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To cite this article: Elizabeth O.A. Oluwalana 2018 *IOP Conf. Ser.: Earth Environ. Sci.* **173** 012035

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Effects of Physico-chemical attributes of forest-based herbal soap on human skin in southwestern Nigeria

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Abstract. There is a growing awareness of medicinal benefits of renewable forest resources that can be used as natural cosmetics for the benefits of human skin health. Today, more rural dwellers in forest reservation have resorted into utilizing more Non-Timber Forest Products (NTFPs) and agro-processing wastes products (APWPs) into African Black Soap (ABS) otherwise called Herbal Soap (HS). Some of the NTFPs that fall under natural cosmetics are herbal soap (black soap) produced from Cocoa Pod Husks (CPH); Shea-butter; Coconut Oil; Aloe-Vera Gel, and Natural Fragrance Oil. This is an excellent natural body-care soap in the original fashion and suitable for all skin types. The major raw materials that are used to produce herbal soap are from NTFPs and APWPs such as CPH; Palm Kernel Oil (PKO); cassava peels (CP) and, Plantain Peels (PP). 5g weight of each sample was dissolved in 50ml of solution (10% Concentration) to get the results. The results of the physico-chemical analysis (PCA) on Herbal soap and photographic impressions of ten (10) samples collected during field survey from different locations in South western, Nigeria revealed the following: The pH range of the herbal soaps (10% solution) is between 9.89 to 10.18 which is a good indication that the herbal soaps fall in the mid alkaline pH range - (that is, ideal soap pH range that have little or no irritation on mildest skin texture. Some synthetic soap that bleaches gives a pH range above 10.50 and other acidic soap below 6.98. pH range of the soap (10%) lies between (981-3110) x 10 mg/L which is a good indication. The Total Dissolved Solid (TDS) mg/L of the herbal soaps falls between 981-3110 mg/L which is a good indication of inertness of the soap to atmosphere when expose to moisture. Industrial PKO (981-1775) melted but traditional processed PKO (1800 -3110) stayed dried. The Conductivity (US/cm) of the herbal soaps ranges from 18,200-47,150 (US/cm) ^{x10}. This measured parameter indicates the extents of dissolved ions present in the herbal soap materials that when releases nourishes the skin on use. The higher the dissolved ions, the better for skin absorption of the desirable ions which result into healthy skin in human being

Keywords: Forest Based Herbal soap, Non-Timber Forest Products (NTFPs), Physico-chemical attributes, pH, Healthy Skin



1. Introduction

Researchers have identified some wastes generated from agro-processing enterprises being utilized by small-scale industry to produce consumer products such as black/herbal soap [1, 2]. Some of these raw materials from forest and agriculture are classified as non-timber forest products (NTFPs) and agro-processing wastes products (APWPs). The NTFPs being utilized in FB-SSEs are usually classified into firewood and sawdust (off-cuts and dust from sawn timbers); medicinal plants (bark; leaves; roots; seeds); ropes, foods and fruits. The agricultural-processing wastes generated by the rural entrepreneurs include cocoa-pod husks (CPHs); Palm-kernel Oil (PKO); plantain peels; cassava peels and palm kernel bunches (PKBs).

African black soap (ABS) is all-natural soap handcrafted that have more than 100 varieties of black soap [3]. Each region and tribe has his or her own recipe that has been handed down through generations. Ghanaians and Nigerians have used black soap to help relieve acne, oily skin, clear blemishes and various other skin problems, including eczema and psoriasis. African women use black soap during pregnancy and afterwards to keep them from getting stretch marks and to protect them from dry skin that often accompanies pregnancy [3]. Black or herbal soap is used in many traditional medicine formulations, for the cure of uterine fibroid, vaginal infections, and charms. Herbal soap is unique in that it contains no preservatives and colour enhancers. In recent year, there has been a grassroots return to making “natural” soap in the home [4]. In modern times, the use of herbal soap has become universal due to a better understanding of the role of personal hygiene and medicinal importance on skin in particular. Tables 1 and 2 below shows the medicinal components as reported by Yusuf [1] and mineral composition of Cocoa Pod husk (CPH) by Ozung [5].

1.1 Research Questions

- (i) What are the Non-Timber Forest Products (NTFPs), Agro-processing waste products (APWPs), Value-Added Products (VAPs) being utilized by FB-SSEs Herbal Soap processing?
- (ii) What are the health potentials in terms of medicinal uses and Physico-chemical attributes of herbal soap?

1.2 Objective

The main objective is to analyze the physico-chemical attributes of herbal soap that influence the healthy human skin.

Table 1: Medicinal Potential Components of Cocoa Pod Husk (Moisture free)

Constituents	Percentage
Crude Protein	5.69-9.69
Fatty Substances	0.03-0.15
Glucose	1.16-3.92
Sucrose	0.02-0.18
Pectin	5.3-7.08
Nitrogen free extract	44.21-51.27
Crude fibre	33.19-39.45
Theobromine	0.20-0.29
Ash	8.83-10.18

Source: Yusuf and Okoruwa (1995)

Table 2: Mineral Composition of Ash and of Cocoa Pods

Mineral (g/kg) RCPHM FCPHM HCPHM S.E.M	Mineral (g/kg) RCPHM FCPHM HCPHM S.E.M	Mineral (g/kg) RCPHM FCPHM HCPHM S.E.M	Mineral (g/kg) RCPHM FCPHM HCPHM S.E.M	Mineral (g/kg) RCPHM FCPHM HCPHM S.E.M
Calcium (Ca) 11.16a 5.65b 7.23b 1.64	Calcium (Ca) 11.16a 5.65b 7.23b 1.64	Calcium (Ca) 11.16a 5.65b 7.23b 1.64	Calcium (Ca) 11.16a 5.65b 7.23b 1.64	Calcium (Ca) 11.16a 5.65b 7.23b 1.64
Magnesium (Mg) 2.79a 2.44a 1.53b 0.38	Magnesium (Mg) 2.79a 2.44a 1.53b 0.38	Magnesium (Mg) 2.79a 2.44a 1.53b 0.38	Magnesium (Mg) 2.79a 2.44a 1.53b 0.38	Magnesium (Mg) 2.79a 2.44a 1.53b 0.38
Phosphorus (P) 0.51a 0.30b 0.47a 0.06	Phosphorus (P) 0.51a 0.30b 0.47a 0.06	Phosphorus (P) 0.51a 0.30b 0.47a 0.06	Phosphorus (P) 0.51a 0.30b 0.47a 0.06	Phosphorus (P) 0.51a 0.30b 0.47a 0.06
Potassium (K) 1.98a 1.07b 1.15b 0.29	Potassium (K) 1.98a 1.07b 1.15b 0.29	Potassium (K) 1.98a 1.07b 1.15b 0.29	Potassium (K) 1.98a 1.07b 1.15b 0.29	Potassium (K) 1.98a 1.07b 1.15b 0.29
Sodium (Na) 0.35b 0.48b 0.74a 0.11	Sodium (Na) 0.35b 0.48b 0.74a 0.11	Sodium (Na) 0.35b 0.48b 0.74a 0.11	Sodium (Na) 0.35b 0.48b 0.74a 0.11	Sodium (Na) 0.35b 0.48b 0.74a 0.11

Source: Ozung et al, 2016

2. Materials and Method

2.1 Analytical Techniques

Identification of the Non-Timber Forest Products (NTFPs), Agro-Processing Waste Products (APWPs) and Value-Addition Products (VAPs) used in ashes and/or lye production for making herbal soap. There were many forest plant species used as fuel-wood, ashes and lye production by Forest-Based Small-Scale Enterprises (FB-SSEs) in herbal soap production. The parts of the plants being used are the off-cuts, sawn wood, branch, stem, log waste. They are classified as Non-Timber Forest Products (NTFPs) used as fuel-wood for cooking, baking in the bakery, lye production and soap production. Saw dusts ashes from sawmill are also utilized by the herbal soap processors.

The ashes collected were used to produce lye for production of herbal soap. The part of the tree used are usually classified as wastes, hence, the utilization of these wastes is desirable to generate more income, thereby improve the processors income generating activities leading to poverty reduction and improvement in the livelihood status of the entrepreneurs involved in herbal soap production. Furthermore, some of the plants are in abundant, scarce or not common in the study areas.

Furthermore, agricultural wastes generated during commercial activities such as cocoa processing (Cocoa pod husks), cassava processing (cassava peels), plantains processing (plantains peels), palm oil processing (palm oil bunches) etc. Identification of the wastes that can be used to make herbal soap was carried out during this study as wastes-to-wealth strategy to generate more income to improve the livelihood status of the entrepreneurs.

Some Value-Addition Products (VAPs) that were identified to add value to herbal soap produced by producers or final consumers of value-added herbal soap such Dudu Osun and UNAAB Herbal Soap. Some of these products are pure honey, sheabutter, cocoa butter, coconut oil, camwood (*osun*), lime juice, lime rind, sulphur (*imi-ojo*), Aloe-vera and Ethiopian pepper.

2.2 Physico-Chemical Analysis of Herbal Soap Samples

Chemical analysis was carried out in the laboratory on ten (10) herbal soap samples to confirm the chemical attribute of herbal soap that influence its effect on human skin. Five grams (5gm) weight of

each sample was dissolved in 50ml of solution. (10% Concentration) to get pH range of the herbal soaps. An ideal soap should have little or no irritation on mildest skin texture.

The Total Dissolved Solid (TDS) mg/L of the herbal soaps was analysis to get indication of inertness of the soap to atmosphere when expose to moisture. Herbal soap processed with industrially processed PKO and traditionally processed PKO were tested.

The Conductivity ($\mu\text{S}/\text{cm}$) was the parameter used to measured the extents of dissolved ions present in the herbal soap materials that when released nourishes the skin on use. The higher the dissolved ions, the better for skin absorption of the desirable ions that result into healthy and smooth skin. The chemical analysis results confirmed the age long medicinal attributes associated with herbal soap on the skin.

3. Results and Discussion of Findings

3.1 Utilization of Agricultural-Wastes Products in Herbal Soap Processing Enterprise

There are many agro-processing wastes being utilized in herbal soap production. Some of the products and processing are stated in Figure 1. The first stage involved the collection of dry cocoa pod husks with or without palm kernel bunches and cassava wastes. The second stage entailed the burning into ashes the agro-wastes. The ashes are put into perforated clay pots, water, usually rain water or stream water added and lye is produced. The third stage which is called saponification of lye (*aaro*) and palm kernel oil (*adin-agbon*) or palm oil (*epo pupa*) to produce herbal soap.

The last stage is the value-addition stage which involves packaging herbal soap with or without wastes from generated cassava or yam commercial processing. The wastes used as 'fillers' are classified as cassava granules (*Garri*) waste, cassava flour (*lafun*) waste and yam flour (*elubo*) wastes. Fillers are meant to make the herbal soap look bulky and cheap to the customers. The health implication of the inclusion of the filler has not been ascertained but the fillers likely reduce the potency and lathering effect of the soap.

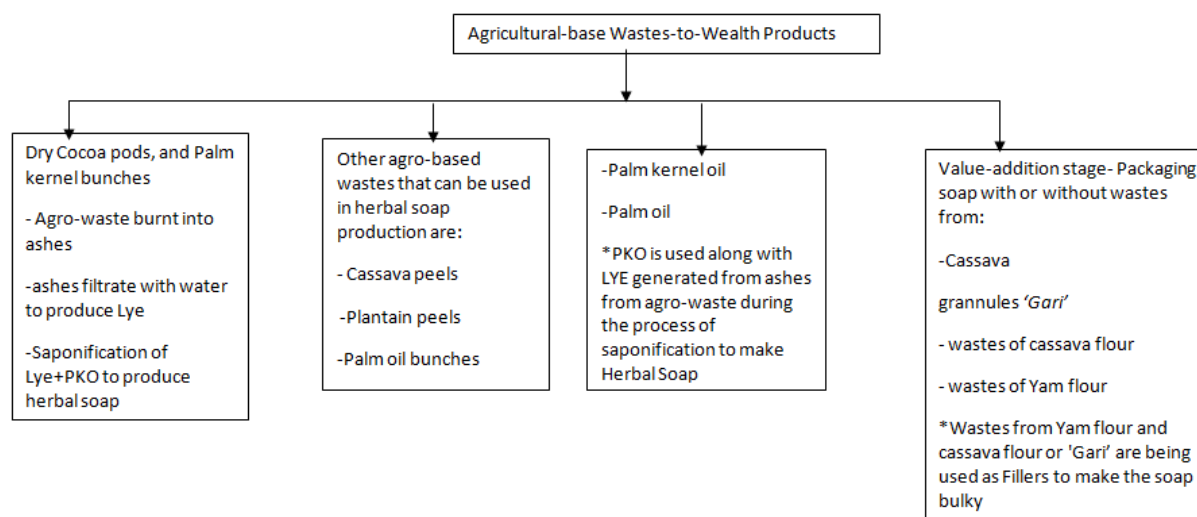


Figure 1: Value chain in herbal soap production and processing (Source: Field Survey, 2015)

3.2 Physico-Chemical Attributes of Herbal soaps from Southwest Nigeria

The result of the Physico-chemical analysis on herbal soaps is presented in Table 3. The photographic impressions of ten (10) samples analyzed are in Figures 2 to 15. Five grams (5gm) weight of each sample was dissolved in 50ml of solution. (i.e. 10% Concentration) to get the result. The pH range of the herbal soaps (10% solution) ranged between 9.8 and 10.18. This is a good indication that the herbal soaps are alkaline with little or no irritation on any skin texture. The Total Dissolved Solid

(TDS) mg/L of the herbal soaps falls between 981 and 3110 mg/L which is a good indication of inertness of herbal soap to atmosphere when expose to moisture. When herbal soap is manufactured with industrially processed palm kernel oil (PKO) with TDS mg/L ranged from 981-1775, it easily melted when expose to moisture. But, when herbal soap is manufactured with traditional processed palm kernel oil (PKO) with TDS mg/L ranged from 1800 -3110) stayed dried when expose to moisture.

Table 3: Physico-Chemical Attribute of Herbal soaps Produced by Entrepreneurs from Southwest Nigeria.

ID	LGA/ State	Vegetation type	Description	pH	TDS (mg/c) ^{x10}	Conductivity (US/cm) ^{x10}
A	Odeda / Ogun	Forest	Cocoa pod Ash + Palm Kernel oil (Traditional/Industrial) (No filler)	10.0	1339/ PKO industrial (melted)	475X5=23,750
B	Ibarapa / Oyo	Derived Savannah	Cocoa pod Ash + Palm Kernel oil (Traditional/Industrial) + (filler-garri)	9.95	1135/ PKO industrial	422X5=21,100
C	Afijo/Oyo	Derived Savannah	Wood Ash + Palm Kernel oil (Traditional/Industrial) + (filler-elubo)	10.10	1723/ PKO industrial	643X5=32,150
D	Iseyin / Oyo	Derived Savannah	Cocoa pod Ash + Palm Kernel oil (Traditional/Industrial) (No filler)	9.99	981/ PKO industrial	382X5=19,100
E ¹	Aawe/ Oyo	Derived Savannah	Cocoa pod Ash + Palm Kernel oil (Traditional/Industrial) (No filler)	9.90	1589/ PKO industrial	546X5= 27,300
E ²	Aawe/ Oyo	Derived Savannah	Cocoa pod Ash + Palm Kernel oil (Traditional/Industrial) (No filler)	10.04	1833/ PKO traditional	639X5= 31,950
F ¹	Akinyele Oyo	Forest	Cocoa pod Ash + Palm Kernel oil (Traditional/Industrial) (No filler)	10.08	1775/ PKOindustrial	617X5=30,850
F ²	Akinyele Oyo	Forest	Cocoa pod Ash + Palm Kernel oil (Traditional/Industrial) (No filler)	10.13	1919/ PK traditional	636X5=31,800
G	Osogbo / Osun	Forest	Wood Ash + Palm Kernel oil (Traditional/Industrial) (No filler)	9.89	3110/ PKO traditional	943X5=47,150
H	Agege/ Lagos	Control /Imported from Ghana	Cocoa pod Ash + Palm Kernel oil (Traditional/Industrial) (No filler)	10.18	1092/ PKO industrial	364X5=18,200

Source: Physico-Chemical field survey Analysis, 2015 Note: 5g sample dissolved in 50 ml of solution. (10% Concentration).



Figure 2: Waste-to-wealth initiative (Utilization of Agricultural-wastes such as Cocoa pod husks in herbal soap making)



Figure 3: Waste-to-wealth initiative (Utilization of Agricultural -wastes such as cassava peels in herbal soap making)



Figure 4: Waste-to-wealth initiative (Utilization of Agricultural - wastes such as Palm-oil bunches in herbal soap making)



Figure 5: Waste-to-wealth initiative (Utilization of Agricultural - wastes such as Plantain peels in herbal soap making)



Figure 6: Herbal soap (Sample A) Cocoa pod ash/lye + fried palm kernel oil (no filler added) found in Osiele, Ogun State, Nigeria, Forest Area.



Figure 7: Herbal soap (Sample B) Cocoa pod ash/lye + fried palm kernel oil (filler added) found in Igboora, Oyo State, Derived Savannah Area.



Figure 8: Herbal soap (Sample C) Wood ash/lye + fried palm kernel oil (filler added) found in Ipako, Oyo State, Savannah Area.



Figure 9: Herbal soap (Sample D) Cocoa pod ash/lye + fried palm kernel oil (filler added) found in Iseyin, Oyo State, Derived Savannah Area



Figure 10: Herbal soap (Sample E) Cocopod ash/lye + white palm kernel oil (no filler added) found in Aawe, Oyo State, Derived Savannah Area.



Figure 11: Herbal soap (Sample F) Cocoa pod ash/lye + fried palm kernel oil (no filler added) found in Aawe, Oyo State, Derived Savannah Area



Figure 12: Herbal soap (Sample G) Cocoa pod ash/lye + fried palm kernel oil (filler added) found in Igboora, Oyo State, Derived Savannah Area



Figure 13: Herbal soap (Sample H) Cocoa pod ash/lye + white palm kernel oil (filler added) found in Akinyele, Oyo State, Forest Area



Figure 14: Herbal soap (Sample I) Wood ash/lye + roasted palm kernel oil (no filler added)



Figure 15: Herbal soap (Sample J) Cocoa pod and plantain ashes/lye + fried palm kernel oil (filler added) found in Agege market, Lagos State, (Control Specimen imported from Ghana)

The conductivity ($\mu\text{S}/\text{cm}$) of the herbal soaps range from 18,200- 47,150 ($\mu\text{S}/\text{cm}$). This measured parameter indicated the extents of dissolved ions present in the herbal soap materials that when released nourishes the skin on use. The higher the dissolved ions, the better for skin absorption of the desirable ions from herbal soap and this result into healthy and beautiful skin. The results of chemical attributes confirm the age long attributes associated with herbal/black soap which is in line with findings of Yusuf and Adeogun [1, 2].

Also, table 4 shows some of the uses to which herbal soap is put into the study area. Majority of the respondents (87.64%) indicated the use of soap as medicine. The medical uses include using the soap for stomach pain, wherein the soap is liquidified in water and drank. It is also used in curing skin diseases such as eczema, prosiasis, ringworm, sores, and wounds. For eczema, prosiasis, and ringworm, the affected part is washed, sometimes scrubbed with a rough object or leaf such as the leaf of *Ficus exasperata* (“eepin” in Yoruba) – sand paper leaf, and the soap is applied. For sores and wounds, affected parts are washed using the soap. Herbal soap is also used as an ingredient in the formulation of anti-fibroid drug. The soap is burnt with other materials, pulverized and taken in daily. The use of herbal soap as cosmetics percentage was 84.46% and daily needs had 81.67%.

The high percentages recorded among the respondents may be as a result of resent awareness of the medicinal benefit derived from uses of natural products as cosmetics or daily needs. Also, the emerging market for natural/herbal products because of healthy living style people are trying to maintain by purchasing and consuming natural products. Furthermore, the use of herbal soap as cosmetics involved additional processes which involved adding other natural/herbal products such as natural honey, shea-butter, cocoa butter, coconut-oil, camwood (*Osun*), sulphur (*Imi-ojo*) and others herbs such as Ethiopian pepper, Aloe-vera, lime juice and rind into the soap before use. Individual

and packaging industries usually use these products to produced value-added herbal soaps such Dudu Osun and UNAAB herbal soaps. Cultural purposes (28.08%) recorded the lowest rate, meaning that few people are still involved in using herbal soap for cultural purposes, maybe based on religious believe.

Table 4: Distribution of Respondents with the Uses of Herbal Soap *

Uses	Ekiti n = 30	Lagos n = 33	Ogun n = 56	Ondo n = 32	Osun n = 16	Oyo N = 335	Total n = 502	%	Mode	Mean
Medical	-	33	56	-	16	335	440	(87.64)	Medical	
Cosmetic	-	33	56	-	-	335	424	(84.46)		
Cultural purposes	-	10	15	-	16	100	141	(28.08)		
Daily Needs	-	30	40	-	2	300	410	(81.67)		

Source: Field Survey, 2015

* Multiple responses.

Values in parentheses are in percentages

4. Conclusion

In conclusion, there are many outstanding policy findings from the study on Forest-based Small-scale Enterprises (FB-SSEs) processing and marketing herbal soap which can guide all stakeholders in policy making for FB-SSEs in South West Nigeria, Nigeria and the world at large. There are opportunities to utilize NTFPs and ABWPs identified in this study to generate wealth and good health. The wealth so generated from wastes can lead to reduction of poverty among the rural entrepreneur generally especially the women processing the herbal soap in particular. This concept is classified as “*waste-to-wealth*” initiative to improve the economic and health status of the beneficiaries. Furthermore, the emerging business opportunity in ash production in Ondo and Ekiti States will provide subsidiary occupation for cocoa farmers who usually dispose the cocoa pod husks as “wastes” on the farm. There is the need for Ondo and Ekiti States Government to utilize the comparative advantage of the abundance of cocoa in these states.

5. Policy Recommendation

1. There is the need for all stakeholders – university researchers, governments, NGOs and individuals to promote appropriate technology that will enhance the utilization of indigenous knowledge especially in herbal soap production. It is in this area that the Asian “Tigers” have excelled in using technology to upgrade indigenous knowledge. It is most unlikely that herbal soap production will eventually be able to withstand technological constraints from industrially produced soaps. The herbal soap production subsector should be vigorously promoted and advertised by all stakeholders.
2. The problem of purchasing modern equipment to process and package products (value-addition process) should be addressed by concerned stakeholders to solve the problems of inefficient resource-use and marketing of products. Wastes-to-wealth technology should be encouraged to enhance the livelihood status of rural entrepreneurs, women processors in particular.
3. The problem of purchasing modern equipment to process and package (value-addition process) should also be solved by providing incentives to the entrepreneur in form of subsidized processing and packaging equipment such as cocoa pod husk drier, PKO pressing machine, soap cutting machine, storage facility, so as to reduce the high cost of labour being encountered by entrepreneurs.
4. There is the need for the communities where Agro-business waste and NTFPs abound to form themselves into cooperative bodies in order to benefit from various credit assistance of State and Federal governments. The assistance can enable them to purchase capital assets such as modern

equipment to remove the drudgery involved in Herbal soap production. Furthermore, the quality and packaging of Herbal soap will be enhanced from the usage of modern machines. More jobs will be created, thereby reducing poverty and increasing standard of living of beneficiaries.

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