Physico-chemical Assessment of Raphia Palm *(Raphia hookeri)* for Paper Making

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ABSTRACT

The physico-chemical assessment of Raphia hookeri for paper making was carried out. The Raphia piassava were reduced to match-stick sized chips using sharp scissors and matchet. The moisture content of the samples were carried out using gravimetric method. The specific gravity, percentage ash and silica content of the raw material were determined using TAPPI standards. The chemical tests carried out include: 1% NaOH solubles, benzene: ethanol (1:1) solubles, cold and hot water solubles. The results obtained reveal that Raphia hookeri has a low specific gravity of 0.372 which makes it suitable for industrial chip washing by floatation method. With its low ash content of 1.27% and silica content of 0.001%, the piassava could be easily converted to chips in the conventional industrial setting with minimum energy requirement. With the 9% solubles for 1% NaOH, the raw material will require less chemicals to soften the fibres. However, Raphia hookeri piassava should not be stored for a long time to avoid biodegradation and loss in pulp yield as its percentage benzene: ethanol (1:1) soluble of 2.73 is low.

Key Words: Raphia hookeri, Piassava, Physico-chemical properties, Paper making.

Introduction

Raphia hookeri are abundant in the southern States of Nigeria. They are cultivated and tapped for palm wine, palm front, palm leaves and for raphia piassava. The piassava are the cord-like strands extracted from the stem and petiole of the plant (Odeyemi, 2007). The piassava could be used in making brushes, storage bags, climbing ropes etc. due to its remarkable strength.

The physico-chemical properties of *Raphia hookeri* are those physical and chemical qualities of the raw material which makes it suitable for use in pulp and paper making. These include but not limited to: moisture content, density, fibre length, silica content, specific gravity and percentage soluble. Odeyemi (2007) reported that *Raphia hookeri* has average fibre length of 2.4mm and 1.71mm for the raphia stem and petiole respectively. The suitability and adaptability of any fibrous raw material for paper making depend on a number of factors namely; its availability in sufficient quantity, beatability, fibre geometry and intrinsic strength, percentage pulp yield, physical and chemical characteristics of the raw material amongst others (Britt, 2007). Raphia piassava is known for its remarkable strength. The researchers are of the opinion that paper made from *R. hookeri* would be of great strength too, considering its medium fibre length of 2.4 mm.

Paper making is the art of producing a sheet material which could be used for writing, printing, wrapping, packaging etc., usually made by drawing cellulose fibres from a suspension in water (Usoro and Utuk, 2017). The process of paper making entails the reduction of the raw materials into chips, followed by pulping the wood chips, washing and cleaning the stock; chemical additives to the stock prior to sheet formation, drying of the paper web, and calendaring. Several studies had been carried out to assess the usability of the available fibrous ligno-cellulosic materials for paper making (Reed, Capper and Neate, 2008). Akpabio, Essien and Eka (2007) carried out extensive studies on *Nypa fruiticans* (Nypa palm). Akpabio (2017) researched on the use of plantain (*Musa paradisiaca*) and banana (*Musasapientum*) plants for paper making. Utuk, Udofia and Uko (2019) evaluated the suitability of elephant grass (*Pennisetum purpureum*) for paper making. The physico-chemical assessment of *R. hookeri* for paper making is intended to examine the suitability and adaptability of the raw material in the production flow processes of paper making.

Materials and Methods

R. hookeri piassava were obtained from three locations namely; Watt market in Calabar municipality, Akpan Andem main market in Uyo Local Government Area and Itam market in Itu Local Government Area. The raphia piassava obtained in cord-like form (of length in excess of 150 cm) were cut manually into uniform length of 3.5 cm using sharp scissors and matchet to produce match-stick sized wood chips. The moisture content of the samples were determined using gravimetric method. The specific gravity, percentage ash and silica content of the raw material were determined using TAPPI Standards (2008). The chemical tests carried out include: 1% NaOH solubles, benzene: ethanol (1:1) solubles, cold and hot water solubles.

Results and Discussion

Table 1: Physical analyses of *R. hookeri*

Quantities	**Units**	**Values**
Specific gravity		0.372
Moisture content	%	13.35
Ash content	%	1.27
Silica content	%	0.001

Source: Field Work, 2015.

The specific gravity of a substance is the ratio of the mass of any volume of it to the mass of an equal volume of water (Umoren, Udoh and Akpabio, 2004). A high specific gravity is an indication that the material cannot float on the fluid (water); whereas a low value means that the material can float. Specific gravity also serve as a basis for determining the price per unit tonne of the raw material. With a mean specific gravity of 0.372 as recorded in Table 1, *R. hookeri* chips can be washed easily by floatation method thereby enhancing the removal of high specific gravity contraries such as stones, metals, broken bottles and the like substances which may accompany the chips due to handling prior to further processing in the industrial mill's practice.

The moisture content of 13.35% for the Raphia piassava (Table 1) will make it easy for the transportation of the raw material. The ash content is an approximate measure of the mineral

salts and other inorganic matters in the wood (Britt, 2007). A high ash and silica content is a direct indication of the difficulty to be encountered during chipping, whereas a raw material with low ash and silica content implies that it could be converted into chips with less power requirement and less blunting of the cutting tools. With a low ash content of 1.27% and a corresponding silica content of 0.001% (as recorded in Table 1), *R. hookeri* piassava is expected to be chipped with less power requirement and minimum blunting of the cutting tool in the conventional industrial mill's practice.

Table 2: Chemical analyses of *R. hookeri*

Quantities	**Units**	**Values**
Cold water solubles	%	4.83
Hot water solubles	%	5.18
1% NaOH solubles	%	9.03
Benzene: ethanol (1:1) solubles	%	2.73

Source: Field Work, 2015.

Table 2 shows that *R. hookeri* piassava has a mean cold water solubles of 4.83%, hot water solubles of 5.18%, 1% NaOH solubles of 9.03% and benzene: ethanol (1:1) solubles of 2.73% respectively, based on the weight of moisture-free wood. The percentage cold and hot water solubles of the piassava do not differ greatly. The piassava has 9% solubles for 1% NaOH which, according to TAPPI standards (2008), indicates that the raw material will require less chemicals during impregnation prior to pulping.

Durable wood contains much higher percentages of extractable matter (in benzene: alcohol) than non-durable ones (Umoren, Udoh and Akpabio, 2004). Cartwright and Findlay (2009), found out that timber containing over 5.0% alcohol soluble matter proved to be durable, provided that the alcohol extracts were mainly phenolic in nature. With an average benzene: alcohol soluble of 2.73% (Table 2), raphia piassava are much liable to attack by biodegradation agents. Hence, the Raphia chips should not be stored longer than necessary so as to avoid excessive degradation and subsequent losses in pulp yield and quality of the final product.

Conclusion

The physico-chemical assessment of *R. hookeri* for paper making had been carried out. *R. hookeri* piassava has a low specific gravity of 0.372 which makes it suitable for industrial chip washing by floatation method. With its low ash content of 1.27% and silica content of 0.001%, the piassava could be easily converted to chips with minimum energy requirement and less blunting of the cutting knives. The piassava has 9% solubles for 1% NaOH which indicates that the raw material will require less chemicals during impregnation prior to pulping.

Recommendation

R. hookeri piassava should not be stored for a considerable long time prior to pulping due to its low benzene: ethanol (1:1) soluble of 2.73% to avoid biodegradation and subsequent loss in pulp yield.

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