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The Effect of Oven Dry Density on Fifty-Two Selected Nigerian Timbers

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Abstract: The effect of oven dry density of fifty-two selected Nigerian timbers was analyzed. The results showed that *Protea elliottii* had the least ODD (19.9×10^{-2}g.cm^{-3}), while *Erythrophleum ivorense* had the highest ODD (108.7×10^{-2}g.cm^{-3}). The high or low ODD observed among the fifty-two timbers is attributed to the amount and compact nature of arrangement of their grains and their cell walls. The results also showed that Nineteen timbers with ODD values less than 50×10^{-2}g.cm^{-3} were said to be low ODD timbers while thirty-three others were high ODD timbers.

Key words: Oven Dry Density · Grains · Cell Walls And Timbers

INTRODUCTION

Wood is the hard, fibrous substance found beneath bark in the stems and branches of trees and shrubs. Practically all commercial wood comes from trees. It is plentiful and replaceable. Since a new tree can be grown where one has been cut, wood has been called the world's only renewable natural resource [1]. It is also an organic material, a natural composite of cellulose fibres (which are strong in tension) embedded in a matrix of lignin which resists compression. In the strict sense, wood is produced as secondary xylem in the stems of trees (and other woody plants). In a living tree it transfers water and nutrients to the leaves and other growing tissues and has a support function, enabling woody plants to reach large sizes or to stand up for themselves [2]. Wood (secondary xylem) is manufactured by a succession of five major steps, including cell division, cell expansion (elongation and radial enlargement), cell wall thickening (involving cellulose, hemicellulose, cell wall proteins and lignin biosynthesis and deposition), programmed cell death and heartwood formation [2, 3].

The size of a tree also varies with the climate, the depth and type of soil in which it grows [1]. Timbers are known as trees grown to be used in building or for making other things. It can be referred to as wood prepared for use in building or for making other things. Wood is the most important natural and endlessly renewable source of energy which has a major future role as an environmentally cost-effective alternative to burning fossils fuel [2]. The major role of wood is not only the provision of energy but also the provision of energy-sufficient material for our buildings and many other products. In addition, developing wood cells represent one of the most important sinks for excess atmospheric CO_2, thereby reducing one of the major contributors to global warming [3].

Density of a material is defined as the mass per unit volume. Density of wood sample is usually calculated as the weight density instead of mass. Therefore, it's obtained by dividing the weight by the volume [4]. There are several ways of determining the volume. The simplest is a calculation based on the direct measurement of length, width and thickness of a squared sample not less than 7.5 x 5 x 2.5cm [5].

The range in densities of the softwood timbers is much lower than that for the hardwood timbers and equally as important, the density range of the softwoods is encompassed by that of the hardwoods; that is, some of the hardwoods are less dense than the softwoods thereby making nonsense of the use of the common terms "softwood and "hardwood" [6 ,7].

In addition to the range in density that occurs among timbers of different species, there is considerable variation

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in density between different samples of the same species. This variation is influenced by such factors as rate of growth, site conditions and genetic composition. Generally, the heaviest wood is found at the base of the tree and there is a gradual decrease in density in samples from successively higher levels in the trunk. The density of wood is of practical interest because it is the best single criterion of strength. It depends on specific gravity and moisture content [7].

MATERIALS AND METHODS

Sample Collection and Preparation: The Fifty- two (52) timber samples were collected from Anambra, Enugu, Ebonyi, Imo, Delta, Edo, Cross River, Akwa Ibom, Abia, Oyo, Lagos, Kano, Sokoto and Rivers State, Nigeria. The timber samples were obtained from the timber sheds at Nnewi, Awka, Enugu, Abakaliki and Benin. The States from where these timbers were collected were ascertained from timber dealers and confirmed by literature [4, 5]. The timber dealers were able to give the Local or common names of the timbers while the botanical names were obtained with the aid of forest officers and the literature [4, 5].

The samples were taken to the saw mill at Nnewi Timber Shed where each timber was cut into two different shapes and sizes. Also dust from each timber was realized. The timbers were cut into splints of dimensions 30x 1.5 x 0.5cm and cubes of dimensions 2.5cm x2.5cmx 2.5cm i.e. 15.625 cubic centimeters. The splints were dried in an oven at 105°C for 24 h before the experiments.

Table.1 Names of the Selected Fifty-Two (52) Timbers Used For This Research

S.No	Botanical Names	Igbo Names	Yoruba Names	Hausa Names	Areas of Location in Nigeria
1.	Monodora tenuifolia	ehuru ofia	lakesin	gujiyadanmiya	Port Harcourt
2.	Pycnanthus angolensis	Akwa-mili	akomu	akujaadi	Calabar, Awka
3.	Moringa oleifera	okwe oyibo	ewe igbale	zogallagandi	Lagos, Ibadan
4.	Protea elliottii	okwo	dehinbolorun	halshena	Nsukka
5.	Caloncoba glauca	udalla-enwe	kakandika	alibida	Onitsha
6.	Barteria nigritiana	ukwoifia	oko	idonzakara	Nsukka, Enugu
7.	Bacteria fistulosa	oje	oko	kadanya	Awka
8.	Anogeissus leiocarpus	atara	ayin	marike	Onitsha, Awka
9.	Rhizophora racemosa	ngala	egba	loko	Calabar
10.	Allanblackia floribunda	egba	eku,eso roro	guthiferae eku	Calabar, Ikom
11.	Garcinia kola	adi	orogbo	namijin-goro	Onitsha, Nnewi
12.	Glyphae brevis	anyasu alo	atori	bolukonu kanana	Calabar
13.	Hildegaridia barteri	ufuku	eso, shishi	kariya	Okigwe
14.	Sterculia oblonga	ebenebe	oroforofo	kukuki	Ibadan
15.	Cola laurifolia	ufa	aworiwo	karanga	Onitsha, Calabar
16.	Bombax brevicuspe	akpudele	awori	kurya	Ikom
17.	Bridelia micrantha	ogaofia	ida odan	kirni	Calabar, Ikom
18.	Bridelia ferruginea	ola	ira odan	kirni and kizini	Onitsha, Awka
19.	Uapaca guineensis	Obia	abo-emido	wawan kurmi	Onitsha
20.	Antidesma venosum	okoloto	aroro	kirni	Onitsha, Udi
21.	Parinari robusta	ohaba-uji	idofun	kasha-kaaji	Onitsha
22.	Cynometra vogelii	ubeze	anumutaba	alibida	Onitsha, Abakali
23.	Amphimas pterocarpoids	awo	ogiya	waawan kurmii	Umuahia, Iko
24.	Lovoa trichiliodes	sida	akoko igbo	epo-ipa	Calabar
25.	Berlinia grandiflora	ububa	apodo	dokar rafi	Enugu
26.	Albizia adianthifolia	avu	anyimebona	gamba	Enugu, Nsukka
27.	Oncoba spinosa	akpoko	kakandika	kokochiko	Onitsha
28.	Dichapetalum barteri	ngbu ewu	ira	kirni	Onitsha, Agulu
29.	Afzelia bipindensis	aja	olutoko	rogon daji	Benin
30.	Afzelia bella	uzoaka	peanut	epa	Owerri, Orlu
31.	Erythropleum ivorense	inyi	erun	idon zakara	Ogoja, Ijebu
32.	Dichrostacys cinerea	amiogwu	kara	dundu	Onitsha
33.	Pentaclethra macrophylla	ugba	apara	kiriya	Onitsha
34.	Tetrapleura tetraptera	oshosho	aridan	dawo	Onitsha
35.	Stemonnocoleus micranthus	nre		waawan kurmi	Ukpor, Awka
36.	Piliostigma thonningii	okpoatu	abafe	kalgo	Kano,Oyo
37.	Hymenocardia acida	ikalaga	orupa	jan yaro	Awka, Enugu
38.	Afrormosia laxiflora	abua ocha	shedun	don zakara	Sokoto
39.	Phyllanthus discoideus	isinkpi	ashasha	baushe	Enugu, Ikom
40.	Gardenia imperialis	uli	oroto	karandafi	Jos
41.	Macaranga hurifolia	awarowa	ohaha		Awka
42.	Sacoglottis gabonensis	nche	atala	chediya	Rivers
43.	Cassipourea barteri	itobo	odu	daniya	Eket
44.	Combretodendron macrocarpum	anwushi	akasun		Udi, Owerri
45.	Lophira lanceolata	okopia	iponhon	namijin kadai	Udi
46.	Homalinum letestui	akpuruukwu	out,obo-ako		Ikom
47.	Cordial millenii	okwe	omo	waawan kurmii	Owerri
48.	Gmelina arborea	gmelina	igi Melina	kalankuwa	Ibadan
49.	Drypetes aframensis		tafia		Ibadan
50.	Khaya ivorensis	ono	oganwo	madachi	Calabaar
51.	Spathoden campanulata	imiewu	Oruru	delinya	Onitsha
52.			Shanty		

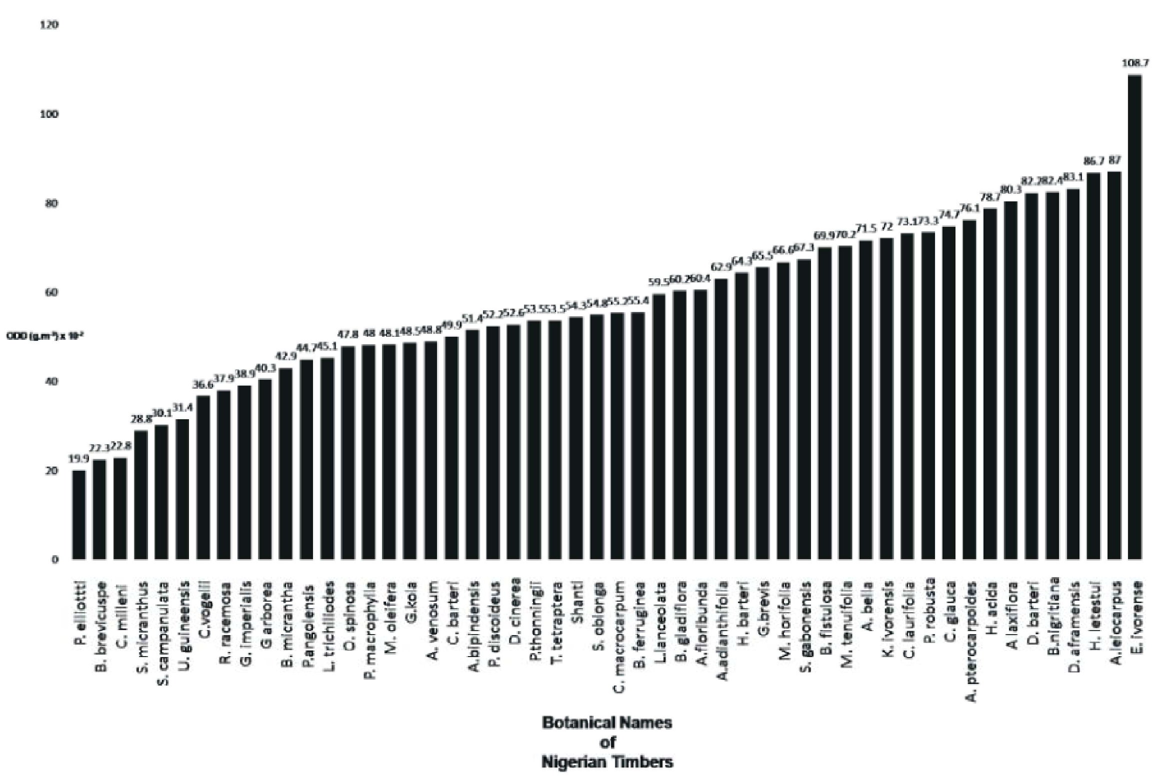
Determination of Oven Dry Density ODD: Three 2.5cm cubes of each timber sample were randomly selected. Each was weighed with top loading balance, Make: Mettler Toledo, Model: PL 203. After recording the initial weight, the sample was transferred into the drying oven at the temperature of 105°C. The sample was left in the oven for three hours. After the heating, the oven was switched off and the sample left overnight to cool. The sample was re-weighed after twelve hours. Care was taken to ensure that sample did not absorb moisture before and during weighing. After recording the second weight for the respective samples, they were taken back into the oven for another three hours at the same temperature. This was repeated until any two subsequent weights were equal i.e. constant weight attained. The weight of a cube was obtained by calculating the average of the three samples of each timber. The volume of each timber sample was calculated by taken the dimensions of the three 2.5cm cubes of each timber sample. The average volume of the three samples was recorded as the volume of each sample of the timbers. The oven dry density of each timber sample was determined by dividing the average oven dry weight of the three samples by the average volume of three samples.

$$\text{ODD} = \frac{\text{Average dry weight of samples}}{\text{Average volume of samples}}$$

RESULTS AND DISCUSSION

Figure 1A represents the graph of Oven dry densities of the fifty-two timbers. The ODD of these timbers were arranged in their increasing order of magnitude. *Protea elliottii* is the timber with the least ODD (19.9 x10^{-2} g.cm^{-3}), while *Erythrophleum ivorense* is the timber with the highest ODD (108.7x10^{-2}g.cm^{-3}). Nineteen timbers with ODD values less than 50 x 10^{-2}g.cm^{-3} were said to be low ODD timbers while thirty-three others were high ODD timbers [3]. The high or low ODD observed among the fifty-two timbers is attributed to the amount and compact nature of arrangement of their grains and their cell walls. The density of wood or timber is a measure of such components that made up the wood. They include compounds such as; cellulose, hemicelluloses, lignin, water, air, inorganics and oil etc. These components vary in composition from one timber specie to another. This is one of the causes of variations in the ODD results obtained when compared to other parameters [6, 7] pointed out that some of the hard woods are less dense

Fig. 1A ODD of Nigerian Timbers



than soft woods thereby making nonsense of the use of the common terms 'softwood' and 'hardwood'. They maintained that the variation is influenced by factors such as rate of growth, site compositions and genetic composition.

CONCLUSION

In conclusion, the high or low ODD observed among the fifty-two timbers is attributed to the amount and compact nature of arrangement of their grains and their cell walls.

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