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WASTE GENERATION IN SHEA BUTTER (*Vitellaria paradoxa*) PRODUCTION AND ITS MANAGEMENT: A REVIEW

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Abstract

Waste disposal is a big challenge in shea butter industry in the presence of tannin, an environmental pollutant which is toxic to soil microbes, makes the waste recalcitrant to biodegradation and unacceptable to animals as feed. Wastes generated during Shea butter processing are indiscriminately disposed thereby becoming menace to the environment. There is lack of enough research into handling and Management of waste from shear butter production. There is different method of shea butter processing and each resulted to waste generation. These methods include: Traditional (local), Mechanical and chemical methods. Local method of shea butter production generates more wastes than mechanical and chemical methods. The negative effects of shea butter waste on environment includes: choking of drain, breed mosquitoes, water borne ailments, generate foul odors and also people using local method of processing normally suffer from smoke related diseases. Waste generated in shea butter production includes: Husk- for removing heavy metals from waste water, making flower vase, plates and decorations, Slurry- Used for local air fresheners, local provision of lightening (candle), Black deposits- used for the filling of cracks in buildings, paint making and local ink usage on slates and board and Waste Water- After potential treatments, can be used for domestic activities of washing, as insecticide and for irrigation farming.

Keywords: Shea production, wastes, Husk, slurry, lManagement, and environmental protection

1. Introduction

For millions of years, shea trees have grown across Africa within a semi-arid zone known as the Sahel-Savannah. And for thousands of years, people have used shea nuts from the trees to make shea butter, an edible fat that is a part of daily life for millions of Africans and, today, for billions around the world (Lovett, 2018). The tree is considered a valuable asset in many parts of Africa where it can be found because of its high yielding edible oil for domestic use and products for cosmetic and pharmaceutical uses. It is important for the livelihoods of the rural population as it has been for over centuries (Lovett and Haq, 2000). Almost every part of the tree has its use, for example: the fruit is eaten and the leaves are used as fodder and serve as an ingredient for making alkaline and paint (Lovett and Haq, 2000). When the leaves are put in water, it forms a frothy opalescent liquid, which is used to bath a patient. The shea tree grows well in 19 countries across the African continent including Nigeria.

Despite the nutritional and economic benefits of Shea, its processing causes a major environmental issue which has become a major public health and environmental concern. Wastes generated during Shea butter processing are indiscriminately disposed thereby becoming menace to the environment.

2. Uses and Application of Shea and Shea Products

Almost every part of the shea tree is used, for example, the fruit is eaten and the leaves are used as fodder for animals and a good alkaline for the paint industry. It also has a wide range of medical and industrial applications. Shea provides fruits for direct consumption, providing good quality vitamins and energy to rural dwellers. The shea seeds/kernels (nuts) from these fruits are sold raw as kernels or further processed into shea butter for cooking, skincare, medicine, and other benefits in many areas of human well-being and rural development (Lovett, 2004). Again, the fruit pulp is an important local nutritional resource, widely eaten by adults and children, and provides a rich source of ascorbic acid, iron, calcium, and vitamins A and B (Hall *et al.*, 1996). The vitamin and mineral-rich vegetable butter extracted from the nut provides a preferred cooking oil of most households especially in rural settlements. It enhances the taste, texture and digestibility of the local dishes. The kernel of the seed contains a vegetable fat known as shea butter.

Lovett (2000) reported that the trees provide regulation through carbon sequestration, wind breaks, and preventing erosion in addition to serving as a habitat for other organisms and direct provisioning of fruits. Shea butter is also used locally as a skin and hair moisturizer, in soap making, as a waterproofing wax and illuminate. It is applied to African percussion instruments (djembe shells, calabash gourds) to increase the durability of wood and leather tuning straps (Hall *et al.*, 1996).

The wood is used for charcoal, construction, for furniture and as pounding mortars (Dalziel, 1937; Abbiw, 1990). The bark is used for traditional medicines and the latex is used for making glue. Shea trees provided fodder for 70% of surveyed households in Nyankpala, northern Ghana (Poudyal, 2011). The husks of the seeds make a good mulch and fertilizer. Studies on the by-products of shea-butter processing have shown that heavy-metal ions can be removed from aqueous solutions, for example waste water, using *Vitellaria* seed husks. Other uses Shea butter as a vegetable fat obtained from the seed. Allantoin, an un-saponifiable compound, is responsible for the anti-inflammatory and healing effect on the skin. Shea butter is also very suitable for making candles because of its high melting point. The black sticky residue, left after oil extraction, is used to fill cracks in walls and as a waterproofing material. Waste water from shea butter production has pesticidal properties. The press cake and the husks remaining after oil extraction are potential fertilizers and fuels. The leaves, soaked in water, produce a good lather for washing.

2.1 Medicinal Uses

Medicinally, Shea Butter is used for topical medicines against rheumatic and joint pains, wounds, swellings, dermatitis, bruises, and other skin conditions. It is also useful as relief from nasal congestion and rhinitis. (Protabase - Plant Resources of Tropical Africa. The leaves are used to treat stomach pain and headache. Ground roots and bark are used to treat diarrhea, jaundice, and stomach ache. Bark infusions have antimicrobial properties and are used against dysentery, (Gaertn, 2012).

3. Methods of Shea Butter Extraction

The traditional water-based extraction (Home-based) method is the commonly used method Mechanical extraction also known as the press method (Cold/Wet press and Hot-press) uses screws and hydraulic instruments. Chemical extraction method which uses solvents such as Ether is industrial-based extraction process, which depends on improved technology and inputs (Hall *et al.*, 1996).

3.1 The Traditional Extraction Method

Iddrisu (2013) list the equipment for primary processing of shea nut into butter and cake to include pan for boiling water, drying mat, mallets, pestles, winnowing basket, and clay pot. He stated that there are two main methods for shea butter extraction: a traditional village process and a mechanical procedure. The traditional process involves many time consuming stages. Using a shea nut press does not only alleviate time consuming process but also improves the fat output. For example, using a shea press fat output will be between 40 to 45% whereas fat output using the traditional method will be about 25% (Niess, 1983)

The traditional processing of shea fruit and extraction of shea butter, also reported by Dalziel (1937) as labour-intensive, women dominated, time consuming and tedious, yielding only 25% of butter (Iddrisu, 2013). The dried kernel is crushed by pounding in large mortars, crushing with stones or mills and roasted to concentrate the oil. Roasted and crushed kernels are dried to further reduce moisture content and ground into paste. Kneading of paste vigorously with warm water is carried out until a white coagulated crude shea butter paste containing oil separates from the water suspension. This paste is whisked out of the water into a pot and boiled in water until oil floats on top. The remaining brown suspension containing mainly nut deposits which solidifies to form the shea nut cake is discarded as waste. The oil, in liquid form, is scooped out into containers leaving behind in the pot a black paste as waste being charred nut deposits that followed the crude shea butter. The oil is then allowed to cool and solidify at room temperature into shea butter. This process is aided by constant stirring with clean dry sticks. The solidified butter is then packaged either as balls or into large containers for market



Figure 2: Local Method of Shea Production.

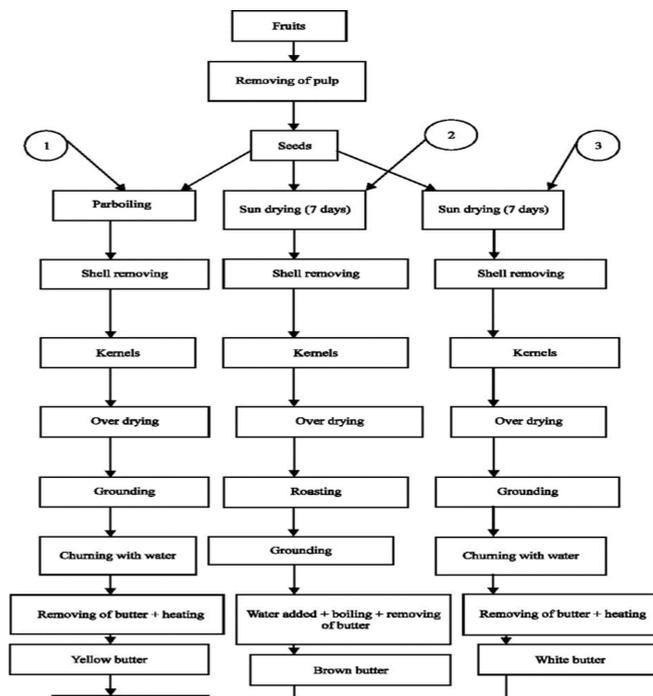


Fig. 3: Flow chart for local processing of shea butter (Agyente *et al.*, 2010)

3.2 Mechanical Extraction Method

Despite the introduction of some technological innovations in the traditional extraction processes such as mechanical crushers, mills and kneading machines, shea butter yields and extraction efficiency by this method are still woefully low (Iddrisu, 2013 cited in Danikuu, 2016). The mechanical extraction method involves the use of expellers and hydraulic pressers. The mechanical extraction technique involves heating the nuts to 15-20°C crushing and then pressing the crushed nuts to release the oil and a first extraction cake. The first extraction cake is further pressed in a second expeller to release more oil and a second extraction cake. As much as 25-80% of shea butter is produced from shea nuts with the mechanical process as against about 25% from the traditional water-based method (Iddrisu, 2013 cited in Danikuu 2016).





Figure 4: Local Method of Shea Production.

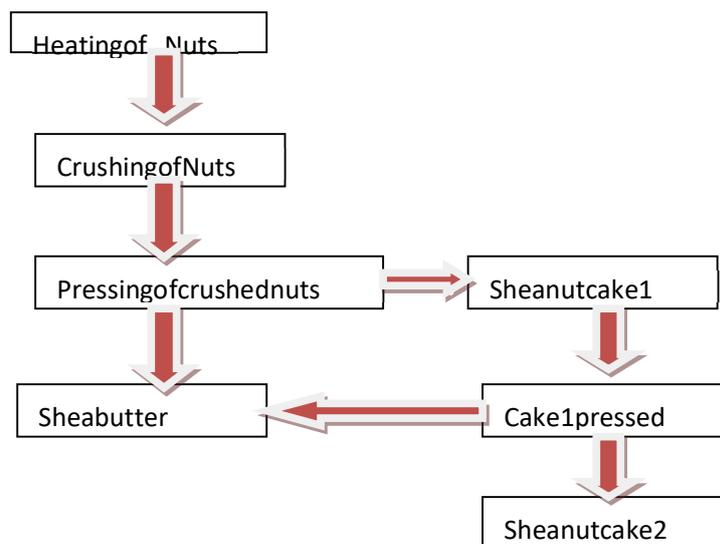


Figure 5: Flow Chart for Mechanical Processing of Shea Butter (Iddrisu, 2013).

3.3 Chemical Extraction Method

This method employs a solvent such as hexane or ether and extraction efficiency is highest as compared to the two techniques described above. The solvent is mixed with the crushed shea nut and after the butter is extracted in the solvent the solvent is subsequently separated from the solvent-oil mixture by distillation. The method can be applied alone or in combination with the mechanical press method (Iddrisu, 2013). In this integrated method the second extraction cake is directed into a chemical plant where a suitable solvent, such as hexane is added at a

ratio of 5 L to a tonne of shea nut (Iddrisu, 2013). The solvent is subsequently separated in a distillation plant. The process yields 98% extraction efficiency (Iddrisu, 2013 cited in Danikuu , 2016). Extraction efficiency is higher in mechanical than traditional and highest in chemical method of extraction, especially when mechanical and chemical are combined.

4. Shea Butter Production in Niger State

Niger State is on the verge of becoming the main hub for Shea Butter in Nigeria. Currently, the state boasts of having the largest collection of Shea trees in the world, controlling about 54 per cent of all the trees in Nigeria and of the vaunted 325,000 metric tonnes of Shea nut and butter exported from Nigeria (Olumide, 2018). According to Olumide (2018), for the State to tap fully into the economic potentials of the Shea tree, it appointed a consultant, First Heritage Global Investments Limited, leading a team of experts, to come up with the Niger State Shea Sector Development Programme (NSSSDP).

Women in Niger State have found the real gold mine in shea processing. From shea butter alone, they have established a major export hub in the state, reputed as the leading exporter of raw shea nut in Nigeria. From Lavun to Bosso, Katcha, Rijau, Mokwa, Mashegu, Mariga, Tafa, Agaie, Wushishi and Edati Local Government Areas (LGAs) lie sprawls of shea trees in the wild from which families in Niger State derive their subsistence, especially from shea butter, one of the most used products obtained from the shea nut. (Onche Odeh, Daily Independent Newspaper)

A survey conducted by Solomon *et al.* (2017) in four local government area of Niger State (Lapai, Katcha, Gbako, and Bosso) with the highest shea butter producers revealed that about 63.2% of the respondents produce between 10 and 30kg of Shea butter per month at the peak period of production. Only about 1.3 percent of the respondents produce above 50kg of Shea butter per month during peak production period while about 5.2 percent produce less than 10kg. According to Solomon *et al.* (2017) the butter production output per month is very low considering the level of work done in the realisation of the butter and recommended that Adoption of improved Shea nut processing technologies and introduction of best practices in Shea butter production by the processors could provide needed intervention to improved butter production output. Below is the table that shows the Respondents Shea Butter Production Output per Month

5. Wastes in Shea Production and Potential Usage

Husk: for removing heavy metals from waste water, making flower vase, plates and decorations. **Slurry:** Used for local air fresheners, local provision of lightening (candle). **Black deposits:** Can be used for the filling of cracks in buildings, paint making and local ink usage on slates and board. **Waste Water:** After potential treatments, can be used for domestic activities of washing, as insecticide and for irrigation farming.





Figure 6: Slurry and Wastewater and Husks from Shea Production.

Waste disposal is a big challenge in shea butter industry in the presence of tannin, an environmental pollutant which is toxic to soil microbes, makes the waste recalcitrant to biodegradation and unacceptable to animals as feed. Inadequate funding by central government, stakeholders and non-governmental organizations to unearth and exploit the full benefits of the sector. Training in the sector geared towards improving the sector which still depends on very old extraction methods is lacking. There is therefore lack of enough research into handling and Management of waste from shear butter production. Local method of shea butter production generate more wastes than mechanical methods and list negative effects of the waste on environment as. It chokes the drain, breed mosquitoes generate foul odours and also reported that people using local method normally suffer from smoke related diseases. It generate large quantity of wastewater which breed mosquitoes and other water borne ailments (Figure 8).



Figure 7: Scene from Improper Management of Shea Wastes.



Figure 8: Pollution of River Course by Wastewater from Shea Production.

5.1 Potentials of Shea Wastes

(Quainoo *et al.*, 2015) reported that Shea shells can be used to phytoremediate soil polluted with Iron, Manganese, Zinc and Copper. (Abdul- Mumeen *et al.*, 2013) also reported that Shea nut cake can be converted into briquette and also has bio-phytochemical properties. (Adazabra *et al.*, 2017) also reported that spent shea water can be added to clay to produce fire clay brick and that the wastewater if sedimented and dried, the slurry can be used as bio fertilizer with some additives (Figure 9.) Ray, 1994 and Mazzafera, 2002, have also reported the use of microbes or microbial enzymes to decompose toxic pollutants in Shea slurry into harmless substances. This innovation has worked and has converted tannin-rich shea husks slurry and pulp to animal feed.



Figure 9: Organic Fertilizer Produced from Combination of Shea Slurry and other Additives.

6. Conclusions and Recommendations

6.1 Conclusion

In the extraction of Shea butter, it is very obvious that a lot of problems are encountered. These problems reduce the efficiency of shea butter production most especially its quality and quantity as seen in the amount of waste generated from it. It is therefore evident that by solving all these problems, there will be improvement in the extraction of Shea butter (the quality and quantity). Since Shea butter is a very good vegetable oil used for so many purposes, improvement in the yield and quality will bring about improvement in income for the people that engages in this occupation and also more Shea butter in the market. Deforestation is also identified as one of the menace contributing to low productivity of the Shea nut.

6.2 Recommendations

Training should be provided and encouraged for the people involved in this extraction on the use of the equipment and also its maintenance and management of the waste. Finally, the government should render the necessary assistance required in supporting research and development in terms of funding upgrading of the existing Shea butter local cottage. Marketing of the finished product (Shea butter) to the right channel. Encourage concerted research effort on Shea butter; an initiative similar to Cassava and Rice production.

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