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Average Metal Contents of Fifty-Two Selected Nigerian Timbers

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Abstract: Average metal content assay of fifty-two selected Nigerian timbers was analyzed. The results showed that timbers with the least average metal concentration of 0.81 $x10^{-1}$% is *Uapaca guineensis* while *Moringa oleifera* has the highest average metal concentration of 13.07 $x10^{-1}$%. The timbers; *Cassipourea barteri* and *Cynometra vogeli* are the only set of timbers with equal average metal concentration of 2.64 $x10^{-1}$%. The timber *Uapaca guineensis* with the least AMC of 0.81 $x10^{-1}$% has the ash content of 2.36% while *Moringa oleifera* with the highest AMC of 13.0 7 $x10^{-2}$% has the ash content of 0.65%, *Erythrophleum ivorence* with the least ash content of 0.28% has the AMC of 6.55 $x10^{-1}$% while *Bombax brevicuspe* with the highest ash content of 3.4% has AMC of 1.56 $X10^{-1}$%. The timber; *Cassipourea barteri* and *Cynometra vogeli* with equal AMC of 2.64 $x10^{-1}$% have different ash contents of 0.72% and 0.66% respectively. Also, *Cynometra vogeli* and *Gmelina arborea* have the same percentage of ash of 0.66% but different AMC of 2.64 $x10^{-1}$% and 3.16 $x10^{-1}$% respectively. *C. macrocarpum* with the least AMC of 1.16 $x10^{-1}$% has the electrical conductivity of 1.91 $x10^{-3}$ sm^{-1} while *M. oleifera* with the highest AMC of 13.07 has electrical conductivity of 0.65 $x10^{-3}$ sm-1. The first and second highest electrical conductivity timbers were *B. brevicuspe* and *P. elliottii* with electrical conductivities of 3.4 $x10^{-3}$ sm^{-1} and 3.22 $x10^{-3}$ sm-1 respectively have far wide range AMC of 1.58 $x10^{-1}$% and 3.09 $x10^{-1}$%. Those timbers with equal electrical conductivity have varied average metal concentrations. Therefore, there is neither direct nor inverse relationship between electrical conductivity and average metal concentration.

Key words: Average metal concentration · Electrical conductivity · Nigerian timbers and Ash contents

INTRODUCTION

Wood has been an important construction material since humans began building shelters, houses and boats. Nearly all boats were made out of wood until the late 19th century. Wood to be used for construction work is commonly known as lumber in North America. Elsewhere, lumber usually refers to felled trees and the word for sawn planks ready for use is timber [1].

New domestic housing in many parts of the world today is commonly made from timber-framed construction. Engineered wood products are becoming a bigger part of the construction industry [2]. They may be used in both residential and commercial buildings as structural and aesthetic materials.

In building made of other materials, wood will still be found as a supporting material, especially in roof construction, in interior doors and their frames and as exterior cladding. Wood is also commonly used as shuttering materials to form the mould into which concrete is poured during reinforced concrete construction.

Timber is an environmentally advantageous building material. It has low embodied energy and contributes to the carbon balance. It reduces CO_2 emissions when replacing other energy intensive building materials and it is a renewable resource [3]. Engineered wood products, glued building products "engineered" for application – specific performance requirements, are often used in construction and industrial applications. Glued engineered wood products are manufactured by bonding

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together wood strands, veneers, lumber or other forms of wood fiber with glue to form a larger, more efficient composite structural unit [4]. These products include glued laminated timber (glulam), wood structural panels (including plywood, oriented strand board and composite panels), laminated veneer lumber (LVL) and other structural composite lumber (SCL) products, parallel strand lumber and I-joists [5].

Engineered wood products display highly predictable and reliable performance characteristics and provide enhanced design flexibility. On one hand, these products allow the use of smaller pieces and on the other hand, they allow for bigger spans. They may also be selected for specific projects such as public swimming pools or ice rinks where the wood will not deteriorate in the presence of certain chemicals and are less susceptible to the humidity changes commonly found in these environments. Engineered wood products prove to be more environmentally friendly and, if used appropriately, are often less expensive than building materials such as steel or concrete. These products are extremely resource efficient because they use more of the available resources with minimal waste. In most cases, engineered wood products are produced using faster growing and often underutilized wood species from managed forests and tree farms [6].

Wood unsuitable for construction in its native form may be broken down mechanically (into fibers or chips) or chemically (into cellulose) and used as a raw material for other building materials, such as engineered wood, as well as chipboard, hardboard and medium-density fiberboard (MDF). Such wood derivatives are widely used: wood fibers are an important component of most paper and cellulose is used as a component of some synthetic materials. Wood derivatives can also be used for kinds of flooring, for example laminate flooring [7].

MATERIAL 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 [7, 8]. 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 [7, 8].

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.

Determination of Elemental Contents: The elements analyzed for in each timber sample was lead, copper, calcium, zinc, mercury, sodium, potassium, cadmium, magnesium and arsenic. The steps adopted in the elemental analysis were:

- Ashing the sample
- Digestion of the sample
- Analysis of the elements using the Atomic Absorption Spectrophotometer (AAS).

RESULTS AND DISCUSSION

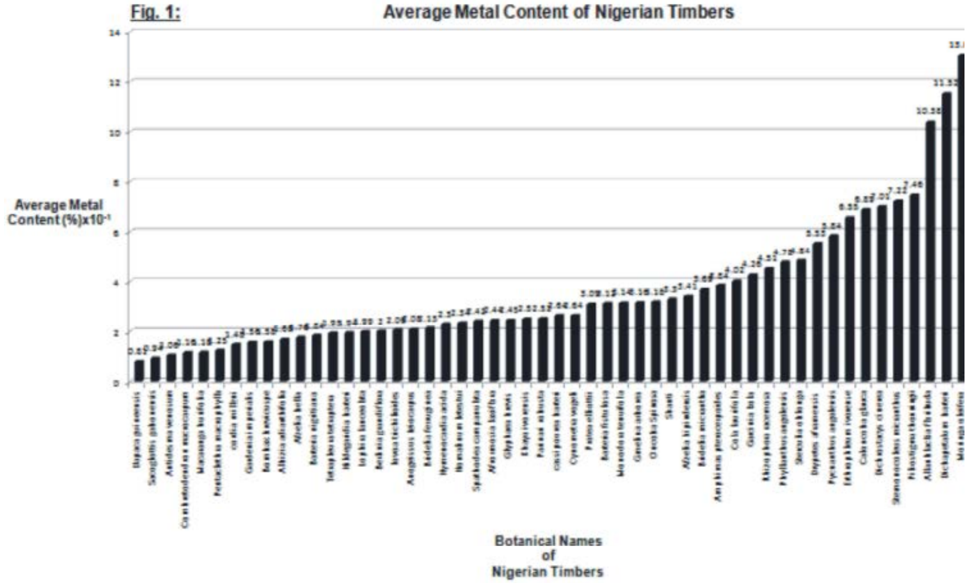
Figure 1 above represents the bar chart of average metal concentration (AMC) of timbers. The average metal concentration of these timbers is arranged in increasing order of magnitude. The timbers with the least average metal concentration of 0.81 $x10^{-1}$% is *Uapaca guineensis* while *Moringa oleifera* has the highest average metal concentration of 13.07 $x10^{-1}$%. The timbers; *Cassipourea barteri* and *Cynometra vogeli* are the only set of timbers with equal average metal concentration of 2.64 $x10^{-1}$%.

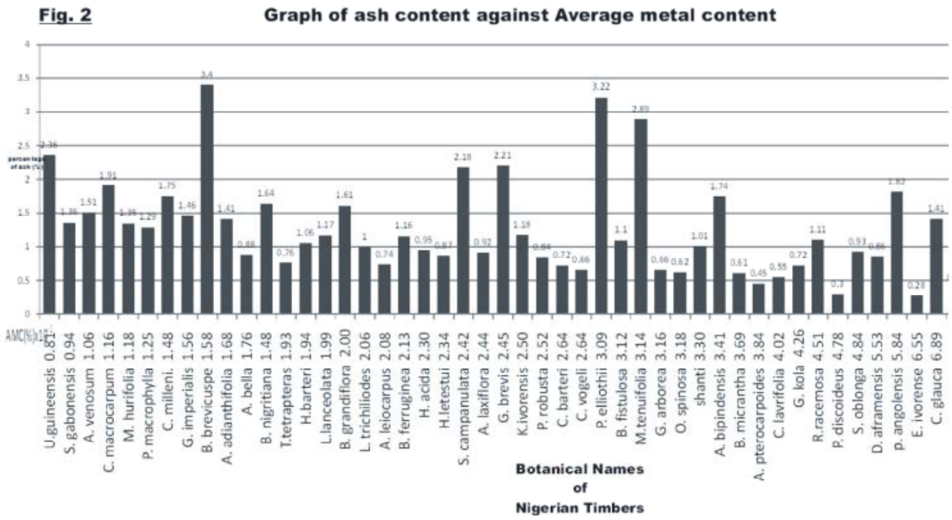
Figure 2 showed the graph of ash content or percentage of ash against average metal concentration. The timber *Uapaca guineensis* with the least AMC of 0.81 $x10^{-1}$% has the ash content of 2.36% while *Moringa oleifera* with the highest AMC of 13.0 7 $x10^{-2}$% has the ash content of 0.65%, *Erythrophleum ivorence* with the least ash content of 0.28% has the AMC of 6.55 $x10^{-1}$% while *Bombax brevicuspe* with the highest ash content of 3.4% has AMC OF 1.56 $X10^{-1}$%. The timber; *Cassipourea barteri* and *Cynometra vogeli* with equal AMC of 2.64 $x10^{-1}$% have different ash contents of 0.72% and 0.66% respectively. Also, *Cynometra vogeli* and *Gmelina arborea* have the same percentage of ash of 0.66% but different AMC of 2.64 $x10^{-1}$% and 3.16 $x10^{-1}$% respectively. From the graph, all timbers with very low ash content values (between 0.3% to 0.66%) possess high average metal concentrations. At low AMC, most timbers have high ash content. Though, there are few exceptions which may be due to difference in their environment and chemical composition. Thus, it was observed that there is an inverse relationship between the ash content and average metal concentration of these timbers.

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		tafla		Ibadan
50.	Khaya ivorensis	ono	oganwo	madachi	Calabaar
51.	Spathodea campanulata	imiewu	Oruru	delinya	Onitsha
52.			Shanty		

Fig. 1: Average Metal Content of Nigerian Timbers





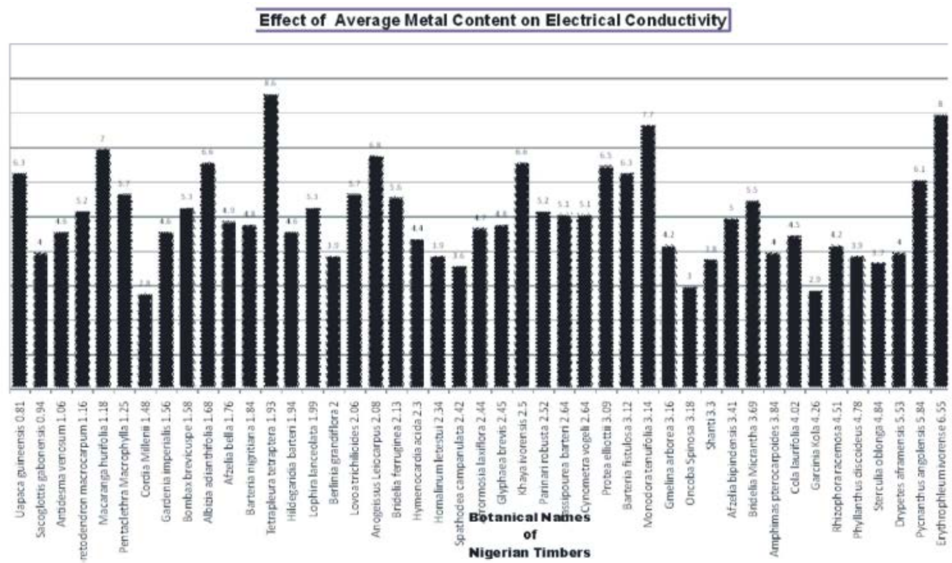


Fig. 3:

Figure 3 depicts the graph of electrical conductivity against average metal concentration. The graph shows that, *C. macrocarpum* with the least AMC of 1.16 $x10^{-1}$% has the electrical conductivity of 1.91 $x10^{-3}$ sm^{-1} while *M. oleifera* with the highest AMC of 13.07 has electrical conductivity of 0.65 $x10^{-3}$ sm-1. The first and second highest electrical conductivity timbers were *B. brevicuspe* and *P. elliottii* with electrical conductivities of 3.4 $x10^{-3}$ sm^{-1} and 3.22 $x10^{-3}$ sm-1 respectively have far wide range AMC of 1.58 $x10^{-1}$% and 3.09 $x10^{-1}$%. Those timbers with equal electrical conductivity have varied average metal concentrations. Therefore, there is neither direct nor inverse relationship between electrical conductivity and average metal concentration. This observation is clear and well expected. The average metal concentration of these timbers will not be dependent on their ash content and electrical conductivity. This is because, research finding have proved to some extent that the accumulation of certain metals in plants and animals depends in an area where the environment is polluted with some heavy metals, the plant or the animal is bound to incorporate large quantity of the metals into its cell and tissue [8] and [9]. It must also be realized that the metals are not in form of ions in the woods.

Aquatic plants that grow near rivers and seas containing nourishing or micro constituent elements imbibe the elements into their tissues. This is because; they absorb the water (solution of the element) from the sources. It is known that "one of the sources of iodine is seawater and that some amount of this element is presented in the brown seaweed called *larminaria* [10]. Therefore timbers grown around seawater are expected to be rich in iodine.

Research also reveals that fishes caught in polluted seas and rivers contain some amount of heavy metals in their tissues [11]. Research reports have indicated that metals occur in significant amounts in both temperate and tropical timbers [12] and [13].

It has been reported that metals, though varying in concentrations in the timber species, influence some characteristics of the timbers, such as thermal conductivity, flammability, after-glow time, ignition time and evolution of smoke particulate [14]. It was pointed out earlier that behaviour of wood in response to fire is dependent on many factors which include moisture content, oven dry density, pore content and arrangement of grains (fibre): wood irrespective of its biogenesis consists essentially of three major components; the cellulose fibre, the binding material or lignin and relatively small percentage of hemicelluloses [15]. The amounts of these macromolecules vary in wood species. In considering the thermal or electrical properties of these timbers in relation to their average metal content, these major factors, the amount of the three major components of wood and the arrangement of grain must be put into consideration.

CONCLUSION

In conclusion, the results of this analysis revealed that the average metal concentration of these fifty two timbers is not dependent on their ash content and electrical conductivity. Therefore, there is neither direct nor inverse relationship between electrical conductivity and average metal concentration of the timbers analyzed.

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