***Review Article***

# NATURAL SKIN-CARE PRODUCTS: THE CASE OF SOAP MADE FROM COCOA POD HUSK POTASH


## ABSTRACT

Consumer demand for natural and organic personal care products has increased steadily due to the fact that some synthetic chemicals have been proven to be harmful to human health. Soaps are general personal hygiene and general cleaning products and they can either be natural or synthetic. A popular local soap produced in Ghana is considered to be a natural soap because it is made from natural ingredients such as potash obtained from cocoa pod husk (CPH) and unrefined vegetable oils such as palm kernel oil. At the Cocoa Research Institute of Ghana (CRIG), the soap has been re-formulated by adding cocoa butter or shea butter to improve on its nourishing effect. Soap made with CPH potash is found to be soft on the skin and has the properties of the ingredients used in its preparation, making it effective against bacterial and fungal diseases such as eczema and psoriasis. The lathering volume of the soap ranges from 200-300 ml, total fatty matter from 84-87% and an average pH value of 10, an indication of the absence of free caustic alkali. There is a high demand for the soap locally and it is therefore recommended that its industry be expanded for both local and international markets.



**Keywords**: personal care, skin care, cocoa pod husk, potash, palm kernel oil, cocoa butter, shea butter, natural soap


## INTRODUCTION

The skin, which is the body's largest organ, acts as a physical barrier between the body and many atmospheric pollutants. When products such as soaps, shampoos and cosmetics are used on the skin, the ingredients in them come into direct contact with the skin (1). These ingredients are normally absorbed through the skin into the body. Investigations by the Herb Research Foundation have shown that the body absorbs 60% of chemicals in these products directly into the blood stream (2) and this has raised concerns about the long term effects of chemicals used in cosmetics and soaps (1). This has therefore increased consumer demand for natural and organic personal care products since synthetic chemicals are perceived to pose potential health risks (3).

Skin care products are substances used to enhance the appearance and odour of the human body. Currently, they dominate the demand for personal care products (4). In 2011, they dominated the demand with 32.1% share, followed by hair care and cosmetic products. North America accounted for 34.8% of the global demand and is expected to grow at a compound annual growth rate (CAGR) of 9.8% from 2012 to 2018. Japan and China dominated the Asia

Pacific market, accounting for over 64% market revenue in 2011. At the country level, the U.S. was the largest market for natural and organic personal care products followed by Japan and Germany. In Africa, beauty and skin care products are the fastest selling items after food. With a fast growing economy and population estimate of 1.2 billion in 2017, Africa draws attention from all Consumer Goods players especially the beauty and personal care manufacturers (4). According to Euromonitor International, Nigeria and South Africa were the biggest personal and beauty care markets in the continent valued at €1.57 and 2.97 billion respectively in 2012 (4).

Toiletries are primarily used to clean the body and maintain personal hygiene. These products fall into the fast moving consumer group due to their high demand and how quickly they are consumed. This group includes bathing soaps, both liquid and solid. Soap is obtained from saponification reaction of fat and alkali and it is a popular washing and cleaning product. They are therefore, indispensable items as a daily requirement in homes, offices, schools, hospitals, restaurants, etc. The market of soaps is quite enormous especially for personal hygiene and general cleanliness and there is a big opportunity for market globally. Soaps can either be natural or synthetic. Synthetic soaps are made from synthetic ingredients such as artificial fragrances, colours and preservatives, some of which have been proven harmful to mammal health and can cause severe skin irritation in some people. Caustic soda (sodium hydroxide) and potash (potassium hydroxide) are the only bases used in soap production (5). This is because some bases produce insoluble soaps, some are too expensive and some do not work at all. These include calcium hydroxide, lithium hydroxide and ammonium hydroxide (5). Table 1 describes some of the properties of these bases. Hydroxides of calcium, lithium and magnesium are highly insoluble in water. Caustic soda makes hard soaps and potash makes soft and liquid soaps.

Table 1: Properties of some bases that can be used in the production of soap

| **IUPAC name** | **Molecular formula** | **Molar mass (g/Mol)** | **Solubility in water (g/100ml) at 20 $^{o}$C** |
|---|---|---|---|
| Sodium hydroxide | NaOH | 40.00 | 111 |
| Potassium hydroxide | KOH | 56.11 | 121 |
| Calcium hydroxide | $Ca(OH)_2$ | 74.09 | 0.173 |
| Lithium hydroxide | LiOH | 23.95 | 12.8 |
| Magnesium hydroxide | $Mg(OH)_2$ | 58.32 | 0.00064 |
| Ammonium hydroxide | $NH_4OH$ | 35.04 | Miscible |

Source: (6)

Caustic potash was initially obtained from the ashes of any organic materials particularly wood ash (7). It can also be obtained from cocoa pod husk. Cocoa pod husk forms between 60-70% of the cocoa fruit and it is normally left on the farm floor to rot after pod breaking. It contains high amounts of water when fresh, high level of fibre and an appreciable amount of protein (Table 2). It also has high levels of minerals with the predominant one being potassium, which makes it a good source of caustic potash. Potash production from cocoa pod husk is already an established small-scale cottage industry in Ghana. This paper therefore seeks to review the

production of soap for skin care using natural ingredients and caustic potash from cocoa pod husk.

**Table 2: Chemical composition of cocoa pod husk**

| Parameter | Composition (% Dry matter) | Mean (%) |
|---|---|---|
| Moisture | 84.20-86.90 | 85.70 |
| Crude protein | 5.70-7.60 | 6.25 |
| Crude fibre | 28.75-34.50 | 33.40 |
| Ash | 7.73-8.33 | 8.00 |
| Theobromine | - | 0.02 |
| Na | 0.014-0.031 | 0.016 |
| K | 3.43-4.27 | 3.77 |
| Ca | 0.42-0.52 | 0.46 |
| Mg | 0.21-0.33 | 0.25 |
| Fe | 0.002-0.005 | 0.003 |
| Energy (mJ/kg) | - | 4.72 |

Source: (8)

## Cocoa pod husk as a source of potash for soap production

The making of soaps from ash-derived alkalis has been an age-old craft in many West African countries (9). Ash-derived alkalis offer cheap alternatives to imported ones (8). Agricultural waste materials contain a good percentage of potash and these materials include palm fruit peduncle (10), plantain peels, banana leaves, maize cob, wood, sugar beet waste and many others. Potash from cocoa pod husk (CPH) is a valuable traditional source of alkali for the local soft soap industry in Ghana (11, 12).

It is estimated that a tonne of fresh cocoa pod husk will produce about 16 kg ash after drying and burning (11). This ash contains about 40% potassium salts (potash), mainly in the carbonate form. Thus, one tonne of fresh pod husk will produce about 6 kg potash. The annual cocoa production for the year 2011/2012 in Ghana was 1 million tonnes (13). This implies that about 8.71 million tonnes of fresh pod husk were produced in that year. Therefore, processing the entire fresh husk produced would have yielded an estimated amount of 140,000 tonnes ash or approximately 56,000 tonnes of potassium salts. In this light, the Cocoa Research Institute of Ghana (CRIG) in collaboration with the Kwame Nkrumah University of Science and Technology designed and built an ashing kiln for medium-scale production of potash from CPH for the local soft soap industry (11)
.

## Properties of fats used in CPH potash soap production

Fats used in the commercial production of soap are normally obtained from tallow, lard, palm oil, palm kernel oil, coconut oil, marine oil, etc (7). However, palm oil (PO) and palm kernel oil (PKO) are the main fats used by the local soap industry in Ghana because they are readily available and cheap as compared to other oils. Table 3 shows the annual production of PO and PKO in Ghana from 2010 to 2014. These oils are not harmful and are good in making the skin healthy.

**Table 3: Production of PKO and PO in Ghana**

| Market year | Production (000 MT) | | Growth rate (%) | |
|---|---|---|---|---|
| | PO | PKO | PO | PKO |
| 2010 | 120 | 16 | 0.00 | 0.00 |
| 2011 | 120 | 17 | 0.00 | 6.25 |
| 2012 | 130 | 17 | 8.33 | 0.00 |
| 2013 | 135 | 19 | 3.85 | 11.76 |
| 2014 | 135 | 19 | 0.00 | 0.00 |

Source: (14)

Palm kernel oil is the main fat used in the production of CPH potash soap. It is normally used in the unrefined state and contains fatty acids such as lauric (48.2%), myristic (16.2%), palmitic (8.4%) stearic (2.5%), oleic (15.3%) and linoleic (2.3%) acids (15) (Table 4). The high lauric acid content of PKO adds hardening and lathering properties to the soap. Studies have also shown that lauric acid has a strong antimicrobial property against *Propionibacterium acnes*, *Staphylococcus aureus* and *Staphylococcus epidermis* colonized on mouse ears (16). Both intradermal injection and epicutaneous application effectively decreased the number of *P. acnes* colonized with mouse ears. *P. acnes*, which promotes follicular inflammation (inflammatory acne) is the most sensitive to lauric acid of the three bacteria tested. Myristic acid has a variety of uses in the beauty care industry as fragrance, opacifying agent, surfactant, cleansing agent and emulsifier. It also acts as a lubricant due to its high rate of absorption by the skin and anti-inflammatory agent (17). It increases moisture and hydration. Oleic acid also acts as a skin penetration enhancer (17) and used in the treatment of skin disorders. Palm kernel oil is stable at high cooking temperatures due to its high saturated fat content. At CRIG, a protocol has been developed for the production of both solid and liquid soap for bathing using PKO and potash from CPH.

Table 4: Properties of fatty acids in PKO

| Chemical name | Type of fatty acid | Molecular formula | Molar mass (g/Mol) | Melting point ($^{o}$C) |
|---|---|---|---|---|
| Lauric acid | Saturated | $C_{12}H_{24}O_2$ | 200.32 | 43.8 |
| Myristic acid | Saturated | $C_{14}H_{28}O_2$ | 228.37 | 54.4 |
| Stearic acid | Saturated | $C_{18}H_{32}O_2$ | 284.48 | 69.3 |
| Palmitic acid | Saturated | $C_{16}H_{32}O_2$ | 256.42 | 62.9 |
| Oleic acid | Unsaturated | $C_{18}H_{34}O_2$ | 282.46 | 13.0 |
| Linoleic acid | Unsaturated | $C_{18}H_{32}O_2$ | 280.45 | -5.0 |

Source: (18)

Cocoa butter and shea butter can also be used in the production of the soap. Cocoa butter is predominantly made up of oleic, palmitic and stearic acids whiles shea butter is mainly made up of oleic and stearic acids (19, 20). They also contain vitamins A and E, as well as other phytochemicals. These constituents make the two butters excellent moisturizers and are used in the treatment of skin conditions such as eczema, dermatitis, scars and stretch marks. Cocoa or shea butter both make good quality soap with creamy lather. However, too much of it in soap will suppress the lather.

**Quality and benefits of soap made from CPH potash**

In Ghana, soap made from CPH potash was developed centuries ago by local women not only for effective cleansing but for maintaining healthy skin and hair. It is known by many names based on the local dialect of the area where it is produced. The recipe has not changed much since it was formulated. However, it has been constantly re-engineered to make it more suitable for use. At CRIG, the soap has been re-formulated by mixing the PKO with either cocoa butter or shea butter to enhance its nourishing effects on the skin. Liquid soap has also been developed from CPH potash. Quality assessment conducted by the Ghana Standards Authority on both the solid and liquid soap made from CPH potash has revealed that they contain no free caustic alkali and have lather volumes ranging from 200-300 ml. Total fatty matter, which is an indication of good quality or free fatty acids in the soap, also ranged from 84-87%. Any soap with fatty matter above 70% is considered to be a good soap.

The average pH of both the liquid and solid soaps made from CPH potash is 10. However, pH of the skin is 4.7(21), indicating that the skin is slightly acidic. When the skin is too alkaline, it becomes dry and sensitive and when it is too acidic, which is normally rare, the skin becomes inflamed and painful to touch (22). Although soap made from CPH potash is highly alkaline, it is found to be soft on the skin because potassium is known to keep skin cells hydrated and moisturized by absorbing water molecules from the atmosphere. The pH value of 10 in the soap is an indication of the absence of free caustic alkali.

Soap made from CPH potash and PKO mixed with cocoa butter or shea butter is unique in that it has the combined properties of all the ingredients used. It has been found to reduce skin

inflammation and irritations such as acne, moisturize both dry and normal skin, and clear blemishes, spots and other skin diseases such as eczema and psoriasis. It also has anti-bacterial and anti-fungal properties. The potash used is also produced from a natural source, making the soap soft on both sensitive and normal skin. The soap also contains glycerin, which is a natural by-product of the soap making process. Unlike other commercial soaps, the glycerin produced is retained and this enhances the moisturizing effect of the soap. The natural ingredients used make the soap non-toxic to the environment because they are biodegradable, making the disposal of unwanted soap easy.

## Marketing of soap made from CPH potash

The demand for products containing natural and renewably sourced ingredients is growing very fast across the world and it is expected to boost the toiletry industry (23). These types of products are particularly more expensive than those made from synthetic chemicals because consumers perceive them to be healthy and beneficial. In addition, consumers also expect dramatic, visible results from such products. The global market for soaps is dominated by a small number of multinational companies with strong brand identity and enormous advertising budgets. There is very high competition between these multinationals and the top players include Unilever, Procter and Gamble, Colgate Palmolive and Johnson & Johnson. In Ghana, Unilever has about 70% of the high-class toiletries and personal care markets and their products are targeted at the average Ghanaian (24). Paterson Zochonis (PZ) Cussons also accounts for 20% of the high-class toiletries market and their products are targeted at the affluent, middle class Ghanaian who cares about beauty. The key brands of these two companies are Imperial Leather and Lux soaps. However, another niche market is the local soap made from CPH potash with a distinct Ghanaian scent, which could be sold in the national and sub-regional markets (24).

A marketing study conducted on both solid and liquid soap produced at CRIG on pilot-scale (Table 5) has shown that there is demand for the products and they are also economically viable. The study also indicated that producing liquid from CPH potash is more profitable than the solid soap and producing in large quantities generates more profits.

**Table 5: Summary of market studies of soap produced from CPH potash**

| Year | Product | Qty (kg) | EPC* (Gh¢) | ELC** (Gh¢) | Revenue (Gh¢) | %GP*** |
|---|---|---|---|---|---|---|
| 2012 | Solid soap | 3300 | 17,282.16 | 6,635.61 | 28,302.50 | 15.5 |
| | Liquid soap | - | - | - | - | - |
| 2013 | Solid soap | 1298 | 8,806.50 | 3,530.36 | 13,368.00 | 7.7 |
| | Liquid soap | 3034 | 14,684.56 | 9,572.27 | 63,921.50 | 62.1 |

EPC* – estimated production cost, ELC** – estimated labour cost, GP*** – gross profit

## CONCLUSION AND RECOMMENDATION

Soap made from CPH potash is an all natural soap made with food grade oils with good lathering properties and total fatty matter content of more than 70%. It has antimicrobial and antifungal properties and it is known to moisturize the skin and clears the skin of blemishes, spots and other diseases. Local demand for the soap is quite high and its production is also profitable. It is therefore recommended that this local soap industry be expanded and promoted on both local and international markets.


## ACKNOWLEDGEMENT

This article is published with the kind permission of the Executive Director of Cocoa Research Institute of Ghana.


## REFERENCES:


1. Stryker L. (2012). Why switch to all natural cosmetics, The Organic Make up Co. Inc.
2. Fairley Josephine, (2001). Organic beauty: look and feel gorgeous the natural way, Dorling Kindersley Publishing, London, 2001.
3. Steventon K. and Cowdell F. (2013). Acne and diet: a review of the latest evidence, *Dermatol Nursing*, vol 12 (2), pp28-34.
4. Liduena J-M., El-Karoui H., Ambil J. and Catimel C. (2014). Beauty and Personal care in Africa, In: Think act: CONTENT, Editors: Schwenker B., Bouee C-E. and Oltmanns T., Roland Berger Strategy Cosultants GmBH, Hamburg.
5. Evans D.C. (1937). Experimental soap making, *J. Chem. Educ.*, 14 (11), pp 534
6. Lide, D. R., ed. (2005). *CRC Handbook of Chemistry and Physics* (86th ed.). Boca Raton (FL): CRC Press. p. 4-80.
7. Onyegbado C.O., Iyagba, E.T. and Offor O.J., (2002).Solid Soap Production using Plantain Peel Ash as Source of Alkali, *Journal of Applied Sciences & Environmental Management*, Vol. 6 (1), pp 73-77
8. Ahenkorah Y., Halm B. J. and Amonoo R. S. (1981) Cocoa pod husk as source of potassium fertilizer, *Turrialba,* vol 31, pp 287-292.
9. Nwoko V.O. (1980). Chemical Processing Development. *Proceedings of the 10th Annual Conference of the Nigerian Society of Chemical Engineers*, pp 40 -53.
10. Kuye A.O. and Okorie C. (1990). Factors Affecting The Lixiviation of Palm Bunch Ash As A Source of Alkali For Soap Production *Ife Journal of Technology*, vol 3 (2), pp 33-37.
11. Adomako D., Oppong H., Gyedu E., Tuah A.K., Dodoo R.E. and Hanson F.K.N. (1996). Pilot-scale production of cocoa pod husk ash for the soft soap industry in Ghana, *Proc.*

*12th International Cocoa Res. Conf.*, Salvador-Bahia, Brazil, 12-23 Nov, 1996 1021-1026.

12. Onifade K.R. (1994). The Potential Application of Cocoa Pod Husks for the Manufacture of Caustic Potash *Journal of Agricultural Technology 2 (2): 59 -64 .*
13. United States Department of Agriculture (USDA), (2012). Ghana: Cocoa Report Annual, Global Agricultural Information Network (GAIN) Report, GAIN Rep. no. GH1202.
14. United States Department of Agriculture (USDA), (2014). Major Vegetable Oils: World Supply and Distribution (Commodity View). Oilseeds: World Market and Trade.
15. Chow C.K. (2007). Fatty acids in Foods and their health implications, 3rd Edition, CRC Press, Taylor and Francis Group, UK, pp 241.
16. Nakatsuji T., Kao M.C., Fang J-Y., Zouboulis C.C., Zhang L. Gallo R.L. and Huang C-M. (2009). Antimicrobial property of lauric acid against *Propionibacterium acnes*: Its therapeutic potential for inflammatory *Acne vulgaris*, *J Invest Dermatol*. Vol129 (10), pp 2480-2488.
17. Touitou E, Godin B, Karl Y, Bujanover S, Becker Y. 2002, Oleic acid, a skin penetration enhancer, affects Langerhans cells and corneocytes. J Control Release. 80(1-3):1-7.
18. Windholz M., Budavari S., Blumetti R.F. and Otterbein E.S. (eds.). (1983). The Merck Index, 10th ed. Rahway, NJ: Merk and Co.
19. Davrieux F., Allal, F., Piombo G., Kelly B., Okulo J. B., Thiam M., Diallo O. B. and Bouvet J.-M. (2010). Near Infrared Spectroscopy for High-Throughput Characterization of Shea Tree (Vitellaria paradoxa) Nut Fat Profiles. *Journal of Agricultural and Food Chemistry*, 58, 7811-7819
20. Summers V. (2014). The manufacture and chemistry of chocolate, *Decoded Science*, Filed under Chemistry Headlines, assessed on 3 Nov, 2014.
21. Lambers H., Piessens S., Bloem A., Pronk H. and Finkel P. (2006) natural skin surface pH is on average below 5, which is beneficial for its resident flora, *Int J Cosmetic Sci*. vol 28 (5), pp 359-370.
22. Giglio K. (2013), The key to great skin, www.womenshealth mag.com, assessed on Feb 18, 2015
23. McDougall A. (2012). US cosmetics market to be driven by demand for naturals and anti-aging, Cosmetics Formulation and Packaging Newsletter, www.CosmeticsDesign.com , assessed on Nov 3, 2014
24. Karp Rod A. (2003). Market survey of plant based-fragrances in Ghana, Report produced for Natural Resources International.