of the solution for a brief period before sinking back into the rest of the solution and the soap was ready(trace stage). This took 50 minutes since the stirring was manually.

Step 5:

After trace had reached, guava extract and lavender fragrance were added each at a time. The concoction was mixed until everything looked even toned.

Step 6:

The soap was then poured into soap making molds to make it harden from there.

Step 7:

The molds were then covered with their lids and then wrapped with towels to make sure no heat escaped as this was essential for the initial curing process. The soap was then left for 28 hours to cure before shaping.

Step 8:

Once the soap solidified within the wooden soap mold and was hard enough to slice, it was each carefully measured. The prepared soap was trimmed and carved until the desired shapes were formed. The new soap was laid on a rack so that air can circulate around it as flipping was done once every 6 days hence a need to cure for 3 to 8 weeks. The soap PH level dropped and the finished product was natural and mild at that point as shown below.

Figure 3: Soap ready to put in molds

Figure 4: Soaps obtained after removing from molds

3.6 Physicochemical Analysis

Physicochemical properties for the determination of quality of the prepared soap from guava leaf extract was carried out using the standard procedure as described below;

3.6.1 Determination of Total Fat Matter

Total fat matter was carried out by reacting each soap with an acid in the presence of hot water and then measuring the fat acid obtained. About 10g of the each soap was weight and 150ml distilled water added and then heated. Each of the soap solution was dissolved in 20ml of 15%

H_2SO_4 while still heating until a clear solution was obtained. The fat acid that had formed on the surface of each solution was solidified by adding about 8g of bee wax and then heated again before allowing it to cool and form a cake. The cake was removed, blotted to dry and then the total fatty matter was obtained. Formula used was;

% TFM =(X-M)/P x 100 where X= weight of wax+oil

M=weight of wax

P=weight of soap

3.6.2 Percentage Moisture Content analysis

5g of soap sample was weighed accurately and then placed into a well dried, tarred moisture dish and then dried in an oven for about 2hours at $100^{o}c\pm1^{o}c$. The procedure was repeated until a constant weight was reached (difference between 2 measurements not exceed o.5mg/g of sample). The % moisture content was calculated using the following formula;

% moisture = $(Cs- C_{h})/ (C_s – C_b)$ x 100 where C_s=weight of crucible +soap before heating,

C_h=weight of soap+sample after heating,

C_b=weight of crucible.

3.6.3 Determination of Total Alkali

The total alkali was determined by titrating excess acid contained in the aqueous phase with standard volumetric NaOH solution. 10g of finished soap was weighed and 100ml of neutralized alcohol was added to it. 5ml of 1N $H_2SO_4$was added to the mixture and heated till the soap sample dissolved. The test solution was titrated against 1N NaOH using phenolphthalein as indicator. The total alkali was titrated using the formula; 05M H_2SO_4

% Total alkali= $(VA-V_{B)}/W_S$ x 3.1 where $V_{A=}$volume of acid

$V_{B=}$volume of base

$W_{S=}$weight of soap

3.6.4 Determination of Free Caustic Alkali

5g of finished soap were weight and dissolved in 30ml of ethanol. A 3 drops of phenolphthalein indicator and 10ml of 20% $BaCl_2$ were added and then titrated against 0. Free caustic alkali was obtained by calculating the volume of the acid obtained with the formula;

NaOH= $(0.31x\ V_a)/\ W_S$ Where Va$_=$volume of acid

$W_{S=}$weight of soap

3.6.5 Determination of percentage chloride

10g of the prepared soap were weighed and 100ml of distilled water added to it. The mixture was heated to dissolve the sample. The resulting solution was then transferred into a 250ml volumetric flask and 20ml of 15% Ca $(NO_3)_2$ added to the solution and then shaken to dissolve the soap. Distilled water was then added to the volumetric flask to the 250ml mark. The solution was filtered and methyl red added to 100ml of the filtrate. The solution was titrated against 10N H_2SO_4 until a pink color was obtained. The resulting solution was then titrated against 0.1N $AgNO_3$using K2CrO7as indicator until a brick –red color appeared. Formula used;

% Cl= (Titer volume x 0.585) / W_S Where $W_{S=}$weight of soap

3.6.6: Determination of pH

10g of the powdered soap were weighed and dissolved in distilled water in 100ml volumetric flask in order to prepare 10% soap solution. The pH of the 10% soap solution was determined with a pH meter. 2g of the prepared soap was also dissolved in 10ml of distilled water and stirred till the sample dissolved. The pH was determined with a pH meter.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Phytochemical Analysis for Guava Extract shown in Table 3 below;

Test	Observations
• Phenols and Tannins	+
• Terpenoids	+
• Flavonoids	+
• Glycosides	+
• Saponins	+

Positive (+): presence of constituent

The phytochemical screening of chemical constituents of guava extract revealed the presence of active compounds which are known to exhibit medical and physiological activities. For instance, tannins are polyphenolic compounds that bind to proline rich protein and also interferes with protein synthesis and has shown to have antibacterial activity. Flavonoids are hydroxylatedpolyphenolic compounds produced by plants in response to microbial infections. This aspect of flavonoids has being extensively studied and found to have antimicrobial activity against an array of microorganisms' in *vitro* (M.Cowan et al, 1999). They have ability to form complexes with extracellular and soluble proteins and bacterial cell walls. Terpenoids used mainly for their aromatic qualities, have also been found to be potential agents against inhibiting bacteria (T.Miyazaki et al, 1996). Saponins which are glycosides have been found to have inhibitory effects on gram- positive organism, s.aureus. Therefore, phytochemical analysis revealed that distilled water extract have chemical compounds that possess antibacterial activities.

4.2 Physicochemical properties of soaps

The physicochemical analysis results for various ready-made control soaps and the prepared soap are shown in the Table 4 below;

Commercial soaps	Moisture content (%)	pH	Total alkali (%)	Free caustic alkalinity (%)	Total fat matter (%)	Percentage chloride
Shujaa	11.03±1.15	10.65±0.08	0.00±0.00	0.00±0.00	53.06±1.90	0.14 ±0.06
Ndume	22.14±1.10	10.63±0.05	0.11±0.04	0.00±0.005	52.47±7.18	0.53 ± 0.04
Jamaa	16.53±0.76	11.43±0.03	0.55±0.05%	0.04±0.07	58.36±0.79	0.84 ± 0.03
Prepared soap	11.18±0.08	11.36±0.02	0.00±0.00	0.00±0.01	54.27±2.18	0.41±0.03

The results above for the various commercial soaps are well compared to the results of the prepared soap obtained and are also comparable to the results given in the study done by Onyango Vivian et al,2014 and Viorica et al ,2011.

4.2.1 Moisture Content Analysis

This analysis was done to check on the shelf life of the prepared soap. High moisture content in soap would mean hydrolysis of soap while in storage (reaction of excess water with unsafonified fat to yield free fatty acid and glycerol). From the analysis results, Ndume had the highest percentage moisture content (22.14±1.10%), followed by Jamaa with 16.53±0.76%, the followed by prepared soap with 11.18±0.08%and finally Shujaa with 11.03±1.15%. the prepared soap and Shujaa also fall within the limits of Encyclopedia of Industrial Chemical analysis which is between 10-15%. All the soap samples above also meets KEBs standard for moisture content (22-26%). The dissimilarities obtained in moisture content of the various soaps may be due to difference in methods of preparing soap or inaccurate measurements of water content.

4.2.2 pH Analysis

The pH value for the various soap samples ranged 10-11 with Jamaa having the highest value of 11.43±0.03 followed by Guava soap with 11.36±0.02 followed by Shujaa with 10.65±0.08 and then Ndume with10.63±0.05 which were quite comparable to that of Onyango Vivian et al, 2014. High pH values can make soap to be corrosive to the skin and are as a result of incomplete hydrolysis from saponification process which can be overcomed by adding excess oil or fat or any super fatting agent thus reducing the harshness of soap. The pH values for Shujaa (10.65±0.08) and Ndume (10.63±0.05) were below the KEBs limits hence do not have adverse effects to skin while the pH values of Guava soap (11.36±0.02) and Jamaa (11.43±0.03) are within the set KEBs limits. Soap is alkaline to aqueous solutions and alkaline substances neutralize the protective acid mantle in the body that acts as a bacterial and virus barrier.

4.2.3 Total Alkali Analysis

Total alkalinity is the total amount of substance contained in a soap sample. Such materials may include carbonates and bicarbonates, hydroxides and many others. Jamaa soap had the highest mean value of 0.55%±0.05% followed by Ndume soap with 0.11%±0.04% and finally Guava soap and Shujaa soap both with a mean value of 0.00%±0.00%. This results are almost similar to what obtained in another study by Vivian et al, 2014 for both Shujaa, Ndume and Jamaa.

4.2.4 Free Caustic Alkali Analysis

This parameter determines the abrasiveness of any given soap which results from incomplete saponification. From the analysis, Jamaa soap had the highest caustic alkali of 0.04%±0.07%, followed by Ndume soap with 0.00%±0.005%then Guava soap with 0.00%±0.01% and finally Shujaa soap with a mean value of 0.00%±0.00%. The results of Shujaa and Ndume caustic alkalinity values were comparable to that of Vivian et al, 2014, Ainie et al, of <0.1% for Malaysian soap and Osuji et al, of 0.06% -0.09%. This analysis for free caustic alkalinity showed that the soap samples had no adverse effects on skin since the values were below the KEBs set limits.

4.2.5 Total Fat Matter Content (TFM) Analysis

Jamaa soap had the highest TFM value of 58.36%±0.79% followed by Guava soap with 54.27%±2.18%, then Shujaa with a mean value of 53.06%±1.90% and finally Ndume with a value of 52.47%±7.18%. The results in this study for TFM in all soap samples were well compared with results obtained by Vivian, 2014, which varies between 52% -58% and Viorica et al, 2001 which varied from 34% -61%. The difference in the TFM is due to the type and quantities of fatty materials used, moisture content of soap as well as the method of saponification involved. Unreacted NaOH in the mixture brings about lower TFM. High TFM is important in soaps because it rehydrates the skin making the skin smooth (high fat matter within soaps lubricates the skin)

4.2.6 Percent Chloride Analysis

The analysis of percentage chloride levels in the various soap samples was very crucial to study. If it is in large amounts it can cause soaps to crack. Jamaa soap had the highest percentage chloride of 0.84 ± 0.03 followed by Ndume with a mean of 0.53% ±0.04% then Guava soap with a mean value of 0.21±0.03 and finally Shujaa which had a mean value of 0.14%± 0.06%. The results obtained for Shujaa soap are almost similar to the results obtained by Viorica. The reason for less chloride content in guava soap and Shujaa soap is due to dissolving NaOH pellets in less chlorinated water (distilled water) in the soap making

CHAPTER FIVE

CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

The investigation presented in the current work aimed on obtaining extract from guava leaves and using the extract in production of antiseptic soap. The guava extract obtained using distilled water showed presence of bioactive components which are essential both in medical and physiological activities. The work also evaluated the physical and chemical parameters of the prepared soap in comparison with Jamaa, Shujaa and Ndume as control soaps to check on the viability of the soap for customer use. Saponification reaction was complete for both Shujaa and Guava soap since there was no free alkali present. This result conferred with the free caustic alkali in both Guava and Shujaa (0.00%) indicating total lye conversion giving comparable satisfactory effects. The results also concluded that we should choose soaps that maintains a balance of the physicochemical parameters. For instance, Soaps with least amount of moisture content such as guava soap and Shujaa, have increased self-life compared with those having high moisture content.in addition, high amount of total fat matter in soaps helps in lubricating the skin during bathing. Glycerin incorporated in the soap makes it smoother and softer than pure soap.

5.2 Recommendations

The following areas of research can be carried out to enhance the quality of the results displayed in the study

i. Further improved methods of extraction are required to enhance the quality of the extract produced.

ii. Further studies on fungal and antibacterial analysis of guava extract should be carried out.

iii. The government should recommend use of antiseptic soap with natural profanes rather than those incorporated with chemicals.

iv. Further studies in details should be done on the importance of guava leaves to people’s health.

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