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STUDY OF PHYSICO-CHEMICAL AND MECHANICAL PROPERTIES OF WILLIAM CAVENDISH BANANA PEDUNCLE FIBERS

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ИЗСЛЕДВАНЕ НА ФИЗИКО-ХИМИЧНИ И МЕХАНИЧНИ СВОЙСТВА НА ВЛАКНА ОТ СТЕБЛА НА БАНАН НА УИЛЯМ КАВЕНДИШ

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Abstract

The banana plant is a monocotyledonous plant belonging to the Musaceae family (order Zingiberales), of which nearly 70 species have been discovered. [1]. It generates an enormous quantity of biomass, including the peduncle, which is a potential source of fiber.[2].

This is the part of the banana plant that supports the inflorescence and links it to the rhizomes and fruit. To the best of our knowledge, no work has been carried out on the possibility of using this biomass in the textile sector in Cameroon.

The aim of this work is to study the physico-chemical and mechanical properties of WILLIAM CAVENDISH banana peduncle fibers for use in the textile industry.

According to the literature, several researchers have carried out studies on the extraction of fibers from banana peduncles using various methods, and on their recovery. Based on these studies [3-13], in this work, three different modes of extraction have been carried out.

The peduncles were obtained from the production residues (waste) of the PHP Company located in the Littoral-Cameroon region, Mungo Department and Njombe Penja District. Prior to extraction, the green skin is removed, using drums and tarpaulins for display, followed by biological retting with water, in the dew and mechanical extraction.

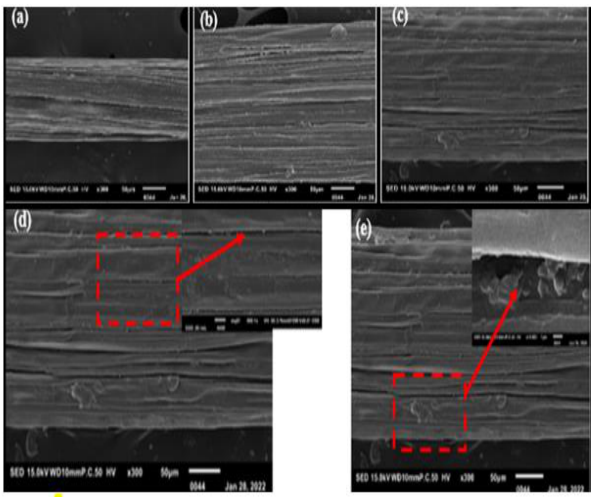
The equipment used for the physical characterization of William banana peduncle fibre (FHBW) is as follows: a mesh meter for length distribution, 100ml pycnometers for density determination; a thousandths balance for weighing; colour assessment using the Datacolor device; the JEOL JSM-IT100 for SEM observation; the VIBROMAT ME and the Projectina for the measurement of fineness and

apparent diameter respectively. With regard to chemical properties, the Van Soest dry biomass fractionation method was used to determine cellulose, hemicellulose and lignin content; the Infra-Red was determined using a BRUKER IR Spectrometer; the NETZSCH STA 449F3 ATG and the X-ray diffractometer were used to determine the thermal stability and the amorphous and crystalline fractions of the FHBW respectively. With regard to the mechanical characterization of FHBW, the tensile test was carried out using the MTS and the flexural test using the KAWABATA module.

The fibers were extracted by three methods and the fiber yield assessed. The results show that water retted fibers have a higher yield compared to dew retted fibers and fibers extracted by lamination. According to the Barbe and Hauteur length analysis, the retted fibers show a good balance with few classes of long and short fibers and a large class of medium fibers compared with the laminated fibers.

SEM observation shows that the fibers extracted by the three methods are in the form of fibers bundles. The fibers extracted by lamination still contain pectin's, in contrast to the visibly smooth fibers extracted by retting. [11]. The longitudinal structure is in the form of small flat ribbons, whatever the extraction method.

As far as cellulose is concerned, it can be seen that extraction methods do not have a major influence. On the other hand, the cellulose content of laminated fibers (74.8%) is higher than that of fibers retted in the dez (73.6%) and in water (71.8%). These cellulose contents are higher than those of Musa acuminata peduncle fibers found in the literature[11].



From the various thermograms obtained, we can see that WBPF are thermally stable up to 82°C. We can conclude from this result that fabrics made from these fibers can be ironed at temperatures below 82°C.

The diffractograms at show that the crystallinity index of the fibers extracted by lamination is more significant (69.53%) than those obtained with water- and dew-retted fibers (58.24% and 54.83% respectively). This low value may be due to the presence of non-cellulosic substances on the fibers.

Looking at the tensile curves, we can say that the extracted fibers have a behavior close to linearity with little viscoelasticity, whatever the extraction method. This type of behavior should lead to rather brittle fractures.

Analysis of the fracture surfaces of the extracted fibers reveals a hollow fiber structure, composed of small, thin-walled, juxtaposed tubes. The facies confirm a brittle fracture mode; the brittle nature of plant fibers has been demonstrated in the literature by Maria et al.[12].

Similarities were observed between the tensile and flexural mechanical properties of fibers obtained by spinning.

The tensile test shows that the fibers retted in the field have lower values than the others; the tenacity of the laminated fibers is higher (58.83 cN/tex) than that of the other methods; however, it is still in agreement with the results of the chemical composition, while the flexural analysis shows that the laminated fibers are stiffer than the retted ones. in comparison with the literature, the tenacity of William banana peduncle fibers is higher than that of flax and sisal fibers, which means that these fibres can be used in textiles [13].

The flexural stiffness values for the different fibers lead to the conclusion that the retted fibers are less stiff than the fibers obtained by lamination.

From the results presented, it can be said that William banana peduncle fibers extracted by the three methods are suitable for textile applications. However, the laminated fibers could be softened for better exploitation.

Keywords: William banana peduncle fiber, physical-chemical and mechanical properties, SEM

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