POTENTIALS OF *Cola nitida* AND *Musanga cecropiodes* EXTRACT AS PRESERVATIVES AGAINST BROWN ROT FUNGUS ON *Gmelina arborea* AND *Pinus carribaae*

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Abstract: Preservative potential of *Cola nitida* and *Musanga cecropioides* extracts as an effective preservative against brown rot fungus (*Sclerotiumrolfsil*) on *Gmelina arborea* and *Pinus carribeae* wood samples was studied. Samples were dimensioned 20 x 20 x 60 mm and analysis of variance α = 0.05 was used to analyse the data obtained. Results however revealed that *Pinus carribeae* had the highest moisture content compared to *Gmelina arborea* with the mean values of 29.53 ± 0.82 and 18.58 ± 0.65, respectively. Also it was established that *Gmelina arborea* in *Cola nitida* hot water extract had the highest absorption rate than ethanol extract with mean values of 17.52 ± 2.43 and 13.65 ± 1.92, 17.63 ± 2.71 and 12.02 ± 1.45, respectively. Also, *Pinus carribeae* hot water extraction had the highest absorption rate with mean values 37.32 ± 3.65 and 32.26 ± 2.56, 37.65±3.65 and 32.26 ± 2.56, respectively. This indicated the weight loss (kg/m^3) of *Gmelina arborea* range from 11.41 ± 1.78 to 17.09 ± 3.83 for hot water extraction across the extracts. While it ranged from 12.04 ± 1.99 to 17.45 ± 5.64 for ethanol extraction method. *Pinus carribeae* exhibited weight loss ranges between 6.21 ± 3.90 to 17.03 ± 4.68, respectively for hot water extraction method and 0.51±0.22 to 20.05±0.67, respectively for ethanol extraction method. These results established that the two plants extract as an effective bio preservative on wood.

Keywords: Absorption, *Cola nitida*, extracts, hot water, *Musanga cecropioides*

Introduction

Preservation of wood to prolong its service life has been studied over the years to eradicate chemical preservation that is harmful to man and the environment. Over the years, researchers have focused on a natural preservatives that can be used to replace the conventional chemicals to extend wood shelf life since it is a porous material and vulnerable to bio degradable attacks from fungi, bacteria and insects.

Chemical preservation is very effective and active against wood degrading agents but toxic and cause environmental pollution harmful to plants, animals and humans. Chromate copper arsenate (CCA) has been banned in many countries including the US and Japan due to their detrimental effect on the natural balance and human health (Gottas *et al*., 2007). Large quantities of these chemicals may result in serious environmental hazard like depletion of soil layer leading to erosion, poor plant growth. Also direct contact with the body through improper handling or application may cause skin irritation and in the extreme, it may affect respiratory tracts when inhaled.

Therefore it is imperative to focus on environment friendly preservatives. With the current problem of global warming and environmental degradation, there is an urgent need to 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 (Arldo *et al.*, 2009). This necessitated the use of natural plant extract (Bio-preservatives) which are less harmful to the environment and more economical to protect wood against degrading agents such as fungi and insect (Faruwa *et al.*, 2015). Biopreservatives constitute a wide range of natural products from both plants and animals which can be useful in the extending shelf life of wood reducing or eliminating survival of pathogenic bacteria and increasing overall quality of the wood products. The objective of this study is therefore, to evaluate the effects of plant extracts as preservative on wood and to evaluate their anti-fungal efficacy.

Materials and Methods

Methods

Pinus carribeae and *Gmelina arborea* were bought from Odeyele plank market at Oluyole, Ibadan in Oyo state, Nigeria, labelled and cut into dimension 20 x 20 x 60 mm. *Cola nitida* was collected at the Horticulture and landscape garden of the Federal College of Forestry, Ibadan while *Musanga cecropioides* was collected at National Horticulture Research, Jericho, Idi-ishin, Ibadan. Collected plant extracts were air-dried for two weeks after which it was grounded (Usman *et al*., 2007). Particles were sieved with 1 - 2 mm mesh size. 100 g of equal weight of each extracts were dissolved in 200 ml ethanol and 200 ml of hot water respectively. After being allowed to soak for 5 h, resultant extract solution was filtered through a sieve (1 mm) and thoroughly washed extracts are diluted with distilled water.

Determination of moisture content

Moisture content was determined by weighing the wood sample before oven dried at ±103ºC for 40 h and the weight constantly measured after 2 h of oven drying. Moisture content was calculated using this formula:

$$\text{Moisture Content} = \frac{\text{Initial weight} - \text{Oven dry weight}}{\text{Oven dey weight}} \times 100$$

Treatment method

Oven dried wood species were impregnated in a transparent cover bowl by soaking with the extracts for 72 h (Nurudeen *et al*., 2012). Total number of wood species used was seventy eight at different concentration level (30, 60, 90% and control) of plant extracts. Two methods of extraction namely hot and ethanol was adopted; two different wood species and one fungus.

30%:30 ml of each extract diluted with 70 ml of distilled water.

60%:60 ml of each extract diluted with 40 ml of distilled water.

90%:90 ml of each extract diluted with 10 ml of distilled water.

Impregnated and conditioning wood species were weighed (T_3) and was air dried for one week.

Determination of percentage absorption

Air dried wood species were spread on the tray for a week and weights after impregnation was recorded to determine the level of absorption rate which was calculated using the formula below:

$$\text{Asborption Rate} = \frac{\text{Conditioning weight} - \text{oven dry weight}}{\text{Oven dey weight}} \times 100$$

Decay test

Treated and untreated wood species were inoculated with a decay fungus (*Sclerotium rolfsii*) in a transparent bowl with cover at room temperature (28±2°C). Weight loss was observed within three months according to ASTMD1413-76 test for solid wood. Percentage weight loss was calculated using;

$$\text{Weight Loss} = \frac{T_3 - T_4}{T_3} \times 100$$

This experiment was laid in completely randomized design (CRD). Data obtained was analysed using ANOVA.

Results and Discussion

The highest moisture content was observed in *Pinus carribeae* at 30% while *Gmelina arborea* had 19% (Fig. 1). As shown in Table 1, the absorption rate of *Gmelina arborea* in *Cola nitida leaf* ethanol extract recorded at 90% concentration was highest, followed by 30 and 60%, with mean values of 13.65±1.92, 13.52±1.62 and 12.34±1.62, respectively. For hot water extract, highest mean absorption rate was observed in 90% concentration followed by 60 and 30% with mean values of 17.52±2.43, 15.06±2.01 and 14.65±1.18, respectively. *Gmelina arborea* in *Musanga cecropioides* ethanol extracts indicated reasonable absorption rate at 90% with mean values ranging from 12.02±1.45 to 12.91±1.66, thus showing the highest absorption rate, followed by 60 and 30% with mean values of 12.91±1.66, 12.85±1.65 and 12.02±1.45 while in hot water extract, the mean values ranges from 14.54±1.98 to 17.63±2.71. It was observed that 90% concentration also had the highest absorption rate followed by 60 and 30% with mean values of 17.63± 2.71, 15.17±2.55 and 14.54±1.98, respectively.

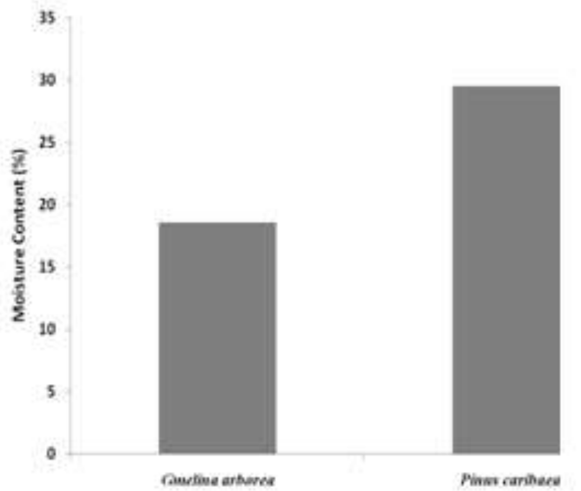

Fig. 1: Mean moisture content (%) exhibited by wood species

Table 1: absorption rate (%) exhibited by wood species in different plant extracts

Wood species	Plant extracts	Conc. (%)	Ethanol	Hot Water
Gmelina arborea	*Cola nitida*	30	13.52±1.62a	14.65±1.18a
		60	12.34±1.64a	15.06±2.01b
		90	13.68±1.92a	17.52±2.43a
	Musanga cecropioides	30	12.02±1.45a	14.54±1.98a
		60	12.85±1.65b	15.17±2.55a
		90	12.91±1.66b	17.63±2.71a
Pinus caribaea	*Cola nitida*	30	30.04 ±2.66a	31.65±2.72a
		60	31.63±2.56a	32.97±2.98b
		90	28.43±1.99a	35.47±3.04a
	Musanga cecropioides	30	12.02±1.45a	14.54±1.98a
		60	12.85±1.65b	15.17±2.55a
		90	12.91±1.66b	17.63±2.71a

Mean±SE with different alphabet in columns are significantly difference (P≤0.05)

However, *Pinus carribeae* wood samples in *cola nitida* leaf ethanol extract indicated the mean absorption rate of 28.48±2.16, 30.04±2.04 and 31.63±2.56 with least in 90% concentration followed by 30% and highest is 60% concentration respectively. Hot water extraction for *cola nitida* also indicated significant mean absorption rate that is equally noteworthy. The absorption rate changes from 31.56±2.72, 32.97±2.98 and 35.47±3.04 with least in 30% concentration followed by 60% and highest in 90% concentration. Considering *Pinus carribeae* in *Musanga cecropioides* ethanol extract method, the absorption ranges from 29.86±2.45 to 32.26±2.56 where 60% had the highest mean value, followed by 90 and 30% with mean values of 32.26±2.56, 30.90±2.16 and 29.86±2.45, while for hot water extract absorption ranges from 28.54±2.11 to 37.32±3.65 whereby 90% had the highest absorption rate of 37.32±3.65, followed by 30% value of 29.08±2.09 and 60% with value of 28.54±2.11.

Cola nitida ethanol extracts at 30% in *Gmelina arborea*, had the least mean weight loss followed by 90 and 60% being the highest mean weight loss with the mean values of 12.09±1.99 followed by 13.06±1.26 and 17.21±5.95, respectively. While for hot water extract, 30% had the least weight loss values followed by 60 and 90% with mean values of 11.41±1.78, 16.85±3.57 and 17.09±3.83, respectively.

Cola nitida ethanol extracts at 90% in *Pinus carribeae*, had the least followed by 60 and 30% with the weight loss mean values of 0.51±0.22, 7.01±0.97 and 7.34±4.19, respectively. For hot water extracts, the least value was found in 90% followed by 60% and 30% with weight loss mean values of 7.44±2.77, 11.20±1.96 and 12.64±2.17, respectively.

Musanga cecropioides ethanol extract at 30% in *Gmelina arborea*, had the least weight loss followed by 60 and 90% with mean weight loss values of 12.03±1.75, 12.83±1.88 and 17.45±5.64, respectively (Table 2). On the other hand, hot water extract at 60% had the least weight loss followed by 30% and 90% with the mean weight loss values of 15.18±5.08, 16.05±4.41 and 17.09±3.38, respectively (Table 2). *Musanga cecropioides* ethanol extracts at 30% in *Pinus carribeae* also had the least in the weight loss followed by 60% and 90% with mean weight loss values of 6.88±1.59, 16.85±3.57 and 20.05±0.67 while for hot water extract, 90% had the least weight loss followed by 60 and 30% with mean weight loss values of 6.21±3.90, 11.91±0.65 and 17.03±4.68.

Musanga cecropioides in *Pinus carribeae* for ethanol extract, 30% had the least in the weight loss follows by 60 and 90% with mean weight loss values of 6.88±1.59, 16.85±3.57 and 20.05±0.67 while for hot water extract, 90% had the least weight loss followed by 60 and 30% with mean weight loss values of 6.21±3.90, 11.91±0.65 and 17.03±4.68, respectively.

Table 2: Effect of *Cola nitida* and *Musanga cecropioides*

Plant extracts	Conc. (%)	*Gmelina arborea*		*Pinus caribaea*	
		Ethanol	**Hot Water**	**Ethanol**	**Hot Water**
Cola nitida	30	12.04±1.99	11.41±1.78	7.34±1.99	12.64±2.17
	60	17.21±0.95	16.85 ±3.57	7.01±0.97	11.26±1.92
	90	13.06±1.26	17.09± 3.83	0.51±0.22	7.44±2.77
Musanga cecropioides	30	12.03 ±1.75	16.05±4.41	6.88±1.59	11.99±4.68
	60	12.83±1.88	15.18±5.08	16.85±3.57	17.03±0.65
	90	17.45±5.64	17.09±3.83	20.05±0,67	6.21±3.90
	Control	30.05±3.38	30.05±3.38	34.87±5.63	34.87±5.63

Extracts at different levels of concentration after 12 weeks of exposure to brown rot fungi on weight loss

Highest moisture content exhibited by *Pinus carribeae* may have been attributed to availability of excess bond water present. The result is in accordance with (Nurudeen *et al.,* 2011) findings who reported that the high moisture content aids microbial activity of the wood.

The result shows that *Gmelina arborea* had low absorption rate compared to *Pinus carribeae*. High absorption rate exhibited by *Pinus carribeae* in both ethanol and hot water extract could be attributed to its physiological content as well as the effect of temperature on the hot water method which was corroborated by Nurudeen *et al.* (2012) who reported temperature as aiding factor that induced absorption rate on wood species. Ability of natural plant extracts to protect wood against degrading fungi and insects have one possible approach for developing new wood preservatives (Kartal *et al.,* 2004). Similar findings observed by Chang *et al.* (1998) reported that α-cardinal obtained from Taiwanian heartwood possess high antifungal effectiveness. Digrak *et al.* (1999) investigated the antimicrobial activities of extracts of Mimosa bark; they reported that extracts has antimicrobial activities. Consequently, *Pinus carribeae* exhibited high absorption rate compared to *Gmelina arborea* in *Cola nitida* and *Musanga cecropioides*.

Analysis of variance conducted establish the significance difference in the absorption rate exhibited by wood species as a result of type of extract used, level of concentration of extracts and the wood species type. Hence, the results indicated that there is significant difference in the method of extractions and level of concentration of the extract, there is no significant difference in the types of extract used.

Control samples mean weight loss was found to be significantly higher than treated wood which established the fact that the control wood sample had little or no resistance to fungi. Hence, this resulted into high weight loss, therefore, the bio preservative used have impact on the weight loss of the wood species used. This is an indication that the extracts used are potential bio-agent against fungi attack. Similar results were reported by Nurudeen *et al.* (2011) that *Pinus carribeae* ranges from 5.26±1.75 to 11.05±2.70. The level of fungi attack depends on the durability of the wood species and their density (Schuttz and Nicholas, 2002). The result of Analysis of variances conducted on weight loss exhibited by wood species on exposure to fungi indicated significant difference for the wood species and plant extracts on the concentration level. This result further proved that both ethanol and hot water extraction method were appropriate for extracting the active ingredient of plants since there was no significantly difference in weight loss due to mode of extraction. This result is in accordance with Nurudeen *et al.* (2012) who discovered that hot water and ethanol extraction method are not significantly different in their effect of wood weight loss. In their studying, they examine *Ceiba petandra* and *Triplochiton scleroxylon* wood species and obtain no significant difference in their weight loss due to the fungi.

Conclusion

Cola nitida and *Musanga cecropioides* extracts can be used to suppress fungal attacks since all the plants responded to the fungal decay thus, reducing environmental pollution in the society. Plant extract could serve as alternative to conventional chemical preservatives which poses threat to the environment.

Conflict of Interest

Authors declare that there is no conflict of interest reported in this work.

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