ASSESSMENT OF ALKALI LEVELS IN PALM BUNCH ASH, FOR BLACK SOAP PRODUCTION

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ABSTRACT

The assessment of the alkali contents of palm bunch ash of three species of oil palm; Elaeis guineensis, Elaeis Oleifera and Elaeis Odora was done. The palm bunch wastes were cut into small sizes, sun-dried and charred to obtain the ashes. Liquid extracts of the ashes were prepared and titrated against 0.5M HCl acid. The molarity of pure alkali extract was 0.25M. Spectrophotometer was used to determine the ionic concentration of the sodium and potassium present in each of the extracts and the actual percentage content of Na_2CO_3, K_2CO_3, NaOH and KOH in each of the extracts was calculated. It was concluded that the ashes contain alkali that can be used to produce solid soap.

Key words: Alkali contents, assessment, palm bunch ash, black soap.

INTRODUCTION

Interest on palms for mankind lies in the high oil content of the mesocarp and kernel of its numerous fruits, which are produced in heavy bunches. Palm bunch ash is the residue obtained from burning palm bunch. Palm bunch is the waste left after the fruits have been removed from the palm. On the other hand, ash is generally defined as the grayish white to black residue left from the combustion of a substance. The nature and characteristics of a given ash are dependent on its source or origin, specifically, palm bunch ashes of the three species: Elaeis guineensis, Elaeis odora, Elaeis oleifera. Plant ashes come in three different forms; Flyash(unstabilized), self-hardened crush ash (stabilized), and Pelleted ash, Flyash being the least dense and most volatile [1]. The chemical characteristics of ashes of plant origin can be divided into; alkalinity macroelements and microelements [2]. The physical properties of the ashes depend on this forms; the chemical alkalinity, macroelements (Ca, Si, Al, Na, etc) and microelements (Fe, Zn,Cu etc). The alkalinity of ashes is explained by the fact that the ashes contain the group one (i) and group two (ii) elements (metals) which include sodium, calcium, potassium and magnesium. These elements easily oxidize, hydrolyze or react with other anions to form alkalis [3], hence, the alkaline nature of the ashes. As a result of the alkaline nature of palm bunch ash, it can be applied in traditional black soap production. Elaeis guineensis, Elaeis odora (both grown in West Africa) and Elaeis oleifera(grown in America) are all possible raw materials for traditional black soap production. Nigeria is richly endowed with numerous palm trees whose ashes have been found to contain the fundamental chemical components (sodium hydroxide and potash) used in the production of soap. Instead of importation of these chemical components from other countries, and reducing the worth of our currency (Naira) when compared to the dollar, palm bunch can be used as a substitute. The objective of this work is to assess the alkali level of palm bunch ash of three different species – Elaeis guineensis, Elaeis odora, Elaeis oleifera which contain predominantly potassium and sodium carbonates, which can be used for soap making by determining the amount of total alkali carbonates and total alkali hydroxides present. The most common used fat or oils for production of soap through saponification reactions are animal tallow, coconut oil, palm oil, kernel oil and linseed oil [4]. The physicochemical characteristic of soap depends on several factors which include the strength and purity of alkali, the kind of oil used and completeness of saponification. Such physicochemical characteristics include moisture content, total fat matter (TFM), pH, free caustic alkalinity and percentage chloride [5]. Soap can be produced either by the traditional or modern methods. The traditional method utilized animal or vegetable oil with agro waste ash as alkaline source. The modern method is a reaction of vegetable oil with sodium hydroxide (caustic soda), which is derived from chemical process [6].

MATERIALS AND METHODS

Palm bunch wastes (empty palm fruit bunches) of three species of oil palm, namely; Elaeis guineensis, Elaeis odora and Elaeis oleifera were collected from a local oil palm processing mill in Ubima, Rivers state, Nigeria.

The palm bunch wastes were cut into small sizes and sun-dried for a period of 6days. The sun-dried materials were charred (carbonized) by open air burning. The ash samples were then grounded to fine particle sizes as small as $1.06x10^{-4}$m to give optimum alkali concentration results as described by Kuye and Okorie [7]. The samples were then bottled and labeled G_1 (Elaeis guineensis), OD_1 (Elaeis odora) and OL_1 (Elaeis oleifera). The samples G_1, OD_1 and OL_1 were put in a crucible and heated strongly with a Bunsen burner for 80 minutes to obtain finer particle sizes. The resulting samples were cooled and further grounded to finer particles, and labeled G_2, OD_2 and OL_2.

About 5g of each of the ash samples (G_1, OD_1, OL_1 and G_2, OD_2, OL_2) were dissolved in 100ml distilled water in beakers. The resulting solution was continuously stirred for a period of one hour using a spatula and allowed for about 15hours for proper absorption. The solutions were then filtered using Whatman No.1 filter paper and a clear extract was obtained. The extracts were made up to 1000ml, using distilled water in 1000ml volumetric flask. 5ml of the 12% $BaCl_2$ was added to 200ml of the extract and titrated against 0.5M of HCl acid using phenolphthalein until the end point was reached. Drops of methyl orange indicator were then added to the solution until an orange or slight orange coloration (depending on the alkali content of the extract) resulted. The molarity of pure alkali-extract was determined to be 0.25M which is in the same range with the molarity of 0.23M obtained by Onyegbado and others [2].

Spectrophotometric analysis of the extract for metallic ions was done using an atomic absorption spectrophotometer to obtain the amount of potassium and sodium ions in the extract.

RESULTS AND DISCUSSION

The spectrophotometric analysis showed that the OL samples contain the highest percentage of potassium ion (16.12% and 15.93%) and sodium ion (0.14% and 0.13%) as shown in Table1. The concentration of potassium ion for the various samples is greater than that of sodium ion. This implies that palm bunch ash extracts contain more potassium ion than sodium ion. The values obtained from the analysis are in line with the range of values given by ABC online forum: K^+ = 17.00± 0.1; Na^+=0.038 ±0.002 [8]. The slight difference in value is due to the concentration of the extracts.

Table1: Average Amounts of K^+ and Na^+ in the Extract (Palm Bunch Ash)

Sample	**K^+ (%)**	**Na^+ (%)**
G_1	14.92	0.13
OD_1	14.31	0.11
OL_1	16.12	0.14
G_2	15.01	0.12
OD_2	13.90	0.09
OL_2	15.93	0.13

Table 2: Percentage Weight of Sodium and Potassium Carbonates in Samples

Sample	**%K_2CO_3**	**%Na_2CO_3**
G_1	31.72	0.28
OD_1	28.18	0.22
OL_1	34.70	0.30
G_2	30.16	0.24
OD_2	25.40	0.16
OL_2	31.30	0.256

Table 3: Percentage Weight of Sodium and Potassium Hydroxides in Samples

Sample	%KOH	%NaOH
G_1	0.690	0.006
OD_1	0.362	0.0028
OL_1	0.83	0.007
G_2	3.46	0.027
OD_2	2.56	0.017
OL_2	3.62	0.029

The percentage weight of potassium and sodium carbonates in the samples are shown in Table 2. The OL samples have the highest percentage weight of potassium carbonates (34.70% and 31.30%) and sodium carbonates (0.30% and 0.256%). This is in accordance with the work of Taiwo and Osinowo (% weight Na_2CO_3 = 0.36± 0.04, % weight K_2CO_3= 43.15± 0.13) [9]. The difference in value is as a result of further heating, duration of dissolution and extraction of the extracts.

The percentage weight of potassium and sodium hydroxides in the samples are shown in table 3. The OL samples have the highest percentage weight of potassium hydroxide (0.83% and 3.62%) and sodium hydroxide (0.007% and 0.029%).
The Elaeis oleifera, of the three species, contains more alkalis which are used for soap making than the other two. The soap produced using 50% potassium hydroxide solution as alkali is "soft" but stronger than thick paste. The ash alkali soap has a harder consistency; sodium soap is very hard. The small difference in hardness between the pure potassium hydroxide soap and the ash-extract soap could be accounted for by the presence of other metallic ions notably sodium [2].

CONCLUSION

Palm bunch ashes can be used to produce neat solid soap which is of almost the same properties as pure potassium hydroxide soap. Instead of importing alkalis for soap production, palm bunch ashes, especially those of Elaeis oleifera, Elaeis guineensis and Elaeis odora should be used as alkali sources. These ashes can be locally sourced because the three species grow abundantly in the West African region. This will help reduce the cost of raw materials, improve production and the economy of the region. When sourcing for raw materials for soap production, Elaeis oleifera should be used as it contains high percentage of potassium carbonate alkali.
Production of soap with purified alkali made from palm bunch ash is an improvement over the conventional method adopted for black soap. The
qualities of soaps thus produced clearly indicated that exploitation of vegetable matter to generate alkali for soap production is worthwhile. Apart from the fact that our environment would be free of those agricultural wastes that often render them untidy, it will save the environment from the potential harmful effects of pollution that commonly associate with these synthetic chemicals. In addition, the heavy dependence on synthetic chemicals for soap production would drastically reduced if concerted effort is made on improving this source of raw material for soap making [10].
The benefits of a cheap and easily available alkali sources for a cash-strapped developing nation such as Nigeria are immense indeed. Efficient designs in the unit operations of the soap making process, as well as in saponification reaction stage, to bring about reasonable substitution of locally derived potassium hydroxide alkali, for imported ones, should be pursued. [2].

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