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Potentials of *Mangifera Indica* Seed Oil Extract as Bio-preservative Against Termite Attack on Wood

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Abstract

The need for preservation of wood to prolong it serviceable life is necessary and thus developing a new safer eco-friendly preservative is of importance because of the damages caused by the chemical preservatives. This study, therefore, investigates the bio preservative potentials of *Mangifera indica* seed oil extract against termite attack on *Triplochiton scleroxcylon and Terminalia superba* wood. The pods of *M. indica* were collected and dehulled after which the seeds were removed from the pods, sundried, and blended to fine powder. The fine cotyledon was subjected to solvent extraction for oil using a Soxhlet apparatus and N-hexane as the solvent. Data collected was analyzed using simple statistics and analysis of variance at $\alpha = 0.05$. The wood was dimensioned into 5 x 5 x 30 cm and 200 ml of seed oil was applied to it using a brush. The treated wood was exposed to field termites and the absorption rate and weight loss to termite attack were determined. Data collected were analysed with *t-test* at α = 0.05. The percentage weight loss of wood samples due to *T. scleroxcylon and T. superba* were 13.76 and 11.52 % respectively. These values are lower than the mean values obtained for the control (14.84 and 12.44 %). The absorption of seed oil extract by the wood samples differ significantly ($P \leq 0.05$). Meanwhile, there was no significant differences ($p > 0.05$) in the weight loss due to termite between treated wood samples but untreated wood samples differ significantly ($p \leq 0.05$). The *M. indica* seed extract can serve as an alternative preservative against termite attack thereby reducing environmental pollution that may arise from the use of conventional chemical preservatives.

Keywords: Seed oil extract, Bio-preservative, Termite, Wood

1. Introduction

Wood is a complete lingo-cellulosic material; it contains polysaccharides and organic compounds, thus decayable and destructible by agents of bio-deterioration like fungus, bacteria, and even termites-a major agent affecting wood in service [1, 2] However, some are durable while some require treatment to increase their durability [3]. Thus, the need for preservation to enhance or prolong the serviceable life of the wood is necessary. Although there are many effective chemical preservatives for this purpose but they are not eco-friendly, and the need for natural or bio-preservatives that pave way for various possible approaches in developing new wood preservatives [4]

According to Arango et al [5] who reported that plant extracts are safe, non-harmful to man, but still effective against plant pathogens when used as preservatives against wood destroying agents. In recent time, different parts of mango have been utilized as herbal remedies such as anticancer, anti-diabetic, anti-inflammatory, antimicrobial drugs as cardio protective, radio protective, recognition of memory and many others [6-7]. Barreto et al. [8] reported that the extract of different parts of mango possess several biological and pharmacological properties. Phytochemical compound of mango seed oil contains alkaloids, glycosides, flavonoids, tannins and saponin [9].

Generally, the presence of tannins, polyphenols, and phytosterols in plants extract could be responsible for it use for the protection of wood [10]. This is similar to the study of the essential oil of O*cilum basilicum* and *Calophyllum inophyllum* that showed antifungal and insect-repelling properties [11-13]. In this study, the preliminary investigations on the potentials of *M. indica* seed oil extract against wood attacking termite was carried out with the view to enhance the service life of wood and minimize environmental pollution.

2. Materials and Methods

2.1 Seed Collection, Preparation, and Extraction of Oil

The mango fruits *(Mangifera indica)* were collected within the Federal College of Forestry, Ibadan, Nigeria, dehulled, and the seed brought out of the pod, sun-dried, and blended to fine powder. The fine cotyledon was subjected to solvent extraction.

Two hundred (200 ml) of n-Hexane was poured into a round bottom flask. In the center of the extractor, 30 g of sample was placed in the thimble and heated at 65 ◦C. The vapor rises through the vertical tube into the condenser at the top while solvent was boiling. The liquid condensate drips into the thimble in the center, which contains the solid sample to be extracted. The extract seeps through the pores of the thimble and fills the siphon tube, where it flows back down into the round bottom flask. This was allowed to continue for 3 h. The thimble was then removed from the siphon tube, allowed to cool and after evaporation of the n-Hexane the oil left was weighed to determine the amount of oil extracted [14].

The percentage oil yield was obtained using Equations 1:

$$O_y = \frac{W_o}{W_s} \quad (1)$$

Where, O_y is the oil yield (%), W_o and W_s are the weights of the oil and blended seeds, respectively.

2.2 Phytochemical Screening

2.2.1 Alkaloids

Aliquot (0.1 mL) of the extracts was added in test tubes and 2 to 3 drops of Dragendoff's reagent were added. The presence of an orange-red precipitate indicated the presence of alkaloids [15].

2.2.2 Flavonoids

A piece of magnesium ribbon was added to extracts at 4 mg/ml, followed by concentrated HCl drop wise. A color change from orange to red indicated flavones and red to crimson indicates flavonoids [16].

2.2.3 Saponins

In a test tube, half gram of the extract was dispensed and 5 mL of distilled water were added to the test tubes and it was stirred vigorously. A persistent froth that lasts for about 15 min indicated the presence of saponins [16].

2.2.4 Steroids

About 2 mL of the extracts were taken into separate test tubes. The residues were dissolved in acetic anhydride and chloroform was then added. A pipette was used to add a concentrated sulfuric acid by the side of the test tubes. The presence of steroids was denoted by a brown ring at the interface of the two liquids and a violet color in the supernatant layer [15].

2.2.5 Tannins

To 2 mL of each aliquot of the extract was diluted with distilled water in the separate test tube and 5 % ferric chloride ($FeCl_3$) solution was added at 2 to 3 drops. Tannins were confirmed with a green-black or blue coloration [15].

2.2.6 Terpenoids

Chloroform (2 mL) of was added to 0.5 g of the plant extracts. Then 2 mL of concentrated sulfuric acid was added carefully and shaken gently. A reddish brown coloration of the interface was formed to show positive results for the presence of terpenoids [16].

2.2.7 Phenols

The extracts were treated with a few drops of ferric chloride solution. The formation of bluish-black color indicates the presence of phenols [15].

2.3 Preparation and Treatment of Wood Test Block

The wood samples (*Triplochiton scleroxylon and Terminalia superba*) were obtained from the Wood workshop, Department of Wood and Paper Technology, Federal College of Forestry, Ibadan, Nigeria. The wood samples were dimensioned into 5 x 5 x 30 cm (longitudinal x radial x tangential directions) [17]. Ten (10) replicates of the wood samples were properly labeled, weighed, and dried at a temperature of 103±2 ◦C for 24 h in an oven until excess moisture content was removed.

The method adopted for wood treatment was brushing, and above 100 ml of the oil was poured into 250 ml of beaker and a soft brush was used to apply the oil. Afterward, the wood test blocks were left to allow the seed oil retained in the wood.

2.3.1 Percentage Absorption

The wood samples were weighed before the experiment (T_1) i.e. the initial weight or the weight of the untreated wood samples. After the wood samples was treated with preservatives, it was reweighed again T_2.

The percentage absorption of the wood samples when preservatives were applied through the brush was calculated based on the difference between the weights before and after soaking and the Absorption rate was estimated by the formula [18].

$$Percentage\ Weight\ Loss = 100\frac{W_2 - W_1}{W_1} \quad (2)$$

Where, W_2= Treated weight; W_1= Dry weight

2.3.2 Field Test

The extracted seed oil was applied by the brushing method on the wood samples and then placed strategically within the spaces dug below the field termite to expose the wood samples to termites for 12 weeks.

2.3.3 Percentage Weight Loss

The remaining wood test blocks were carefully removed, cleaned, oven-dried and weighed to determine the weight loss of the wood. The weight loss percentage to termite attack by individual wood samples was determined according to ASTM method [18].

$$Percentage\ Weight\ Loss = 100\frac{W_3 - W_4}{W_3} \quad (3)$$

Where W_3= Weight after treatment; W_4= Weight after exposure to termite attack

2.4 Data Analysis

The differences in absorption and efficacy of the oil between the two wood species (*T. scleroxylon and T. superba*) were compared using student's t-test.

3. Results and Discussion

3.1 Percentage Oil Yield and Pytochemical Screening

The percentage oil yield of mango seed oil by solvent extraction was 18 % obtainable from the 30 g of sample that was placed in the thimble.

Photochemical screening of plants tells more of protective nature effects of such in diverse ways and the results of the qualitative analysis were revealed in Table 1.

Table 3.1: Qualitative phytochemical screening of *M. indica* seed oil

Phytochemical Composition	Qualitative
Alkaloids	+
Flavonoids	+
Saponins	+
Steroids	+
Tannins	+
Terpenoids	+
Phenols	+

The results revealed that important chemicals like alkaloids, saponins, tannins, steroids, terpenoids, flavonoids and phenols were found to be present in the seed oil. However, the plant alkaloids are said to be active against bacterial, and more of its usage in treatment of skin disorders such as eczema, seborrheic dermatitis, and neurodermatitis [19]. Additionally, these plant steroids are commonly used in cosmetic, soap, and pharmaceutical industries to create creams, ointments, and soaps and served to be a treatment against inflammatory diseases [20]. Besides that, saponins are mostly soap-forming compounds that also have antimicrobial properties. Meanwhile, Jayashree [21] mentioned that terpenoids compounds have been highlighted to possess antibacterial, antidiarrhoeal, antiviral, and antineoplastic effects. Flavonoids have found usage for various biological functions among which are allergy protection, free radicals platelet aggregation, inflammation, microbes, viruses, among others, while Tannin compounds are denoted to inflame mucous membranes, speed up the healing of wounds, and also have astringent properties [22]. The plant materials such as fruits, seed, peels, leaves, and stem contained phenolic compound that are responsible for valuable antioxidant potential of extracts thus regarded as health beneficial constituents [23].

3.2 Percentage Absorption

Figure 3.1 revealed the mean value of the percentage absorption of *T. scleroxylon and T. superba*. The result indicated that *T. superba* has the highest absorption with the mean value of 7.87 % when compared with *T. scleroxylon* (6.26 %). This showed that there was significant difference ($p \leq 0.05$) with *t-value* of 17.43 and probability level of 0.001. The difference could be attributed to variations in physical and anatomical characteristics of the wood. This difference could further be explained by the fact that *T. scleroxylon* is heavier with a density of 490 kgm^3 at 12 % moisture content (i.e. medium and more interlocking grams) than the lighter *T. superba* with a density of 480 kg/m^3 at 12 % moisture content [24].

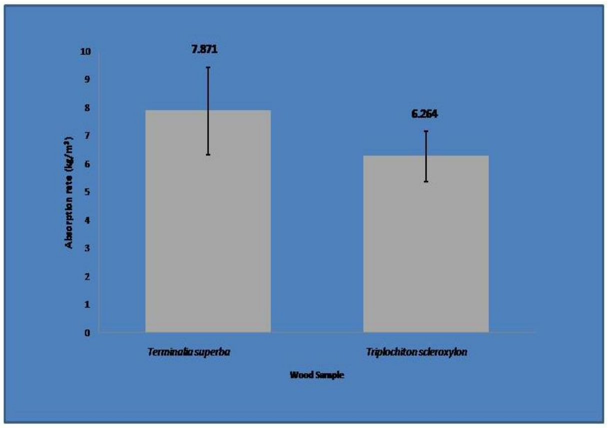

Figure 3.1 Absorption rate of M. indica extract exhibited by wood samples.

Table 3.2: Weight loss by selected wood species to termite attack.

Treatment condition	Wood Species		*t test*	
	Triplochiton scleroxylon	*Terminalia superba*	t value	Probability
Treated (%)	13.76±1.58	11.52±0.66	2.48	0.06ns
Untreated (%)	14.84±1.52	12.44±1.36	2.85	0.05*

Values are mean ±Standard Error

* - mean are significant different ($p \leq 0.05$); ns – mean are not significant ($p > 0.05$)

3.3 Weight Loss to Termite Attack

The weight loss recorded for both *T. scleroxylon* (13.76%) and *T. superba* (11.52%) treated with M. indica seed oil extract were lower than the untreated wood samples (control) which had 14.84 and 12.44 for *T. scleroxylon* and *T. superba* respectively (Table 3.2). The absorption rate of the seed oil extract by *T. scleroxylon* wood sample differ significantly (P≤0.05) from *T. superba* wood sample. In terms of weight loss due to termites, no significant differences (p>0.05) was found in the treated wood samples but the untreated wood samples were found to differ significantly (p≤0.05). Meanwhile, for the treated samples of *T. scleroxylon*, it has a higher value than that of *T. superba* (both values of which are lower than the control values) indicating that samples of the latter was able to resist termite attack more than the former unlike the result obtained for the use of *Ocilum basilicum* on *T. scleroxylon* [12]. The result further implies that *M. indica* contains toxic substances in the seed oil that resist the attack of termite. This corroborates with the efficacy of the plant and the seed oil extract on wood [4-5, 13, 25].

Meanwhile, the phytochemical compounds of plant seed extracts had been preliminarily screened. The results further revealed that alkaloids and terpenoids are present in seed oil are both compounds that are potential antibacterial agents. The antibacterial activity of these extracts may be due to the individual or combination effects of terpenoids groups. The proposed terpenoid lactones involved in the antibacterial activity are andrographolide, 1, 4-deoxyandrographolide, and neoandrographolide [21, 26]. More importantly, *M. indica* has been reported for anti-bacterial and antifungal activity [27]. Generally, the level of biodeterioration attack depends on the durability of the wood species and their density [11].

4. Conclusion

This study showed that *M. indica* seed extract has the potential to resist termite attack as an eco-friendly bio-preservative. It was also found to be more effective on *T. superba* than *T. scleroxylon* but the close range of the values obtained for the control and treated may be due to the method of application of the preservative.

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