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Chemical Properties of Local Black Soap Produced from Cocoa Pod Ash and Palm Oil Waste

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ABSTRACT

This study was carried out to assess the chemical properties of local black soap produced from cocoa pod ashes and palm oil wastes in Ondo State, Nigeria. The pods were collected from a farm, dried and completely burnt to get the ashes (alkali base) while the palm oil waste was collected from a local producer in Owo. The traditional method was used to produce the lack soap and thereafter, the values for total fatty matter (TFM), total free alkali (TFA), free carbonate alkali (FCaA), free caustic alkali (FCA), pH, lather volume and wash active substance were determined. The result indicate that the soap had values of 67.2% (w/w), 7.61% (w/w), 2.27% (w/w), 4.53% (w/w), 10.0 and 280ml respectively for TFM, TFA, FCaA, FCA, lather volume and pH while the wash-active-substance was found to be 31.05%. These results revealed this soap has similar quality to most locally produced soaps. However, the gross inadequacies in the chemical composition of black soap can be improved upon which can be a potential source of job creation and wealth for teeming Nigerian youths.

KEYWORDS: *Black soap, palm oil waste, cocoa pods, saponification*

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1. INTRODUCTION

Soap is one of the cleaning materials needed by every family. Soap is so important that there is hardly any family that does not use it in their daily activities either in the solid bars, liquid and detergent forms. Soaps are salts of fatty acids and it may be hard or soft depending on the type of ingredients used [1]. Soaps are generally made by the hydrolysis of fats with caustic soda (Sodium hydroxide), thus converting the glycosides of stearic, oleic and palmitic acids into sodium salts and glycerol [2].

Soaps have a cleaning action because they contain negative ions composed of a long hydrocarbon chains attached to a carboxyl group [3]. The hydrocarbon chain has an affinity for grease and oil and the carboxyl group has an affinity for water. That is why soaps are mostly used with water for bathing, washing and cleaning. They are also used in textile industries for textile spinning.

There are many agricultural waste materials generated in homes and littered all over the environment. These materials include palm bunch, cocoa pod, plantain peels, banana peels, maize cobs, cassava peels and others. Some of these agricultural wastes like cocoa pod adversely affects soil fertility and so constitute environmental nuisance to man. However, they are a potential viable source which needs to be harnessed for other uses and to save the environment. According to Adewuji *et al.* [4], several agricultural waste of vegetable origin yield a high potash when combusted. These materials include plantain peels, cassava peels, palm bunch, wood and others.

The local production of potash from the agricultural waste has been observed to be a cheaper alternative source of this much needed chemical used in the production of soap and other alkali based product. Onyegbado *et al.* [3] has observed that alkalis content of potash obtained from ashes of plants origin were high and good for soap production. Presently, the art of homemade soap using caustic soda is gaining acceptance because of emphasizes on entrepreneurship education in our educational system. Production of soap using agricultural wastes is a veritable source of gainful employment for individuals [5].

The recent emphasis on entrepreneurship in our educational institutions coupled with the Nigerian government's efforts to diversify its economy has injected more impetus into the opportunities in local soap business. Moreover, cocoa pods and palm oil wastes are among several agricultural wastes which are usually disposed into the environment with the attendant health hazard is becoming an environmental challenge apart from being an eyesore [6]. Further, these agricultural wastes can be turned into raw materials for soap making industry [7]. Hence, there is a need to assess the chemical properties of the local black soap produced from cocoa pod ashes and palm oil wastes.

2. MATERIALS AND METHODS

2.1. Collection of cocoa pods and palm oil waste

Freshly harvested cocoa pods were sourced from cocoa plantation in Iyere, Owo, Ondo state. They were sundried for four weeks and packed in jute bags until needed. Palm oil residue used for this research was obtained from Emure-Ile local palm oil, Owo local government, Ondo state and was transported to the Laboratory for further use.

2.2. Extraction of Alkali from cocoa pods

The sun dried cocoa pods were burnt properly to form ash which lasted for about 8 hour. The ashed sample was homogenized by crushing between fingers and then sieved with analytical sieve to obtain uniform particles size. About 300 g of the ash was placed in a 3 litre container and 2 litre of distilled water was added. The mixture was placed on a stove and boiled continuously for 4 hour. After which it was allowed to stand for 48 hour and the content was filtered using muslin cloth to obtain clearer extract. The filtrate was allowed to boil further to concentrate it.

2.3. Production of black soap

The traditional method for producing black soap was adopted. 1000 ml of oil extracted from palm oil waste was placed in a stainless steel pot and heated strongly and 500 ml of the derived concentrated alkali solution was gradually discharged into the pot and stirred until the mixture became thickened. The heating continued for about 30min with continuous stirring. The pot with its content was removed from the fire and allowed to cool. The soap was allowed to cure overnight before removing the soap cake.

2.4. Determination of physico-chemical properties of the black soap produced from cocoa pod ash

2.4.1. Determination of Total Fatty Matter (TFM)

The soap sample (5g) was dissolved in 50ml-distilled water and the volume adjusted to 10ml, it was then boiled for about 30min, after which the solution was allowed to cool and then made acidic with 0.1m sulphric acid. The solution is then extracted with 50ml diethyl ether and then with another three-25ml portions of diethyl ether. The combined ether extracts was filtered into a tarred 250ml flask and the ether evaporated. The weight of the total fatty matter is obtained by subtracting the weight of the ether extracts form initial weight of the soap sample [8].

2.4.2. Determination of Total Free Alkali (TFA)

10g of soap sample were digested in freshly boiled ethanol (200ml) on steam bath until the soap sample was dissolved. The solution was heated to boiling and then filtered with standard 0.1m sulphuric acid to phenolphthalein and point. The total free alkali is calculated as potassium oxide using the relationship weight (g) of:

TFA = molarity of acid X formula weight of oxide X volume of acid used (liters).

2.4.3. Determination of Free Caustic Alkali (FCA)

10g of soap were dissolved in 100ml of neutralized ethanol over steam bath and 10ml of barium chloride added to the hot solution. The soap sample is filtrated with0.1m sulphuric acid using phenolphthalein indicator [9]. The amount of free caustic alkali in the soap is calculated using the relationship as;

FCA = molarity of acid X formula weight of barium chloride X volume of acid used (liters).

2.4.4. Determination of Free Carbonate Alkali

Free carbonate is determined by subtracting the free caustic alkali from total free alkali that is:

Free carbonate alkali = TFA-FCA

2.4.5. Determination of Wash-Active-Substance (WAS)

50g of the soap sample was digested in freshly boiled ethanol (300ml). The solution was refluxed for 75 minutes over steam bath and then allowed to settle down. 1% ethanol phenolphthalein (2-4 drops) was added. The solution was filtered and the resulting precipitate was washed with ethanol (50ml) into the flask and then boiled and filtered as before into the flask containing the filtrates. The washings were repeated five times. The combined filtrates were evaporated to dryness over the steam bath and residue was dried in an oven at 105ºC until constant weight. The paste obtained is the W.A.S. [10].

2.4.6. Determination of pH

The pH of the sample was determined using Geirincharz thermos pH meter, 10g of the sample was weighed into a beaker and then 100ml of distilled water was added and agitated to dissolve the sample. The pH meter was standardized at pH 7 according to user's manual. The electrodes were placed in the sample solution then pH was recorded.

3. RESULTS AND DISCUSSION

Cocoa pod soap was prepared as a product of saponification reaction between palm oil and POH solution extracted from cocoa pod ash. The soap free caustic alkali value (2.27%) compares well with the standard literature value. The free caustic alkali is the amount of alkali free to prevent soap from becoming oily [11]. Moreover, the detected free caustic alkali content of the soap is in harmony with the results obtained by earlier researchers [2, 5, 12].

Table 1: Chemical properties of black soap produced from cocoa pod ash and palm oil waste

Parameter	Value
Total fatty matter	67.2%
Total free alkali	7.61%
Free caustic alkali	2.27%
Free carbonate alkali	4.53%
Lather volume	280 ml
Wash active substance	31.05%
pH	10.2

The Wash Active Substance (WAS) obtained for the cocoa pod oil was 31.05% which is similar to the value obtained by Ikotun et al. [13]. This property is believed to make cocoa pod float on the surface of water when dropped in water. It was based on this property that makes it easier to collect cocoa pod on the surface of water during the extraction [14].

The Total Free Alkaline (TFA) value was found to be 7.6 % for black soap made from cocoa pod ash. This value falls within the range reported in literature which was 3-8 % [15]. This means that the palm oil waste can be used for saponification without refining [16].

The Total Fatty Matter (TFM) of cocoa pod black soap was 67.2 % which was found to be in range with the standard literature value (67 – 77 %) [17]. The lower TFM value may be due to the presence of unreacted POH in the mixture.

These differences in the TFM may be responsible for high moisture contents and the quantities of the used fatty materials and also perhaps due to the difference in the saponification method. This re-hydrates the skin making it smooth and additionally the high oil content within the soap acts as a lubricant throughout the day [18]. This property makes it ideal medicinal soap for people in the tropics.

The lather volume (ml) of cocoa pod soap was determined by measuring height of foam formed by the soap with pure water [19]. The lather volume observed in this study was 280 ml which compared well with those obtained from literature. This observation corroborates moisture loss, that is, as the moisture content reduces, the corresponding foaming strength increases [16].

From the results, the pH (10.2) of the black soap produced from cocoa pod ash was consistent with the normal pH range for soap 9-11 [20]. This low value obtained might be due to partial alkali hydrolysis resulting from the saponification process. The reaction can be completed by the addition of excess cocoa pod oil or any other super fatting agent to reduce the severe nature of the soap or addition of excess caustic soda [19]. The prepared soap may not be corrosive to the skin since it was made of a salt of a weak acid (fatty acid) and a strong base (POH). The soap was alkaline in aqueous media. Literature had shown that alkaline substances neutralize the body's protective acid mantle that acts as a natural barrier against bacteria and viruses [21]. Therefore, there is a need to modify the soap to make the pH more skin friendly to protect the user's skin microflora.

CONCLUSION

The data obtained on black soap in this study shows that it can compete favorably with other soaps. The apparent deviation is probably due to its crude nature and that of raw materials. Colorants may be used to improve its aesthetic value via desired coloration of the soap. Also, the soap pH may be adjusted with to neutral for the protection of the skin.

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