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Appraisal of Natural Durability of a Lesser – Known *Boscia anguistifolia* (A. Rich) Wood Using Ground Contact Test

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Abstract

The optimal utilization of lesser-known wood species is dependent on their natural durability. In this study, the natural durability of a lesser-known wood species *(Boscia anguistifolia*) using ground contact test was carried out. Wood blocks of *Boscia anguistifolia* and *Ceiba petandra* (reference species) with dimensions of 20 x 20 x 300 mm were obtained from the axial and radial direction of the trees. The wood blocks were conditioned and their moisture content determined before exposure to ground contact for 12 weeks after which their weight loss was determined. Data obtained were analysed using analysis of variance (ANOVA) at 0.05 probability level. The moisture content of *B. anguistifolia* and *C. petandra* ranged from 12.80 – 18.02 % and 12.73- 16.63%, respectively while the weight loss of *B. anguistifolia* and *C. petandra* ranged from 5.10 – 69.11% and 37 – 50 % respectively along the axial position. It was observed that the core wood in the base portion of *B. anguistifolia* has the lowest weight loss value of 5.10% while the reference species has a value of 39.73%. Conclusively, *B. anguistifolia* is moderately durable at the base part of the species when compared with the reference non-durable species used in this study.

Key words: *Boscia augustifolia*, *Ceiba pentadra*, *Ground contact* test, Moisture content, Weight loss

1. Introduction

Tropical forests are endowed with a high diversity of species within which only selected species are extracted for purposes like plywood, railway sleepers, construction, etc. Due to increasing population, conversion of more lands for agricultural purposes and rapid industrial development, forest resources are fast diminishing, and it has become a necessity to make use of the less-known species [1]. There are approximately 200,000 hardwood species and 1000 softwood species in Nigeria. Out of this total number, only 2,300 hardwood tree species are commercially important such as Ayous (*Triplochiton scleroxylon*), Sapele (*Entandrophragmma cylindricum*), African mahogany (*Khaya ivorensis*), Iroko (*Chlorophma excelsa*) and Afara (*Terminalia superba*) [2]. Other species are considered secondary species and are, therefore, mostly used locally for firewood and other low value construction applications [3]. In order to appraise the utilization potentials of any wood, in addition to the knowledge about the anatomical, physical and mechanical properties, information on the ability of wood species against insect and fungi decay is vital [1].

According to European standard CEN (1994) EN 350-1 [4], natural durability is "the inherent resistance of wood to attack by wood-destroying organisms". Eaton and Hale, [2] defined natural durability or decay resistance "as the capability of the heartwood of any wood species to withstand decay". In most cases, sapwood is regarded as the part that is susceptible to bio-deteriorating agents. The durability of timber structures is subject to the natural durability of wood in addition to other chemical treatments that can extend its service life. However, the natural durability of wood species may be compromised if the moisture content of timber structures is above the fibre saturation point or the moisture content required in the service environment where the wood structure is expected to function [5]. Several reports described the durability of tropical woods in terms of durable and not durable [4, 6-9].

The major problem facing lesser known wood species is inadequate technical information about the wood species, thereby leading to the rejection of the species for other well-known species. To tackle this problem, research on lesser-wood species is important to determine their natural durability and make the information available to the end users [10]. The increase need of wood for structural purposes has led to the use of wood indiscriminately without putting the properties relating to end-use into consideration [11]. Due to increase demand of the durable and popular species such as Iroko, Mahogany, Ekki, Teak and many more has led to a decrease in the availability of these species due to over exploitation in most tropical countries including Nigeria. It is therefore imperative to investigate the lesser known species in the forest.

Boscia angustifolia is a shrub with a height of between 10 –14 m. It is mostly found in the savanna areas and in deciduous wood bush land in West Africa. It usually grows in locations such as mountains, laterite soils and occasionally dry riverbeds. The *B. angustifolia* wood is a hardwood used for various purposes such as in production of charcoal, carpentry and water storage containers [12-13]. Recent research on the wood species revealed high-quality physical and mechanical properties of the wood which also varies along the bole, thereby making it a useful species [12]. However, there is no documented reports on the natural durability of *B. angustifolia*. It will be beneficial to wood users if there is ample information on its natural durability. The usefulness *of B. angustifolia* therefore requires comprehensive understanding of its natural durability which can only be obtained through scientific research.

2. Materials and Method

2.1 Procurement and Preparation of Wood Samples
The study was carried out at Department of Wood and Paper Technology, Federal College of Forestry, Ibadan, Nigeria. The trees were extent between latitudes 7°23'42.53" - 7°23'48.14"N, and longitudes 3°51'20.67" - 3°51'49.52"E. Two trees of *B. augustifolia* were felled, delimbed, bucked and cut into bolts length and one disc each was taken from the base, one from middle and one from the top of the felled log. Each of the discs was cut and arranged according to their categories, labelled and cut into dimensions of 20 x 20 x 300 mm while *C. pentadra* wood were gotten used as reference. The initial weight of the wood samples was taken and oven dried at temperature of 103 ± 2 ºC to a constant weight. The moisture content of the wood blocks was determined according to Equation 1.

$$\% \text{ M.C} = \frac{W_1 - W_2}{W_2} \times 100 \qquad (1)$$

Where W_1 and W_2 are the weight of wet and oven dry woods, respectively.

2.2 Graveyard Test
The durability of test specimen was assessed by partially burying in outdoor ground contact. A total of 45 wood specimens of *B. augustifolia* and *C. pentadra* (a reference species which also serves as the control) with dimensions 20 x 20 x 300mm comprising of four replicates along the radial and axial section of the wood were obtained. The wood specimens were inserted in the soil up to 2/3 of their lengths for 12 weeks and were placed 2 feet apart [14-15]. After 12 weeks, the test specimens were removed, conditioned and their weight losses were determined using equation 2.

$$\text{Weight loss } (\%) = \frac{W_1 - W_2}{W_2} \times 100 \qquad (2)$$

Where W_2 and W_3 are weight of specimen before and after graveyard test, respectively [9].

2.3 Statistical Analysis
Analysis of variance (ANOVA) and mean separation using Duncan Multiple Range Test (DMRT) was used to evaluate the variation along and across different directions of the woods.

3. Results and Discussion

3.1 Moisture Content

The result of the moisture content of *B. anguistifolia* and *C. petandra* (a reference species which also serves as the control) is presented in Table 3.1. The moisture content range from 12.80 – 18.02 % for *B. anguistifolia* while *C. petandra* range from 2.73 – 16.63 %. The moisture content decreases from base to top along the axial position of the tree while there was no significant difference in the moisture content of the wood along the radial position of the top layer. In the middle of the wood there was also no significant difference in the moisture content of the wood. In the base of the wood in the axial direction, the moisture content of the *B. anguistifolia* decreases from core to the outer position (14.95 - 18.02 %). The base part has the highest moisture content which decreases significantly to the top in the axial direction. However, there are significant differences in the moisture content of the wood species along the sampling height and radial position. This result indicates that there is no significant difference in the moisture content of both the sapwood and the hardwood of these species. This result is in line with the findings of Adebawo *et al.* [12] who also reported same trend for the moisture content of this particular specie. Consequently, *Ceiba pentandra*, a reference species also has moisture content which ranged from 12.73-16.63% along the axial direction. There is no significant difference in the moisture content of *C. pentandra* in all the three parts of the tree in the radial direction, moving from outer to the core of the wood. However, in the axial direction, there is a higher moisture content in the middle and base portion of the wood compared to the top. This result is similar to the findings of Yamamoto *et al.* [16], who observed a decrease in the moisture content from the bottom to the upper part of the stem of the three wood species, *Acacia mangium*, *A. auriculiformis* and *Hybrid acacia*. The higher moisture content observed in the base portion of *B. anguistifolia* and *C. pentandra* could be attributed to the sampling position that is breast height [16].

Table 3.1: Mean values of moisture content of *Boscia angustifolia and Celba petandra*

Wood species	Sampling Height	Radial Position	Moisture Content (%)	Specific Gravity
		Outer	12.80±0.69a	0.52±0.00b
	Top	Middle	14.54±0.45ab	0.44±0.02e
		Core	14.16±0.16ab	0.47±0.07d
		Outer	14.71±3.98ab	0.49±0.01c
B. anguistifolia	Middle	Middle	13.15±1.42a	0.52±0.07b
		Core	15.96±2.16b	0.44±0.02e
		Outer	14.95±3.11ab	0.54±0.01a
	Base	Middle	16.40±0.12b	0.51±0.05b
		Core	18.02±4.94c	0.51±0.02b
		Outer	14.11±1.40ab	0.55±0.00b
	Top	Middle	12.73±0.65a	0.54±0.01c
		Core	13.23±1.73a	0.51±0.03
		Outer	16.63±1.23b	0.56±0.06b
C. pentandra	Middle	Middle	15.26±0.24ab	0.54±0.00c
		Core	15.73±0.23b	0.55±0.04c
		Outer	16.23±0.23b	0.57±0.05b
	Base	Middle	15.33±0.3b	0.59±0.05b
		Core	16.33±1.3b	0.66±0.07a

Mean Value± SD, number with the different alphabet are significant different ($p \leq 0.05$)

Plate 3.1: Wood samples of *Boscia anguistifolia* and *Ceiba petandra* (reference species) at Graveyard.

3.2 Weight Loss

The mean percentage weight loss of *B. anguistifolia* and *Ceiba pentadra* wood species after exposure to 12 weeks ground contact test is presented in Table 3.2. The plate showing the experiment at graveyard is presented in Plate 3.1. The mean percentage weight loss of *B. anguistifolia* ranged from 5.10 % - 69.11% along the axial position with a decreasing pattern observed from top to base along the bole of the tree. The top of the *B. anguistifolia* wood species has the highest weight loss (61.57 - 69.11 %) that increases from middle to the outer and middle to the core of the species. The middle portion of the wood also experienced a weight loss that decreases from the middle to the outer part of the wood. However, the base portion of the wood has the lowest weight loss values ranging from 5.10 – 28.5 % decreasing from outer to the core of the wood. On the other hand, the mean percentage weight loss of *C. petandra* wood species ranged from 37– 50% with a decreasing trend observed from the top to the base. From this result, it is observed that the reference species (*C. petandra*) has a higher weight loss than *B. anguistifolia* in the middle and base portions along the axial direction while highest weight loss was observed in *B. angusitifolia* species at the top position when compared to *C. petandra* at the same position.

The observed decrease in weight loss at the base and the middle portions of *B. anguistifolia* showed an increase in wood specific gravity. According to a previous work [12], specific gravity of *B. anguitifolia* increased from top to the base (0.44-0.54) in the axial direction of the wood. The higher weight loss observed in the outer wood could be due to the presence of sapwood, which was rapidly degraded during the first few weeks leaving the heartwood with final mean weight loss of 5.10%.

Table 3.2: Mean percentage values of weight loss of *B. anguistifolia* and *Ceiba pentandra* along axial and radial position after 3 months of ground contact.

Sampling Height	Radial Position	Weight loss (%)	
		Boscia angustifolia	*Ceiba pentandra*
Top	Outer	63.39±19.07e	47.22±4.87a
	Middle	61.57±4.02e	47.26±3.82b
	Core	69.11±5.07e	50.29±2.55b
	Mean	64.69±11.04	48.25±4.38
Middle	Outer	25.11±5.93c	39.01±3.98a
	Middle	40.04±4.92d	38.2±3.23a
	Core	19.48±5.19b	37.01±2.74a
	Mean	28.21±10.28	38.071±5.70
Base	Outer	28.53±7.55c	38.33±2.56a
	Middle	11.68±5.49ab	37.83±2.44a
	Core	5.10±1.11a	39.723±5.66a
	Mean	15.11±11.41	38.63±6.15

Mean value± SD, number with the different alphabet are significant different ($p \leq 0.05$)

There are significant differences in the weight loss of the wood along the axial and across the radial position of the wood. This result corroborates the findings of Owoyemi and Olaniran [17] who observed higher weight loss in the outer part (sap wood) of medium density wood of Mahogany and Osan Igbo with weight loss of 18.60% and 30.34% respectively. It could also be noted that the resistance of the wood species to termites vary with the axial position which is also related to the density of the wood species [12]. This appears to have greater influence on the natural resistance.

The weight loss of some common hard wood species after exposure to ground contact for 6 months is presented in Table 3.3. The result of the present study showed that the top position is not durable when compared with the weight loss of other hardwood species such as *Lophira alata* with a weight loss of 1.39 % even after 6 months exposure [17]. However, the weight loss reported for the basal portion of the tree compares favorably with other reported wood species as presented in Table 3.2. Comparing the result of the reference species (*C. petandra*), it could be observed that up to 50% of the wood species is lost even after 3 months of exposure. This indicates that approximately 100% weight could be lost after 6 months exposure as observed in some other non-durable wood species such as *Astonia congensis* and *Terminalia ivorensis* [17].

Table 3.3: Weight Loss of some common tropical hardwood after 6 months of ground contact

Scientific names	Trade names	Weight loss (%) after 6 months
Diospyros spp	Ebony	18.03±0.97b
Lophiraalata	Ekki/Iron wood	1.39±0.12a
Celtis zenkeri	Ita	5.09±0.21a
Khaya grandifoliola	Mahogany	18.60±0.80b
Terminalia superb	Afara	48.76±0.82c
Alstonia congensis	Ahun	100.00±0.00d
Terminalia ivorensis	Idigbo	100.00±0.00d

Source: Owoyemi and Olaniran [17]

From the results, *B. anguistifolia* can be rated as moderately durable compared to *Ceiba pentandra*. Hence, it falls within the stipulated value required for natural durability. In addition, while comparing with the *C. petandra* from the top to the base in the axial direction of the tree, it could be said that *B. angustifoila* wood is moderately durable because the level of attack by deteriorating agent is more prevalent on *C. petandra*.

4. Conclusion

This research work has presented the natural durability of lesser – known wood species, *B. angustifoila* using C. *pentandra* as reference wood species. The weight loss of *B. anguistifolia* decreased from top to base along the axial position and the least mean weight loss is 5.11% in the core wood in the base portion of the wood. However, the reference species, *C. petandra* has a higher mean weight loss (39.73%) at this portion of the wood. The results of this study have shown that *B. angusitifolia* is moderately durable when compared to the non-durable reference species used.

Reference

[1] Balasundara MN, Gnamaharan R. Natural durability of commercial timbers of Kerala with reference to decay KFRI (Kerala Forest Research Institute, Peech, Thrissur) Research paper Report 35. 1985, 15 p.

[2] Eaton RA, Hale MDC. Wood, decay, pest and protection. Chapman and Hall, London. 1993, 546 p.

[3] Nzokou P, Wehner KE, Kardem DP. Natural durability of eight tropical Hardwood from Cameroon. *Journal of Tropical forest science*, 2015;**17**(3): 4-6.

[4] CEN (1994) EN 350-1: Durability of wood and wood-based products. Natural durability of solid wood. Part 1. Guide to the principles of testing and classification of the natural durability of wood. European Committee for Standardization, Brussels, Belgium.

[5] Cruz I, Munoz AS, Ercoland B, Lemaire CR, Pretto A, Nauto G, Moreno YC. Apostaderos de pinnipedosen Punta Entrada (Santa Cruz, Patagonia Argentina). Explotacionhumana e historical natural. Magallania. 2015;43(1): 291 – 308.

[6] Sallenave P. Prosperities physiques et mecaniques des tropicaux. Centre Techniques forestier. Tropical Publ. 2015;8(23):33

[7] Fonrin Y, Pougunr J. 1976: Natural Durability and hesnaation of One Hundred Tropical African Woods. Ottawa International Development Centre, Ottawa.

[8] Desch HE, Dinwoodie JM. Timber, Its Structure, Properties and Utilization. The Macmillan press Ltd., London. 1981: 410 p.

[9] Petternson ND. Commercial Timbers of the World" Fifth edition. Gower Technical Press, Hants, 1988:1-339

[10] Morris PI. Understanding Biodeterioration of wood instructions fornix Canada cooperation British Columbia council. 1998:30 p.

[11] Dinwoodie M. Timber, its nature and behaviours. *Van Nostroy and Reynolds C.* Ltd. 2000: 56-59.

[12] Adebawo FG, Ajala OO, Aderemi T. Variation of physical and mechanical properties of *Boscia angustifolia* (A. RICH.) wood along radial and axial stem portion. *PROLIGNO*, 2019:9(1):32-42.

[13] Orwa C. Mutua A, Kindt R, Jamnadass R, Simons A. Agroforest tree Database: a tree reference and selection guide version 4.0. 2009. Available at http://www.worldagroforestry.org/af/treedb/

[14] Emerhi EA, Adedeji GA, Ogunsanwo OY. Termites' resistance of wood treated with *Lagenaria breviflora*B. Robert fruit pulp extract. *Nature and Science*, 2015;13(5):105

[15] Noor Azried AR, Salmah U, Rahims. Comparison of accelerated decay and grave yard test on selected Malaysian timber species. *Journal of Tropical Resources and Sustainable Science,* 2015;3:38-241.

[16] Yamamoto K, Sulaiman O, Kitingan C, Choon LW, Nhan N T. Moisture Distribution in Stems of *Acacia mangium*, A. *auriculiformis* and *Hybrid Acacia* Trees. JARQ 2003;37(3): 207 – 212.

[17] Owoyemi JM, Olaniran OS, Natural resistance of ten selected Nigerian wood species to subterianean termite's attack. International journal of Biological Science and Application. 2014;1(2):35-39.