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Termiticidal Effects of *Moringaoleifera* seed Oil Extract on *Gmelinaarborea*roxb.Wood

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Abstract: *The study was carried out to investigate the termiticidal effects of Moringaoleifera seed oil extract on Gmelinaarborea wood. The wood samples of Gmelinaarborea was converted into 60 x 20 x 20mm^3 billets, oven dried and treated with Moringa seed oil extract at 60ml, 70ml, 80ml and 90ml concentration levels. The treated wood sample was exposed to termite attack at the grave yard for a period of 12weeks. The Moringa seed oil extract retention into the wood and percentage weight loss of the wood after termite attack were assessed. The experimental design was Completely Randomized Design involving 4 concentration levels replicated 5 times. Data obtained were subjected to Analysis of Variance (ANOVA). Results obtained revealed that the retention level of preservative in the wood ranged between 25.55kg/m^3 and 125.11kg/m^3, while the percentage weight loss of the wood ranged between 38.04% and 98.00%. The highest concentration (90ml) had the highest (125.11kg/m^3) significant ($p \leq 0.05$) retention and lowest (38.04%) significant weight loss. The level of effectiveness exhibited by the bio preservative Moringa oil extract thus recommend the need to exploit the development of other forms of natural base plant preservatives for protection of wood and wood products in service.*

Keyword: *Gmelina; Moringa; Preservatives; and Termiticidal*

I. Introduction

Wood is one of the oldest best known structural material and one of the few renewable natural resources (1). Jerrold (2005), reported that wood is an extremely versatile material with a wide range of physical and mechanical properties; it is also a renewable resource with an exceptional strength to weight ratio. According to Fabiyi*et al*., (3) the demand for wood and wood products is increasing because it is valued for use in construction and bio-energy. However, due to diversity in nature and character in wood, exploitation of tree for structural and construction purposes was selective and limited to strong and durable species (4). Despite the usefulness of wood, its service life can be degraded by various bio deteriorating agents; these include fungal infection, termites, insects, marine borers, fire attack and mechanical failure (5) which contributes to its limited selectivity. A review of the natural durability of 1500 commercial wood species worldwide shows that 191 of the commercial species are very resistant to bio-deteriorating agents, 189 are resistant, 298 moderately resistant and 826 nonresistant (6). As such, it becomes pertinent to preserve many of these economically important wood species in other to prolong their life span.

One of such commercially important wood species is *Gmelinaarborea*Roxb. Owoyemi and Kayode, (7) opined that thewood is commonly available, but has limited use for exterior job because of its susceptibility to termites attack. Ifebueme*et al*., (8) asserted that the heartwood of *Gmelinaarborea* wood is resistant to penetration by preservatives, it has a medium specific gravity of 0.47 which ranges from 0.40 to 0.54, large diameter vessels of 30 to 65 per 10 m^2 axial parenchyma cells that are predominantly associated with vessels and multi-serrated rays of 4 to 10 cells wide as well as the thin walled fibers and tracheids which account for penetrating the sapwood of this species with water-borne and oily preservatives.

Termites destroy wood by feeding on its components, thereby reducing its structural ability and appearance. Cellulose being the principal food of termites, wood and wood products such as paper, fabrics and wood structures are avidly consumed, and hence, a constant effort is directed towards their control (9).Degradation of wood by termites is a chronic problem in many tropical regions particularly in the Sub Sahara Africa, resulting in serious monetary and material losses with far reaching impact on the increasing demand for timber (10). There are several attempts and approaches on termite control. In the past, research was on chemical methods of control with an obvious lack of concern over side effects caused by the use of these chemicals. With the current problem of global warming and environmental degradation, these chemical preservatives have been prohibited due to environmental restrictions and thus, there is a search for alternative techniques which can extend wood service life, and which also at the same time is less harmful to the environment and man. Treating wood with the appropriate preservative increases its service life and also helps to conserve our nation's timber resources (11). Researchers are now focused towards alternative nontoxic and biological methods of control (12, 13). A typical environmentally friendly plant and alternative to synthetic chemical is *Moringaoleifera*. Many researchers have also reported that, *Moringaoleifera*oil and micronutrients contain antitumor, antiepileptic, antidiuretic, anti-inflammatory and venomous bite characters (14). The objective of this research study therefore to investigate the termiticidal effects of *Moringaoleifera* seed oil extract on *Gmelinaarborea* wood.

II. Materials And Methods

2.1 Preparation and Treatment of Material

The Gmelina wood samples used for the study was sourced from Katako local Timber market in Jos, Plateau State. The wood samples were dimensioned to 60mm x 20mm x 20mm billets and oven dried at $103\pm2^{0}C$ for 24hours to reduce its moisture content to 12% and for sterilization of the wood from possible inherent bio deteriorating agents. The weight of the wood samples were then measured and recorded as W_0.

The seed oil of *Moringaoleifera* was extracted based on the procedure adopted from Abdulkarim, et al., (15). 50g of the seed powder was wrapped in a soxhlet extractor and 250ml of petroleum either in 500ml volumetric Flash. The extraction was done using 80ºC electro thermal heater for the period of three (3) hours. This was done continuously until the sample of 800g of*Moringaoleifera*powder was exhausted. After the removal of exhausted sample, oil was recovered. The oil extracted was thereafter sectioned into different concentration levels of 60ml, 70ml, 80ml and 90ml.

Preservative treatment application method adopted was brushing method based on the volume of oil extract used due to its economic value. The bio preservative oil extract was applied on the wood billets with aid of a brush which covered the surface entire wood surface area. Thereafter, the billets were re-weighed and the treated weight recorded as W_1.

2.2 Grave Yard Termite Exposure

The efficacy of the bio preservative oil extract on Gmelina wood was carried out at the timber grave yard field of Federal College of Forestry, Jos. The wood samples were buried 5 m radius round a termitarium within the timber graveyard field leaving some length above the ground level and mulched with dry grass. In order to make the environment conducive for termite infestation the grass was watered once daily. Standard method for laboratory evaluation to determine resistance to subterranean termites (16) was modified in order to evaluate the degree of resistance of the treated woods to termite attack as suggested by Olufemi*et al*., (17). The wood billets were exposed to termite attack for a period of 12 weeks (18, 19). The billets were then removed from the termite mould, cleaned, oven dried and re weighed. The final weight was then measured as W_2. The preservative retention and percentage weight loss were calculated as follow ("equations 1 and 2");

$$\textbf{Retention}\left(\frac{\textbf{kg}}{\textbf{m3}}\right) = \frac{GC}{V} \text{ x } 10 \quad (1)$$

$$\textbf{WeightLoss}(\%) = \frac{W_1 - W_2}{W_1} \text{ x } 100 \quad (2)$$

Where:

G = $(W_1 - W_0)$ = initial weight of the wood before treatment subtracted from initial weight of wood after treatment

C = grams of preservative in 100g of treating solution,

V = volume of sample in m^3

W_2 = Weight of oven dried billets after grave yard field experiment

2.3 Experimental Design and Statistical Analysis

The experimental design adopted for the study was Completely Randomized Design involving 4 concentration levels replicated 5 times. An untreated wood billets was also included as the control. A total number of 25Gmelina wood billets were used for the experiment. Data obtained from the bio preservative oil retention and percentage weight loss were subjected to Analysis of Variance (ANOVA) to determine significant effects of the concentration levels. Follow-up analysis was carried out using Duncan Multiple Range Test (DMRT) where significant differences existed (20).

III. Results And Discussion

3.1 Results

The results of the termiticidal effect of concentration levels ofMoringa oil extract on retention and % weight loss of *Gmelinaarborea* wood is presented in Fig. 1. The result indicated that as the concentration level increased from 0ml to 90ml of the Moringa oil extract, the retention level increased with 90ml concentration level exhibiting the highest bio preservation retention level. This implies that the higher the concentration or volume of bio preservative oil extract applied on the wood, the higher the retention level of the preservative in the wood. Retention level or quantity of preservatives in wood is an essential factor in the effectiveness of the preservatives against bio deteriorating agents. Similarly, as the concentration level of the bio preservative oil extract increased from 0ml to 90ml, the percentage weight loss reduced subsequently. The highest concentration level (90ml) had the lowest percentage weight loss. This suggests that higher concentration of the bio preservative oil extract increases the resistance of the wood to termites attack. The result of the Analysis of Variance (ANOVA) as shown in Tables 1 and 2 revealed that the different concentration levels had significant effects on the bio preservative oil extract retention in the wood and percentage weight loss at 5% probability level.

Mean Termiticidal effect of concentration levels of Moringa oil extract on Retention (kg/m^3) and % Weight loss of *Gmelinaarborea* wood as presented in Table 3 revealed that all the different concentration levels of the bio preservative oil extract had significant effects on the retention ability of the Gmelina wood. The highest concentration level (90ml) showed the highest (125.11kg/m^3) significant retention level of the oil extract in the wood. The same trend applies for percentage weight loss of the wood after termite attack. The untreated Gmelina wood billet had the highest (98%) significant weight loss unveiling the low natural resistance of the wood of *Gmelinaarborea* to termite attack which might be one of the reasons why it was classified among non-durable wood species. The effects of 80ml and 90ml concentration level on percentage weight loss of the wood billets after termite attack were not significantly different from each other at 5% probability level. It can thus be inferred from this observation that the maximum range of concentration level of the oil extract should be within the range of 80ml and 90ml as both concentrations will still display the same effect on resistance of the wood to termite attack.

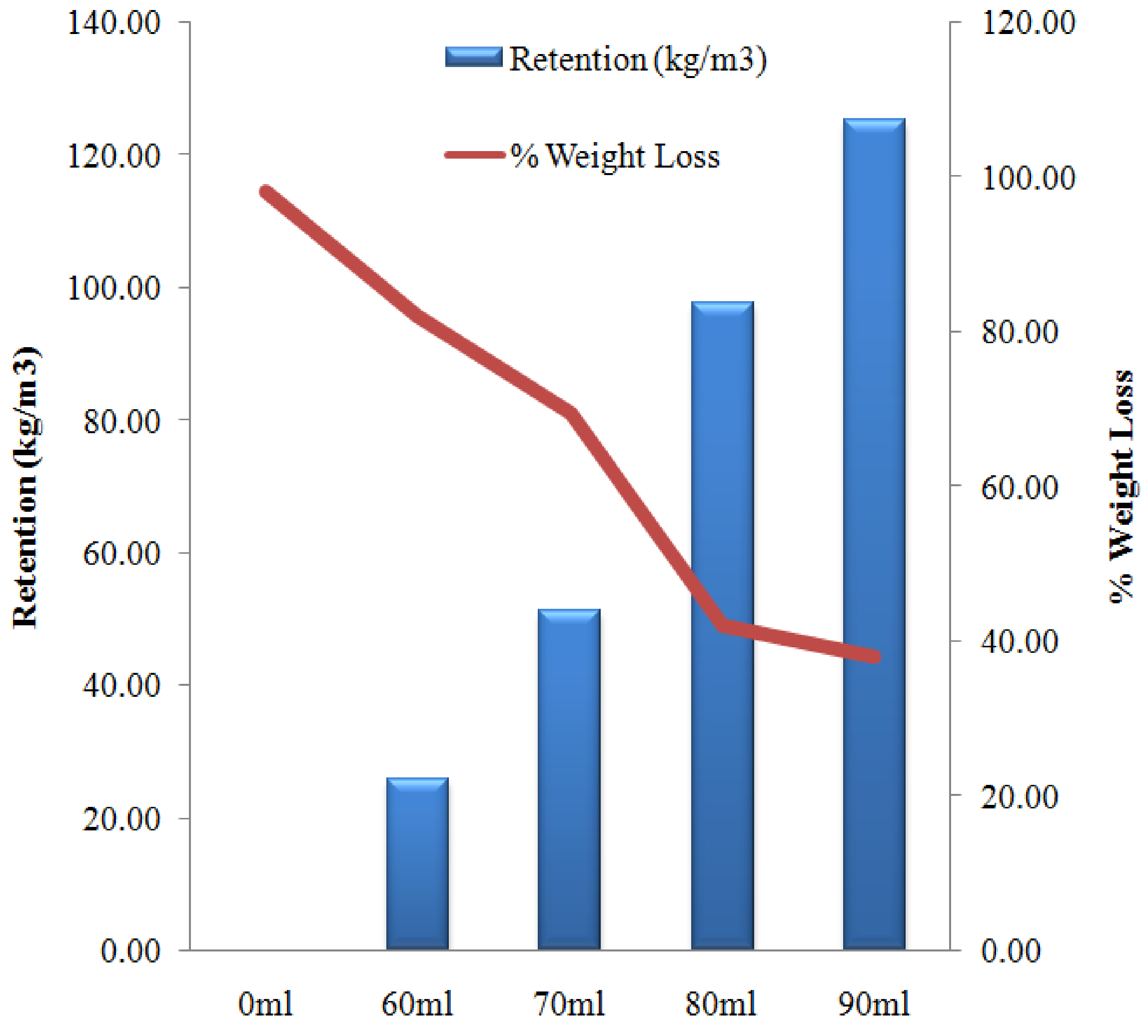

Figure 1: Termiticidal Effect of Concentration Levels of Moringa Oil Extract on Retention and % Weight Loss of *Gmelinaarborea* wood

Table 1: Analysis of Variance of Termiticidal Effect of Concentration Levels of Moringa Oil Extract on Retention of *Gmelinaarborea* wood

Source	Sum of Squares	df	Mean Square	F	Sig.
Concentration Levels	7925.97	4	1981.49	251.688	0.001*
Error	78.73	10	7.87		
Total	8004.70	14			

* significant

Table 2: Termiticidal Effect of Concentration Levels of Moringa Oil Extract on % Weight Loss of Gmelinaarborea wood

Source	Sum of Squares	df	Mean Square	F	Sig.
Concentration Levels	31486.25	4	7871.56	3320.000	0.001*
Error	23.71	10	2.37		
Total	31509.97	14			

* significant

Table 3: Mean Termiticidal Effect of Concentration Levels of Moringa Oil Extract on Retention (kg/m^3) and % Weight Loss of *Gmelinaarborea* wood

Conc.	Retention (kg/m3)	% Weight Loss
0ml	0.00^{e}	98.00^{a}
60ml	25.75^{d}	81.88^{b}
70ml	51.19^{c}	69.34^{c}
80ml	97.48^{b}	42.07^{d}
90ml	125.11^{a}	38.04^{d}
SE±	**1.62**	**0.89**

Means in the same columns having the same superscripts are not significantly different ($p \leq 0.05$)

3.2 Discussion

The retention level of preservative in the wood ranged between 25.55kg/m^3 and 125.11kg/m^3, while the percentage weight loss of the wood ranged between 38.04% and 98.00%. This range of values is less that values reported by Faruwa*et al.*, (21) effectiveness of selected bio-based preservatives on control of termite and fungi of wood in service. They reported retention values of 0.13- 156.25 kg/m^3 for *Gmelinaarborea*; 0.26 – 385 kg/m^3 for Ceibapentandra and 0.37 – 228 kg/m^3 for *Triplichitonscleroxylon*; while for percentage weight loss, the values ranged between 10.50 and 80.1% (*Gmelinaarborea*); 46.37 – 100.00% (*Ceibapentandra*); and 26.22 – 100.00% (*Triplochitonscleroxylon*) after treatment with Tar oil, *Parkiabiglobosa*extract and *Tridaxprocumbens*extract. Malami*et al.*, (18) in their study on effect of different wood preservatives on weight loss in Obeche wood exposed to termites reported 19.8 and 246.9% range of values. This is supported by the findings of Adegeye*et al*., (22) that also worked on T. scleroxylon and *Gmelinaarborea* treated with kerosene and solignum in which similar weight loss was obtained. Similar findings were obtained from Erythrophyllum spp. by Mailumo and Falemara (19).

The reason for this low range of values as compared with Faruwa*et al.*, (21) reported values can be attributed to low viscosity of the bio preservative oil extract of Moringa. This collaborates with the findings of Owoyemi and Kayode, (23) that the nature of preservative chemicals affects the quantity absorbed by wood. Owoyemi, (24) in his study opined that the viscosity of preservatives is a major consideration when applying preservatives in wood protection because this will determine whether further dilution is necessary. However, previous study carried out byOwoyemiand Kayode(7) revealed that dilution of preservatives tends to reduce their concentration. The effectiveness of preservative treatment as established by Falemara*et al.*, (11) depends on chemical formulation selected, method of application, wood species, moisture content before and after treatment, pretreatment methods, amount of preservative retained, depth of penetration and distribution, viscosity and temperature of the treating solution, vacuum and/ or pressure regimes and their durations are some of the parameters that influence wood treatability (25). In the same vein, the difference in anatomical structure of wood has a lot of influence on the absorption and retention of wood preservatives (26). This assertion corresponds with the report of Owoyemi, (24), that the dry heartwood of Gmelina is resistant to penetration by both water-borne and oily preservatives even when treated with vacuum pressure and hot treatment methods. Deposition of extraneous materials in the wood cell walls and in the lumens during the biochemical transformation of the sapwood into heartwood, encrustation of the pit membrane surface as well as the in-growth of obstructing tyloses into the vessels are majorly responsible for the impermeability of Gmelinaheartwood.

The phytochemical analysis of the Moringa seed oil extract revealed the presence of alkaloids, saponins, flavonoids, cardiac glycoside and steroids. This attributed to its efficacy against termite attack. The variation in its effect with respect to different concentration can be attributed to the assertion of Mazhar*et al.*, (27) that all the crude extracts showed antitermitic activity in a dose-dependent manner. Saponins are produced by plants as a defense mechanism to stop attacks by foreign pathogens, which makes them natural antibiotics (28). Flavonoids are known to protect inflammation, platelet aggregation, allergies and microbial infection (29). Mazhar*et al*., (27) thus affirmed that the seed extracts of medicinal plant offer a source of naturally occurring chemicals that could be used as termite controlling agents and this activity is attributed with the presence of phytochemicals of diverse chemical structure that had repellent, antifeedant, or toxic effects on termites in feeding assays (30).

IV. Conclusion

The study revealed that *Moringaoleifera* seed oil extract showed considerable effectiveness against termite attack on *Gmelinaarborea* wood at varying concentration levels. The maximum range of effective concentration level was found to be between 80ml and 90ml of the Moringa seed oil extract. Though the level of efficacy as observed from the study wasconsiderably low compared to other plant extracts and synthetic chemical, the level of effectiveness exhibited by the Moringabio preservative oil extract thus encourage the use of environmentally friendly plant extracts to locally preserve wood and wood based products at cost effective prices. There is therefore the need to exploit the development of other forms of natural base plant preservatives for protection of wood and wood products in service.

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