*Sospoly Journal of Engineering, Entrepreneurship & Environmental Studies, Vol. 6 (1&2) Dec. 23,*
*ISSN: p2536-7183, e2714-2720:* ***Available at http://uaspolysok.edu.ng/sospolyjeee/***

# CONSTRUCTION AND TESTING OF A SHEA BUTTER PROCESSING PLANT

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***ABSTRACT***
*Shea butter is very economical in the world for the multiple uses it performs in food, cosmetics, and medical purposes and it contains biofuel for various applications, The abundance of resources of Shea butter in the country is under-utilized. Traditional methods have limitations in processing shea butter for domestic and export purposes. The aim is to construct and test a shea butter processing plant by designing and fabricating an improved plant that combines various processes into a single machine for quality and productivity at a good rate and efficiency. Material considerations were based on the availability of material, cost, condition of work, and amenability in the fabrication process, Mild steel was selected in the fabrication both in bench work and machining shafts and pulleys for transmission systems. The method of bench operation_was followed for the construction The fabrication was completed without the design construction of a dryer, which would attract other fabrication such as a conveyor to feed the dried nuts to other systems of the plant. Boiling water was prepared from outside the boiler. The factors in the tests were the mass of raw shea nuts sent for the process, the time taken in the process, and the mass of butter yield. Two rounds of tests were conducted, with the first test processing 2kg of nuts in 3 hours, yielding about 150 percent, and the second test using 2kg of a different nut, in 2 hours yielding 200 percent, obtaining 4000 grams of butter. The same masses of nuts at 2kg were used for the two tests. The second test yields a better amount of butter. This was understood from the species of the tree and the moisture content of the nut.*

**Keywords: Construction, Processing, Shea nuts, Shea butter**

## INTRODUCTION

Shea butter is very economical in the world for the multiple uses it performs in food, cosmetics, and medical purposes and it contains biofuel for various applications. The abundance of resources of Shea butter in the country is under-utilized. Sokoto has Shea butter and there is a need for adequate research for a standard physicochemical analysis and additives to improve the use of Shea butter, and Shea residues have not been commercially utilized.

Attention was not paid to developing the technology to aid the hard labour of processing the shea butter, the human error and poor use of equipment among the dominant of the shea tree, sub-standard method of production, and the traditional method have been the limitations in the processing of shea butter for domestic and export purposes.

The harvesting method and treatment of the fruits and nuts are a greater challenge to obtain the butter. According to the tradition to obtain a shea butter in the first position was to collect the

number of samples required and then proceed to dry the fruits, after which the dried one will move to breaking the shell and collecting the nuts. The nuts will then be roasted, crushed, and ground for the formation of a water solution. To separate the butter it will be churned and heated, and finally, go for decanting and boiling.

**Problem statement**

The problems in processing shea butter were since no documented Shea butter processing plant, traditional methods are used which always produce low oil yield. So there is a need to design and fabricate a processing machine for the Shea butter. Shea butter is vital in the world for the multiple uses it performs for various applications. The abundance of resources of Shea butter in the country is under-utilized. Sokoto has Shea butter and there is a need for adequate research for a standard physicochemical analysis and additives to improve the use of Shea butter, Shea residues have not been commercially utilized but the challenge mentioned above is the technology in the fabrication of the refinery system.

**Aim**

To construct and test a shea butter processing plant

**Objectives**

1. To design and fabricate an improved plant for processing the Shea butter.
2. To combine the number of processes into a single machine for the achievement of quality and productivity at a good rate and efficiency

About 20%-35% was achieved from the traditional method. Besides all these, there is a need for a standardized way of production and still needs more attention to improve the properties(Goumbri et al., 2021). Similarly in Ghana, a design of a rotary roaster for Shea oil production was conducted to arrest the problem of oil quality and yield. Fatty acid value, acid value, and peroxide value were analyzed to aid the design. The construction was designed at the capacity of 60kg/batch and to reduce the moisture by 40%. From the construction, the moisture of the oil increases with boiling time and decreases with roasting time. The highest moisture content achieved was 6.12 ± 0,02%. There is a need for further improvement in industrial production (Chemistry, 2020; Tulashie et al., 2020) Similar research was conducted in a different part of the region yet needs more improvement.

Microwave-Assisted The studies made on biofuel from Shea oil were limited, and there was a need for more explode. Most of the work done was on biodiesel and some briquette fuel from Shea nuts(Ajala et al., 2020; Kano, 2017; Khan et al., 2021; Tulashie et al., 2020)

**Design Consideration**

After the separation between the shell and the fruit nuts, and as the shell is passed to the tank the nuts will later be sent to the grinding chamber where the nuts will be ground and passed to the next process. MIXING CHAMBER (a drum of 1.5' height and 1.5' diameter)

In the mixing chamber, a paste mixed in water solution is formed, and enough heat is provided to churn and heat the solution. The paste was collected from the grinding chamber which is also arranged vertically and parallel to the shell tank, one step down from the drying chamber. FRAME AND WATER TANK are provided to complete the process in the machine.
These components are the components of the initial design and each chamber stands as a complete machine and that is why the construction is called a plant, a plant always consists of more than one machine. The original design before construction is shown in Fig. 1.

**Material**

Material consideration in this design was based on the availability of the material, the cost, the condition in which the component will be subjected to work, and amenability in the fabrication process of the design. The condition at which the component will work in the process of roasting, churning, and drying processes, or the transmission of motion will be at moderate friction and temperature.

Mild steel was selected in the fabrication both in bench work and machining shafts and pulleys for transmission systems. The lagging material will be clay sand to protect the loss of heat and safety from touching the outside hot surfaces.

**Method**

The method considered all the traditional processes carried out by humans to extract the shea butter which was improved for easy and clean processes. These are summarised into four components viz: DRYING CHAMBER (a drum of one-foot height and one feet diameter)
The process of drying the raw fruits and breaking the shell is designed in the first chamber called a Drying Chamber. The limitation or challenge in this chamber was the removal of the sweet fleshy food of the fruit, where such food is not needed the raw fruit will be directly fed into the machine, but, in this design, the removal of the flesh will meet in further enhancement.

**Shell Tank**

A tank is designed to collect the broken shell of the fruit from the Drying Chamber, both the drying chamber and the tank are arranged vertically, and the tank beneath the chamber is in a box shape with the dimensions of 24 X 12 X 12 inches.

**Grinding Chamber**

After considering the materials, the method of bench operation was followed for the construction which involved measurement and marking out, cutting the metals (according to the specifications}, filing each component then joining and final assembly of the plant. Due to the serious inflations

of the material at the time of construction, the original design was completely changed to a different design. This can be seen from the final shape of the construction.

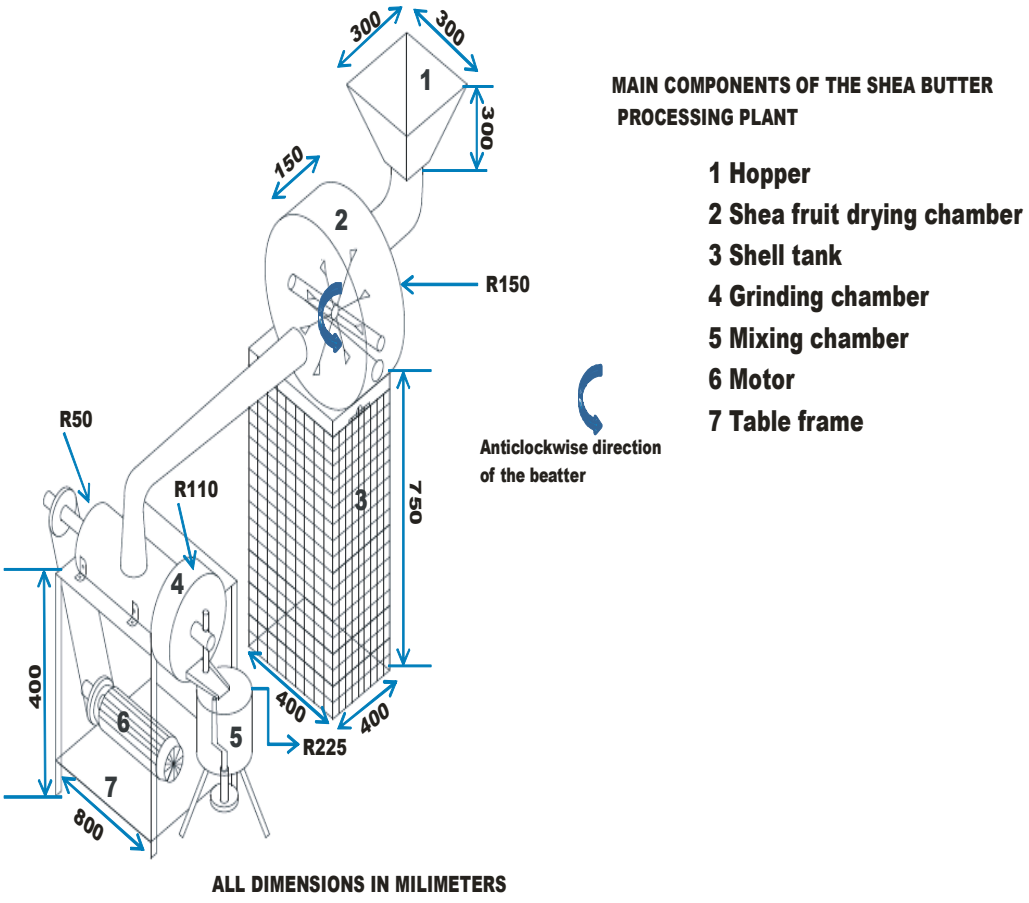


**FIGURE 1 PROCESSING PLANT**

g were carried out according to design as shown below: Plate 1 which consists of a hopper and perforated diaphragm,

**PLATE 1 HOPPER AND PERFORATED DIAPHRAGM**

The thresher also consists of a set of beaters having a shaft fixed on bearings to both sides. The beaters are placed on top of half of the thresher on top of the diaphragm as shown in PLATE 2

**PLATE 2 BEATERS ON A THRESHER**

A **blower** attached to the thresher separates the shell of the dry shea fruit and the nuts, The Assembly of the blower and the thresher welded together is shown in PLATE 3

**PLATE 3 ASSEMBLY OF THRESHER AND BLOWER**

The blower sends the nuts to a **sump (**A **s**ump is a container designed to collect the tiny particles of the nuts from the blower) A **screw conveyor** is designed to collect the nuts to a grinding machine. **A screw Conveyor** as the name implies is a conveyor in the form of a screw designed on a shaft that is covered with a casing, the picture provided during the construction is shown in PLATE 4

**PLATE 4 SCREW CONVEYOR**

The conveyor is driven by an electric motor using a belt drive system. The conveyor to bring up the nuts will move clockwise direction. For a successful motion, the pulley of the conveyor shall be bigger than that of the electric motor. The Grinding Machine will grind the nuts to a paste and directly fall into the mixer for mixing the paste as a solution, electric motor of the mixer will stir the mixture of the paste and hot water to separate shea butter from that solution. Plate 5 below shows the plant grinder collecting the nuts from the conveyor.

**PLATE 5 GRINDER**

The mixer of the shea plant is shown in plate 6 the mixer consists of a stirrer attached to an electric motor placed overhead of the square drum which accommodates the hot water and the paste solution for the shea butter.

**PLATE 6 MIXER**

**Transmission Systems in the Plant**

The transmission systems are belt-pulley drive systems. The electric motor as the prime mover having double pulleys transmits the motion via the belt to the thresher which uses double pulleys to blow that separates the shell and the nuts of the shea fruit. Also, the same motor transmits motion to the grinder. A different motor for the conveyor was used. Different Views for the Complete Plant

**PLATE 7 VIEWS FOR THE COMPLETE PLANT**

## Testing Procedure

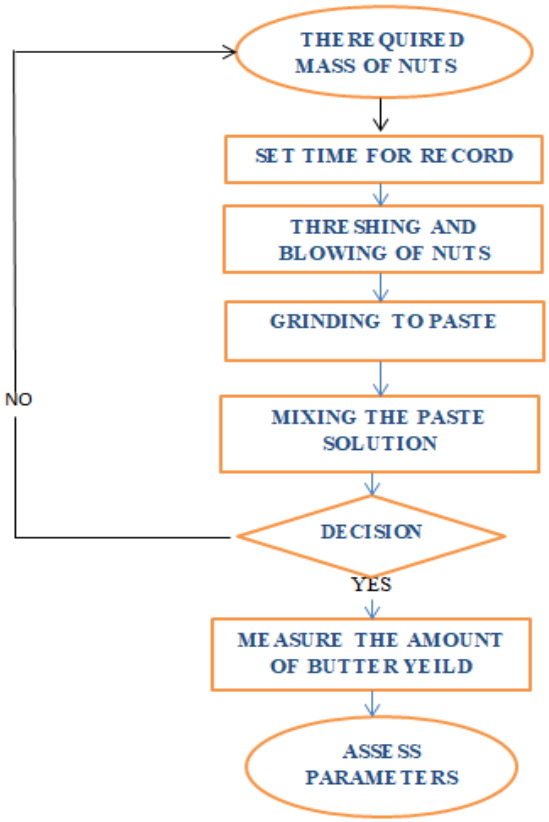

**Figure 2 TESTING PROCEDURE**

The test was carried out according to Figure 2 shown above. The machine has been tested and The thresher beat the dried fruit with a mixture of nuts and shell. The blower had separated the shell outside the plant and the nuts were collected to the sump. The conveyor was able to convey the nuts to the grinder. The shea nuts were desired to start with three kilograms, the time was recorded through processes. Two or three rounds of tests can be repeated. In this case, only two tests were conducted.

**Result**

The machine has been tested successfully and the result was good, Successful mixing has given the output for good analysis and assessment. In the first test, the 2kg of the nuts was processed in 3 hours; the yield was measured to about 150 percent, giving 3000 grams of the butter. The second test used 2kg of a different nut which was processed in 2 hours and gave a better yield of 200 percent, obtaining 4000 grams of the butter.

**Discussion**

The factors in the test were the mass of raw shea nuts sent for the process, the time taken in the process, and the mass of butter yield. The same masses of nuts at 2kg were used for the two tests. The second test yields a better amount of butter. This was understood either from the species of the tree or the moisture content of the nut. The first 2kg were in the store for two years having less moisture and taking more time in the process while the second test of 2kg was in the store for less than a year.

**Challenges Faced at the Execution of the Fabrication**

Inflations at the cost of materials cost of diesel at the shortage of power supply which was very rampart etcetera. This made it compulsory to separate the drying system and the heating system from the plant, consequently the initial design from Figure 1 entirely changed to a different pattern. Despite the ample time given for the fabrication a lot of factors resulted in difficulties and delays for the execution of this particular fabrication such as the fund allocated at this crucial condition inflation. As a new fabrication the required design of the grinder was not able to be obtained, only the domestic shape was employed. Obtaining the fruit is seasonal apart from the lack of orientation on the economic value and medical value of the fruit to people who destroy life shea trees for charcoal making causing scarcity and expensiveness to the fruit. The fruit can be seen in plate 8.

**PLATE 8 RAW SHEA FRUITS**

## CONCLUSION

The fabrication was completed without the design construction of a dryer which will attract other fabrication such as a conveyor to feed the dried nuts to other systems of the plant. The boiled water also had to be prepared from outside the boiler. The arrangements of the machines in the plant were successful and the operation was successful.

## RECOMMENDATION

The plant uses high power consumption at a time of both fuel and power scarcity the operation will not be economical, therefore there is a need to convert the plant into solar solar-powered system.

## ACKNOWLEDGMENTS

We greatly appreciate the Tertiary Education Trust Fund (TETFUND) in Nigeria for providing funds to carry out the construction. We would like to express our gratitude to Umaru Ali Shinkafi Polytechnic Sokoto and the management for accommodating the project and the whole personnel of the mechanical engineering workshop.

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