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Comparative Evaluation of Some Physicochemical Properties on Selected Commercially Available Soaps on the Zambian Market

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Abstract

The Zambian market has witnessed an impressive upsurge in the production and consumption of a variety of soaps in recent years. However, there is scant, if any, knowledge of the quality and safety of these soaps. In this undertaking, the quality of some selected soaps was evaluated. The soap samples were randomly obtained from various supermarkets. The qualities of soaps were assessed based on the following physicochemical parameters: free caustic alkali (FCA), moisture content (MC), total fatty matter (TFM), pH and total alkali content (TAC). Upon analysis, a variation in these physicochemical properties was observed. Percent MC ranged between 6.70% ± 0.06% and 18.13% ± 0.13%. Solo and Yebo recorded the highest MC. The pH values ranged from 10.70 ± 0.02 to 12.23% ± 0.01%. Yet again, Yebo had the highest pH followed by Solo and then Romeo. The TAC was between 2.00% ± 0.06% to 2.40% ± 0.01% and FCA values were from 0.00 to 0.021% ± 0.00%. Romeo had the highest TAC value (2.40% ± 0.01%) followed by Dettol (2.31% ± 0.05%). Only Solo and Yebo showed some traces of FCA. On the other hand, TFM values ranged from 51.60% ± 0.60% to 78.15% ± 1.66%. Romeo recorded the highest TFM value (78.15% ± 1.66%) and Yebo recorded the lowest (51.60% ± 0.60%). On average, most soaps analysed herein were of fairly acceptable quality and are fit for use.

Subject Areas

Analytical Chemistry, Applied Sciences

Keywords

Soap, Total Fat Matter, Total Alkali Content, Moisture Content, pH,

Free Caustic Alkali

1. Background, Scope and Aim

"Cleanliness is next to godliness" is one popular adage extensively used in our societies in reinforcing the need and importance of keeping ourselves and our surroundings clean. In line with this aphorism, cleanliness could, therefore, imply a moral quality. Cleanliness may be described from an abstract standpoint as a state of being clean and free from dirt and the habit of achieving and maintaining that state. On a practical level, cleanliness is related to hygiene and disease prevention [1]. Washing is one way of achieving physical cleanliness, usually with water and often some kind of cleaning agent. With the intent of maintaining physical cleanliness regularly, an assortment of cleaning products is used in our everyday lives. These products safely and effectively remove soil, germs and other contaminants from our bodies, clothes, dishes and surroundings [2]. Soap, amongst many other products, is a typical example of a cleaning agent commonly used in enhancing beauty and maintaining physical cleanliness.

From a layman's perspective, soap can be described as any substance used usually in combination with water, to remove soil or greasy stuff from the skin, clothing, dishes, floors and walls. From the scientific standpoint, soap is a mixture of sodium or potassium salts of various naturally occurring fatty acids [3]. Now, fatty acids are not found in a free state in nature; commonly they exist in combination with glycerol (a trihydroxy alcohol) in the form of triglyceride. The structure of glycerol and triglyceride is shown in **Figure 1**. Fats and oils are called triglycerides (or *triacylglycerols*), because they are esters composed of three fatty acid units joined to glycerol [4]. Therefore, fats and oils are considered a source of fatty acids and it is for this reason that they are, to a great extent, employed in soap production.

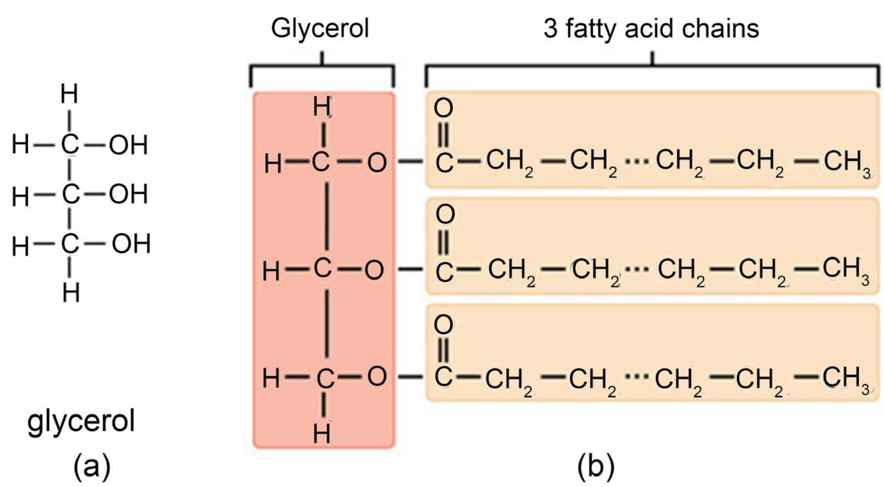

Figure 1. Structures of glycerol and triglyceride [5] [6].

The Nature of Soap and its Manufacturing Process

The potassium or sodium salt of fatty acids is the fundamental active agent present in all soap products. This active agent compound consists of a long hydrocarbon chain (composed of carbon and hydrogen atoms) with a carboxylic acid group at one end which is ionic as one oxygen atom is bonded to a metal ion, usually a sodium or potassium ion. The hydrocarbon end is non-polar and is soluble in non-polar substances (such as fats and oils), and the ionic end (the salt of a carboxylic acid) is soluble in water [7]. The structure of one type of soap molecule is represented in **Figure 2**. This molecule is an example of a primary component present in a soap product and the nature of the structure enables the soap to remove dirt from our bodies. A range of different types of soap products is commercially sold on the markets world over and come in various formulations including: bars, tablets, liquids, powder, pastes and flakes [8].

$$CH_3\text{-}CH_2\text{-}CH_2\text{-}CH_2\text{-}CH_2\text{-}CH_2\text{-}CH_2\text{-}CH_2\text{-}CH_2\text{-}CH_2\text{-}CH_2\text{-}CH_2\text{-}CH_2\text{-}CH_2\text{-}CH_2\text{-}\overset{\overset{\large O}{\|}}{C}\text{-}O^{-}Na^{+}$$

Non-polar hydrocarbon chain (soluble in nonpolar substances) | ionic end (soluble in water)

Figure 2. The structure of a soap molecule is adopted from David A. Katz [7].

Soap is typically produced from a hydrolysis reaction of a strong alkali (basic) reagent usually Sodium Hydroxide, NaOH (commonly known as *caustic soda or lye*), or Potassium Hydroxide, KOH (commonly known as *caustic potash*), with natural fats/oils (obtained from plants or animals) under controlled conditions in a process called saponification [9]. Regardless of the saponification reaction being depicted as a one-step reaction as illustrated below (**Figure 3**), it, in fact, involves two steps. Firstly, Triglycerides first undergo hydrolysis producing glycerol and fatty acid molecules. After that, the fatty acid portion is turned into a salt by reacting with a basic solution of the NaOH. This salt of the fatty acid is precipitated out and is what is known as soap [10] [11]. The soap is then dried and pressed into bars (in the case of hard soap) [6].

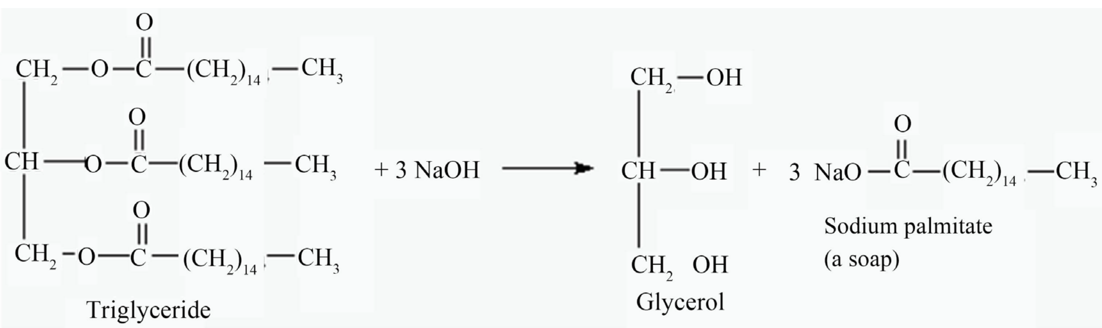

Figure 3. Saponification reaction of triglyceride (fat).

Fat/oil + NaOH/KOH → glycerol + sodium/potassium salt of fatty acid [12]

Two forms of soap are obtained from the process depending on the alkali used. NaOH produces "hard soap" whereas KOH forms "soft soap" - hence used to make liquid soap. Nonetheless, both soaps are readily soluble in water, either cold or warm [11]. Several different types of fatty acids are used in soap production. However, palmitic, lyric, stearic (saturated fatty acids), linoleum and oleic acid (unsaturated fatty acids) are the types that are widely applied in the manufacture of soap [13] [14]. There is prevailing knowledge that a high-quality soap is obtained from a combination of fatty acids [14]. But to continuously produce high-quality soap, there is a need to be consistent in selecting the apposite oils/fats with their different fatty acids. Neverthless, some manufacturers produce soap of questionable quality partly due to utilization of oils/fats of low quality such as beef fat tallow. Most of these oils of low quality contain non-saponifiable fatty acids. A large amount of unsaponifiable fatty acids lower the quality of a soap product [14] [15]. A finished soap product is not exclusively composed of fatty acid salts; it also contains additives such as fillers, emollients, preservatives and many others in different proportions. These additives are used to lower its cost of production and/or confer a variety of special, unique properties of a respective soap product [11].

Quality control and standard assurance of any type of commercially produced consumables and non-consumable products, including soap products aids in keeping the citizenry safe and healthy. In recent times several articles have been published to address the issue of quality and safety of commercially produced soap around the globe [6] [16] [17] [18] [19] [20]. It is worth mentioning that poor quality soap has been implicated in many skin conditions such as acne, eczema, hives, rashes, skin irritation and possibly cancer [21]. Many authors contend that poor quality soap is as a result of poor methods of preparation and utter carelessness on the part of the manufacturers during the production stage [14] [19]. To guarantee compliance by manufactures to adhere to manufacturing products of acceptable quality, many countries have instituted standard regulatory boards such as the Zambia Bureau of Standards (ZABS), Bureau of Indian Standards (BIS), Standard Organization of Nigeria (SON), Uganda National Bureau of Standards (UNBS), Kenya Bureau of Standards (KEBS) and South African Bureau of Standards (SABS), etc, which are mandated to formulate standards for an array of products including soaps. At international and regional level, there organizations such as the International Standard Organization (ISO), American Oil Chemists Society (AOCS), East African Standards (EAS) and the African Organization for Standardization (ARSO) that set standards that a product must meet to be considered fit for consumption. Countries may as well adopt some of the developed standards or product analyses protocols developed by these international and regional organizations.

According to some selected peer-reviewed and published articles, a soap of satisfactory quality is one that strikes a balance in all the measurable physicochemical (relates to physical and chemical characteristics) parameters which include but not limited to; Total Fat Matter (TFM), Free Caustic Alkali (FCA), Total Alkali Content (TAC), Moisture Content (MC), pH, etc., [12] [17] [20]. These physicochemical properties of soap determine their quality and cleansing efficacy [12]. To add on, these physicochemical characteristics of soap are affected by several factors which include the strength and purity of alkali used, the kind of oil/fat used and the completeness of the saponification reaction [20].

TFM is one of the most important characteristics describing the quality of soap. It is essentially a measure of identifying the amount of fatty matter present in soap [11] [14]. It is also described as the total amount of fatty matter, mostly fatty acids, that can be separated from a sample after splitting with a mineral acid, usually hydrochloric acid [22]. The latter description of TFM is actually the basis of the method employed in determining TFM in this paper. TFM value is reported as a percentage. A low TFM value is usually associated with hardness and lower quality of soap. By and large, soap with low TFM is a result of utilization of relatively large amounts of fillers during their production. Fillers, which are usually dry powders, tend to make soap harder and this makes it be harsh on the skin and when used in large amounts, fillers affect soap texture consequently making it to quickly get mushy when left in water for a specific period [14].

In older days in Europe and some countries now, soap with TFM 75% minimum was referred to as Grade I and 65% minimum as Grade II. The soap with the higher TFM gives more lather, lasts longer and more importantly, cleans one's skin better and more gently. The least quality soap (Grade III) has to have at least 60% TFM [11]. The BIS categorizes toilet soaps into three grades based on the total fatty matter present in them. If TFM is beyond 76%, it is classified as grade I and it has a very good quality. TFM above 60% fits to grade II and TFM above 50% fits to grade III [14]. For ZABS standard ZS 056 of 2009, a soap product must have a minimum value of 55% for TFM. For MC and FCA, the maximum values are 25% and of 0.05% by mass respectively.

Latterly, Zambia has witnessed an impressive upsurge in the production and consumption of soap products [23]. The market has been "flooded" with a range of different types of soap products of which, there is scarce information vis-à-vis soap quality. Some soap sold directly to consumers may have been made to the manufacturers' formulations and specifications rather than to any official standard quality specifications. Notwithstanding this, any product should meet certain specific standards set by respective national or international standards bodies. As a consequence, the need for constant quality surveillance on the commercially available soap products sold in the open markets is of extreme importance [6] [24]. Herein, we report the measurable physicochemical properties of a selection of soaps available on the Zambian market. At the time of this investigation and to the best of our knowledge, there wasn't any published article that had reported on the physicochemical properties of soap products available on the Zambian market.

2. Materials and Methods

2.1. Equipment and Reagents

Analytical balance (Ohaus, scout pro SPU202), pH meter (Crison base 20), oven (Memmert model 500), distillation apparatus, distilled water, petroleum ether, sodium hydroxide (0.5 N), methyl orange indicator, phenolphthalein indicator, nitric acid (0.5 N), oxalic acid (0.25 M), Sulphuric acid (0.05 N), sodium carbonate (0.05 N), anhydrous sodium sulphate, pH buffers (4, 7 and 9) and distilled ethanol (95 %w/w). All chemicals were of analytic grade and were obtained from reputable manufacturers.

2.2. Sample Collection and Preparation

Eight different soap samples were acquired from different supermarkets around Lusaka, Zambia. Three bars of each soap brand were procured. Soap samples were randomly selected, that is, no criterion was employed in selecting which soap samples to be analyzed. The samples were removed from the plastic covers and reduced into smaller pieces with the aid of a grater. Then they were thoroughly mixed to obtain a homogeneous sample; a representative of the samples purchased. Grated samples were kept in airtight glass containers filled to capacity so that there is no headspace. The samples were then stored at a temperature of 4˚C until when required for them to be subjected to specific rigorous laboratory operations as described below. Each parameter was then measured in triplicate.

2.3. Analysis of the Physicochemical Properties of Soaps

2.3.1. Moisture Content

Moisture content was determined as described in [20] which is also a standard procedure prescribed by AOCS [17] with some minor modifications. 5.00 g of the sample was weighed in a dry and tarred crucible and placed in the oven at 103˚C ± 2˚C for 2:30 hrs. The crucible plus sample was allowed to cool in a desiccator and then re-weighed. The percent moisture content was determined by employing the following formula:

$$\%\text{Moisture content} = \frac{Cs - Ch}{Cs - Cw} \times 100 \tag{1}$$

where;

Cw = weight of the crucible

Cs = weight of crucible + sample

Ch = weight of crucible + sample after floating.

2.3.2. pH

The pH was determined as described in [20] with very minor modifications. 2.00 g of soap was dissolved in 20 ml distilled water to make a 10% soap solution. Then the solution was left to stand overnight to allow the complete dissolution of soap. The pH was measured with a pH meter on the following day.

2.3.3. Total Fatty Matter

Total fatty matter and Total alkali content were determined as described in [11] with some minor modifications. 5.00 g of the sample was weighed and dissolved in 100 ml of 50% v/v ethanol. Then the mixture was heated on the water bath until the entire sample had been dissolved and while the solution was still hot, 40 ml of 0.5 N nitric acid was added followed by vigorous shaking. The solution was then left to cool at room temperature and transferred in a separatory funnel. The fatty acids were extracted with two portions of 50 ml and 25 ml petroleum ether. The two organic portions were then combined and dried by using anhydrous sodium sulphate to remove any traces of water and evaporated on a tarred crucible. The remaining aqueous layer was kept for determination of total alkali content while the total fatty matter was determined using the following formula:

$$\%\text{fatty matter} = \frac{Y - X}{Ws} \times 100 \tag{2}$$

where:

Y = weight of crucible + sample after evaporation

X = weight of empty crucible

Ws = weight of sample

2.3.4. Total Alkali Content

Total alkali content was determined as follows; 5.00 g of the sample was weighed and dissolved in 100 ml of 50% ethanol. Then the mixture was heated on the water bath until the entire sample had been dissolved and while the solution was still hot, 40 ml of 0.5 N Nitric acid was added followed by vigorous shaking. The solution was left to cool to room temperature and transferred in a separatory funnel. The fatty acids were then extracted with two portions of 50 ml and 25 ml petroleum ether leaving the aqueous layer. The total volume of the aqueous layer was measured with a measuring cylinder and a 10 ml portion from this was titrated with standardized NaOH using methyl orange as indicator. The total alkali content was determined using the following formula.

$$\%\text{of alkalinity} = \frac{Y \times 100}{W} \tag{3}$$

where: Y is the alkalinity factor obtained by a mathematical expression described by [11].

W = weight of sample

2.3.5. Free Caustic Alkali

Free caustic alkali was determined as described by [18]. Consistent with this prescribed method, 2.5 g samples were dissolved in 15 ml distilled ethanol and heated in the water bath until the sample had completely dissolved. This was followed by the addition of about 5 drops of phenolphthalein indicator and 5 ml of 20% $BaCl_2$. The resultant solution was titrated against 0.05 M H_2SO_4, to the disappearance of pink colour. The free caustic alkali was calculated using the formula:

$$\text{Free Caustic Alkali} = \frac{0.31 \times Va}{W} \tag{4}$$

where:

Va = volume of acid

W = weight of sample

3. Results and Discussion

In this paper, a total of five parameters to determine the physicochemical properties of some soaps on the Zambian market were analyzed. The results of the physicochemical properties of the soap samples are recorded in **Table 1** below. Moisture content (MC) was the first parameter to be determined. MC is a measure of the amount of free water present in the soap. It is an important parameter used to determine the shelf life of soap [16]. Excess water in soap reacts with any unreacted triglycerides (Fats/Oils) which might be present in soap, that is, they undergo hydrolysis to form fatty acids and glycerol on storage [17]. Thus, superfluous water would undoubtedly affect the quality of soap and certainly reduce its shelf life.

Table 1. Physicochemical properties of selected commercial soaps in Zambia.

Commercial name of the soap	Moisture Content (%)	pH	Total Alkali Content (%)	Free caustic Alkali (%)	Total Fatty Matter (%)
Romeo	10.33 ± 0.07	11.37 ± 0.02	2.40 ± 0.01	0.00 ± 0.00	78.15 ± 1.66
Dettol	8.67 ± 0.07	11.15 ± 0.03	2.31 ± 0.05	0.00 ± 0.00	65.40 ± 1.06
Solo	18.13 ± 0.13	11.49 ± 0.02	2.00 ± 0.06	0.0037 ± 0.00	61.50 ± 0.10
Protex	8.50 ± 0.10	10.70 ± 0.02	2.13 ± 0.01	0.00 ± 0.00	70.80 ± 1.80
Yebo	18.10 ± 0.08	12.23 ± 0.01	2.18 ± 0.05	0.021 ± 0.00	51.60 ± 0.60
Mediherb	10.70 ± 0.08	11. 31 ± 0.03	2.24 ± 0.04	0.00 ± 0.00	73.10 ± 0.10
Lifebuoy	12.20 ± 0.00	11.10 ± 0.04	2.03 ± 0.01	0.00 ± 0.00	63.40 ± 0.90
Lux	6.70 ± 0.06	11.06 ± 0.02	2.32 ± 0.05	0.00 ± 0.00	74.5 ± 1.22

From the data collected it was found that the percent MC of the soap ranged from 6.70% ± 0.06% to 18.13% ± 0.13%. From this study, we found out that Solo and Yebo had the highest MC of 18.13% ± 0.13% and 18.10% ± 0.08% respectively. On the other hand, Lux had the lowest MC of 6.70% ± 1.49%. Further, the percent MC for Romeo (10.33% ± 1.12%), Mediherb (10.70% ± 1.32%) and lifebuoy (12.20% ± 0.0%) were within limits set by the Encyclopaedia of Industrial Chemical Analysis (EICA) of 10% - 15% [18]. Whereas the values for Dettol, Protex and Lux 8.67% ± 1.33%, 8.50% ± 1.66% and 6.70% ± 1.49% respectively were lower than the EICA standards. However, most of the soap analyzed will not provide a conducive environment for the growth of microbes since they are within the recommended moisture content of 10% - 20% [25]. Low MC for Lux could be due to a prolonged time difference from the time the soaps were manufactured to the day they were purchased for analysis. Overall, the percent MC values determined in all the soaps were within acceptable limits; they are also below that which is recommended by ZABS (ZS 056) of which the maximum should be 25% by mass for total moisture and volatile matter.

pH was the next parameter to be determined. pH is the measure of the acidity or alkalinity of a substance [2]. pH is also a significant parameter in determining the quality of soap. Soap with pH values below 5 and those with pH way above 10 are associated with harshness on the hands and skin [2] [8]. Conversely, it must be noted that soap is naturally a salt of a weak acid (fatty acid) and a base. Hence, it is alkaline in aqueous solution; as a result, soap is generally expected to have a pH above 7. In the present study, the determined pH values were between 10.70 ± 0.02 and 12.23 ± 0.01. Of all the soap samples analyzed, Yebo had the highest pH (12.23 ± 0.01), followed by Solo (11.49 ± 0.02), then Romeo (11.37 ± 0.02) and Mediherb (11.31 ± 0.03). Dettol and Lifebuoy had pH values of 11.15 ± 0.03 and 11.10 ± 0.04 respectively. Protex recorded the lowest pH value of 10.70 ± 0.02. Soap with very high pH (highly alkaline) indicates that they may be corrosive to the skin. Strongly alkaline cleansing products tend to neutralize the body's protective acid mantle that acts as a barrier against bacteria and viruses [17]. Healthy skin has a pH of 5.4 to 5.9 [26]. Generally, pH values obtained in this work were slightly higher than those obtained by [20] but, similar to what [6] obtained. Further, the values obtained in this probe were above the BIS stipulated range of (7 - 10). Relatively high values observed in some soaps may be an indication of incomplete alkali hydrolysis resulting from the saponification process. Higher pH values in soap products can be overcome or controlled by the addition of excess fat/oil (supperfatting) in acceptable amounts or application of pH adjusters to reduce its harshness and corrosiveness on the skin [2] [27].

The total alkali content (TAC) is the other parameter that was determined. It represents the amount of total alkaline component in soap. It includes alkaline compounds such as sodium/or potassium hydroxides, oxides, carbonates or bicarbonates [17]. According to the BIS, good quality soap must have less than 5% of TAC whereas, for the ISO specification, soap should have amounts below 2% of TAC [11]. In the current study, the determined TAC was between 2.40 ± 0.01 and 2.00 ± 0.06. These values were comparable to those obtained by [11] which were in the range of 2.96 to 1.61. However, they were higher than the 0.2% standard value set by the EAS but, comparable to the 2% specified in the ISO.

Free Caustic Alkali (FCA) was also determined. Principally, FCA content determines the abrasiveness of the soap. Superior soap should contain little or no free alkali [24]. Soap with an excess amount of FCA irritates the skin and wear-out clothes [26]. Alkaline soaps are characterised by a high content of FCA can lead to skin dryness and scaling which cause the skin becomes susceptible to fungal attacks. This is because the excess alkali will saponify the fats and oils that are normally found on the skin as a protective coat to form soluble soap and therefore get washed away thereby rendering the skin dry [24]. The recommended FCA content of soap by the EAS is less than 0.1%. In the current investigation, all the soaps had no FCA except for Yebo and Solo which showed some presence of traces FCA amounting to 0.021% and 0.0037% respectively. Nonetheless, these amounts of FCA that was present in Solo and Yebo were less than the set of the EAS (0.2%) and that set by ZABS (maximum should be 0.05%). However, it is also worth noticing that these very two soaps (Yebo and Solo) that had some traces of FCA also had the highest pH values. But then again, the FCA values determined do not call for any concern.

As earlier stated, total fatty (or simply fat) matter (TMF) is the most important parameter in determining the quality of soap; in this study, it was, therefore, also determined. The IOS and EAS standard for toilet soap is 76%. [11]. In the current study, TMF values ranged from 51.60% ± 0.06% to 78.56% ± 1.66%. Romeo had the highest TMF value of 78.56% ± 1.66% followed by Lux (74.5% ± 1.22%), Mediherb (73.10% ± 0.10%) and then Protex with TFM of 70.80% ± 1.80%. On the other, hand Yebo and Solo had the least amounts of 51.60% ± 0.60% and 61.50% ± 0.10% respectively. Dettol and Lifebouy had medium values 65.40% ± 1.06% and 63.40% ± 0.90%. The TFM values for Lux (74.5% ± 1.22%), Dettol (65.40% ± 1.06%) and Lifebuoy (63.40% ± 0.90%) obtained in this work were lower than those obtained by [20] whose values were as follows; Lux (85.10 ± 0.01), Dettol (100 ± 0.00) and Lifebuoy (87.23 ± 0.04) [20]. On the other hand, values for Lux and Dettol obtained in the current undertaking were significantly higher than those obtained by [6] for which Lux total fatty matter was 35.00% and for Dettol was 15%. The discrepancy could be due to different methods of analysis or method of soap production in different regions; however, this was not confirmed. What's more, in this assessment, it was observed that colorants and other constituents in soap can contribute to the determined TFM value because some solvents such as chloroform, would also extract these additives during TFM determination. It is for this reason we elected to utilize petroleum ether for extraction purposes. In this regard, it is strongly recommended that certain procedures which employ solvents that do not remove these additives should be avoided when determining TFM otherwise the reported TMF value might not be the true reflection of the actual value.

4. Conclusion

The obtained results showed a variation in the physicochemical properties of the analyzed soap. To some extent, Solo and Yebo presented the most variation in terms of physiochemical properties from the other soap. Their moisture contents were higher than any of the other soap analysed. Besides, their TFM values were also lower compared to the other soap samples. However, these results were acceptable for bar soap and not for toilet soap. With an exception for Romeo soap, with TMF of 78.56% ± 1.66%, the rest of the soaps had TMF values less than the BIS and EAS standard for toilet soap. Under the BIS, Solo, Mediherb, Protex, Lux, Lifebouy and Dettol can hence, be classified as grade II while Yebo as grade

III. Other parameters which include moisture content, free caustic alkaline and total alkali content were within the limit for good quality soap. On average, the soaps analysed were of acceptable quality and are fit for use.

5. Recommendations

Irrespective of the fact that soaps analysed here have been determined to be of a fairly acceptable standard, we would like to recommend that another study on a larger scale, analysing as many different soaps as possible, with an inclusion of many other parameters be carried out. This will certainly be more conclusive and give an even clearer picture of the quality of soaps that the Zambian consumers are subjected to. Further, we are of the opinion that ZABS should update the standard so that it caters for more parameters to be met for a soap to be on the Zambian market. The ZS 056 standard only provides for four parameters that a soap product is required to meet for it to be considered fit for the consumers. In the current state, we feel a room has been created for the market to be flooded with inferior soap products. Finally, it is worth asserting that excessive and frequent use of any regular soap (as well as other cleansing products) may result in increased skin dryness and tautness, especially when applied to the face during the cold and dry season and in individuals with dry, sensitive skin [28]. Thus, we urge sagacious use of these cleaning products; keep your skin healthy by choosing the right soap for your skin; select a soap that keeps a balance among the physicochemical properties discussed.

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Conflicts of Interest

No conflict of interest has been declared by the authors.

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