International Journal of Sciences, Engineering & Environmental Technology (IJOSEET), 17(17): 015-021, 2025
ISSN 0749-9650

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Development and Quality Assessment of African Black Soap (ABS) Enriched with Natural Additives

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Abstract: *Skincare products play a vital role in the external repair and management of damaged skin. Indigenous African Black Soap (ABS), produced through the process of esterification, is well-known for its potent cleansing, antimicrobial, and therapeutic properties. Traditionally, ABS has been modified with natural additives to enhance its effectiveness in treating of various skin disorders. This study investigated the production process of African Black Soap and evaluated the quality of ABS modified with selected natural additives. The soap was prepared by heating palm kernel oil with a filtrate derived from cocoa pod ash, along with additional ingredients at elevated temperatures. The resultant soap was divided into three samples: Sample A, which contained unmodified ABS; Sample B, ABS modified with orange peel and turmeric powders; and Sample C, ABS modified with Moringa oleifera leaves and turmeric powders. The physicochemical properties of the modified and unmodified ABS samples were analyzed using established analytical methods. Results showed that total alkali content ranged from 25.3% to 31.1%, total fatty matter ranged from 38.5% to 100%, foamability ranged from 1 cm to 2 cm, free caustic alkali ranged from 55.5% to 66.9%, and pH (10% solution) ranged from 8.9 to 9.7. Additionally, phytochemical analyses revealed the presence of key compounds with the following ranges: tannins (0.01–0.28 mg/100g), alkaloids (0.85–0.94 mg/100g), phenolics (0.68–1.09 mg/100g), steroids (0.04–0.08 mg/100g), terpenoids (0.02–0.03 mg/100g), saponins (1.03–2.13 mg/100g), flavonoids (0.61–0.78 mg/100g), and anthraquinones (0.03–0.08 mg/100g). These findings indicated that modified ABS has higher levels of phytochemicals and desirable physicochemical properties, suggesting its potential therapeutic application in managing skin disorders. The enhanced quality and phytochemical content of modified ABS support its use as an effective cleansing and skin treatment product.*

Keywords*: African Black Soap, modification, physicochemical properties, phytochemical analysis*

1. Introduction

Skincare products are defined as products applied to the skin with the purpose of improving its appearance, health and texture. Thus, skin care products are intent to nurture skin and maintain personal hygiene due to its natural or synthetic chemical composition. Indigenous African black soap (ABS) is one of the various skincare products that are available based on their special chemotherapy potential including cleansing, antibacterial and skin toning care materials. The science of African black soap is referring to soap produced from the ash-derived alkali agricultural waste materials of plantain peels and vegetable oil without the addition of cosmetic enhancing ingredient (Ogunbiyi and Enechukwu, 2021). Its production technology is made through the process of esterification at elevated temperature. In literature, African black soap usually contains bioactive compounds such as alkaloids, tannins, saponins, flavonoids, and phenolic compounds, which have been reported to exhibit antimicrobial properties (Bello, 2018, and Adedapo *et al.*, 2019). The soap widely used by different tribes in Nigeria has different local names, such as *Ose dudu* in Yoruba land and Eko Zhiko in Nupe tribe (Getradeghana, 2000). It was popularly called “anagosamina” by the Ghanaians which mean the pepper sellers soap (Bella, 2011).

Phytochemicals are non-nutritive plant chemicals which occur naturally in plants that have protective or disease preventive properties. They are nonessential nutrients, meaning that they are not required by the human body for sustaining life. It is well-known that plant produces these chemicals to protect them but researches demonstrate that they can also protect humans against diseases. Traditionally, some Africans continue to use medicinal plant material to modified African black soap as natural additives and claimed to combat various diseases including the management of patients with skin disorders without scientific proof, and also, there is limited/or no scientific data regarding its knowledge of physicochemical properties. Researches have shown that soap that contain minimum amount of moisture will increase the self-life and high amounts of total fat matter helps for lubricating the skin during washing (Ibrahim and Adepoju, 2020; Idoko *et al.,* 2018; Habib *et al.,*2016). Kumar *et al.* (2021) formulated and evaluated herbal soap using Neem (*Azadirachta indica*) and Tulsi (*Ocimum sanctum*) extracts, its antibacterial and antifungal properties made it effective against common skin pathogens.

The study aimed at assessment of physicochemical properties and phytochemical constituent of modified and unmodified laboratory ABS. The natural selected additives chosen include the true orange peel, *moringa oleifera* and turmeric powders. The main reason for choosing these herbs was their pharmacological properties, which include redox properties, which allow them to act as reducing agents. For example, many researchers have reported *moringa oleifera* for its nutritional and antioxidant properties of this plant (leaf) (Okafor *et al.,* 2019; Falowo *et al.,* 2018; Gopalakrishnan *et al.,* 2016; Anwar *et al.,* 2007). In addition, turmeric soap is known for its antioxidant properties, which help in reducing pigmentation and improving skin tone (Nwankwo *et al.,* 2021).

2. Material and methods

2.1.Material

Cocoa pods and plantain peels ash, palm kernel oil, Tumeric powder, Orange peels powder and *Moringa oleifera* leaves powder.

2.2. Chemicals/Reagents

All chemicals and reagents used for the study are analytical grade.

Preparation of African black soap

Freshly prepared raw black soap paste (made up of cocoa pods and plantain peels ash) was bought from a producer along Atidade sawmill, Akoda Ede, Osun state, and it was brought to Chemistry Department, Federal Polytechnic Ede, Osun state for natural additive process enhancer. The black soap was prepared according to the method described by Ikotun *et al.* (2015) with little or no modifications.

Figure 1: Research Student black soap: modification in progress

The manufacture of AB soap involved the following step-wise processes:

- The raw ash powder (about 750 g) was placed in 1,500 mL of distilled water in a large covered bowl, agitated for 10 minutes and allowed to stand overnight.
- The slurry mixture was then filtered with muslin cloth to get the ash filtrate (alkali) about 1,200 mL.
- A pot was placed on a burner prepared from local firewood. See Figure 1.
- 400 mL of palm kernel oil (PKO) was poured into the pot and heated to 70 ^{0C} boil.
- 1,000 mL of the filtrate was gradually poured along the side wall of hot pot containing PKO. As the ash filtrate was pouring into the boiled PKO pot, the mixture started to foam and thickens.
- The mixture was left to heat for two hours. Thereafter, 100 mL of the filtrate was also added gradually into the mixture and allowed to gently boil for 30 minutes.
- This process was repeated till the ash filtrate was used up. 10 min later, the mixture was thoroughly stirred and as the stirring continued, the mixture began to solidify.
- 40 mL of distilled water was then added to the solid mixture and stirred thoroughly to form a dark brown soap.
- Finally, small quantity of distilled water was slowly added bit by bit to the mixture, stirring continuously until completely homogenized, the AB soap was traditionally packed as shown in Figure 2.

Figure 2: Packaged and branded ABS

2.3. Preparation of the natural additive enhancer with black soap

Turmeric powder, orange peels powder and *moringa oleifera* leaves powder were added as additive into two different portions of soap in separate labeled containers. The mixture was manually pounded with mortar and pestle. Sample A, contained 20 g of orange peel and 20 g of turmeric powders ponded with 100 g ABS and Sample B, contained "20 g" of *Moringa oleifera* leaves powder and 20 g of turmeric powder ponded with 100 g ABS while Sample C contained 100 g African black soap (ABS) without any additives. Physiochemical and phytochemical analysis were carried out on each sample.

3. Results and discussion

Table 1 ***Physiochemical properties of modified and unmodified African black soaps***

Sample	**Ph**	**Moisture content (%)**	**Free caustic alkaline (%)**	**Total Alkali content (%)**	**Total fatty matter (%)**	**Foam Height (cm)**
A	9.7±0.7	5.68±1.8	6.76±1.1	2.87±0.7	36.25±2.2	175±3.5
B	10.1±1.0	5.24±2.9	6.76±2.7	2.98±0.3	52.75±3.18	110±1.4
C	9.7±0.7	5.01±1.4	5.71±2.7	2.6±1.0	116.5±1.2	125.8±1.1

Sample A= Black soap with orange peel and turmeric powders
Sample B = Black soap with *moringa oleifera* and turmeric powders
Sample C = Black soap without additives.

3.1. pH

The result of 10% solution shown in Table 1 indicates that the pH of samples ranged from 9.3±0-10.08±10. The pH values for all the soaps fall within the range for pH of good soaps is 7-10 (Idoko *et al.,* 2018; Olayinka *et al.,* 2016). Incomplete hydrolysis from saponification process produces high pH values.

3.2. Moisture Content

The moisture content ranged from 5.0-5.7%. This indicates that most of the African black soaps both modified and unmodified analyzed will not favors the growth of microbes since they are lower than the recommended value of 10-20% (Joselany *et al.,* 2011). Moisture content is a

parameter that is used in assessing the shelf –life of a product (Bboluwaji *et al.,* 2019; Tewari, 2004; AOAC, 2000).

3.1. Free caustic alkali

Free caustic alkali is one of the parameters that cause the abrasiveness of any given soap. The free caustic alkali is the amount of alkali free to counter and avert the soap from becoming oily. The free caustic alkalis for modified soaps were ranged from 6.76% to 6.77% and unmodified soap was found to be 5.71%. These results were within the standard value declared by Nigeria industrial standard (NIS) 490: (NIS, 2006). Excess free caustic alkali causes skin itching (Adebayo *et al.* (2020).

3.4. Total Fatty Matter

Total fatty matter was one of the major characteristics describing the quality and nature of soap. It is defined as total amount of fatty matter, mostly fatty acids, that can be separated from a sample after splitting with mineral acid, usually hydrochloric acid (HCl). The unmodified black soap has a total value of 116.5% and modified black soaps ranged from 36.3% to 52.8%. The values of modified black soaps are lower than that of the International Standard Organization (ISO). This could be as a result of some natural additives powder used to enhance black soaps properties or too much heat at elevated temperature. Total fatty matter above 80% is suitable for dry skin (Mak-Mensah and Firempong, 2011).

3.5. Quantitative phytochemical investigation

Table 2 Quantitative phytochemical properties of modified and unmodified African black soaps.

Sample	**Alkaloids mg/100g**	**Tannin mg/100g**	**Phenolic mg/100g**	**Steroids mg/100g**	**Flavonoids mg/100g**	**Saponin mg/100g**
A	0.89±0.01	0.28±0.03	0.68±0.58	0.05±0.03	0.74±0.01	2.0±0.02
B	0.94±0.02	0.01`±0.01	1.03±0.02	0.07±0.03	0.78±1.36	2.13±0.02
C	0.85±0.01	0.22±0,01	1.09±0.01	0.08±0.01	0.61±0.06	1.03±0.02

Sample A = Black soap with orange peel and turmeric powders
Sample B = Black soap with *moringa oleifera* and turmeric powders
Sample C = Black soap without additives

The results data presented in Table 2 revealed phytochemical analysis result of modified and unmodified African black soaps. Six secondary metabolites were quantified in aqueous extract of each sample. The alkaloid content ranged from 0.85 to 0.94 mg/100g, unmodified sample has lower alkaloid content; Tannin ranged from 0.01 to 0.28 mg/100g, black soap modified with orange peel modified with moringa leaves powders has higher value of tannin. Phenolic content ranged from 0.68 to 1.1 mg/100g. Steroids content ranged from 0.05 to 0.08 mg/100g. Flavonoids content ranged from 0.61 to 0.78 mg/100g and saponin content ranged from 1.03 to 2.13 mg/100g. Thus, all the samples are rich in alkaloids, tannins, phenolic, steroids, flavonoids and saponin.

Conclusions

ABS raw was produced and modified with *moringa oleifera* leaves, orange peel and turmeric powders. The physicochemical properties and phytochemical constituents of the soap samples were determined according to the standard methods of analysis. These results findings indicated that modified African black soap has higher levels of phytochemicals and desirable physicochemical properties, suggesting its potential therapeutic application in managing skin disorders. The enhanced quality and phytochemical content of modified African black soap support its use as an effective cleansing and skin treatment product. Thus, this study shows the addition of plant extracts and plant products such as orange peel, turmeric, and *moringa oleifera* powders during compounding of African black soap (ABS) production have a positive significant effect in the product skin disorder usage.

Acknowledgement

The authors acknowledge Federal polytechnic Ede for providing reagents and space for the success of this study.

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