Original Research Article

Antifungal Effectiveness Of Pyrolytic Oil Obtained From *Triplochiton Scleroxylon* (De. Wild) Sawdust On Selected Wood Species

UNDER PEER REVIEW

Abstract

This study was carried out to investigate the effectiveness of pyrolytic oil obtained from *Triplochion scleroxylon* sawdust as a preservative against fungi attack on selected wood species. The wood samples used for the experiment were dimensioned into 20 x 20 x 60 mm and soaked for 72 h to obtain appreciable absorption. The percentage absorption after soaking and weight loss after exposure to termite were determined. Data were analyzed using simple statistics and analysis of variance at $\alpha_{0.05}$. The highest and lowest percentage absorption was recorded for *Terminalia randii* and *Alstonia bonnie with* 23.20 and 13.10 % respectively. Analysis of variance result indicates a significant difference in wood species used. The result obtained for weight loss revealed significant differences in wood species and fungi used. The result further showed that untreated samples (control) recorded the highest weight loss to white and brown rot fungi. It is evident that pyrolytic oil possesses a great potential in the prevention of fungi attack as it contained phenolic compound.

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Keywords: Pyrolysis, Pyrolytic oil, wood, biodeteriorating agent, fungi

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1. INTRODUCTION

Protection of wood products from degradations and deterioration through wood preservation is an active part of forestry, playing a very important role in forestry conservation worldwide as well as allowing great strides forward in meeting global wood demand [1]

Wood being a biological material is readily degraded by bacteria, fungi, and termites [2.3]. However, some wood species are resistant to these degrading agents while others are very susceptible to deterioration [4]. Those that are susceptible must be treated with preservative chemicals to increase their service life. Wood preservation is a process of reducing and/or preventing attack by wood deteriorating agents thereby increasing the service life of wood [5]. Using natural products to enhance the service life of wood will minimize environmental pollution and injury to the workers caused by toxic wood preservative chemicals. Besides, the use of locally produced preservatives will lead to reduced importation of costly preservatives and save on foreign exchange. The availability of cheap but effective wood preservatives is likely to increase the percentage of wood treated before use. This will lead to less frequency of replacement of timber and a reduction in the rate of deforestation.

Recently, the studies on the use of plant extracts have opened a new avenue for the control of plant diseases and pathogens [6-8]. Wood extracts are natural compounds and are rich in bioactive compounds such as tannins, polyphenols, and lignins which are toxic to wood degrading organisms.

Pyrolytic oil is dark brown, free-flowing organic liquids that are comprised of highly oxygenated compounds [9]. The synonyms for pyrolytic oil include bio-oil, pyrolysis oils, pyrolysis liquids, liquefied wood, bio-crude oil (BCO), wood liquids, wood oil, liquid smoke, wood distillates, pyroligneous acid, and liquid wood. Pyrolytic oil contains organic compounds like phenols, alcohols, ketones, esters, aldehydes, oxygenated hydrocarbons [10-12].

In recent time, pyrolytic oil obtained from many different sources of biomass are receiving intense interest as a new wood preservative against biodeteriorating agents. Furthermore, the number of studies based on this new usage is constantly increasing [13-20]. Hence this study therefore aimed at evaluating the effect of pyrolytic oil against wood-decaying fungi using selected tropical wood species to promote environmentally friendly preservatives and increase its durability while in service.

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2. MATERIALS AND METHODS

2.1 Treatment of Wood Sample

The soaking method was used for the treatment of wood with the pyrolytic oil. The wood samples were completely immersed in the pyrolytic oil for 72 h to obtain an appreciably amount of absorption.

2.1.1 Absorption Test

After the treatment, the wood was drained and reweighed to determine the percentage and this was determined thus;

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

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

2.2 Preparation of Culture Medium

The white-rot fungi (*Pleurotus ostreatus*) and Brown rot (*Sclerotium rolfsii*) were obtained from the Pathology Department, Forestry Research Institute of Nigeria. The fungi were cultured using Potato Dextrose Agar as the culturing medium. 40ml of PDA was poured into McCartney bottles and sterilized by autoclaving at 0.1 N/mm2 (120 ℃) for 20 minutes. The medium was inoculated with the test fungi within 6 days after the preparation of the bottles [21].

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2.3 Infection of Test Blocks

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Wood samples treated with the pyrolytic oil were infected by placing them in the bottles in which there were actively growing cultures of the test fungi. The blocks were placed in the bottles containing each of the two test fungi such that they came in contact with the aerial mycelium of the fungus then incubated at room temperature (27 ± 2 ℃) in the laboratory for 16 weeks. At the end of the incubation period, the blocks were removed from the culture bottles, cleaned off the adhering mycelium, and oven-dried at 103 ℃ to constant weight [21].

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2.4 Weight Loss

Percentage weight losses of each wood sample due to fungi attack was calculated using the formula below:

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

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

2.5 Data Analysis

Data obtained were analyzed statistically. Analysis of variance (ANOVA) was used for significant differences between treatments (selected wood species). When the ANOVA indicated a significant difference among selected wood species, a comparison of the means was conducted, employing the Duncan Multiple Range Test (DMRT) to identify which groups were significantly different at $\alpha_{0.05}$.

3. RESULTS AND DISCUSSION

3.1 Effect of absorption of pyrolytic oil by selected wood species

The absorption of pyrolytic oil by the selected wood species is significantly different (Table 1). The analysis of variance conducted showed that there is a significant difference (p<0.05) among selected wood species used. It could also be observed that there is variation in the rate at which each of these wood species absorbed the pyrolytic oil. Though the pyrolytic oil contains both heavy and light [20].

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Table 1. Analysis of variance for percentage absorption of selected wood species

Source of Variation	Df	Sum of Squares	Mean Square	F	Sig.
Wood Species	4	163.33	40.83	10.43	0.00*
Error	10	39.17	3.92		
Total	**14**	**202.49**			

*- significant (p<0.05)

A comparison of the means was conducted using Duncan Multiple Range Test (DMRT) to identify which wood species were significantly different (Table 2) shows that the most absorbed wood is *Terminalia randii*. The lowest and highest percentage absorption was recorded as 13.10 and 23.20 % for *Alstonia bonneii* and *Terminalia randii.* The low and high absorption of these preservatives by wood can be attributed to the vessel arrangement in the wood [21]. The vessels constitute the main channel for flowing in of preservative solution into the wood in the longitudinal direction. Also, the viscosity of the pyrolytic oil and the structure of the wood used [22, 20]. Absorptions are usually low for oil borne preservatives because of their high viscous nature.

Also, the absorption of preservatives by many wood species differs and this can be too attributed to the wood structure. Beside, penetration ability, the viscosity of the preservative and chemical composition of the preservative can also contribute to the absorption of preservative.

Table 2. Absorption of pyrolytic oil by selected wood species.

Wood species	Percentage Absorption (%)
Alstonia bonneii	13.10(0.15)a

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Ceiba pentandra	16.00(0.59)ab
Pterocarpus osun	18.10(0.17)b
Terminalia randii	23.20(0.85)c
Triplochiton scleroxylon	17.77(2.32)b

Mean; Standard error in parenthesis. Values with the same alphabet in the column are not significantly different (p≤0.05) using Duncan Multiple Range Test.

3.2 Effect of fungi attack on preserved wood with pyrolytic oil

Table 3 showed the percentage weight loss of wood samples as a result of fungi attack on two wood species *Alstonia bonnei, Ceiba pentandra, Pterocarpus osun, Terminalia randii, Triplochiton scleroxylon*. Table 4 revealed that there is a significant difference in the wood species as attacked by fungi regarding treated and untreated while no significant exist in the fungi used for this study. It can be shown that the untreated samples (control) recorded the highest weight loss to white and brown rot fungi with the mean value of 39.35 and 35.21; 42.82 and 45.47; 37.92 and 39.15; 35.78 and 33.55; 36.84 and 37.52 % for *Triplochiton scleroxylon*, *Pterocarpus osun, Alstonia bonnei, Ceiba pentandra and Terminalia randii* respectively. Moreover, *Triplochiton scleroxylon* shows the least weight loss to white and brown rot fungi with a mean value of 4.46 and 5.90 % respectively.

The result of the weight loss obtained can be attracted to the effectiveness of the pyrolytic oil [20] thus pyrolytic oil contained organic compounds like phenols, alcohols, ketones, esters, aldehydes, oxygenated hydrocarbons [12]. This gives it the quality for preserving wood against the fungi as corroborated by [20] who preserved wood against termite attack using pyrolytic oil.

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Table 3. Influence of period of soaking on percentage weight loss of selected wood species.

Wood Species	Conditions	Fungi	
		Pleurotus ostreatus	*Sclerotium rolfsil*)

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Triplochiton scleroxylon	Treated	11.22(1.10)	11.15(3.97)
	Not Treated	39.35(4.27)	35.21(2.24)
Pterocarpus osun	Treated	4.46(1.03)	5.90(0.49)
	Not Treated	42.82(3.39)	45.47(4.46)
Alstonia bonneii	Treated	10.43(5.19)	10.61(1.92)
	Not Treated	37.92(4.72)	39.15(4.61)
Ceiba pentandra	Treated	13.72(5.50)	13.01(8.62)
	Not Treated	35.70(9.81)	33.55(13.02)
Terminalia randii	Treated	10.07(3.28)	7.47(5.22)
	Not Treated	36.84(1.00)	37.52(3.86)

Mean; standard error in parenthesis. Values with the same alphabet in the rows are not significantly different ($p \le 0.05$) using Duncan Multiple Range Test.

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Table 4. Analysis of variance (ANOVA) for percentage weight loss

Source of variation	Df	Sum of Squares	Mean Square	F	Sig.
Wood species (WS)	4	21.48	5.37	0.19	0.94ns
Condition (CO)	1	12224.25	12224.25	428.09	0.00*
Fungi (FUG)	1	1.82	1.82	0.06	0.80ns
WS * APA	4	503.55	125.89	4.41	0.01*
WS * FUG	4	34.52	8.63	0.30	0.88ns
APA * FUG	1	0.00	0.00	0.00	1.00ns
WS * APA * FUG	4	24.00	6.00	0.21	0.93ns
Error	40	1142.21	28.56		

Total	**59**	**13951.84**

***-significant (p≤0.05), ns-not significant (p>0.05)**

Conclusion

This research concluded that pyrolytic oil obtained from wood sawdust possesses great potential as it contained phenolic compounds in the prevention against fungi attack.

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