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Physicochemical Analysis For Quality And Safety Of Some Selected Animal Soaps Compared To Human Soaps In Plateau State, Nigeria.

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Abstract: *Soaps are cleaning agents that are usually made by reacting alkali with naturally occurring fats or fatty acids. In this work, animal and human (toilet) soaps purchased from the main markets in Jos North and Jos South LGA of Plateau State were analysed to compare the values on quality and safety criteria for different characteristics. The comparison of result on percentage moisture content for both animal and human soaps is between 1.38-8.44 and 1.96-6.58, pH is between 9.79-10.02, percentage free caustic alkali is between 0.20 -0.16 and 0.01-0.06, foam height (cm) is between 0.20 -3.00 and 0.50-3.50, percentage total free fatty matter (TFM) is between 7.60-36.10 and 11.72-49.65 while percentage alcohol insoluble (MIA) is between 55.46-89.00 and 53.82-90.30. These results were compared with data in several literatures. It was concluded that the values determined are within the limits set by standard except for the values of TFM and MIA which are not within the standard values. It is concluded that there should be constant evaluation and test for animal and human skin products by regulatory bodies.*

Key words: *Soap, fatty acid, animal soaps, human soaps*

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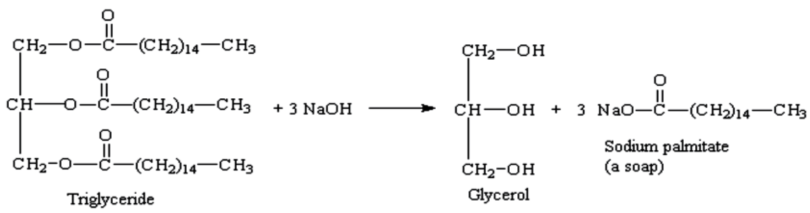
I. Introduction

Soap is a salt of a fatty acid and based on its chemical properties as an anionic surface-active agent (surfactant), it is used to clean and wash skin and clothing. It is also used in textile spinning and soaps constitute important components of lubricants. Soaps for cleaning are produced by treating triglyceride-rich vegetable or animal oils and fats (such as castor seed oil, shea butter, palm oil, palm kernel oil and tallow) with a strong alkaline solution (Chamber and Bathe, 1978).

Fatty acids are unsaturated monocarboxylic acids that have long carbon chains. The process by which triglycerides react with sodium or potassium hydroxide (lye) to produce glycerol and a fatty acid salt (soap) is called saponification (Abulude et al., 2007).



Fatty acids with only ten or fewer carbons are not used in soaps because they irritate the skin and have objectionable odours (Chalmers and Bathe, 1978).The qualities of soaps are determined by their physicochemical properties, which in turn depends on several factors like the strength and purity of alkali, the kind of oil used and completeness of saponification. Physicochemical characteristics important in assessing soap quality include moisture content, total fatty matter (TFM), pH, free caustic alkalinity and percentage chloride (Roila et al., 2001).

Studies have shown that soaps show some antibacterial activities (Rama et al, 2011) which could either be bactericidal or bacteriostatic. The normal micro-biota found on the skin of humans is usually different than those on other mammals. Indeed, skin microbial communities assemble in a species-specific manner on mammalian hosts (Ross et al., 2018).Therefore, it can be expected that the physicochemical properties of these soaps may differ. Although all grooming products (humans and animals) are designed to maximize cleaning and minimize irritations, harsh soaps can strip natural oil from the integument and may irritate the skin. It is expected that human soap should be used for human skin while veterinary soaps for pets (www.vetmed.wsu.edu).

The totality of features and characteristics of toilet soap product that bears on its ability to satisfy stated or implied needs of a consumer is its quality. Toilet soaps sold directly to consumer however, are usually made to manufacturer's own formulations and specifications rather than to any official quality specifications. Such specifications might perhaps be involved only if questions of trade description arise. Now, considering the sensitivity of the skin of both animals and humans to chemicals, there is a need to keep close quality surveillance on all skin preparations in the open markets (Viorica et al., 2011). In the present study, we carried out some physicochemical assessments of some animal and human soap and compared these with the reference standards.

II. Materials And Method

Soap samples were obtained as finished products from the open market in Jos South and Jos North, Plateau State. A total of ten soaps with five (5) veterinary soaps and five (5) human soaps were obtained from retail outlets. The soaps were stored in a cool and dry place pending completion of physical and chemical analysis on each soap tablet (SON, 1992; Buttler, 1997).

Preparation of samples

The soap mass was determined first by scrapping the surface of the soap tablet to about 0.50-1.00 cm deep before portions of the subsequent mass was analysed. Actual weight of each of the soap was determined using a sensitive weighing balance (Buttler, 1997).

Determination of pH

About 2 g of soap was weighed into a 200 ml beaker and 20 ml of distilled water was added and shaken. The suspension was allowed to stay for 12 hours. The pH was measured using a Jenway 630 pH meter.

Determination of moisture content

About 5.0 g of sample was taken in a dried and tarred moisture dish and dried in an oven for 2 h at 101°C and this process was repeated until the weight became constant. It was removed from the oven and kept in a desiccator. After cooling, the weight was taken using a sensitive weighing balance. The percentage moisture content was determined as follow:

% Moisture content = (Cs - Ch / Cs - Cw) × 100

Where Cw= weight of crucible, Cs=weight of crucible + sample, Ch = weight of crucible + sample after drying (Ashrafy et al., 2016**).**

Determination of foam height

About 2 g of soap was dissolved in 1 Litre volumetric flask and made up to mark with distilled water. About 50ml of the solution was gently introduced into a measuring cylinder slanted slightly at about 30^o angle such that it flowed along the walls to avoid foaming. A sub-sample of 200 ml of the solution was taken in a conical flask and poured into a separating funnel which was already clamped with outlet closed. The measuring cylinder was then put directly beneath the funnel while the height of the foam generated was read from the cylinder immediately the funnel outlet was opened (Ogunsuyi and Akinnawo, 2012).

Determination of alcohol insoluble

About 5 g each of soap samples were dissolved in 50 ml hot ethanol and quantitatively transferred in a pre-weighed Whattman filter paper of 4.2 mm diameter. The residue was dried in the oven at 105^{o}C for 30 minutes, cooled in the desiccator and weighed again.

Determination free caustic alkali

Free caustic alkali was determined by the method described by Milwidsky and Gabriel (1994). According to the method, 5 grams of finished soap was weighed and dissolved in 30 ml of ethanol. Few drops of phenolphthalein indicator and 10 ml of 20% $BaCl_2$ were added. The resulting solution was then titrated against 0.05M H_2SO_4 (aq). The volume of the acid obtained was calculated using the formula (Onyango et al., 2014):

$$FCA = \frac{0.31 \times V_A}{W}$$

Where; V_A is the volume of acid
W is the weight of soap

FCA is the free caustic alkali

Determination of free fatty matter

The total free fatty matter (FFM) was determined according to the method of Onyango et al., (2014):
The FFM was calculated as follow:

$$FFM = [100 - (MC - MIA)] \div 1.085$$

Where; MC is the moisture content and MIA is the matter insoluble in alcohol.

III. Results And Discussion

The physicochemical properties of animal soaps are in Table 1 while those of human are in Table 2.

Table 1: Result of the physicochemical analysis on quality and safety of animal soaps

Commercial Name of Soap®	Moisture Content (%)	pH	Matter Insoluble in Alcohol (%)	Free Fatty Matter (%)	Foam Height (cm)	Free Caustic Alkali (%)
Prime	6.68	9.79	77.40	16.00	2.4	0.16
Pet	3.40	10.02	89.00	7.60	0.2	0.02
Steven	7.92	10.00	59.06	33.02	1.0	0.06
Vetcan	1.38	9.90	86.78	11.84	1.0	0.04
Ectopel	8.44	9.83	55.46	36.10	3.0	0.02

Table 2: Result of the physicochemical analysis on quality and safety of human (toilet) soap

Commercial Name of Soap®	Moisture Content (%)	pH	Matter Insoluble in Alcohol (%)	Free Fatty Matter (%)	Foam Height (cm)	Free Caustic Alkali (%)
Imperial Leather	6.40	9.93	58.06	35.54	2.5	0.06
Family Care	4.92	9.59	53.82	41.26	0.5	0.04
Lux	4.46	9.69	90.30	49.65	3.0	0.05
Eva	6.58	9.63	81.76	11.72	3.5	0.01
Giv	1.96	9.66	82.22	15.82	2.5	0.03

Moisture content is a parameter that is used in assessing the shelf life of a product. High moisture content in soap would lead to reaction of excess water with un-saponified fat to give free fatty acid and glycerol (hydrolysis) on storage. The results of the moisture content of the animal soap in Table 1 showed that Ectopel® had the highest percentage moisture content of 8.44%, while Vetcan® is the lowest with moisture content of 1.38%. From the results obtained in Table 2, Eva® soap had the highest moisture content of 6.58%, while Giv® soap has the lowest value of 1.96%.Our results differ greatly with that obtained by Nangbes et al., (2014) for Lux®, Imperial Leather® and Premier® soap. The amount of moisture in both animal and human soaps was low and when stored over long period will not undergo hydrolysis, and hence will not favour the growth of microbes. Though the moisture content for all analysed soap samples were below the limits of Encyclopaedia of Industrial Chemical Analysis ranging between 10%-15% (Onyango et al., 2014). There is no much variation in the moisture content of the animal and human soaps, however the slight difference might be due to method of preparation.

The pH value of Pet® soap is higher than all other soaps analyzed with a value of 10.02 which is not much different from Steven® soap with a value of 10.00. Prime® soap has the lowest pH value of 9.79 (Table 1). But for human soap, the highest pH value was recorded for Imperial Leather® with value of 9.93, whereas Family Care® soap was the lowest with value of 9.59 (Table 2). Although our results compare favourably with previous work with values between 9.6-10.51(Idoko et al., 2018), they were above the limit set by Standard Organization of Nigeria (SON) with values ranges between 6.5-8.5. High pH content indicates high amount of unspecified and unsaponified matter due to incomplete alkaline hydrolysis. The result obtained for Lux® is higher when compared to Nangbes et al., (2014) but similar to that of Ashrafy et al., (2016). However, the pH of Imperial Leather® was higher than that obtained by Nangbes et al., (2014). The higher pH of animal soaps compared to human soaps could be as a result of the manufacturing process, considering a pH capable of reducing microbial load on the fur of the animals. The pH of the human skin is around 5.5 and any human soap above pH of 8.5 set by SON might result in dehydration and irritation of the skin.

For analysis of matter insoluble in alcohol (MIA), Pet® soap has the highest percent MIA of 89.00%, among the animal soaps while Lux® was the highest among the toilet soaps with value of 90.30%. Ectopel® soap and Family Care® soaps respectively has the lowest values of 55.46% and 53.82%. The alcohol insoluble matter measures the amount of non-soap ingredients known as builders or fillers such as sodium silicate, sodium phosphate, sodium carbonate and minor constituents (bleaches, whitening agents and fluorescing agents present in the finished product). Our result was in contrast with previous work (Nangbes et al., 2014) having a range between 1.46-5.30% but similar with the work of Idoko et al., (2018) with a value between 36-77%.

The values obtained for total fatty matter (TFM) for animal and human soaps ranges between 7.60%-36.10% and 11.72%-49.65% respectively indicating that the values were below that of Standard Organisation of Nigeria (SON) of ≥76% set for human soap. Since the higher the value of TFM the higher the cleaning power of the soap, this suggests that the soap analysed have less cleaning ability.

The level of foam height is attributed to the type of oil use in making the soap especially the palm kernel oil whose major fatty acid is lauric acid known for its high formability (Viorica et al., 2011). Ectopel® and Eva® produced the greatest foam height of 3.0 and 3.5 cm respectively while Pet® soap and Family Care® have the poorest formability among the two categories of soaps.

Free caustic alkali is one of the parameters that determine the abrasiveness of soap (Onyekwere, 1996). With the standard value of 5% maximum declared by Bureau of Indian Standards (BIS) and 2% maximum declared by International Standard Organisation (ISO), the result of our analysis indicated that all the analyzed soaps are acceptable having a value of 0.02%-0.16% and 0.01%-0.06% for both animal and human soaps respectively agreeing with the work of Idoko et al., (2018) with values between 0.06-0.22%.

IV. Conclusion

The animal soaps (Prime®, Pet®, Steven®, Vetcan® and Ectopel®) and human soaps (Imperial Leather®, Family Care®, Lux®, Eva® and Giv®) were analyzed and values compared on quality and safety criteria for moisture content, pH, matter insoluble in alcohol, total free fatty matter, foam height and free caustic alkali. A cursory look at the obtained results reveals some similarities in parameters for animal and human soaps like pH, matter insoluble in alcohol, total free fatty matter, foam height, and free caustic alkali. The results were compared with standard values and it can be concluded that most of the values are within the limits set by standard.

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