MORINGA OLEIFERA: A UNIQUE RESOURCE FOR PULP AND PAPER PRODUCTION

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ABSTRACT

The investigation examines the fibre characteristics of *Moringa oleifera* to determine its suitability for pulp and paper manufacturing in Nigeria. The fibre length of the species was considered to be fairly long .The fibre length (1.1906mm) and coefficient of flexibility (67.89 %,) was not significantly different within the sampling position of the trees. The outcome of the result indicated that the value increase from the base (64.11µm) to the middle (64.72µm) and later decrease towards the top to (55.10 µm), however, the follow up test shows that the average fibre diameter (61.31µm); while at the middle and base are the most significant. For the lumen width, cell wall thickness, Runkel Ratio and felting power (41.68µm, 10.01µm and 0.50) was also significant at the base ($p<0.05$).The result of the investigation showed that all part of the species i.e. base , middle and the top can be utilized for pulp and paper production. The species is a potential material for pulp and paper production.

Key words: *Moringa oleifera*, pulp and paper, fibre length, Runkel Ratio, Lumen

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INTRODUCTION

The growing demand for pulp and paper products by the increasing Nigeria population with an estimate of over 140million people has a steady increasing requirements for pulp, paper and paper products and has also placed a lot of pressure on the pulp and paper industries. Lintu (1990), disclosed that high rate of paper consumption has since skewed from advanced countries to the developing countries. This is an indication of great challenges of the developing countries in terms of meeting the requirement of paper demand by the end of 21st century. FAO (1990) projected that the demand for paper and paperboard in Africa will increase from 3.31 million m^3 in 1993 to 8.27 million m^3 by the year 2010 while that of Nigeria is expected to reach 338000 m^3 from 169000m^3.

The major species used as raw material for pulp and paper making are the long fibre exotic wood species such as Gmelina, Eucalyptus and the Pine. Wood possessing and long fibre, low percentage of vessels and ray cells, low gelatinous fibre as well as thin walled fibres is most desirable for the paper industries. (Panshin, 1994). Pulp can be made from a number of species of wood but the commercial utility of a particular species depend on many factor which include the suitability of their fibres since, each has its own unique properties and may be used when blended with each other for making different grades of paper (Famuyide and Adejoba, 2004). Two factors are usually considered for any wood as a source of fibre for pulp and paper production, the first is yield of fibre per given volume or weight of the wood while the second is the quality of the resulting fibre. The former depends on the wood, prior to pulping processes employed in conversion into pulp, while the later is the wood and paper quality resulting from any pulp wood plantation. (Osadare, 2001) and (Udohitinah, 1993) discovered that coniferous wood, especially pines with longer tracheid length than the fibre of hardwood species, will for long remain the major source of long fibre pulp in the world. Hence, the increase paper demand calls for research into lesser used species that could serve as good potential raw material for paper production.

(Adejoba *et al*, 2008). This study was designed to evaluate the fibre characteristics of *Moringa oleifera* which is abundantly available. A study of its fibre characteristics will give detailed constituents of its relevance and desirability for pulp and paper industry.

Moringa oleifera Lamarck belong to Moringaceae family. It is a slender, deciduous, perennial evergreen tree that originated in India but has spread to other regions of the world (Foidl *et al*., 2001). It is one of the fastest growing trees in the world with high biomass yield, high crude protein of + 25% and a balance of other nutrients in the leaves (Makkar and Becker, 1996, Foidl *et al*, 2001; Asaolu *et al*, 2010). Moringa provides food, medicine, fuel and other uses but it's potential as an important browse plant for small ruminants diet supplementation has not been fully documented (Gutteridge and Shelton, 1993; Anjorin *et al.*, 2010) Moringa can thrive well in any region where the soil is not waterlogged (Asaolu *et al*., 2006). Although in cultivation the primary goal is vegetable production, the tree can also play a role in erosion control, as a live fence, as a windbreak, for shade and as a bee plant. (Bosch, 2004).

MATERIALS AND METHOD

SAMPLE COLLECTION

This study was conducted at Forestry Research Institute of Nigeria (FRIN) at Ibadan while the materials for the study were obtained from the Central Nursery of Forestry Research Institute of Nigeria (FRIN) Ibadan. Samples were collected from the mature bole of two trees each with no visible defects at the different point along the axis direction of the tree that is at the base, middle and top respectively.

SAMPLE PREPARATION

The wood slivers were obtained and put into test tubes and macerated with an equal volume (1:1) of glacial acetic acid and 30% hydrogen peroxide as adopted by Oluwadare, (2006). This was later heated in an oven for four hours at 80^0C until it bleached white and soft. The hydrogen peroxide acts as the oxidizing agent which bleached the wood silvers completely to white while the glacial acetic acid acts as the cooking medium which soften the silvers. The chemical mixture was decanted and macerated fibers were rinsed several times with distilled water and defiberised to separate each fibres apart. This process was conducted for each of the wood sample collected from the three different levels along the tree bole.

The fibers were viewed under photography microscope; twenty five fiber samples each were randomly measured from the base, middle and top of the selected trees. This amounted to one hundred and fifty (150) samples. The fibre dimension evaluated included fibre length (FL), fibre diameter (D), lumen width (LW) and fibre cell wall thickness (FT); from these parameters derived values for Coefficient Flexibility (F), Runkel Ratio and Felting Power were calculated. Descriptive analysis and analysis of variance (ANOVA) were adopted to analyse the parameters obtained while Duncan multiple range was used to determine the level of significance.

Computation

The cell-wall thickness was obtained by dividing the difference between the fibre diameter (D) and the lumen width (LW) by two (2):

$$\text{Cell-Wall Thickness (CW)} = \frac{D - LW}{2} \qquad \text{------------- (eqn 1)}$$

The lumen width (LW) is the internal cavity; it is the average measurement of the fibre diameter

$$\text{Lumen Width (LW)} = \frac{D}{2} \qquad \text{------------ (eqn 2)}$$

$$\text{Flexibility} = \frac{LW}{D} \times 100 \qquad \text{------------- (eqn 3)}$$

$$\text{The Runkel Ratio (RR)} = \frac{2W}{D} \qquad \text{-------------- (eqn 4)}$$

RESULT AND DISCUSSION

Table 1 showed the mean value for the fibre characteristics of the wood samples collected at the three different levels (base, middle, top) of the selected trees of M*oringa oleifera*.

Average fibre length was observed to be 1.1906mm along the stem. There was a decrease in the fibre length (1.1900mm) from the base to the middle (1.1623mm), thereafter increase towards the top (1.2196mm).This is in line with the view of Osadare and Udohitianh (1993) and Ogunsanwo,(2000).

Average fibre diameter was (61.31µm); outcome of the result indicated that the value increase from the base (64.11µm) to the middle (64.72µm) and later decrease towards the top to (55.10 µm), this observation agree with the report of Ojo *et al* 2008 and Adejoba *et al*, 2008

The lumen width average means was (41.68µm) and the result increase from the base (39.35µm) to the middle (47.61µm) and later decrease towards the top (38.08µm).

The average cell wall thickness means was (10.01µm).The value increases from the base (12.78µm) and the middle was (8.84µm) and the top decreases to (8.41µm).This is in line with the Observation of Ojo *et al* 2008.It was also observed that the species has a thin walled fibres.

The average means of Runkel Ratio was (0.50).This increases from the base (0.65) and decrease to the middle (0.38) and thereafter increase towards the top (0.46).It was reported that a fibre with Runkel Ratio of less than one has a potential for pulp and paper production. (Yusuff, 2007). In the same vein, the species has a potential material for pulp and paper production since the Runkel Ratio is less than one (1).

The average flexibility is 67.89%. It increases from the base (61.40%) to the middle (73.49%) and thereafter decreases towards the top (68.79%).This are within the range of 570% for most soft wood. The fibre is expected to collapse readily and flatten during beating operations. It is as well expected that the paper produced from this species will have a considerable inter-fibre bonding and hence have great tensile strength as well as favour those properties that affect printing.

The average mean for slenderness is 19.85; the values increase from the base (18.78) and decreases toward the middle (18.13) and subsequently increase toward the top (22.64).

Table 2 shows the ANOVA result of *Moringa oleifera*. The fibre length was not significantly different within the sampling position of the trees. Whereas the follow up test shows that the fibre diameter at the middle and base are the most significant. For the lumen width, cell wall thickness, Runkel Ratio and felting power, the most significant is at the base ($p<0.05$).The result of the investigation showed that all part of the species i.e base, middle and the top can be utilized for pulp and paper production.

CONCLUSION

The result of the investigation of fibre characteristics of the wood stem of moringa oleifera revealed that the species have a long fibre length for paper production. A distinct pattern of variation could be attributed to other fibre characteristics of the species. Longer fibre can be obtained from the base portion and towards the top portion of the species. The derived parameters i.e, the Cell wall thickness, Runkel Ratio, Lumen Width and the flexibility shows that the pulp is good and can be used to produce paper of different grades. The result of the investigation therefore showed that the species is a good potential material for pulp and paper production in Nigeria.

It is therefore recommended that more research should be carried out on the species to look at the chemical and anatomical composition and characteristics in paper manufacturing.

REFERENCES

Adejoba,O.R, Onilude,M.A, Areo,O.S and Joseph,F (2008): Evaluation of Luffa Cylindrica plants in Paper making. Journal of Research in Agriculture Vol 5, No 4, 2008 pg 44-47.

Anjorin T.S, Ikokoh, P. and Okolo, S (2010). Mineral composition of Moringa oleifera leaves, pods and seeds from two regions in Abuja, Nigeria. International Journal of Agriculture and Biology 12: pp 431 – 434.

Asaolu V.O, Odeyinka S.M, Akinbamijo O.O, Sodeinde F.G (2010) – Effects of Moringa and bamboo leaves on groundnut hayutilization by West African Dwarf goats. Livestock Research for Rural Development 22(1)

Bosch, C.H., 2004. Moringa stenopetala (Baker f.) Cufod. In: Grubben, G.J.H. & Denton, O.A. (Editors). PROTA 2: Vegetables/Légumes. [CD-Rom]. PROTA, Wageningen, Netherlands.

FAO (1990); Trees.Their classification,gross anatomical features and their functions.

Famuyide,O.O and Adejoba,O.R (2004):Non-Wood Fibres, an alternative to fibre supply. A publication of Association of Wood and Paper Technology Students, Federal College of Forestry, Ibadan.

Foidl N, Makkar H.P.S and Becker K. (2001). The potential of Moringa oleifera for agricultural and industrial uses. In: proceedings of International Workshop. What Development potential for Moringa Products October 29th to November 2nd 2001. Darussalam, Tanzania.

Gutteridge R.C and Shelton H, M (1993) Forage tree Legumes in Tropical Agriculture published by the tropical grassland society of Australia Inc. pp 79 – 81.

Lintu, L (1990). World market situation and new trends in newsprint. **In:** (Proceedings) *; International Seminar on Newsprint from Bagasse*, La Habana (Cuba), 2-5 Oct 1990 Hernandez Ramirez, J. *(ed.)* Calatayud Jimenez, J.R. *(ed.)* / Cuba-9, La Habana (Cuba); ONUDI, Vienna (Austria) , 1990, p. 41-52

Makkar, H.P.S and Becker K (1996) Nutritional value and anti nutritional components of whole and ethanol extracted Moringa olefera leaves. Animal Feed Science and technology. 63 (1 – 4) pp 221 – 228.

Ojo,A.R,Alao, O.J.,Onilearo,K.S.,Asinwa,I.O,Badejo,B.Y, and Bello,F.B
(2008): Evaluation of selected fibre characteristics of the wood of Leucaena leucocephala (Lam) Dewit along the vertical axis. Obeche Journal 27(1), Nov 2008 34-37.

Ogunsanwo,O.Y. (2000).Characherization of Wood properties of plantation Grown Obeche (*Triplochiton sceleronxylon* K Schum) In Omo Forest Reserve, Ogun Sate, Nigeria.

Osadare,A.O.(2001).Basic wood and pulp properties of Nigerian Grown Caribbean pine (pinus caribea Morelet) and its relationship with tree growth indices. Ph.D Thesis, Department of Agricultural Engineering, Faculty of Technology, University of Ibadan, Nigeria.

Osadare,A.O.and Udohitinah,J.S.(1993).Fibre characteristics of some Nigerian raw materials for long fibre pulp production. In Oduwaye, A.E (1993): Forestry for Urban and Rural Development in Nigeria. Proceedings of the 23rd Annual Conference of the Forestry Association of Nigeria, Ikeja, Lagos.

Pansin,J.B (1994):The Utilization of natural resource. Unasylva Vol 1&2 4-6 FAO journal Vol.102, prepared by the Hens M.Gregson and Anorld H.

Yusuff, S.O. (2007). Evaluation of the Fibre characteristics of Kenafs (Hibiscus sabdariffa and Hibiscus canabinus) and Yellow bush (Durata ripens).ND project in the Department of Wood and Paper Technology, Federal College of Forestry, Ibadan.

Table 1: Mean values of the fibre characteristics of *Moringa oleifera*

Fibre Characteristics	Tree 1	Tree 2	AV mean	Mean
Fibre Length(mm):				
Base	1.1936	1.1864	1.1900	1.1906
Middle	1.1440	1.1805	1.1623	
Top	1.2336	1.2056	1.2196	
Fibre diameter(µm):				
Base	64.16	64.06	64.11	61.31
Middle	64.96	64.47	64.72	
Top	54.08	56.12	55.10	

Lumen width (µm):				
Base	38.72	39.98	39.35	41.68
Middle	47.20	48.01	47.61	
Top	37.92	38.24	38.08	
Cell wall thickness (µm):				
Base	12.72	12.84	12.78	10.01
Middle	8.88	8.79	8.84	
Top	8.08	8.74	8.41	
Runkel ratio				
Base	0.66	0.64	0.65	0.50
Middle	0.38	0.37	0.38	
Top	0.45	0.46	0.46	
Coefficient of flexibility %:				
Base	60.38	62.41	61.40	67.89
Middle	72.51	74.47	73.49	
Top	69.44	68.14	68.79	
Felting power :				
Base	19.04	18.52	18.78	19.85
Middle	17.94	18.31	18.13	
Top	23.80	21.48	22.64	

Table 2

Sources of variation	Sum of Squares	Mean Square	F
Fibre Length	.003	.002	4.553
Fibre Diameter	115.996	57.998	78.879
Lumen Width	106.989	53.495	136.809
Cell wall thickness	23.227	11.614	152.109
Runkel Ratio	23.227	11.614	152.109
Coefficient of Flexibility	148.710	74.355	46.219

Felting Power	23.809	11.905	12.337

ANOVA

Fibre Length

	Sum of Squares	df	Mean Square	F	Sig.
Fibre Length	.000	1	.000	.000	.988 ns
Fibre Diameter	115.996	2	57.998	78.879	.003 *
Lumen Width	106.989	2	53.495	136.809	.001 *
Cell wall thickness	23.227	2	11.614	152.109	.001 *
Runkel Ratio	23.227	2	11.614	152.109	.001 *
Coefficient of Flexibility	148.710	2	74.355	46.219	.006 ns
Felting Power	23.809	2	11.905	12.337	.036 *