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TRAINING **MANUAL** ON

Processing Of High-Quality Shea Butter Using An **"Improved Shea Kernel Roaster"**



WACWISA - UDS

UNIVERSITY FOR DEVELOPMENT STUDIES



WACOMP | Ghana
West Africa Competitiveness Programme

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Target Beneficiaries

Individual Processors
Women Group Processors
Shea Nut Pickers
Artisans (Roaster) Producers

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Women treating Shea nuts

This document has been prepared, under the guidance of Ebe Muschialli, Industrial Development Officer at UNIDO and with the contributions of Dr. Charles Sackey, UNIDO Chief Technical Advisor in Ghana based on the experience in Northern Ghana by West African Centre for Water, Irrigation and Sustainable Agriculture (WACWISA) of the University for Development Studies Comments and suggestions on issues raised in this manual are welcome and may be addressed to Ebe Muschialli, e.muschialli@unido.org

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About the Manual

Shea butter is derived from the nut of the Shea tree (Vitellaria paradoxa C.F. Gaertn.) which is widely distributed across 21 countries in the semi-arid and arid savannah regions of sub-Saharan Africa. The shea tree grows naturally in the wild in the dry savannah belt of West Africa from Senegal in the west to Sudan in the east, and onto the foothills of the Ethiopian highlands. Shea butter, the most important commodity in the Shea value chain has become tradable because of its export potential as it is composed of five (5) principal fatty acids: palmitic, stearic, oleic, linoleic, and arachidic. Approximately 85 to 90% of the fatty acid composition in shea butter consists of stearic and oleic acids which significantly influence its consistency based on their relative proportions. The stearic acid gives it a solid consistency, while the oleic acid influences how soft or hard the shea butter is, depending on ambient temperature.

The production of Shea butter has been a key income source for rural women over the years and has resulted in improving the living standards of these women.

The major uses of Shea butter include:

- *local consumption as food*
- *cosmetics, soaps and detergents*
- *medicines*
- *cultural and religious purposes.*

On the global market, it is also widely used in the pharmaceutical and cosmetic industry.

Processing of Shea nuts into butter however is often carried out using different traditional and semi/fully mechanized processing methods with each method involving several unit operations and different butter yields and quality.

Despite the extensive research activities on Shea butter processing in relation to butter quality, there seem to be wide variations in quality across the various processers of Shea butter in Northern Ghana. The procedures and processes used in the processing of Shea butter affect health and safety, exposing processors to health and safety risks. For this reason, training in enhanced methods becomes necessary.

This manual, therefore documents steps and activities as procedures to be used in the processing of Shea butter to lead to standardized high-quality butter and competitiveness on the global market. The focus of the manual is the use of an improved Shea nut roaster known as the *"Improved Kernel Roaster"* which has been funded by UNIDO.

Target Groups

This training manual is primarily designed for:

- Individual women Shea nut processors
- Small-scale shea butter processors
- Women Group Shea butter processors
- Equipment (roasters, milling, kneading machine, etc) operators and artisans
- Metrologists / welders / fabricators or local artisans

Aims of the Training Manual

1. To be an easy-to-use and standardized Shea butter processing procedures and technologies guide for the processing of high-quality Shea butter in Ghana

2. As a tool to support the empowerment of Shea butter processors on improved health and safety at processing facilities / centres.

Manual Development and Delivery

The training manual has been developed by the West African Centre for Water, Irrigation and Sustainable Agriculture (WACWISA) of the University for Development Studies (UDS) forming part of the agreement between WACWISA-UDS and United Nations Industrial Development Organization (UNIDO) on the implementation of the intervention focusing on "Shea butter Processing in Northern Ghana. Analysis of Linkages Between Processing Procedures, Occupational-Related Health Hazards and Products Quality'' under the UNIDO implemented project West Africa Competitiveness Programme (WACOMP).

WACOMP is a partnership initiative between the Economic Community of West African States (ECOWAS) and the European Union (EU) and it was funded by the 11th European Development Fund (EDF) of the European Union.

The manual includes information gathered from literature and field experiences of the West African Centre for Water, Irrigation and Sustainable Agriculture (WACWISA) of the University for Development Studies, especially from Shea butter processors for improved Shea butter quality.

The training manual has been structured to facilitate use in training Shea butter processors and it is divided into two Modules:

Module I: *Training on Processing of High-Quality Shea butter using "Improved Shea Kernel Roaster"*

Module II: *Training on Health and Safety for Women in Shea Butter Processing.*

Effective delivery of the modules contained in this training manual can only be achieved with the use of a participatory methodology.

The pictorial presentation of sections of the modules makes some of the activities self-explanatory. Images and pictures of activities were captured with the consent of individuals depicted in the images.


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MODULE I

PROCESSING OF HIGH-QUALITY SHEA BUTTER USING AN
"IMPROVED SHEA KERNEL ROASTER"

About Module I

This Module is designed for Shea butter processors and stakeholders involved in the Shea butter value chain to allow them to improve their skills and knowledge that are useful in processing high-quality butter.

The manual explains the steps that should be adopted for quality assurance and quality Shea butter production. The module covers various topics as best practices for quality assurance and safe butter production.

To promote quality assurance aimed at producing quality butter, the following are considered necessary under the module:

- *Materials and Equipment as training needs of the module;*
- *Steps for Quality Shea Butter Production.*

The necessary steps for quality Shea butter production have been categorized into eight (8) activities:

1. *Sorting, washing and drying of nuts*
2. *Crushing of nuts*
3. *Roasting of crushed nuts*
4. *Milling of crushed nuts*
5. *Kneading*
6. *Boiling/cooking of crude butter*
7. *Cooling and solidification*
8. *Packaging and standardization*

Training Objective

To equip trainees with the necessary skills and knowledge to process high-quality Shea butter for both domestic use and/or commercialization.

Training Needs

1. Materials

a. *Raw material - Shea nuts*
b. *Water*
c. *Fuel Wood*
d. *Mortar and pestle/or "dum-bell shaped" wooden structure*
e. *Decanter*
f. *Aluminum Pots*
g. *Aluminum Basins*
h. *Baskets*
i. *Rubber Buckets*
j. *Wooden and Aluminum Ladles/Stirrer*
k. *Polythene Bags*
l. *Carton Boxes*

2. Equipment

a. *Mechanical Crusher powered by electricity*
b. *Improved Shea kernel Roaster*
c. *Burr/Plate Milling Machine*
d. *Kneading Machine*

Characteristics of the Improved Shea Kernel Roaster

a. A roaster drum with a metal handle and lid for easy loading and off-loading.

b. Three (3) straight flight profiles are incorporated into the roaster drum.

c. Straight flight profiles of 1.9 cm improve the turning of crushed Shea nuts.

d. Loading weight of 36 kg (equivalent to 13 bowls).

e. Roaster stands 78 cm in length, 52 cm in width and 40 cm in height.

f. Off loading support handle designed at 48 cm from roaster drum.

Advantages of the Use of the Improved Shea Kernel Roaster

a. Promotes even mixing of crushed Shea nuts allowing even distribution of heat.

b. Allows faster and uniform roasting of crushed nuts.

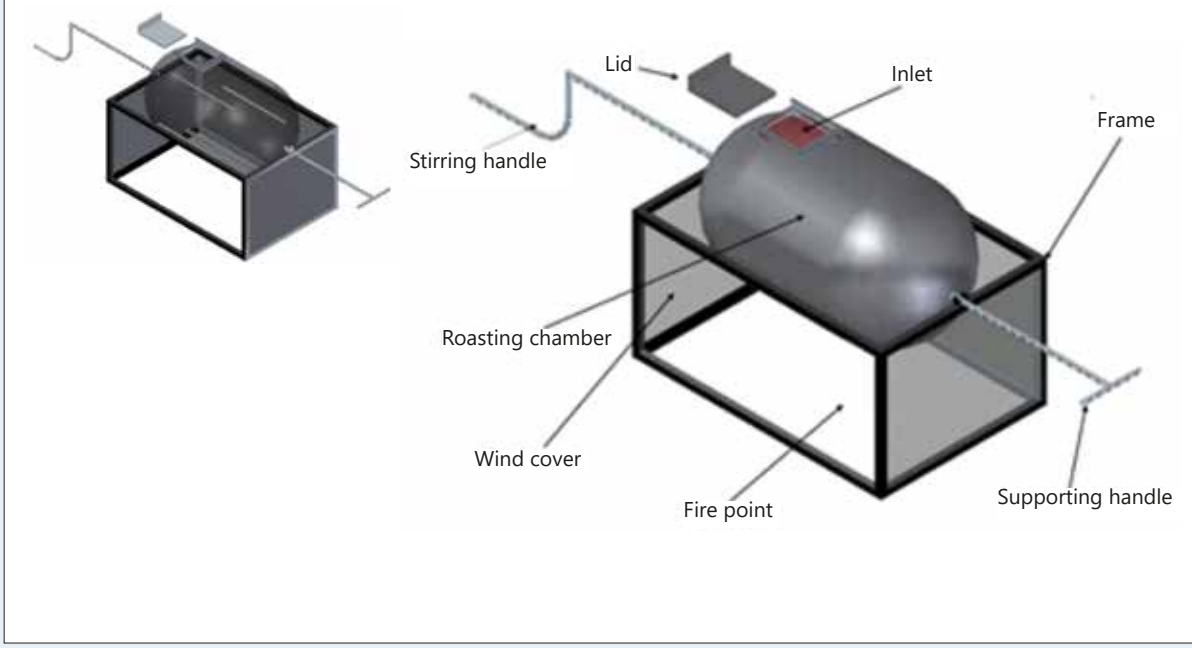
c. The Roaster stand is designed to allow even distribution of heat energy across the roaster drum.

d. Reduces energy/fuel wood consumption and thus reduces the effect on climate.

e. Contributes to improved Shea butter quality.

f. Simple, less costly, easy to fabricate and use by the women in the context of economic, cultural and environmental considerations.

g. Results in over 40% increase in Shea butter yield and up to 30% increase in Stearic, Oleic, palmitic and linoleic Free Fatty Acids (FFAs) concentration.



Steps for Quality Shea Butter ProcessingUsing Improved Shea Kernel Roaster

Eight (8) steps in processing high-quality Shea butter using the Improved WACWISA Roaster are:

1. *Sorting, Washing and Drying of Nuts.*
2. *Crushing of Nuts (Mechanical/Manual).*
3. *Roasting of Crushed Nuts using Improved WACWISA Roaster.*
4. *Milling of Crushed Nuts.*
5. *Kneading of Shea Paste.*
6. *Boiling/Cooking of Crude Butter.*
7. *Cooling and Solidification.*
8. *Packing and Standardization.*

Step 1: *Sorting, Washing and Drying of Nuts*

a. Dried Shea nuts/kernels should be sorted on a clean surface and all 'spoilt nuts', impurities and contaminants safely removed.

b. Shea nuts with signs of fungal growth should also be removed and the remaining good nuts used for the production of Shea butter.

c. Use potable/clean water to washShea nuts to remove dust and dirt.

d. Use potable/clean water to make nuts moist and improve shea nuts' quality for easy crushing without breaking into powder.

e. Shea nuts should not be soaked in water before crushing.

f. Shade drying of washed nuts is encouraged and should be done on a clean dry platform preferably on a concrete floor to remove excess water from nuts before crushing.

g. Shea nuts ready for crushing should not be sun-dried as it will make crushing difficult and the result is the production of powder.



Women Sorting and Washing Shea Nuts

Step 2: *Crushing of Nuts (Mechanical/Manual)*

a. Sheanuts should be crushed into grits using an electric-powered mechanical crushing machine to both avoid contamination and save time.

b. A "dumb-bell shaped' wooden structure against a clean surface or a pestle and mortar can also be used for nut crushing (Note that this is a slow process and produces little volume).

c. Shade-dry crushed nuts for about 30 minutes on a dry platform to reduce moisture to 7 – 8 % and enhance the efficient roasting of the crushed nuts.



Crushing Nuts into Grits

Step 3: *Roasting of Crushed Nuts Using Improved Shea KernelRoaster*

a. Crushed nuts should be roasted using an Improved Shea Kernel Roaster with straight flight profiles and a loading capacity not exceeding 36kg (13 bowls).

b. The improved roaster is affixed with straight flight profiles of height 1.9cm along the drum to lift crushed nuts and make them rain across the roaster section. This promotes even mixing of crushed nuts allowing even distribution of heat.

c. Roasting should be done for about 45 minutes until crushed nut grits turn golden brown.

d. Regular turning during roasting is advised to promote uniform roasting and ensure grits are not burnt.

e. Heat energy for roasting is supplied through fuel wood and it is initially maintained at the recommended levels and gradually reduced as the grits turn golden brown.



A Woman Roasting Crushed Nuts

Step 4: *Milling of Crushed Nuts*

a. The milling machine should be clean to avoid contamination with impurities during milling.

b. Milling should be done using an electric-powered but mechanical mill to avoid contamination with engine oil.

c. Roasted nuts should be milled into a uniform very fine smooth paste.



Milling Crushed-Roasted Nuts into Very Fine Smooth Paste

Step 5: *Kneading of Shea Paste*

a. Milled paste should be allowed to cool in the open air for about 1 - 2 hours to achieve a paste temperature of about 34 oC to 40 oC.

b. Kneading should be done preferably using an electric kneading machine to avoid contamination of paste.

c. Milled paste should be poured into the kneader and allow kneading to take place for about 30-40 minutes until fluffy and light.

d. For hand kneading, gradually add cold water (warm water during harmattan season) and stir gently and uniformly with hands in one direction without breaking momentum to aid the oil extraction.

e. Crude butter should be washed only once before skimming to preserve the vitamin content of the butter.

Step 6: *Boiling/Cooking of Crude Butter*

a. Crude butter should be boiled over mild heat using the improved stove to conserve energy and also protect the processor from heat stress.

b. Stir crude butter during boiling to facilitate evaporation of water while constantly skimming-off waste/dirt that appears on top of the oil throughout the boiling process.

c. The boiling of the crude butter should be stopped when bubbles disappear completely.

d. Oil should be decanted carefully to separate it from the residue underneath.

e. Allow decanted oil to cool in an open-air and dust-free space/area for several hours.

f. The Shea oil is then filtered while still warm to remove impurities through a microfilm (water filter net).



Boiling Of Crude Butter Stirring To Facilitate Evaporation Of Water

Step 7: *Cooling and Solidification*

a. Cooling, stirring and solidification of the filtered Shea oil should be done within an enclosed clean room to avoid re-contamination with impurities.

b. Shea oil should be stirred for about 1-2 hours to enhance cooling, prevent lumps and enhance smooth solidification.

c. Shea oil should be left to solidify (semi-liquid) in an enclosed clean room.

Step 8: *Packing and Standardization*

a. Solidified Shea butter should be stored in cardboard boxes lined with polyethene films to prevent the escape of oil and oxygenation, and also protect it from re-contamination.

b. Packaging of butter should be done before it solidifies (semi-liquid).

c. The name and address of the processor, weight and other production details should be labelled on the box and placed in a well-ventilated room on raised wooden pallets to avoid wetting.


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MODULE II

HEALTH AND SAFETY FOR SHEA BUTTER PROCESSORS

About Module II

Health and safety are vital issues with Shea butter processing but there are no proper measures, protocols or contingency plans put in place at processing centres to address or minimize the risks. This Module presentssome techniques, practices, and tools necessary to minimize health and safety hazards during Shea processing. The Module provides supporting information, which includes health and safety with examples of worked solutions and good practices.

The form of health and safety and worked examples are not an exhaustive list but cover the main risks and hazards identified during a baseline study conducted bythe West African Centre for Water, Irrigation and Sustainable Agriculture (WACWISA)-University of Development StudiesShea butter processing procedures in Northern Ghana in addition to a broad consultation process with various stakeholders.

The Module considers health and safety dangers that processors are usually exposed to:

1. *Snake and Scorpion Bites*
2. *Smoke Inhalation*
3. *Burns and Cuts*
4. *Sun and Heat Exposure*
5. *Loud Sound Effects/Hearing Loss*
6. *Slip Hazards*
7. *Muscular Skeletal Injuries.*

A trainer on health and safety for processors in Shea butter processing should familiarise the trainees with the training objective.

Training Objective

To empower Shea butter processors with skills and knowledge to improve the health and safety conditions at processing facilities as well as toprovide good practices for health and safety prevention strategies and solutions.

Health and Safety Training Needs for Shea Processors

Snake and Scorpion bites

Processors experience snake and scorpion bites when working on farms, collecting Shea nuts as well as during processing of the Shea nuts. Often, snakes and scorpions live - in dark places and come into contact with processors in the Shea value chain. Snake and scorpion bites can lead to loss of man-hours and even loss of lives if not attended to with the care needed.



Figure 1: Snake *(left)* and scorpion *(right)*

Prevention Strategies

a. Protective clothing such as boots and gloves should be used by women during Shea collection and sorting.

b. Torchlight or solar lamps should be used to light dark places or poorly lit areas.

c. Processors should watch while walking and stepping on rocks or logs and much care should be taken during picking Shea fruits or nuts.

d. They should also be careful when handling dead or apparently dead snakes to avoid accidental scratches.

e. Nuts should be stored in clean, well-spaced, bright and ventilated places.

First-Aid: Checklist

a. In case of a snake bite, remove a snake from the victim using a stick or bag especially when attached.

b. For a scorpion sting, remove the venomous stinger of the scorpion from the victim and tie the affected part to prevent the spread of the venom.

c. Victims of snake bites should be moved to safety.

d. Identification of the type of snake is very important for purposes of treatment.

e. Tight clothing should be removed from snake-bitten part of the body.

f. Immobilize the patients, particularly if a bitten limb, to prevent absorption and spread of venom.

g. Place the patient in the recovery position (lying down on the left side) to minimize the risk of shock and inhaling vomit.

Smoke Inhalation

Processors are exposed to smoke (carbo-monoxide) during especially boiling and roasting activities along the Shea butter processing value chain.

The methods of cooking over open fire with biomass (fuelwood, dung, crop waste and coal) present several health risks to women.

The fuel produces harmful particles and when inhaled regularly can cause diseases including;

a. Pneumonia
b. Stroke
c. Heart disease
d. Chronic obstructive pulmonary disease
e. Lung cancer

There is also a link between household air pollution and low birth weight, tuberculosis, cataracts and certain cancers.

Prevention Strategies

a. Access to processors andprocessor groups to clean cookstoves will reduce smoke inhalation.

b. Avoid deadly indoor air pollution.

c. Processors should cook in well-ventilated outdoor areas to minimize smoke exposure.

Burns and Cuts

Burns are injuries to the skin mainly caused by heat or due to excessive heat exposure during the kernel, roasting, boiling, etc. stages of the Shea value chain.
The risk of burns is high when using open fires from cookstoves to boil Shea kernels or make Shea butter.

Prevention Strategies

a. Avoid wearing loose clothing during cooking.

b. Wear clothing materials made of cotton.

c. Avoid wearing highly flammable synthetic materials.

Whenever there is a minor burn:

a. Run cool water over the area of the burn.

a. Use a clean, cold, wet towel to reduce pain.

a. After soaking the burn, cover it with a dry, clean bandage, and prevent it from pressure and friction.

d. Provide waterproof plasters for cuts after treating the cuts with iodine and gentian violet.

First-Aid for Major Burns

For major burns:

a. *The victim should stop, drop and roll.*

b. *Wrap the person in thick materials, preferably cotton, to smother the flames.*

c. *Douse the person with cool water.*

d. *Elevate the burned area above the heart.*

e. *Take the person to a medical facility as fast as possible.*

Sun and Heat Exposure

The body uses sweat to cool down normally. During sunny, hot days, sweating will not be enough to cool down the body. Processors of Shea should drink adequate water and rest under a shade. This will prevent suffering from heat exhaustion or stroke.

Processors who are suffering from heat exhaustion may complain of symptoms like dizziness, headache, sweaty skin, weakness, cramps, nausea, vomiting and fast heartbeat.

Prevention Strategies

a. *Processors should drink a lot of water every 15 minutes, even ifnot thirsty.*

b. *Rest in the shade to cool down.*

c. *Wear a hat and light-coloured clothing.*

d. *Processors should learn the signs of heat stress/ illness (e.g. headache, dizziness, nausea etc.).*

e. *Processors should be aware of emergency procedures during heat stress and also keep an eye on fellow workers.*

Loud Sound Effects / Hearing Loss

The use of grinding mills and nut crushers exposes processors to hearing loss due to continual exposure to noise. The severity of the damage to the ear depends on the intensity of the noise and the duration of the exposure.

Preventing Strategies

An indicator of a processor at risk of hearing lossincludes if a person cannot understand what's being said from ameter distance. If/when there is ringing in the ears after exposure to noise or hearing seems muffled after leaving the area.

a. *Control the noise by insulating the source.*

b. *Use hearing protection in the form of earmuffs or ear-plugs.*

c. *Decreased the duration of exposure to the noise.*

Slip Hazards

Processors do slip, trip and fall when undertaking Sheaprocessing activities. This can lead to injuries such as sprains and strains bruises, fractures, abrasions and lacerations.

Prevention Strategies

The slip hazards may be due to human error like fatigue, stress and distraction or environmental factors such as poor lighting.

- The workspace should be well-lit and spacious.

- Clean up water spills immediately after they occur.
- Reduce load and do not carry too much at once.

Muscular Skeletal Injuries

In the process of transporting heavy bags/weights of Sheakernels or Shea butter, processors should ensure that head loads do not exceed 25 to 30 kg. This prevents serious back or neck injury.

Prevention Strategies

- *The head load should not exceed the weight limit of 25 to 30 kg.*
- *Processors should avoid carrying or lifting heavy loads alone or by themselves.*
- *Heavy loads should be divided into small pieces.*
- *Processors should take regular breaks of 10 minutes for every hour of work.*
- *Processors should go for regular health check-ups at least once a year even when they do not feel sick.*



DISCLAIMER

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The WACOMP consists of one regional component and sixteen national components (15 ECOWAS Member States and Mauritania).

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