Mechanical Properties of *Ficus vallis-choudae* (Delile), A Lesser Utilized Species in Nigeria

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Declining availability of the prime economic species in the Nigerian timber market has led to the introduction of Lesser-Used Species (LUS) as alternatives. Their acceptability demands information on the technical properties of their wood. The aim of this study was to investigate the mechanical properties of *Ficus vallis-choudae* to determine its potential for timber. Three mature *Ficus vallis-choudae* trees were selected and harvested from a free forest area in Ibadan, Oyo State, Nigeria. Samples were collected from the base (10%), middle (50%), and top (90%) along the sampling heights of each tree, which was further partitioned into innerwood, centrewood, and outerwood across the sampling radial position. Investigations were carried out to determine the age, density, moisture content, impact strength, modulus of elasticity, modulus of rupture, compressive strength parallel-to-grain, and shear strength parallel-to-grain. The mean impact bending strength, modulus of rupture, modulus of elasticity, maximum shear strength parallel-to-grain, and maximum compression strength parallel-to-grain for *Ficus vallis-choudae* at 12% moisture content were 20.4 N/mm^2, 85.8 N/mm^2, 709 N/mm^2, 10.7 N/mm^2, and 33.6 N/mm^2, respectively. The study found the species to be dense with high strength properties in comparison with well-known timbers used for constructional purposes.

Keywords: Deforestation; Lesser used species; Mechanical properties; Ficus vallis-choudae; Well-known timbers

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INTRODUCTION

The Nigerian forest contains a vast stock of tree species, of which hundreds are suitable for sawing and therefore have the potential for commercial utilization (Ogunsanwo *et al*. 2000). Unfortunately, few of the species, such as *Milicia excelsa*, *Triplochiton scleroxylon*, *Nauclea diderrichii*, *Afzelia africana*, *Entandrophragma cylindricum*, *Afzelia pachyloba*, *Albizia zygia*, *Celtis zenkeri*, *Daniellia ogea*, *Daniellia oliveri*, *Diospyros mespiliformis*, *Distemonanthus benthamianus*, and *Entandrophragma candollei*, among others, are still sought after (Adedeji 2016).

Increase in Nigeria's population has brought pressure on the timber species listed above, resulting from high demand for furniture, construction purposes, and fuel wood. This situation has led to the rapid shrinking of natural forests (Sadiku 2016). The demand for good quality timber has been increasing, and government regulations and environmental restrictions to preserve the world's existing forest have mounted pressures on logging in many developing countries (Cherdchim *et al*. 2004). Modern forest management approaches, including the search for alternative substitute timber species for those most exploited, are increasingly employed in the timber sectors in Africa. Remarkable progress has been reported in Nigeria (Aguda *et al*. 2012), Ghana (Otengo-Amoako 2006), Tanzania (Gillah *et al*. 2006), and Mozambique (Alexandre 2011). Several studies have been conducted about the wood properties of lesser-used species growing in Africa, aiming to reduce pressure on well-known species (Poku *et al*. 2001; Ishengoma *et al*. 2004; Zziwa *et al*. 2006).

Ficus vallis-choudae was selected for this study based on the plank market survey conducted by the Timber Engineering section of the Forest Products Development and Utilization Department, Forestry Research Institute of Nigeria. The survey showed the availability of the species in the timber market, and little or nothing is known about its properties. *Ficus vallis-choudae* is a lesser-used species that is currently utilized due to the scarcity of other species whose properties had been evaluated. Therefore, it is important to determine the mechanical properties of this wood prior to its utilization, considering that there is potential for collapse of buildings and other structures, as well as other problems that can pose dangers to the end users (Adetogun *et al.* 2010).

EXPERIMENTAL

The Study Area

The study area was a free forest area called Longe Village, Busogbooro, along Ibadan/Ijebu Ode Road in the Oluyole local government area in Ibadan, Oyo State, Nigeria. It is surrounded by many other villages, which include Onigambari, Adebayo, Aba-Dalley, Mamu, Aba-Igbagbo, Idi-Ayunre, Ajibode, Lagunju, Gbale-Asun, Akintola, and Onipade. Longe Village is located at latitude 07° 09.715`N and longitude 003° 53.235`E. It is 122 mm above sea level with an average annual rainfall of 1421 mm. The relative humidity ranges from 84.5% from June to September, and 78.8% from December to January (WAHIP 1997).

Materials Selection

Sampling selection and preparation

The trees were felled and their merchantable heights were measured. Bolts 91.44 cm long were cut from each tree at the base (10%), middle (50%), and top (90%) of the merchantable length, as shown in Fig. 1. Nine bolts were then transported to the sawmilling section of the Department of Forest Products Development and Utilization (FPD&U), Forestry Research Institute of Nigeria (FRIN), in Ibadan, for conversion. Planks were obtained from all the bolts, and they were taken to the Wood Workshop Section for further conversion to test samples. The planks were sectioned into six equal portions, labelled 1 to 6 from bark to bark. Sections 1 and 6 formed the outerwood portion, section 2 and 5 formed the middlewood, and 3 and 4 formed the innerwood portion, as shown in Fig. 1.

Wood Properties Evaluation

Mechanical properties

The mechanical properties that were tested for in this study included the modulus of rupture (MOR), the modulus of elasticity (MOE), the maximum compressive strength parallel-to-grain (CS//), the maximum shear strength parallel-to-grain, and the impact bending strength (IBS).

Determination of MOR and MOE

Panshin and De Zeeuw (1980) described MOR as the magnitude of load required to cause failure during bending stress. The samples for this test were required to have dimensions 20 × 20 × 300 mm^3. The MOR was calculated using equation below,

$$\mathrm{MOR} = (3PL) / (2bd^2) \tag{4}$$

where MOR is in N/mm^2, P equals the load at some point below the proportional limit (N), L is the distance between supports for the beam (mm), b is the beam width (mm), and d is the thickness (depth) of the beam (mm).

The MOE measures the resistance to bending, or the stiffness of a beam or other wooden member. It is the ability of a material to regain its original shape and size after being stressed. Pansin and Dezeeuw (1980) and Desch (1981) stated that the ability of a wood member to bend freely and regain normal shape is called flexibility and the ability to resist bending is called stiffness. This was calculated using Eq. 5,

$$\mathrm{MOE} = (PL^3) / (4bd^3\Delta) \tag{5}$$

where P is the load at some point below the proportional limit (N), L is the distance between supports for the beam (mm), b is the beam width (mm), d is thickness (depth) of the beam (mm), and Δ is deflection.

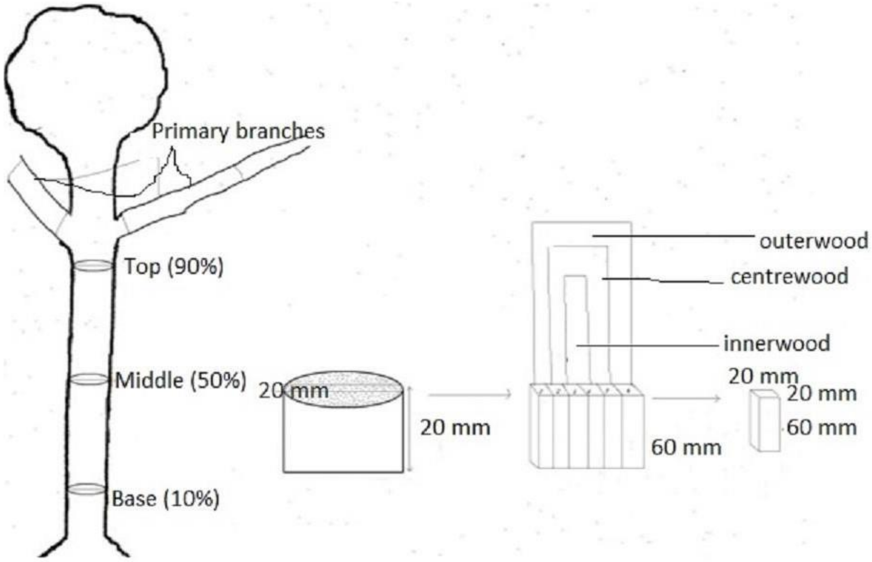

Fig. 1. The selected parts of samples

Determination of Maximum Compressive Strength (MCS) Parallel-to-grain

The MCS parallel to the grain is the ability of a material to resist a crushing force or stress applied on the body. The compressive strength parallel to the grain test was conducted using wood samples of 20 mm × 20 mm × 60 mm. The values obtained were used to calculate the compressive strength using Eq. 6,

$$\mathrm{MCS} = \mathrm{P} / bd \ \mathrm{N/mm^2} \tag{6}$$

where MCS is the maximum compressive strength (N/mm^2), b is the width (mm), d is the depth (mm), and P is the load (N).

Determination of IBS or Impact Work

Impact bending strength is the ability of wood samples to resist a suddenly applied load, and it is one of the criteria for measuring toughness (Desch 1981). Impact bending is generally or widely used as an indication of toughness of wood material. This test was conducted using a sample of 20 mm × 20 mm × 300 mm. The maximum distance of the hammer drop was read and recorded directly from the impact bending machine in meters, the work-done during this process was also determined and recorded. The impact work was calculated using the equation below,

$$\text{IBS} = W/A = (Fd) / (bd) \tag{7}$$

where IBS is impact work (J/m^2), W is work-done (J), A is the surface area of the samples (mm^2), F is the weight of the hammer (N), d is the distance of hammer drop (mm), b is the width of the sample (mm), and d is the depth of sample (mm).

Equipment Used

A computer control electronic universal testing machine manufactured by Jinan Hensgrand Instrument Co., Ltd. in Jinan, China with model number WDW-50 was used for the mechanical properties determination (Fig. 2). A Sartorius moisture analyzer (Sartorius MA35; Sartorius Company, Göttingen, Germany) was used to determine the moisture content of the samples before test (Fig. 3).

Fig. 2. Computer control electronic universal testing machine

Fig. 3. Sartorius moisture analyser

Statistical Analysis

An analysis of variance (ANOVA) was conducted using IBM SPSS software, version 20.0 (Armonk, NY, USA). All statistical analyses were conducted as a factorial experiment in a completely randomized design (CRD) *via* a one-way ANOVA to determine significant differences among treatment means. Separation of treatment means was carried out using Duncan multiple range test (DMRT). This was completed to know the differences between means and to choose the best treatment combination from the factors considered.

Determination of Maximum Shear Strength Parallel-to-grain

The measure of wood's ability to resist the internal slipping of one part onto another along the grain is referred to as shear strength. The maximum shear strength was measured parallel to the grain. Test samples of 20 mm × 20 mm × 20 mm were used. The maximum shear strength parallel to the grain was calculated using the equation below,

$$\text{Shear} = P / (bd) \tag{8}$$

where P is the load (N), b is the width (mm), and d is the depth (mm).

RESULTS AND DISCUSSIONS

Impact Bending Strength

The IBS of *Ficus vallis-choudae* wood was 20.45 N/mm^2. It decreased from the base to the top along the sampling height and decreased from the innerwood to the centrewood across the radial sampling position, as shown in Table 1. This pattern of variations in *Ficus vallis-choudae* along the sampling height agreed with the findings of Ogunsanwo (2000), Adedipe (2004), Aguda *et al.* (2012), Aguda *et al.* (2015), Adejoba *et al.* (2016), and Ojo (2016) on the species *Triplochiton scleroxylon*, *Gmelina arborea*, *Chrysophyllum albidum*, *Staudtia stipitata*, *Elaeis guineensis*, and *Borassus aethiopum*, respectively. This study's finding was contrary to the reports of Ajala (2005) on *Anningeria* *robusta*, which showed an inconsistent pattern of variation. Adejoba (2008) also reported the same value of impact bending strength at the base, middle, and top on *Ficus mucuso*, and Aguda *et al.* (2014) on *Funtumia elastica*. The decrease in the IBS of *Ficus vallis-choudae* from the innerwood to the outerwood agreed with the report of Aguda *et al.* (2012) concerning *Chrysophyllum albidum*, Aguda *et al.* (2015) on *Staudtia stipitata*, and Ojo (2016) on *Borassus aethiopum*.

The decrease in the IBS of *Ficus vallis-choudae* contradicted the reports of Ogunsanwo (2000) on *Triplochiton scleroxylon*, Adedipe (2004) on *Gmelina arborea*, Adejoba (2008) on *Ficus mucuso*, Aguda *et al.* (2014) on *Funtumia elastica*, and Adejoba *et al.* (2016) on *Elaeis guineensis*. Green *et al.* (1999) concluded that this pattern of variation results from the fact that wood is a natural material and trees are subjected to constantly changing influences; hence wood properties vary considerably.

Table 1. Summary of the Mean Values of Selected Mechanical Properties of *Ficus vallis-choudae*

		Sampling Height			
Property	**Radial Position**	**Base (10%)**	**Middle (50%)**	**Top (90%)**	**Pooled Mean**
Impact bending (N/mm^2)	Innerwood Centrewood	24.50 ± 7.30 21.74 ± 8.11	23.64 ± 7.41 19.95 ± 8.16	22.21 ± 6.23 18.44 ± 5.48	**23.45 ± 6.90^a** **20.04 ± 7.32^b**
	Outerwood	19.53 ± 6.75	18.15 ± 7.89	15.86 ± 5.58	**17.85 ± 6.83^c**
	Pooled Mean	**21.92 ± 7.52^a**	**20.58 ± 7.99^b**	**18.84 ± 6.23^c**	**20.45 ± 7.34**
Modulus of Rupture (N/mm^2)	Innerwood Centrewood Outerwood	101.33 ± 31.13 94.05 ± 23.86 76.73 ± 18.83	97.35 ± 38.19 83.18 ± 31.93 73.76 ± 20.33	83.93 ± 11.55 81.98 ± 18.06 79.76 ± 17.40	**94.20 ± 29.52^a** **86.40 ± 25.29^b** **76.75 ± 18.63^c**
	Pooled Mean	**90.70 ± 26.67^a**	**84.76 ± 31.88^b**	**81.89 ± 15.67^c**	**85.79 ± 25.72**
Modulus of Elasticity (N/mm^2)	Innerwood Centrewood	7759 ± 2726 8772 ± 2848	7426 ± 2182 7032 ± 1663	7788 ± 2570 6787 ± 2034	**7658 ± 2451^a** **7530 ± 2361^b**
	Outerwood	6006 ± 941	6285 ± 1275	5957 ± 1174	**6083 ± 1122^c**
	Pooled Mean	**7512 ± 2561**	**6914 ± 1772**	**6844 ± 2104**	**7090 ± 2175**
Max Shear Strength (N/mm^2)	Innerwood Centrewood	12.40 ± 1.39 11.78 ± 1.43	11.30 ± 1.46 10.68 ± 1.87	10.13 ± 1.41 9.73 ± 1.61	**11.28 ± 1.68^a** **10.73 ± 1.82^b**
	Outerwood	11.40 ± 1.46	10.30 ± 1.65	8.37 ± 1.95	**10.02 ± 2.09^c**
	Pooled Mean	**11.86 ± 1.46^a**	**10.76 ± 1.69^b**	**9.41 ± 1.81^c**	**10.68 ± 1.93**
Max Compression Strength Parallel-to-grain (N/mm^2)	Innerwood Centrewood Outerwood	37.46 ± 4.20 36.03 ± 5.19 33.91 ± 5.21	35.06 ± 4.61 33.52 ± 4.91 32.58 ± 5.88	32.09 ± 4.32 32.00 ± 5.17 29.39 ± 4.07	**34.85 ± 4.82^a** **33.85 ± 5.35^b** **31.96 ± 5.35^c**
	Pooled Mean	**35.80 ± 5.00^a**	**33.72 ± 5.15^b**	**31.16 ± 4.73^c**	**33.56 ± 5.28**

Means with the same superscript in the same column are not significant ($p < 0.05$)

Table 2. Analysis of Variance (ANOVA) for IBS, MOR, MOE, MSS and MCS

Source of variation	df	Sum of squares	Mean squares	F
IBS Trees	2	5319.75	2659.87	459.06*
SH	2	215.09	107.54	18.56*
RP	2	716.75	358.38	61.85*
Trees * SH	4	253.76	63.44	10.95*
Trees * RP	4	3.82	0.96	0.17^{ns}
SH * RP	4	9.47	2.37	0.41^{ns}
Trees * SH * RP	8	73.24	9.16	1.58^{ns}
Error	108	625.78	5.79	
Total	134	7217.67		
MOR Trees	2	36924.69	18462.34	72.14*
SH	2	1817.68	908.84	3.55*
RP	2	6877.67	3438.84	13.44*
Trees * SH	4	8136.62	2034.15	7.95*
Trees * RP	4	1850.18	462.55	1.81^{ns}
SH * RP	4	2273.87	568.47	2.22^{ns}
Trees * SH * RP	8	3095.34	386.92	1.51^{ns}
Error	108	27639.95		
Total	134	88615.99		
MOE Trees	2	2898518.78	1449259.39	0.37^{ns}
SH	2	1.21	6065687.37	1.54^{ns}
RP	2	6.89	3.44	8.74*
Trees * SH	4	4.62	1.16	2.93*
Trees * RP	4	9118744.05	2279686.01	0.58^{ns}
SH * RP	4	2.52	6290629.82	1.60^{ns}
Trees * SH * RP	8	4.37	547498.08	1.38^{ns}
Error	108	4.26	3941927.69	
Total	134	6.34		
MSS Trees	2	262.81	131.41	304.87*
SH	2	135.53	67.76	157.22*
RP	2	35.68	17.84	41.39*
Trees * SH	4	1.97	0.49	1.14^{ns}
Trees * RP	4	3.81	0.95	2.21^{ns}
SH * RP	4	5.34	1.34	3.10^{ns}
Trees * SH * RP	8	5.30	0.66	1.54^{ns}
Error	108	46.55	0.43	
Total	134	496.98		
MSC Trees	2	1570.40	785.20	61.55*
SH	2	485.93	242.97	19.05*
RP	2	196.65	98.33	7.71*
Trees * SH	4	12.86	3.21	0.25^{ns}
Trees * RP	4	11.57	2.89	0.23^{ns}
SH * RP	4	16.90	4.23	0.33^{ns}
Trees * SH * RP	8	62.87	7.86	0.62^{ns}
Error	108	1377.82	12.76	
Total	134	3735.00		

*Significant and ns = not significantly different at 5% probability level
IBS = Impact Bending Strength, MOR = Modulus of Rupture, MOE = Modulus of Elasticity, MSS = Maximum Shear Strength parallel to grain and MCS = Maximum Compressive Strength parallel to grain.

Modulus of Rupture

The MOR obtained for *Ficus vallis-choudae* wood was 85.8 N/mm^2. FPRL (1966) recorded a mean value of 83.3 N/mm^2 for *Milicia excelsa*, 76.3 N/mm^2 for *Mitragyna spp.*, 95.5 N/mm^2 for *Khaya senegalensis*, and 39.9 N/mm^2 for *Antiaris africana*. Izekor (2010) recorded mean values of 76.9 N/mm^2, 104.0 N/mm^2, and 134.7 N/mm^2 for 15-, 20-, and 25-year-old *Tectona grandis* wood, respectively. Aguda *et al.* (2012) recorded 154.3 N/mm^2 for *Staudtia stipitata* and Adejoba *et al.* (2016) reported 66.3 N/mm^2 for *Elaeis guineensis*. The MOR values obtained for *Ficus vallis-choudae* compared well with the economical species already used for structural applications. The MOR of *Ficus vallis-choudae* decreased from the base to the top along the sampling height and also decreased from the innerwood to the outerwood.

The decrease in MOR from the base to the top for both species agreed with the reports of Hughes and Esan (1969) on *Gmelina arborea*, Ogunsanwo (2000) on *Triplochiton scleroxylon*, Fuwape and Fabiyi (2003) on *Nauclea diderichii*, Adedipe (2004) on *Gmelina arborea*, Adejoba (2008) on *Ficus mucuso*, Izekor (2010) on *Tectona grandis*, Aguda *et al.* (2014) on *Funtumia elastica*, Adejoba *et al.* (2016) on *Elaeis guineensis*, and Ojo (2016) on *Borassus aethiopum*. The decrease in MOR from the base to the top differs with the reports of Aguda *et al*. (2012) on *Chrysopyllum albidum* and Aguda *et al*. (2015) on *Staudtia stipitata*. The decrease in MOR of *Ficus vallis-choudae* from the innerwood to the outerwood in this study disagreed with Ogunsanwo (2000) on *Triplochiton scleroxylon*, Fuwape and Fabiyi (2003) on *Nauclea diderrichii*, Adedipe (2004) on *Gmelina arborea*, Adejoba (2008) on *Ficus mucuso*, Izekor (2010) on *Tectona grandis*, Aguda *et al.* (2014) on *Funtumia elastica*, Adejoba *et al.* (2016) on *Elaeis guineensis*, and Ojo (2016) on *Borassus aethiopum*. The decrease in the MOR from the innerwood to the outerwood may have been due to growth ring formation, as the growth ring at the innerwood is older than the centrewood and outerwood, and age is one of the factors that determines the strength properties of wood. The decrease may also have been due to the presence of extractives in the innerwood region that tend to increase the weight-carrying capacity of the wood.

Modulus of Elasticity

The MOE was 7090 N/mm^2, and it decreased from the base to the top and also decreased from the innerwood to the outerwood. The decrease in MOE from the base to the top recorded for *Ficus vallis-choudae* wood accorded with the findings of Ogunsanwo (2000) on *Triplochiton scleroxylon*, Fuwape and Fabiyi (2003) on *Nauclea diderrichii*, Adedipe (2004) on *Gmelina arborea*, Adejoba (2008) on *Ficus mucuso*, Izekor (2010) on *Tectona grandis*, Aguda *et al.* (2012, 2014, and 2015) on *Chrysophyllum albidum*, *Funtumia elastica*, and *Staudtia stipitata*, Adejoba *et al.* (2016) on *Elaeis guineensis*, and Ojo (2016) on *Borassus aethiopum*. The decrease in MOE from the innerwood to the outerwood varies according to the reports of Ogunsanwo (2000) on *Triplochiton scleroxylon*, Fuwape and Fabiyi (2003) on *Nauclea diderrichii*, Adedipe (2004) on *Gmelina arborea*, Adejoba (2008) on *Ficus mucuso*, Izekor (2010) on *Tectona grandis*, Aguda *et al.* (2012, 2014, and 2015) on *Chrysophyllum albidum*, *Funtumia elastic*a, and *Staudtia stipitata*, Adejoba *et al.* (2016) on *Elaeis guineensis*, and Ojo (2016) on *Borassus aethiopum*. The decrease in the MOE from the innerwood to the outerwood may have been due to growth ring formation, as the growth ring at the innerwood is older than the centrewood and outerwood, and age is one of the factors that determines the strength properties of wood.

Maximum Shear Strength Parallel-to-grain

The maximum shear strength parallel to the grain of *Ficus vallis-choudae* wood was 10.68 N/mm^2. The shear strength decreased from the base to the top along the sampling height and also decreased from the innerwood to the outerwood across the radial sampling position. The decrease in the shear strength parallel to the grain from the base to the top and also from the innerwood to the outerwood conformed with the findings of Ogunsanwo (2000) on *Triplochiton scleroxylon*, Fuwape and Fabiyi (2003) on *Nauclea diderrichii*, Adedipe (2004) on *Gmelina arborea*, Adejoba (2008) on *Ficus mucuso*, and Aguda *et al.* (2014, 2015) on *Funtumia elastica* and *Staudtia stipitata*, respectively. The decrease in the shear strength parallel to the grain from the innerwood to the outerwood for *Ficus vallis-choudae* accorded with the findings Fuwape and Fabiyi (2003) on *Nauclea diderrichii*, on *Ficus mucuso*, and Aguda *et al.* (2014, 2015) on *Funtumia elastica* and *Staudtia stipitata*. This pattern of variation across the radial sampling positions disagreed with the reports of Ogunsanwo (2000) on *Triplochiton scleroxylon*, Adedipe (2004) on *Gmelina arborea*, and Adejoba (2008) on *Ficus mucuso*.

Maximum Compression Strength Parallel-to-grain

The maximum compression strength parallel-to-grain was 33.6 N/mm^2. The maximum compression strength parallel-to-grain of *Ficus vallis-choudae* wood decreased from the base to the top along the sampling heights and decreased from the innerwood to the outerwood across the radial sampling positions. FPRL (1966) recorded 16.9 N/mm^2 for *H. barteri*, 30.4 N/mm^2 for *A. africana*, 34.4 N/mm^2 for *Daniellia oliveri*, Takahashi (1978) reported 16 N/mm^2 for *B. aethiopum* sample in Ghana, Adejoba (2008) reported 13.7 N/mm^2 for *Ficus mucuso*, Izekor (2010) reported 43.7 N/mm^2, 58.5 N/mm^2, and 75.4 N/mm^2 for 15-, 20-, and 25-years-old *Tectona grandis*, Aguda *et al.* (2012, 2014, and 2015) recorded 45.6 N/mm^2, 20.4 N/mm^2, and 45.9 N/mm^2 for *Chrysophyllum albidum*, *Funtumia elastica*, and *Staudtia stipitate*, respectively. This range shows that the values obtained from this study agreed with the range of values obtained for economic wood species that are already popular in structural applications. The decrease in maximum compression strength parallel-to-grain from the base to the top recorded for *Ficus vallis-choudae* wood agreed with the findings of Ogunsanwo (2000) on *Triplochiton scleroxylon*, Fuwape and Fabiyi (2003) on *Nauclea diderrichii*, Adedipe (2004) on *Gmelina arborea*, Adejoba (2008) on *Ficus mucuso*, Izekor (2010) on *Tectona grandis*, Aguda *et al.* (2012, 2014, and 2015) on *Chrysophyllum albidum*, *Funtumia elastica*, and *Staudtia stipitata*, Adejoba *et al.* (2016) on *Elaeis guineensis*, and Ojo (2016) on *Borassus aethiopum* respectively. The decrease in maximum compression strength parallel-to-grain from the innerwood to the outerwood disagreed with the reports of Ogunsanwo (2000) on *Triplochiton scleroxylon*, Fuwape and Fabiyi (2003) on *Nauclea diderrichii*, Adedipe (2004) on *Gmelina arborea*, Adejoba (2008) on *Ficus mucuso*, Izekor (2010) on *Tectona grandis*, Aguda *et al.* (2012, 2014, and 2015) on *Chrysophyllum albidum*, *Funtumia elastica*, and *Staudtia stipitata*, Adejoba *et al.* (2016) on *Elaeis guineensis*, and Ojo (2016) on *Borassus aethiopum* respectively.

CONCLUSIONS

1. The impact bending strength, modulus of rupture, modulus of elasticity, maximum shear strength parallel-to-grain, and maximum compressive strength parallel-to-grain of *Ficus vallis-choudae* decreased from the base to the top and also decreased from the innerwood to the outerwood.

2. Comparison of the strength values obtained with other economic tree species showed that *Ficus vallis-choudae* compared well with *Albizia zygia*, *Anogeissus leiocarpa*, *Afrormosia laxiflora*, *Distemonanthus benthamianus*, *Piptadeniastrum africanum*, *Nesogordonia papaverifera*, *Guarea cedrata*, and *Mansonia altissima*. The strength values of *Ficus vallis-choudae* were higher than *Milicia excelsa*, *Gmelina arborea*, *Khaya ivorensis*, *Tryplochiton scleroxylon*, *Terminalia ivorensis*, and lower than *Celtis zenkeri*, *Lophira alata*, *Scottellia coriacea*, *Cylicodiscus gabunensis*, *Nauclea diderrichii*, and *Sterculia oblonga*.
3. These results showed that any part of the wood of *Ficus vallis-choudae* can be used for heavy construction, structural work, and furniture. *Ficus vallis-choudae* can serve as substitutes for economical but endangered tree species.

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