POTENTIALS OF SHEA WASTES (OIL AND WATER) AS PRESERVATIVES AGAINST WOOD BIODEGRADATION

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Abstract

The problem of insufficient wood and wood products especially among the inhabitants of Ayetoro has led to the use of woods with lesser durability potentials commonly, *Funtumia elastica* and *Daniella oliveri*. This is why it becomes necessary to study preservatives that can prolong the service life of these available species preferably from locally sourced materials. Hence, the evaluation of the potentials of shea butter wastes as wood preservatives. The shea butter wastes were obtained from an active shea production point in Ago Are in Oyo State. *Funtumia elastica* and *Daniella oliveri* were used as test blocks for the experiment and they were buried in an active termitarium in the College of Agricultural Sciences, Olabisi Onabanjo University, Ogun state. After 16 weeks, the test blocks were exhumed and visual assessment was carried out to assess the extent to which the test blocks were attacked by termites. Phytochemical analysis showed higher concentrations of phenol (0.136), tannin (0.0036), alkaloids (0.426) and flavonoids (0.078) in the shea butter waste water compared to the shea butter waste oil. However, the waste oil showed greater preservative potential than the waste water as there was a significant difference in weight loss between the two species (*Funtumia elastica* and *Daniella oliveri*) treated with both the waste oil and the waste water at $p \leq 0.005$. Within the confinement of this study, it is therefore concluded that the shea waste oil has greater potential as a preservative than the waste water to prolong the shelf life of a wood species. Furthermore, other wood species can be focused on using this shea waste oil as well as other application methods other than brushing.

Keywords: Shea tree, preservative, waste water, black sludge, *Funtumia elastica*,, *Daniella oliveri*.

Introduction

Shea butter tree (*Vitellaria paradoxa*), the sole specie in the genus Vitellaria (PFAF, 2022) of the family Sapotaceae, is a deciduous tree with a spreading crown and grows about 25 m in height. 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 occurring in 21 countries, Nigeria inclusive (Wikipedia, 2022). The kernel (nut) contains a vegetable fat known as shea butter (Protabase, 2022) used for cooking, confectionery and cosmetic purposes. The of the seed (often incorrectly called 'nut') contains a vegetable fat known as shea butter [Howes, 1948; Protabase, 2021; Facciola, 1998]. This butter made from the shea tree is widely known especially when an alternative to cocoa butter is needed to be processed into a wide range of food products including chocolate and it is also becoming more popular in the cosmetic industry (Schreckenberg, 2000; Jibreel *et al*., 2013). In the course of producing shea butter, two sets of wastes are released into the environment: the brownish waste water and the black sludge (Jibreel *et al*., 2013).

The waste brown water is normally disposed off and the waste black sludge is dried in the compound for further use in some climes (Jibreel *et al*., 2013) and dispose off in other areas. The adverse impacts of the processing of the shea butter on the environment related with the large volumes of water used in processing which is scarce, changes in the soil structure at disposal locations and inhibition of plant growth. However, Abagale *et al* (2020) posited that shea waste sluge or slurry possessed a positive effect on soils studies in Tamale metropolis, Ghana, as the slurry helped to increased concentration levels of plant primary and secondary nutrients; influenced soil pH, carbon content percentage and soil EC by increasing their levels; thus translating to plant growth and yield. Hence, this study focused on the other ways that the shea waste water and sludge can be utilized sustainably.

The continuous demand for wood and its by-products to meet up the needs of a geometrically increasing population has led to alternative lesser used species replacing otherwise economic wood species. Ayetoro, Ogun State, is not left out as *Daniella oliveri* and *Funtumia elastica* seemed to be among their favourite wood species. Moreover, these species do not last in service as they become prone to fungal and insect attacks within a short time probably due to lack of maturity or inadequate preservative treatment and so may require further protection (Emmanuel and Owoyemi, 2018). Tree maturity cannot be tackled as a result of increase in population, continuous deforestation, wood versatility and legislative issues which is why the preservative aspect is best considered. Many preservatives abound in the market but only few can be said to have less adverse effect on the environment and human health. There is therefore a need for a readily available preservative preferably organic in order to safeguard the environment and human health.

The shea wastes were considered for this study because existing literatures showed the waste water to have pesticidal properties (Protabase, 2022) while the shea butter itself is being used by makers of traditional African percussion instruments to increase the durability of carved wood, dried calabash gourds, and leather tuning straps (Wikipedia, 2022). On the other hand the waste black sludge has been used to fill cracks in walls and known to be waterproof in nature (Protabase, 2022). The wood from the tree has been known to be termite resistant. All these properties of the shea tree informed the basis of this research.

Materials and Methods

Study Area

The shea wastes used for this study were collected from an active shea production point in Ago- Are, Oyo State located at latitude 8°30'0"N and longitude 3°24'36"E (Retrieved from Wikimapia, 2022).. This part of the country belongs to the savannah region which coincides with the region of distribution of the shea tree.

Determination of the phytochemical components in shea butter wastes (water and oil)

Both the shea waste water and oil were subjected to phytochemical analysis using A.C.O.A (1992) to determine the presence and concentrations of tannins, phenols, alkaloids and flavonoids.

Sample Preparation and Treatment of Test Blocks

Planks of good quality and straight grained stock of *Daniella oliveri* and *Funtumia elastica* were procured from a local plank market in Ayetoro, Ogun State, Nigeria. Fifty test blocks of 30cm were obtained from each plank (fifty test blocks of each wood species). Twenty samples of each species were soaked in the shea waste water for 12 hours while another twenty samples of each species were smeared with the waste oil. Ten untreated test blocks served as control for each species.

The test blocks so prepared were then weighed and the weight obtained for each sample was taken as initial weight (Dw_1). The samples were oven dried for 24 hours at a constant temperature of 105°C. The test blocks were weighed after oven drying before incubation in the grave yard. The weight obtained was taken as the initial dry weight of treated samples (Dw_2).

Grave yard Test

The treated and untreated test blocks were buried within the active regions of the termitarium and left for 16 weeks in the grave yard. Weekly inspections were carried out to assess the effect of the termites on the test blocks. At the end of the incubation period, the test blocks were evacuated from the grave yard. All adhering substances were carefully removed. The excavated test blocks were air dried under room temperature for three days. The weight obtained was taken as final dry weight of treated samples (Dw_3).

Two criteria were used to evaluate the efficacy of the shea waste water and oil as preservatives against termite attack. viz-a-viz

i. Visual inspection of samples.
ii. Weight loss.

The extent of termite damage was scored in accordance with EN 252: 1989 as stated in Table 1 below:

Table 1: Description of Termite attack

Rating	Description of Attack
0	No attack
1	Slight attack
2	Moderate attack
3	Severe attack
4	Failure (test blocks crumbled)

The percentage weight loss was determined using the relation proposed by Adetogun (1998)

$$\% \text{ Weight loss} = \frac{Dw2-Dw3}{Dw2} \times \frac{100}{1}$$

Statistical Analysis

The data collected was subjected to Analysis of Variance (ANOVA).

Results and Discussion

Phytochemical Analysis of Shea Waste Oil and Shea Waste Water

The phytochemical analysis carried out revealed the presence of tannins, alkaloids, flavonoids as well as phenols in both waste water and oil obtained in the cause of shea butter production. From Table 2, it can be deduced that the shea waste water had a higher percentage (0.426) of alkaloids than the shea waste oil (0.367). The trend of phytochemical presence in the shea waste water and oil showed that the waste water had more concentrations of flavonoids (0.078), tannin (0.0036) and phenols (0.136) compared to the shea butter waste oil. This may be the reason why the timber of *Vitellaria paradoxa* (shea tree) has great durability as the presence of these phytochemicals had been shown in the report of Znot *et al* (1988) to protect wood from biological destruction.

Hence, the shea butter waste water contained more phytochemicals than the waste oil. This support the claim that waste water from shea butter production has pesticidal properties and has been mixed with stored cowpea seeds in Burkina Faso to protect them from being eaten by the weevil *Callosobruchus maculatus*.

Table 2 Phytochemical Analysis of Shea Waste Water and Oil

Sample	Alkaloids	Flavonoids	Tannin	Phenolics
1	0.367	0.062	0.0029	0.118
2	0.426	0.078	0.0036	0.136

Where,

(1) represents Shea Butter Waste Oil

(2) represents Shea Butter Waste Water

Visual analysis of test samples

From Table 3, it can be deduced that for the two species (*Funtumia elastica* and *Daniella oliveri*), the control failed the preservative test because all the samples were eaten up by the termites. This agrees with the submission of Znot *et al* (1988) that high penetration of antioxidants into wood protects wood from biological destruction.

For the waste oil, *Daniella oliveri* was attacked moderately by the termites while the *Funtumia elastica* samples were severely attacked by the termites. The *D. oliverii* (590 kg/m^3) in the shea waste oil had better resistance to termites than the *F. elastica* (457 kg/m^3) as a result of varying densities. For the waste water, both species (*Funtumia elastica* and *Daniella oliveri*) failed the preservative test because all the samples were also eaten up by the termites.

Thus, it could be inferred that treatment of wood samples with shea butter waste oil reduced the attack of termites on the wood samples. This is similar to what Omole and Adetogun (2010) obtained for *A.toxicaria, C. petandra and T. scleroxylon* treated with spent engine oil. The oil was a better option because there was a better penetratiuon than the shea waste water. Also, the presence of elemental components in the oil such as sulphur could add to the resistance of the wood to the termite attacks during the period of incubation.

Table 3 Table Showing the Visual Analysis of Test Samples

Species	Control	Waste Oil	Waste Water
Funtumia elastica	4	3	4
Daniella oliveri	4	2	4

Where,
(2) represents Moderate attack
(3) represents Severe attack
(4) represents Failure

Statistical Analysis Of Weight Loss (Mean)

From Table 4, the mean weight loss of *Funtumia elastica* is 57.78% and the mean weight loss of *Daniella oliveri* is 10.99%. It can therefore be deduced that the highest weight loss was recorded in *Funtumia elastica* as compared with *Daniella oliveri*. This is due to the increased rate of attack by termites on *Funtumia elastica* compared to *Daniella oliveri* probably as a result of the wood density. The mean loss recorded for this study was far greater than the average weight loss for *Ceiba pentandra*, *Antiaris toxicaria* and *Triplochiton scleroxylon* ranged between 0.64-1.94%, 0.48-1.47% and 0.38-1.32% respectively reported by Omole and Adetogun (2010). Statistical analysis result (Table 4) showed that there was a significant difference (0.005) in the efficacy of the preservatives with regards to species type and level of penetration of the waste oil and waste water. This supports the findings of Omole and Adetogun (2010) that mode of application and level of penetration affect the efficacy of engine oil used as prrservative for *C. petandra, A. toxicaria* and *T. scleroxylon*.

Table 4 Mean Weight Loss of *F. elastica* and *D. oliveri* after graveyard test

Specie	Mean	**p-value**
Funtumia elastic	57.78 ± 6.91	0.005
Daniella oliveri	10.99 ±10.98	

Conclusion and Recommendation

Within the confinement of data collected and analyzed during the course of this study, it is therefore concluded that:

i. Wood samples not subjected to any form of treatment (control) were completely destroyed using the grave yard test as a result of low natural durability.
ii. Wood samples treated with shea butter waste water were completely destroyed by termite attack using the grave yard test as a result of lower penetration compared to those treated with waste oil.
iii. Wood samples treated with shea butter waste oil were moderately attacked by termites using the grave yard test. This may also be affected by the density of the species.

From the foregoing, it is recommended that more studies be conducted using shea butter waste oil with other wood species preferably those with high natural durability. Shea butter waste oil may be used as an alternative form of wood preservative where other preservatives are not applicable whether due to high cost of procurement or unavailability. This is because it is readily available especially in shea butter-producing communities and it is cheap.

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