HANDMADE PAPER FROM RAPHIA

U.D.AKPABIO
DEPARTMENT OF CHEMISTRY AND BIOCHEMISTRY
UNIVERSITY OF UYO, P.M.B. 1017, UYO
AKWA IBOM STATE NIGERIA

(Receieved June 24, 1998) (Accepted Nov., 11, 1998)

ABSTRACT: Raphia obtained from the dorsal surface of the leaves of Raphia hookeri was examined as a possible raw material for paper making. Analysis showed that it contains 2.2% ash and 3.0% moisture but the latter is reduced to 8.0% on air drying. Its solubilities in hot water and 1% NaOH are 5.0% and 10.0% respectively while benzene-ethanol mixture (2:1) extracts 5.4% of the material. It has a fibre length of 1.26mm and a 0.014mm width and contains both lignin and resin acids.

Raphia is easily pulped and bleached with H_2O_2: CH_3COOH mixture (1:1) and a solution of sodium hypochlorite yielding 45.0% and 50.0% pulp respectively. Sheets of paper manually made from the unbeaten pulp stock with a locally fabricated hand mould have good formation with soft texture and water absorbency capacity of 4.87; low tensile-tear strength of 24.5Nm^{-1} and are readily disintegrated in water. Such papers are suitable for making water dispossable tissues and paper towels.

INTRODUCTION

Paper produced manually is referred to as handmade paper. However, the quantity of handmade paper could not meet with consumers demands and therefore during the industrial revolution in Europe paper making machines were introduced to produce more paper based on the mechanisation of hand made paper technique (Watson, 1978). Today, nearly all the papers are machine made. Machine made papers usually have smooth surfaces against the undulations present in handmade papers and which are of special interest to the artists. Another disadvantage of machine made papers is that the stored life is shorter than that of handmade paper. Thus, some specialty papers are still presently produced by hand. Also, paper making machines are becoming very expensive to purchase and maintain and developing countries like Nigeria find it difficult to run paper mills. There is the need therefore to apply simple, economic and easily adaptable technique to produce paper.

Raphia is a natural cellulosic composite material formed at the dorsal side of the leaves of the plant Raphia hookeri. It is obtained from the leaves by carefully peeling the upper face covering layer with fingers. Traditionally, raphia is used in making bags, mats, baskets and decorative wearing apparels for cultural and dancing troupes during festivals. Recently, it is also used singly or in combination with leather and rubber to make shoes and other souvenirs. However, these raphia products usually have inferior qualities as compared to products from leather only and modern polymers. This is because raphia readily absorbs water and is easily attacked by insects. Also, although raphia is easily dyed with bright colours, these usually dull off shortly after exposure to sunlight and contact with water. Attempts to modify raphia chemically with bleaching and pulping agents reduce the cellulose strands into mere fibres and make it unsuitable for the traditional proucts. This paper reports the work on a possible alternative use of raphia as a raw material for paper making and examines the properties of handmade paper from raphia.

MATERIALS AND METHODS

Extraction of Raphia: The fresh leaves of a mature palm wine tree (R. hookeri) were obtained in Uyo. The average length was 114.25cm and the width measured 2.65cm. The raphia was peeled from the dorsal surface of each leaf. The average length and width of the raphia strands were 98.5cm and 7.7mm respectively. These strands were cut into pieces, each of 0.5cm length, dried in air and kept for further work. All chemicals were purchased from the chemical stores.

Determination of the Characteristics of Raphia

The solubility of raphia was determined in hot water and 1% NaOH according to Britt (1981) while the percentage extractive in benzene-ethanol mixture was carried out according to Tappi Standard Procedure (1976). Moisture and ash contents were determined by following the procedures of Browning (1977). Triplicate determinations were made and the average calculated. The fibre length and width were determined with an optical microscope. The presence of lignin and rosin were established by following the method of Browning (1977). A single stage pulping and bleaching of the raphia was done with (1:1) H_2O_2: CH_3COOH mixture and commercial 3.5% hypochlorite solution (parazol) and the yield was determined (Casey, 1980). The results of these determination are presented in Table 1.

Paper Making:

Making of the hand mould: The hand mould of edge dimensions 20cm x 26cm and the wire section of 13cm x 13cm, consisting of iron rods base was covered with nylon gauze and mounted on a wooden frame (the deckle). All the materials used for the construction of the mould were collected locally and welded together.

Preparation of the Pulp stock: A stock of 0.12% consistency was prepared by dispersing 10g of the pulp in 1 litre of water followed by manual disintegration with a steel rod and final dilution of the stock to 8 litres in a bucket. The suspension was subsequently poured into a basin.

Sheet formation:

Paper sheets were formed using the prepared stock and the hand mould by following the method of BPBMA (1936).

Paper testing:

The paper made was tested for certain desirable properties. The length, width, thickness and weight were measured directly with appropriate instruments while the volume, density and grammage were calculated using standard formulae. The tear-tensile (T-T) strength was measured with a spring balance using an adaptation of the standard procedure of Britt (!981) while the water absorbency capacity was determined by direct immersion method (Robert et al., 1985). Moisture was determined following the method of Browning (1977). The results are shown in Table 2.

Table 1: Characteristics of the raphia

Moisture content (fresh sample) (%)	-	30.0
Moisture content (Dry sample) (%)	-	8.0
Ash (%)	-	2.2
Solubility in hot water (%)	-	5.0
Solubility in 1% NaOH (%)	-	10.0
Benzene: ethanol extract (%)	-	5.4
Fibre length (mm)	-	1.26
Fibre width (mm)	-	0.014
Pulp yield:		
H_2O_2 pulp (%)	-	45.0
HOCl pulp (%)	-	50.0
Lignin (Phlorogucinol)		+ (dull red)
Rosin (Liebermann - Storch)		+

RESULTS AND DISCUSSION

Table 1 shows the characteristics of the raphia. The moisture content of the fresh sample was higher than that of the air dried sample. This implies that the fresh raphia should be dried in air or at a lower temperature. 60 - 80°C before using it for any material construction or sale. Thus, it is more economical to buy air dried raphia with higher solid content than the fresh sample.

The solubilities in hot water and 1% NaOH were relatively low compared with the values obtained for non-woody plant parts, e.g. Pandanus candelabrum (root 30.5, 25.5, stem: 30.0, 33.3; leaves 26.5, 31.0% (Akpabio and Eno, 1997). The amount of 2:1 benzene-ethanol extractives was also lower than that of the leaves of P. Candelabrum (16.3%), because the latter result included the chlorophyll content which is not present in raphia.

Table 2: Some paper properties of the raphia paper and the bleached unbeaten kraft pulp paper.

Properties	Raphia Paper	Kraft Paper
Grammage (GSM)	67.4	68.8
Area (m^2) - (m^2)	0.017	0.017
Caliper thickness (m)	0.21×10^{-3}	0.28×10^{-3}
Volume (m^3)	3.6×10^{-6}	4.8×10^{-6}
Density (Kg/m^3)	318.1	244.0
T - T force (N)	0.49	0.59
T - T strength (N/M)	24.5	27.8
T - T index (NM/g)	0.36	0.40
Moisture content (%)	8.1	8.2
Absorbency capacity (AC water)	4.87	4.40

It is evident from Table 1 that raphia contains short fibres with narrow width and a l/w ratio of 90 which indicates that the fibres are less flexible than the leaf fibre of P. candelabrum with fibre length of 1.98mm, width 0.118mm and l/w ratio of 168.4 (Akpabio and Eno, 1997). Also, the initial brightness of the raphia pulp after bleaching was comparable to that of the bleached imported kraft pulp.

Table 2 shows some properties of handmade raphia paper compared with those of imported bleached kraft pulp paper. Raphia paper was found to be denser, thinner and less bulky than the kraft paper.

Although the tensile-tear (T - T) strengths of both types of paper were generally low, the kraft paper had a higher value than the raphia sheets. The low strength property can be explained by the fact that the pulps were not beaten. According to Britt (1981), development of strength properties in the paper is associated not only with the fibre length of the pulp but also with the process of refining (beating).

The water absorbency capacity of raphia paper (water leaf sheet) was slightly higher than that of the kraft pulp while the water absorbency capacity of a commercial tissue paper was found to be 4.5.

This result shows that raphia paper even when unbeaten, is very absorbing and such hand made paper can be adapted for use as absorbent tissue paper and paper towels. Since it is a weak paper, it readily disintegrates when immersed in water and this makes for easy disposal of such paper by water system.

On the other hand, it may be blended with other pulps to make other types of paper or the pulps may be mechanically and chemically treated to make strong papers. Besides the use of raphia pulp in paper making, experiments have shown that it is a potential source of cellulose derivatives especially cellulose acetates used in the textile and plastics industries.

CONCLUSION

The study shows that raphia is a suitable material for making pulp and paper. Unbeaten handmade waterleaf sheets give good water absorbent papers suitable for tissues and paper towels. Hand moulds can also be fabricated from locally available materials. In Nigeria today, papers are highly consumable products but scarce in quantity, as well as being expensive. It is hoped that if handmade paper venture is set up, using pulp from raphia and other suitable agricultural wastes (e.g. maize straws (Britt, 1981), and locally fabricated hand moulds, it will be profitable and will contribute to the economy development of the country by creating employment opportunities and providing useful paper products for local application.

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