Advanced Materials Research Vol. 367 (2012) pp 335-341
Online available since 2011/Oct/24 at www.scientific.net

doi:10.4028/www.scientific.net/AMR.367.335

Evaluation of Wood Properties of *C. albidum* Tree Grown in Akinyele Local Government Area of Ibadan, Nigeria in Relation to its Utilization

N. A. Adewole[1,a] and A. B. Ajibi[2]

[1,2] Department of Agricultural and Environmental, Faculty of Technology, University of Ibadan, Oyo State, Nigeria
[a]dabukyo@yahoo.com or _an.adewole@mail.ui.edu.ng
[a]Cell phone: +234-803-396-3707

Keywords: Fruit tree, *C. albidum* tree, Tree characteristics, Wood properties, Wood utilization

Abstract: Fruit trees are hardly ever sought for their wood until recently. Fruit trees like *C. albidum* is now being used for structural and non structural purposes in city suburbs. This study investigated wood properties and few tree characteristics of *C. albidum* grown in Akinyele Local Government Area (ALGA), Ibadan, Oyo State, Nigeria. The aim was to mitigate the dearth of information on these features in relation to its utilization. Samples were collected from five emerging settlements in the study area while structured questionnaire and on-the-spot assessment were the instruments employed for data collection during survey stage. Physical appearance, moisture content (MC), green and oven-dry density, specific gravity of oven-dry samples, natural durability against termite, modulus of elasticity (MOE) and modulus of rupture (MOR) were determined via experimentation. Samples used for static bending strength were prepared in accordance with ASTM D 143 standard of 1991. The obtainable mean bole length, basal, middle and top girths were 4958mm, 1823mm, 1473mm and 1427mm respectively and the tree is moderately buttressed. The wood is brownish-white, crossed grain, coarse textured and fairly resistant to termite attack. Averagely on wet basis, MC and density are 52.46 %, 949 kg/m^3 respectively and dry density is 739 kg/m^3. Also MOR and MOE are respectively 1964N/mm^2 and 1163.60N/mm^2. The wood density compares with that of few commercially known tree species in N-strength group thus preferred for non-structural than structural use especially when high bending stress is required.

Introduction

Forests are the main supplier of renewable resources essential to mankind while wood is the most important of the tangible material extractable from it. The preference of wood as invaluable resource by early man was hinged on its availability, accessibility and flexibility of use. This observation agrees with a report on the choice of wood for truss fabrication for temporary structure in Nigeria as an action contingent on available [1]. Continue overdependence on known wood has reduced their supply drastically. The shortage of commercially known timber species has being an issue for public debate for more than two decades ago [2, 3, 4].

In Nigeria and as far back as 1979, the forest is reported to be suffering from progressive depletion in wood supply so much so that a ban had to be imposed on exportation of unprocessed wood and lumber [5]. Population explosion in Nigeria has further aggravated annual declination rate of commercial timber supply to 3.5% as at 2005 [6]. The new trend introduced by the unending population growth is the unprecedented migration of rural dwellers to major cities. This has facilitated the emergence of new settlements from hitherto villages adjacent to Nigerian cities. The consequence is the result of volatility of cost of available commercial timber [7, 8]. It should be noted that the emigrants are largely low income earners [9] and their pursuit are to erect non-complex *'mostly tenement'* buildings. The new trend is to source for their wood need outside the commercial wood species principally because of the cost. This has exposed any tree growing on hitherto farms but now building sites and its neighborhood to unguarded exploitation and indiscriminate use.

However, one of the crucial questions in tropical-forest management today is the future of lesser-known species. It is believed that hundreds of potentially valuable trees are left behind for social mis-management and complete abuse. The lack of information on their wood properties in relation to utilization has made this possible. If information is available to guide their utilization, lesser-known wood species could ameliorate the problem of wood supply sustainability [7, 8, 10, 11, 12]. There exist several fast growing emerging settlements in Akinyele Local Government, Ibadan, Oyo State, Nigeria. There are evidences that *un-familiar woods*, fruit tree inclusive, now serve as alternative to commercially known species for various end use in these settlements. One of the fruit trees which its uses is rampart is *C. albidum* wood because of its relative abundance. Yet, there is dearth of information on its wood properties and characteristics. For the *C. albidum* wood to be used to its best advantage, the specific characteristics and properties must be well known [13]. The aim of this study was to generate such data for use in guiding its utilization.

Materials and Methods

Data on characteristics of *C. albidum* tree, availability, end-use pattern and factors influencing its uses were collected using structured questionnaire and on-the-sport technique during the survey conducted in the study location. Test samples were obtained from five trees harvested from Aroro-Makinde, Idi-Omo, Mogaji, Okunna, and Fasola, being the most prominent emerging settlements in Akinyele LGA, Ibadan, Oyo State, Nigeria (see Figure 1). From log base (25cm from ground level) of mature *C. albidum* trees with average basal girth of 1400 mm, 40mm thick disks were extracted from each three (Figure 2). The same size of disk was extracted separately from tree middle and top respectively. Test sample were then prepared from the disks in accordance with respective ASTM standard used for different tests. *C. albidum* wood colour, texture and luster were examined visually while the grain direction was determined using metal scriber. The moisture content, natural durability against termite and statics strength were determined in accordance with ASTM D 2016 – 74 of 1991, ASTM D 2017-96a and ASTM D 1037-96a. Specific gravity at oven dry condition was calculated based on the determined oven dry and green density values [14].

The control sample used for grave yard test is *Gmelina arborea* wood while active termite nests within University of Ibadan was used for the experiment (Figure 3). For static bending test, 75 replicates (Figure 4) were used and the test conducted using "Houndsfield Tensometer" with constant load rate of 0.1 m/s. Load corresponding to maximum deflection was used for Modulus of Rupture (MOR) computation while the slope of the graph for maximum load and corresponding deflection was used for Modulus of Elasticity (MOE) computation.

Results and Discussion

General Information and Characteristics of C. albidum Tree in the Study Area: *C. albidum* tree falls in tall or medium sized tree category and exists as small diameter trees with moderate flute but sometimes heavily buttressed (Figure 5). It is often planted and protected in farms and villages for its edible fruits in the study area. *C. albidum* tree is easily identified with grey bole with pale brown bark and exudes white latex when slashed with sharp object. In Table 1, details of the characteristics of *C. albidum* tree studied indicates that the trees has average bole length of 4,958mm with basal, middle and top girths being 1,823mm, 1,473mm and 1,427mm respectively. The wood extracted from *C. albidum* tree is commonly sawn to 50mm x 152mm x 1829mm (2in. x 6in. x 12ft.) and the size is sold for between four hundred and fifty naira (#450) and five hundred and fifty (#550) as at December 2009 in the study area.

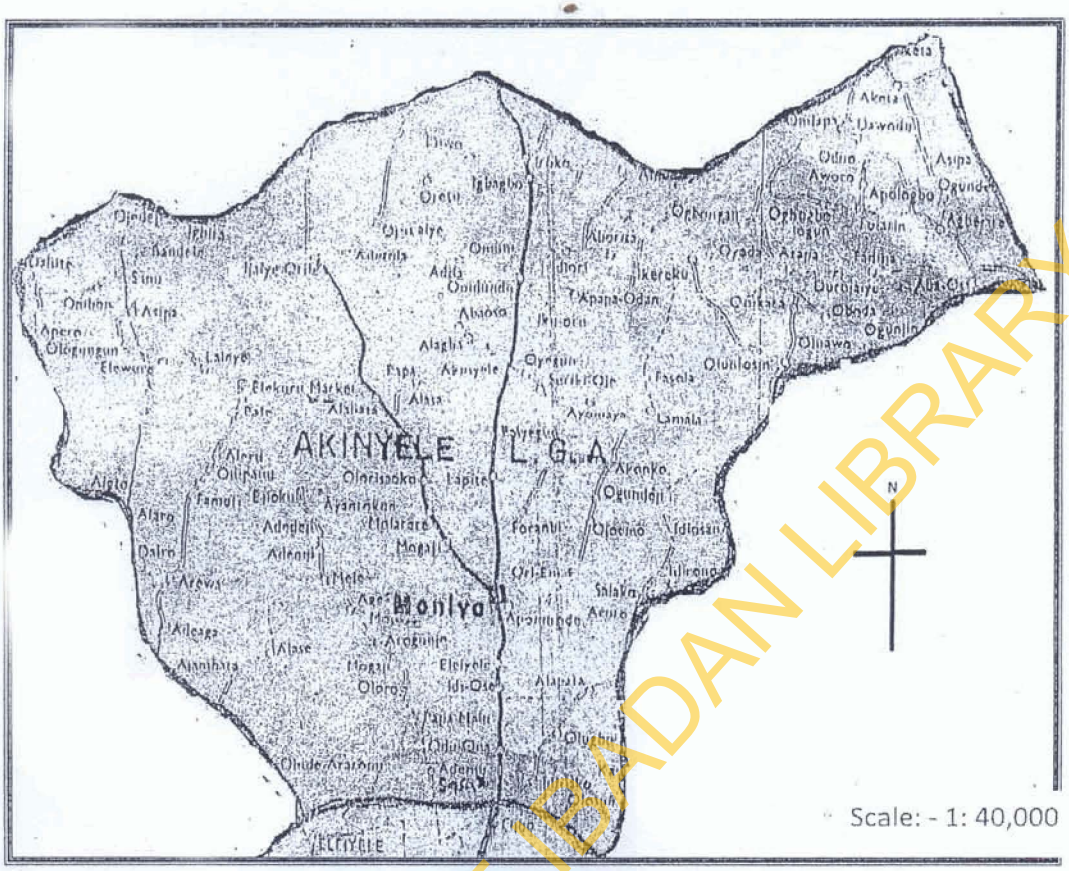

Figure 1 Adapted Map of Akinyele LGA from Map of Ibadan

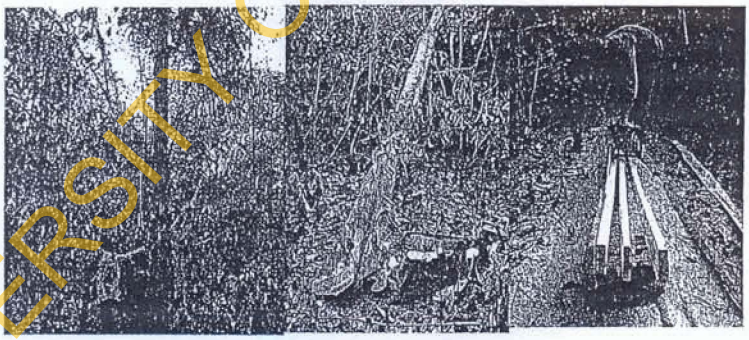

Figure 2 One of the Samples of *C. albidum* Tree used for the Investigation

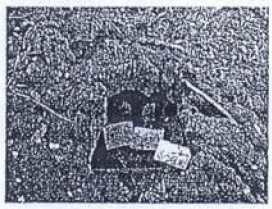

Figure 3 Sample of the Termite Nests Used for the Investigation

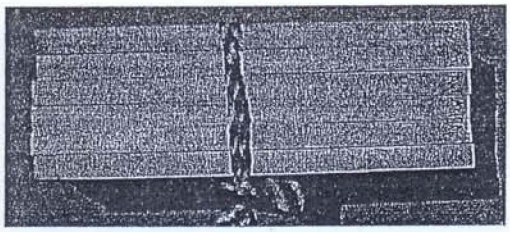

Figure 4 A Sample of *C. albidum* Wood Used for Static Bending Test

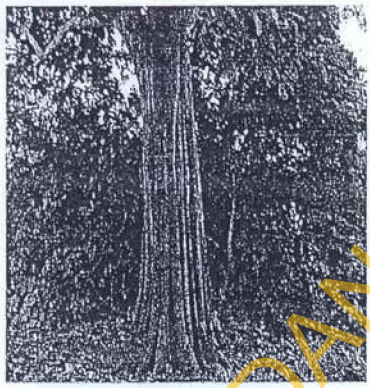

Figure 5 A Sample of Heavily Buttressed *C. albidum*

Table 1 Features of C. *albidum* Tree from Which Samples Were Collected

Tree	Location	Bole Length [mm]	Base Girth [mm]	Middle girth [mm]	Top Girth [mm]
A	Idi – Omo	5639	1981	1499	1422
B	Aroro	6274	2210	1575	1549
C	Okunna	7340	1422	1346	1295
D	Fasola	5537	1499	1448	1397
E	Mogaji	5944	2007	1499	1473
AVERAGES		**4958**	**1823**	**1473**	**1427**

C. albidum tree is relatively abundant in all the villages and emerging settlements in Akinyele Local Government. It is common in all the plank markets in the area and is called '*Agbalumo wood*' in the locality. The wood is used as alternative material majorly in the production of household furniture and structural items like truss member, beam and column. It is infrequently employed in the production of other wooden items. Beside its availability and accessibility, it is equally cheap relative the commercially known timber. In the view of about 87% of the respondents, *C. albidum* wood is perceived as being naturally durable, strong and do not see anything wrong in its been used when wet.

Physical Appearance: *C. albidum* wood is brownish-white when freshly cut and gradually turns darker as it dries in air. It is crossed-grained, coarse in texture and of medium luster (Figure 6). The grain nature is an indication of limitation in its load bearing capacity because whenever it is loaded the direction of loading will often be at an angle to its grain direction [15].

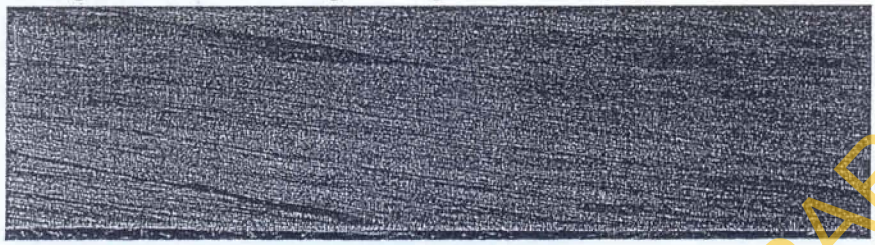

Figure 6 The Grain and Colour of *C. albidum* Wood

Moisture Content and Densities: The average green moisture content (MC_g) of C. *albidum* is 52.48%. This value varied from log top to the base thereby conforming to the direction of moisture variation along tree bole. The implication of low green moisture content implies that little time would probably be required to dry C. *albidum* wood. At the 52.46 % mc the corresponding green density is 949kg/m^3 but 739kg/m^3 is the average value recorded as the oven-dry density. The variation of C. *albidum* wood densities is shown in Table 2; the trend shows that the value increases from base to the top. Oven-dry density value compares favourably with that of some well known timbers classified as low density wood. Thus, nailing which is the prevailing method of wood fastening in Nigeria will not be a problem since resistance to nailing is commonly associated with high wood density [16].

Specific Gravity and Resistance to Termite Attack: The wood specific gravity at oven-dry condition is 0.739. The first inspection after two weeks of burying *C. albidum* wood samples shows that debarked samples were susceptible as it was slightly attacked while un-debarked samples remain un-attacked. However, the *Gmelina arborea* used as control was heavily attacked and by four weeks it had become fully attacked. The extent of attack on debarked samples of *C. albidum* increases gradually but the extent of at the end of the test period, 60 days, both barked and debarked samples of *C. albidum* wood had been attacked. It is an indication that *C. albidum* wood has poor resistance to termite attack.

Table 2 Density and Specific Gravity of *C. albidum* Wood

Tree samples	Base GD [kg/m^3]	Top GD [kg/m^3]	Base Oven DD [kg/m^3]	Top Oven DD [kg/m^3]	Base Specific Gravity	Top Specific Gravity
A	1123	1118	849	821	0.849	0.821
B	942	839	741	688	0.741	0.688
C	1006	885	765	687	0.765	0.687
D	949	852	747	673	0.747	0.673
E	928	850	744	678	0.744	0.678
MEAN	**989.8**	**908.8**	**769.2**	**709.4**	**0.769**	**0.709**

Legend: GD= Green Desity, DD = Dry Density

Moduli of Elasticity and Rupture: The mean MOE and MOR for green samples were found to be 1,164N/mm^2 and 1,964N/mm^2 and at the same moisture content. Computed MOR values decreases as one moves along the bole length from the tree base (2,070 N/mm^2) to middle (1,95N/mm^2) and to the top (1,874N/mm^2). Contrarily, the lowest value of MOE was recorded for sample taken from log middle (1,119N/mm^2) and highest value from sample taken from the base (1,208N/mm^2). The MOE for the top is 1,164N/mm^2. Both MOE and MOR values were lower when compared with that of some known commercial wood species often used in the production of structural member that is required to sustain high bending stress. More work has to be done to further confirm the suitability of *C. albidum* for making such structural members.

Possible Strength Group and Suggestive Uses: Based on the values obtained for the basic density and specific gravity of *C. albidum* wood, it may be classified in N_7 strength group [17]. This puts C. albidum wood in the categories of wood species that are more appropriate for the production of novel and furniture items. It is advisable to restrict its structural application to the production of structural members where high bending strength is not desirable.

Conclusion

Findings showed that *C. albidum* wood is currently being blindly used as alternative to commercially known wood species in the production of different structural members and household furniture among other sundry uses by dwellers of the emerging settlements in Akinyele Local Government Area of Ibadan, Oyo State Nigeria. It is used as alternative to known economic tree species because of availability, accessibility and cost effectiveness. Its wood is brownish-white, cross grained, coarse texture and of medium luster. The green moisture content is about 54% hence will require short drying time. It is a low density wood and not resistant to termite attack, hence, it is not advisable to use in contact with ground unless it is treated. Its density and specific gravity values put it in N_7 strength group in accordance to [17]. Despite limitation imposed by tree features, useful lumber sizes are still being obtained from *C. albidum* tree while its harvesting and conversion were carried out exclusively using power saw (Chainsaw). The maximum nominal size available to users in the plank markets in the study area is 50mm x 152mm x 1829mm (2in. x 6in. x 12ft.). *C. albidum* wood can safely be used for production of indoor furniture, tool handle, novel items and other decorative items.

References

[1] Adewole Adedapo. N., "Design And Fabrication of a Two Meter Span of 4 – Web Pratt Truss Using *Psidium Guajava L.* (Guava) Wood" An M.Sc Thesis from the Department of Agricultural Engineering, University of Ibadan, Nigeria, 2002, 120Pgs.

[2] Timber Research and Development Association (TRADA), Timbers of the word. Vols. 1 & 2. Longman, New York, 1980, 394pp

[3] Dargavel J and Sheldon G 1987. Prospects for Australian Hardwood Forest, Centre for Resource and Environmental Studies, Australian National University, Canberra, 1987, 94pp

[4] Kretschmann E. David and Green W. David 1999. Mechanical Grading of Oak Timbers *Journal of Materials in Civil Engineering,* Vol. 11, No. 2, May, 1999, 7pp

[5] Lucas E.B, Factors Preventing Wider Commercialization of Nigerian Tree. Forest Product Journal. 33(5), 1983, Pgs 64-68.

[6] Federal Ministry of Environment, A review of Nigeria's Wood Resources. An Invited Paper at a Seminar on Wood Products Industry to Federal Department of Forestry, Federal ministry of Environment, Abuja, Nigeria. 2005, 157Pgs.

[7] Zziwa A., M. Bukenya, O. E. Sseremba and R.K. Kyeyune,, Non-traditional tree species used in the furniture industry in Masaka District, Central Uganda. Uganda Journal of Agricultural Sciences, 12(1), 2006, 57-66

[8] Unasylva, Lesser-known tropical wood species : How bright is their future? No. 145 *www.fao.org/docrep/q9270e/q9270e02.htm* downloaded in May 2010- Cached

[9] ITTO. 1993a.. The Economic Linkages between the International Trade in Tropical Timber and the Sustainable Management of Tropical Forests. http://www.fao.org/docrep/w4388e/w4388e0p.htm accessed on may 17, 2007

[10] Tsoumis, G.T., Science and technology of wood: structure, properties, utilization New York, N.Y. Van Nostrand Reinhold, 1991, 494 pp.

[11] Kliger, R., Mechanical properties of timber products required by end-users. Proceedings of World Conference on Timber Engineering, 31st July - 3rd August 2000. Whistler, Canada.

[12] Lucas E. Olorunnisola A. and Adewole N, Preliminary evaluation of (*Psidium guajava l.*) Tree Branches for Truss Fabrication in Nigeria. Agricultural Engineering International: the CIGR Ejournal. Manuscript BC05010.Vol.May,2006, 11Pgs.

[13] FPL, Wood handbook: Wood as an Engineering Material. Published by McGraw Hill, Illinois Madison Wisconsin New York, 1999, 2369Pgs.

[14] American Society for Testing and Materials (ASTM), Annual Book of ASTM Standards. (Reference: D 2016 – 74 and D 143) Vol. 04.10 (Wood), published by West Conshohocken, Pennsylvania, PA 19428, USA. 1998, 3362Pgs.

[15] Faherty K. F and Williamson T.G., Wood Engineering and Construction Handbook Published by McGraw-Hill Handbook. 3rd Edition, 1994, 987Pgs.

[16] Alade, G.A. and Lucas E.B., Timber Connector: a Major Contributor to Structural Failure in Wooden Components in Nigeria. Paper Presented at the 36th Annual Meeting of the Forest Products Research Society, Mechanical Fastening Session, New Orleans, U.S.A. 1982, 22 Pgs.

[17] Nigeria Code of Practice (NCP), Code of Practice for the Structural Use of Timber. 1973, 37Pgs.

Advances in Materials and Systems Technologies III
10.4028/www.scientific.net/AMR.367

Evaluation of Wood Properties of C. albidum Tree Grown in Akinyele Local Government Area of Ibadan, Nigeria in Relation to its Utilization

10.4028/www.scientific.net/AMR.367.335