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Effectiveness of *Azadirachta indica* A. Juss (Neem) Seed Oil in Controlling Wood Termite

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ABSTRACT: The protection of wood against biodeteriorating agents like termite during processing or in service has call for serious possible approach using new safer, environmental friendly preservatives hence this study therefore evaluated *Azadirachta indica* seed oil against termite attack on *Gmelina arborea* and *Triplochiton scleroxylon* wood. The seed oil was obtained using a soxhlet apparatus and N-hexane as the solvent. The wood was dimensioned into 20x20x20 mm and the seed oil was applied by brushing, dipping and soaking and exposed to termitarium while the absorption rate and weight loss to termite attack were determined. Data collected was analyzed using simple statistics and analysis of variance at $\alpha_{0.05}$. The antimicrobial properties of the need seed oil are due to the availability of phytochemicals which promote antimicrobial activity. The maximum wood protection against termite of all the methods of application was obtained from soaking. The absorption and weight loss ranged from 11.20 - 43.88 % and 56.50 -61.58 % for *G. arborea* and *T. scleroxylon* respectively. However, all the application methods used for the wood treatment proved to be effective over the untreated wood.

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The cause of wood deterioration during its processing or in service is of great concern to wood and environmental scientists. In recent time, the damage to wood has become so high in tropical region that the use of preservative treatment becomes compulsory. Though, attention has being shifted from the use of chemical preservative that increase environmental pollution and injure the workers. Besides, it has been duly observed that there are greater potentials in the use of plant and oil extractives as natural preservatives as many components of their extracts are very toxic to organisms imparting decay resistance to wood (Osman *et al.,* 2007 Amienyo *et al.,* 2007, Kirker *et al.,* 2013, *Tascioglu et al.,* 2013, Adegoke *et al.,* 2015, Brocco *et al.,* 2017, Okanlawon *et al.,* 2020). Among all wood-feeding organisms (insects), termites cause the most serious damage being an integral component of various ecosystems in Africa (Nkunika, 2010).They are responsible for considerable damage in building structures, attack growing trees, synthetic products, wool and agricultural crops (Malaka, 1996). The oil from seeds of tree species to produce biodegradable chemical capable of prolonging service life of non-durable wood is a promising approach to wood preservation. An example of species with such potential is *Azadirachta indica.* This study is therefore aimed at evaluating the effectiveness of seed oil from *A. indica* (Neem) against wood decaying termite using selected tropical wood species with a view to promoting environmental friendly preservatives.

MATERIALS AND METHODS

Seed collection and preparation: Azadirachta indica seeds were collected from Polytechnic Ibadan, Nigeria. The Seed of *A. indica* was peeled to removed endocarp and oven dried at 103±2 °C to reduce its moisture content. The seeds were later ground with a laboratory electric blender.

Extraction of A. indica seed oil: Two hundred (200 ml) of n-Hexane was poured into round bottom flask. 30 g of the sample was placed in the thimble and was inserted in the centre of the extractor. The soxhlet was heated at 65 °C. When the solvent was boiling, the vapour rose through the vertical tube into the condenser at the top. The liquid condensate drips into the filter paper thimble in the centre, which contains the solid sample to be extracted. The extract seeps through the pores of the thimble and fills the siphon

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tube, where it flows back down into the round bottom flask. This was allowed to continue for 6 h. It was then removed from the tube, allowed to cooled and weighed to determine the amount of oil extracted (Adegoke *et al.,* 2015).

Phytochemical screening of A. indica seed oil: Phytochemical screening of *A. indica* seed oil was done following the standard procedure by the method of (Brain and Turner, 1976). The seeds were ground and subjected to phytochemical screening for the presence and amount of alkaloids, saponins, tannins, steroids, terpenoids, flavonoids, and phenolic.

Preparation and treatment of wood test block: The wood samples of *Gmelina arborea* and *Triplochiton scleroxylon* were obtained from tree samples within Federal College of Forestry, Ibadan. The wood samples were planed and dimensioned into 20 x 20 x 60 mm (longitudinal x radial x tangential directions).They were labeled, weighed (initial weight-T_1) and dried in an oven at a temperature of 103± 2 °C until excess moisture content was removed.

The methods adopted for wood treatment were brushing, dipping and soaking method. Small portion of the oil was poured into 600 ml of beaker and a soft brush was used to apply the oil. For dipping method, portion of the oil was poured into 600 ml of beaker, the wood sample was dipped and removed immediately while the wood sample was completely immersed for 72 h in order to achieve soaking. Afterward, the wood test blocks were drained and reweighed to determine the percentage absorption using equation 1.

$$\%AR = \frac{T_3 - T_2}{T_2} X\ 100 \dots (1)$$

%AR = Percentage Absorption, T_3= Weight after soaking, T_2 = Oven-dried weight

The treated wood test samples were placed on a wire mesh and conditioned under room temperature in the laboratory for 72 h, the wood samples were withdrawn and weighed (T_4)

Weight loss: The percentage weight loss of each wood sample due to termites attack was calculated using the formula below

$$\%WL = \frac{T_4 - T_3}{T_3} X\ 100 \dots\dots (2)$$

%WL = Percentage weight loss, T_3 =Weight after conditioning, T_4 = Weight after exposure to fungi

Data analysis: Analysis of variance (ANOVA) was used for significant different between methods of application and wood species. A comparison of the means was conducted employing Duncan Multiple Range Test (DMRT) to identify which groups were significantly different at $\alpha_{0.05}$ when the ANOVA indicated a significant difference among methods of application and wood species.

RESULTS AND DISCUSSION

Phytochemical Screening: As presented in Table 1, the results of qualitative and quantitative phytochemical analysis of *A. indica* seed oil. The results revealed that seed extracts of medicinal plant offers a source of naturally occurring chemicals like alkaloids, flavonoids, saponins, steroids, tannins, terpenoids, and phenolic with 2141.7, 1418.3, 43.3, 218.3, 975.0, 826.7 mg/100g and 62 GAE/g. respectively. Mahmood *et al.*, (2008) affirmed that these compounds also serve to protect the plant against infections by microorganisms, predations by insects and herbivores, while their odor and flavor are responsible for their pigments. More importantly, scholars (Haller, 1990, Mossini *et al.,* 1993, Sofowora, 1993, Allameh *et al.,* 2002, Kumar *et al.,* 2018) reported the biological activity of the neem crude extracts and their different part such as leaf, bark, root, seed, etc have been used as traditional medicine for the treatment of various diseases ranging from the teeth decay, ulcers, swollen liver, malaria, among other.

Besides, the phytochemicals like alkaloids, flavonoids and saponins are antibiotic of plants thus act as the defensive mechanism of plants against different pathogens (Kumar *et al.,* 2009 and Kumar *et al.,* 2018).

Table 1. Qualitative and quantitative phytochemical screening of *A. indica* seed oil.

Phytochemical Composition	Qualitative	Quantitative Value(mg/100g)
Alkaloids	+	2141.7
Flavonoids	+	1418.3
Saponins	+	43.3
Steroids	+	218.3
Tannins	+	975.0
Terpenoids	+	826.7
Phenols	+	62.0 GAE/g

Percentage absorption of wood samples: The Figure 1 shows the effect of application method on percentage absorption of *G. arborea* and *T. scleroxylon* wood in that soaking method recorded the highest absorption percentage with 11.20 and 43.88 % for *G. arborea* and *T. scleroxylon* respectively while the lowest was at brushing for *G. arborea* and *T. scleroxylon* for dipping and brushing with 8.2, 38.5 and 39 % respectively. There were significant variations ($p<0.05$) in the methods of application, and interaction between periods of method and wood species but not for wood species as revealed in Table 2. The absorption increased with different application methods however, absorption is proportional to the treatment time in soaking (Owoyemi *et al.,* 2011; Adegoke *et al.,* 2015 and Okanlawon *et al.,* 2020). The absorption of preservatives by many wood species differs and this can be attributed to wood structure. Beside, penetration ability, viscosity of preservative and chemical composition of the preservative can also contribute to the absorption of preservative.

Table 2: F-calculated of ANOVA table for percentage absorption and weight loss

Source of variance	Absorption (%)	Weight Loss (%)
Methods of application (MA)	191.55*	464.62*
Wood species (WS)	636.97*	0.00ns
MA*WS	73.19*	3.36ns

**-Significant (P≤0.05); ns-No significant (P>0.05)*

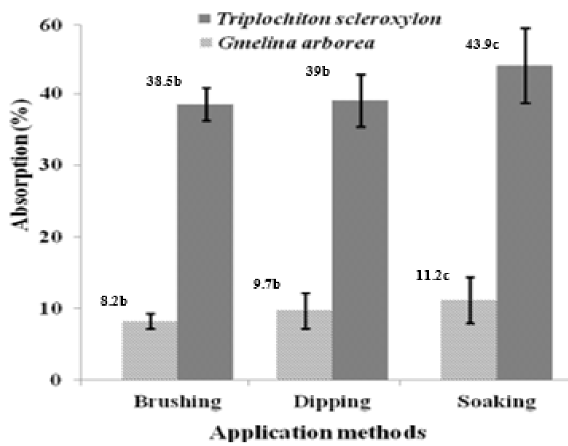

Fig 1: Effect of application methods on percentage absorption of *G. Arborea* and *T. Scleroxylon* wood. *Mean values with the same alphabet in each bar are not significantly different (p≤0.05) using duncan multiple range test:*

Percentage weight loss to termite: The percentage weight loss of *G. arborea* and *T. Scleroxylon* wood to termite explain the effect of *A. indica* seed oil. It was also noticed that untreated wood block had percentage weight loss of 56.50 and 61.58 % while lowest weight loss were recorded for soaking method at 3.89 and 4.66 % for *G. arborea* and *T. scleroxylon* wood respectively as revealed in Figure 2. The Table 2 shows the significant differences that exist in application methods of *A. indica* seed oil to after weight loss to termite attack (p<0.05). In respect to the wood block considered for this study, the extent of weight loss indicated the antimicrobial properties of the need seed oil may be due to the availability of phytochemicals (alkaloids, flavonoids, tannins and saponins) which promote antimicrobial activity (Akujobi *et al.,* 2004, Ogbulie *et al.,* 2007, Mohammed *et al.,* 2012). Mazhar *et al.,* (2013) also affirmed that the seed extracts of medicinal plant do offers a source of naturally occurring chemicals that could be used as anti-termite. However, number of studies also has also proved the effectiveness of seed oil originated from plant to be more effective (Osman *et al.,* 2007 Amienyo*et al.,* 2007, Tascioglu *et al.,* 2013, Adegoke *et al.,* 2015, Brocco *et al.,* 2017, Okanlawon *et al.,* 2020). Convincingly, the phytochemical constituents present in the seed oil are very toxic and active against wood termite.

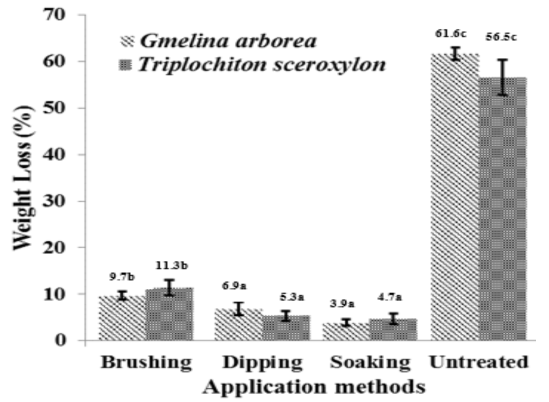

Fig 2: Effect of application methods on percentage weight loss of *G. arborea* and *T. Scleroxylon* wood. Mean values with the same alphabet in each bar are not significantly different (p≤0.05) using duncan multiple range test**.**

Conclusion: The antimicrobial properties of the crude leaf extract of *A. indica* seed oil may be due to the availability of phytochemicals which promote antimicrobial activity. Hence, these findings provided preliminary scientific information on the potential of the seed oil to control termite. However, *A. indica* seed oil is completely feasible to be use as alternative chemical based preservative. Consequently, all the methods of application proved to be effective over the untreated wood while soaking method is most preferred.

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