Journal of Emerging Trends in Educational Research and Policy Studies (JETERAPS) 2 (2): 139-143
 (ISSN: 2141-6990)
jeteraps.scholarlinkresearch.org

A Quantitative Analysis of Some Nigerian Wood Species as Local Material in Printmaking Technology

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Abstract
Contemporary research trends in Nigeria have always emphasized the need for identification of the possibilities of developing indigenous technologies for art and crafts that would be proudly tagged "made-in-Nigeria". Experimentation skills and local productivity is of the essence in, promotion of indigenous technologies that are achievable within the limit of locally available materials. Incidentally, one of the important aspects of instruction in Graphics that seems to suggest the need for a study of materials and exploration for aesthetic art production is printmaking. This research has therefore focused on investigating the suitability of some Nigerian wood species as local material in printmaking technology. Locally sourced wood species i.e. Iroko (Melicia excelsa), Obeche (Triplochiton scleroxylon), Mansonia (Mansonia altissima), Mahogany (Entandrophragma cylindricum), Omo (Cordia millenii), Aye (Sterculia rhinopetalia), Afara (Terminalia superba), Ayinre (Albizia lebbek), Danta (Nesogordonia papaverifera), and Abura (Mitragyna ciliata) were quantitatively examined by using the criteria of ink absorption rate, cut characteristics, texture registration and durability testing. The factors or parameters that determine good, quality print impression have been identified to be the texture of the wood itself, its ink absorption pattern, the cut characteristic and the durability of wood in term of whether it is hardwood or wood that is easily attacked by wood-boring insects and which can destroy or give bad turning point to the design on the surface of the wood. However, the findings show that Iroko, Mansonia, Omo and Danta wood species have passed the test of the parameters and are attested all appropriate for woodprint in the preferable order in which they have been indicated above. Obeche, Ayinre, Mahogany, Afara, Abura and Aye are in that order usable but white wood species such as Obeche, Abura and Ayinre are not durable.

Keywords: wood species, printmaking, transformation, aesthetic, wood-boring

INTRODUCTION

Common belief seems to be that science and technology develops a nation, but Nwogu (1991) has shown otherwise. It states that nations of the world that were early in realizing the indispensability of research to overall national development, and accorded it the necessary priority it deserves, are today reaping bountiful fruits of their foresight. The nations now regarded as scientifically and technologically advanced virtually rule the world, and are steadily marching on to control the outer space (Nwogu op cit). Research efforts have again been noted by Lindbeck and Lathrop (1977) to be responsible for the various developments. According to Lindbeck and Lathrop (*op cit*), the new products, materials, and processes which help us to live better do not just happen accidentally, they are invented and perfected by persons who work in research and development.

Artistic, scientific and technological creativity are products of researches and discoveries of man., and in response to his eye, mind and feelings has caused his hands to endow the raw, uninformed materials of nature with aesthetic significance, Therefore, making them not only things of beauty and expression but of relevance to the need of the society (Haruna, 2003). For this reason, art, science and technology are accessories that should web together to produce research results that bear relevance with the present and future needs of the country. Fatuyi (2000) opines that art and technology are quite relevant to any nation's development in view of the functional relationship of art to the society. If art is truly a technological tool in national development (Fatuyi, *op cit*), and if creative and aesthetic awareness among Nigerians is needed for rapid national advancement in science and technology (Okpalaoka, 1999: 21), it is therefore the thrust of this study to support the position of Fuwape (2000) that wood is a versatile artistic raw material. From time to time, the knowledge of its working properties should help the artist in art production and utility. Nigerians as a people blessed with abundant raw materials such as wood, clay, lime, charcoal, silica, bitumen, and other art-related mineral resources (Momoh, 1988, Ekong, 2002, Egonwa, 2004 and National directorate of Employment, 2005), should have genuine delight in creatively exploring possible transformation of the local materials for production experimentations.

AIM AND OBJECTIVES OF THE STUDY

The research focuses on quantitative analysis of the suitability of the working variables of wood in printmaking production. This aspect of the visual arts (printmaking) is a branch of graphics that is technological in process and aesthetic in function. This research investigated some of the Nigerian wood types in table 1 as for their properties as local raw material that can be depended upon as a medium in printmaking technology. The aim of the study is to identify some common Nigerian wood species suitable for wood print reproduction processes. The steps to be taken (objectives of the study) to achieve the aim are to:

i. classify the wood species based on their working characteristics.
ii. find out their suitability for wood print reproduction.
iii. investigate if there is any significant relationship between the selected wood species with respect to print quality.

STATEMENT OF THE PROBLEM

Woodcut is a method of printmaking whereby the image is drawn or written on a block of wood and the background cut to make the image stand out in relief. The surface of wood adds textural registration to prints – a natural effect which no other smooth printing substrate can ever produce. Some factors necessitate this research, first, there is undue emphasis on the use of linocut for printmaking because its surface is flat and of the right hardness for the cutting tools to move easily and smoothly. One drawback, however, is that the rubber-like surface of linoleum sheet does not enhance grainy effects on prints as much as wood would do. How to use what one has to get what is needed has been one of the economic problems most Nigerian artists are facing today. Based on a pilot study that was conducted leading to the identification of the problem, the research revealed that numerous practical innovations have been brought into the field of art and design in Nigeria by renowned artists (Egonwa, 2004, Shyllon, 2004) but currently, studies of the working parameters (texture, ink absorption, cut characteristics and durability) of wood for printmaking is rare especially among printmakers and art and design scholars in Nigeria

JUSTIFICATION OF THE STUDY

According to Ojo (2000), master-printmakers in Nigeria like Late Solomon Wangboje, Bruce Onobrakpeya, Kunle Filani, Bankole Ojo and Kunle Adeyemi have worked on wood prints as an aspect of the graphic design system that has aided the aesthetic and cultural identities of Nigeria but the area that has not been delved into by the Nigerian printmakers is the study of wood itself for printmaking, hence, the gap this study intends to fill is the quantitative study of wood for printmaking. This research is different from what others have done in that it looks at, and documents, the working parametres which make wood suitable for woodcut printing from a quantitative perspective . It is all about determining the right wood for an expected print result in terms of good cut characteristics, ink absorbency, grains and textural advantage and the durability of woodblock for continuous mass production.. This factor would help the printmaker to be familiar with the behavioural pattern of such material.

Table 1. Some local wood species available in Yoruba land, Nigeria.

Yoruba names of wood	Botanical Name(s)
Apa	Afzelia spp
Ayinre	*Albizia lebbek*
Ahun	*Alstonia congensis*
Oro	*Antiaris africana*
Arere	*Bombax spp*
Eku	*Brachystegia spp*
Ita	*Celtis occidentalis*
Iroko	*Melicia excelsa*
Omo	*Cordia millenii*
Black Ebony	*Diospyros spp*
Ayan	*Distemonanthuc bentramianus*
Sapele	*Entandrophragma cylindicum*
Utile	*Entandrophragma utile*
Lagos Mahogany	*Khaya spp*
Ekki	*Lophira alata*
Apopo (African Walnut)	*Lovoa trichilioides*
Danta	*Nesogordonia papaverifera*
Agboin	*Piptadeniastrum africanum*
Osun	*Ptenirocarpus soyauxii*
Akomu	*Shorea spp*
Aye	*Sterculia rhinopetela*
Teak	*Tectona grandis*
Afara	*Terminalia superba*
Idigbo	*Terminalia ivorensis*
Obeche	*Triplochiton scleroxylon*

RESEARCH METHODOLOGY

This research took place in Akure, a growing town in Yoruba land and the Ondo State Capital, Nigeria. Although there are many species of hard and soft wood, ten hard wood species are commonly patronized by timber contractors, builders, woodcarvers and cabinet-makers in the town and the whole ten were picked by census method for the study, and these constituted the sampling size. The research instrument used for this research was self-designed sets of *questionnaire*. It was fashioned in the likeness of Likert scale model. Relevant data were collected from the commercial forest timber contractors, wood carvers, printmakers, and the forest and wood Technology Department of the Federal University of Technology, Akure, Nigeria. Apart from the use of questionnaire, *practical studio experimentation* was carried out in which case the selected wood species were examined in respect of its parameters such as texture registration, ink

absorption, cut characteristics and durability in order to find out if there is significant difference or relationship with respect to the above parametres that determine print quality.

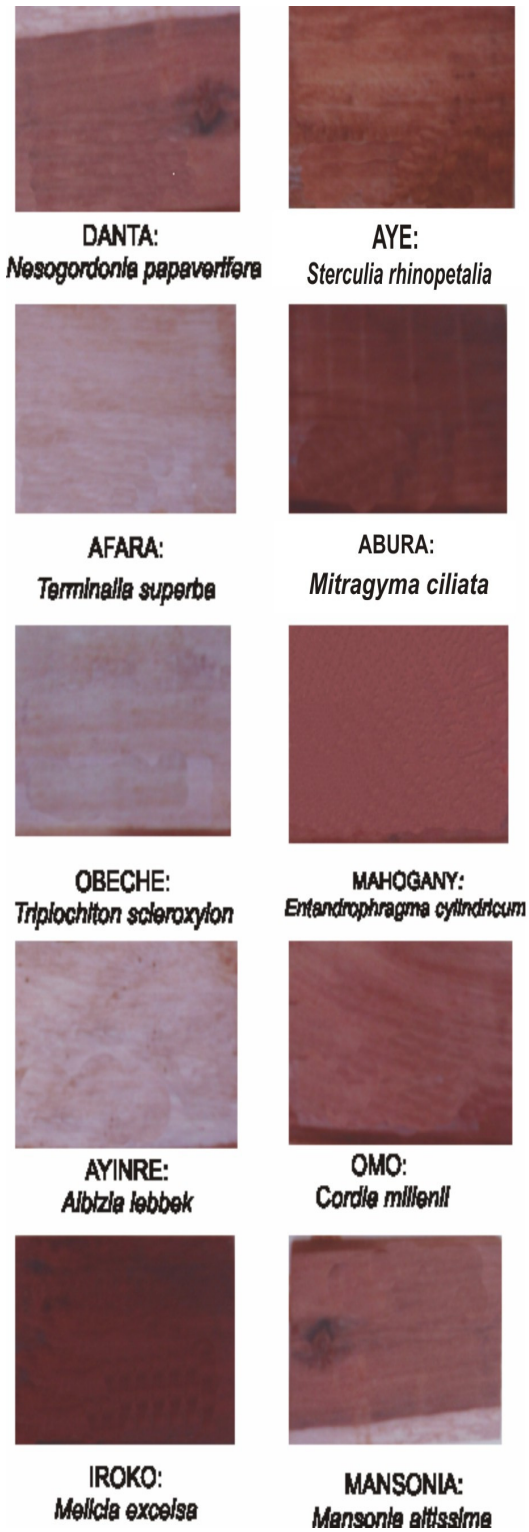

Figure 1. The Ten Tested Wood Species Common In Akure, Ondo State, Nigeria

DATA ANALYSIS AND PRESENTATION OF RESULTS

Analysis of Variance (ANOVA)

The purpose of the analysis of variance (ANOVA) is to test whether there is any significant difference in the means of the factors that determine print quality between the ten woods studied. The ANOVA table is presented in Table 2.

Table 2: ANOVA Table

Source of Variation	Sum of Squares	Degree of Freedom	Means Square	Fcal	Ftab
Wood Print – Quality	11.525	9	1.281	5.103	2.25*
Factors	19.475	3	6.692	25.871	2.96*
Error	6.775	27	0.251		
Total	37.775	39			

* Significant at 0.05 significant level.

The result presented in Table 2 above shows that there is significant difference between the woods in terms of their print quality at 0.05 significant level or 95%confidence level. This is because the calculated F-ratio (5.203) is greater than the tabulated F-ratio (F9, 27, 2.25) at 0.05 significant level.

Table 3: Duncan Multiple Range test of Print Quality of Woods

Wood	Mean + Standard Error
Iroko	2.25 ± 0.25c
Obeche	1.25 ± 0.25ab
Mansonia	2.5 ± 0.25c
Mahogany	1.75 ± 0.25bc
Omo	2.25 ± 0.25c
Aye	0.75 ± 0.25a
Afara	2.0 ± 0.25bc
Ayinre	1.25 ± 0.25ab
Danta	2.25 ± 0.25c
Abura	2.00 ± 0.25bc

Means that carry the same alphabet(s) are not significantly different in their print quality level. Iroko, Mansonia, Omo and Danta, which carry alphabet "c" are not significantly different in their print quality. On the other hand, Obeche and Ayinre, which carry alphabets "ab" do not differ significantly in their print quality. Also, Mahogany, Afara and Abura, which carry alphabets "bc", do not differ significantly in their print quality. Finally, Aye, differs significantly in print quality from the other woods. Hence, based on the result of the analysis, the ten wood species are classified into four groups based on their print qualities as follow:

a. Iroko, Mansonia, omo, danta
b. Obeche, Ayinre
c. Mahogany, Afara, Abura
d. Aye

In order to determine which of the woods have its print quality significantly different from the other, a follow-up test was carried out using Least Significant Difference (LSD) test. The matrix of the mean difference of the ten woods is computed and the result is presented in Table 4.

Table 4: LSD Test of Print Quality of Woods

	Iroko	Obeche	Mansonia	Mahogany	Omo	Aye	Afara	Ayinre	Danta	Abura
Iroko	-									
Obeche	1.00*	-								
Mansonia	-0.25	-1.25*	-							
Mahogany	0.50	-0.5	0.75*	-						
Omo	0.00	-1.00*	0.25	-0.50	-					
Aye	1.50*	0.50	1.75*	1.00*	1.50*	-				
Afara	0.25	-0.75*	0.50	-0.25	0.25	-1.25*	-			
Ayinre	1.00*	0.00	1.25*	0.50	1.00*	-0.50	0.75*	-		
Danta	0.00	-1.00*	0.25	-0.50	0.00	-1.50*	-0.25	-1.00*	-	
Abura	0.25	-0.75*	0.5	-0.25	0.25	-1.25*	0.00	-0.75*	0.25	-

*Mean difference significant at the 0.05 level

Correlation Analysis of the Factors that Determine Print Quality

The correlation matrix of the correlation co-efficient of the factors that determine print quality are presented in Table 5.

Table 5: Correlation Matrix of the Factors that Determine Print Quality

	Print Quality	Texture	Ink Absorption	Cut Characteristics	Durability
Print Quality	1.000				
Texture	0.643*	1.000			
Ink Absorption	0.843*	0.542	1.000		
Cut Characteristics	0.837*	0.429	0.877*	1.000	
Durability	0.717*	0.600*	0.867*	0.842*	1.000

*Correlation is significant at 0.01 significant level.

It could be observed from Table 5 that all the factors that affect/determine print quality are positively correlated with print quality of the wood. This means that an improvement in these factors will improve print quality. Ink absorption has the highest correlation (0.843) with print quality, Cut characteristics (0.837), Durability 0.717) and Texture (0.843). Also, from Table 4, all the determinants of print quality have positive correlations with one another.

Regression Analysis of factors that determines print quality

In order to investigate the factors that determine print quality, multiple linear regression analysis was carried out. Basically, regression analysis specifies the relationship that exists between a dependent variable (predicted variable) and independent variables (predictors or explanatory variables). Explicitly, the relationship that exists between print quality and determinants of print quality could be stated as follows:

$$Y = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + e$$

Where

Y	=	print quality
X_1	=	Texture
X_2	=	Ink Absorption
X_3	=	Cut characteristics
X_4	=	Durability
a	=	Constant term
$b_1 – b_4$	=	Regression co-efficient
e	=	Error term

The empirical result of the regression analysis is presented in Table 6.

Table 6: Empirical result of factors that determines print quality

Variable	Regression co-efficient	t-ratio	Remark
Constant	-0.304	-0.568	NS
Texture	0.348	1.816	NS
Ink Absorption	0.384	1.103	NS
Cut Characteristics	0.674	1.741	NS
Durability	-0.739	-1.241	NS

NS = Not significant at 0.05 level

$R^2 = 0.857$

F4, 5,7.464

Table 6 reveals that the co-efficient of multiple determinations (R^2) is 0.857. This shows that about 85.7% of the variations in print quality are jointly explained by the four variables fitted into the equation. The F-ratio (F0.05, 4, 5, 7.464) is significant at 0.05 level. This shows that the model derived could be relied upon for prediction purposes. However, none of the variables alone significantly determined print quality, but all of them combined together constitute significant determinants of print quality. Finally, from Table 4.5, the following equation could be derived.

$$Y=0.304 + 0.348X_1 + 0.384X_2 + 0.674X_3 - 0.739X_4$$

Ranking of the woods based on total score of factors that determine print quality

In Table 7, the scores of the four factors that determine print quality are presented as well as the total score and ranking of the print quality of the woods based on the total score.

Table 7: Ranking of the print quality of the woods

Wood	Texture	Ink Absorption	Cut Char.	Durability	Total score	Remark
Iroko	2	3	3	1	9	2nd
Obeche	1	1	1	0	3	6th
Mansonia	3	3	3	1	10	1st
Mahogany	2	2	2	1	7	4th
Omo	3	3	2	1	9	2nd
Aye	1	1	1	0	3	6th
Afara	3	2	2	1	8	3rd
Ayinre	3	1	1	0	5	5th
Danta	3	3	2	1	9	2nd
Abura	3	2	2	1	8	3rd

Table 7 shows that in terms of print quality, Mansonia ranked first, Iroko, Omo and Danta ranked second, Afara and Abura ranked third, Mahogany ranked fourth, Ayinre ranked fifth while Obeche and Aye ranked sixth.

CONCLUSION

This research focuses on the study of only ten out of the local wood species available in Akure and its suburbs. The wood species selected randomly were Iroko (*Melicia excelsa*), Omo *(Cordia millenii)*, Mansonia *(Mansonia altissima)*, Danta *(Nesogordia papeverifera)*, Obeche *(Triplochion scleroxylon),* Mahogany *(Entandrophragma cylindricum)*, Aye *(Sterculia rhenobetalia)*, Afara *(Terminalia superba)*, Ayinre *(Albizia lebbek)*, and Abura *(Mitragyna ciliata)*. Their structures, physical and mechanical properties were looked into in line with woodcut technique and the expected end results. In pursuit of the above therefore, the conduct of this study was restricted to Akure Township and the local villages surrounding it with assistance from the Department of Forestry and Wood Technology, Federal University of Technology, Akure, Ondo State, Nigeria. A number of forest timber contractors and wood carvers were contacted in the local places visited and they proved useful during the process of the study. More also, supplies of wood planks of various species were abundant both in quality and quantity.

As mentioned earlier, ten wood types were randomly picked, studied and cut to make print impressions on paper. In the process however, observation on wood durability, pliability and ink absorption and cut resistance were recorded. So also in the process, it is discovered that some level of softness is required when selecting wood for cutting. Wood grain textures and weight of woodblock from which print impression is to be taken are noted to be of little importance in wood printing as they may alter designs and figurations or give the printmaker a bad turning point while making prints.

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