# Study of Properties of Banana Fiber, Extracted from Egyptian trees

**Lecturer/ Hanaa Abu Zaid Khalil**
**Lecturer at Spinning and Weaving Department Faculty of Applied Arts- Damietta University- Egypt**

## Abstract

seeking spinning and Weaving industries are to produce eco-friendly fiber Natural . fibers have distinct properties like high strength, low weight, low cost processing and bio degradability than synthetic fibers[1]. banana fibers have the advantage of coming from an agricultural residue. Egypt produces around 65,000 feddans annually from banana trees and these trees are disposed of in a polluting environment . Fibers have been extracted by mechanical means from banana tree[2]. The aim of this paper is to examines how to extract banana fiber and study the mechanical , chemical and physical properties of fiber.

**Keywords:** banana fibers; chemical and physical properties; extract; Natural fibers

**الملخص :-**

تسعى صناعة الغزل والنسيج دائماً لإنتاج ألياف طبيعية صديقة للبيئة ذات خصائص متميزة مثل قوة الشد وخفة الوزن وذات تكلفة منخفضة وقادرة على التحلل البيولوجى مقارنتاً بالألياف الصناعية .

وتعتبر الياف الموز من الألياف الطبيعية التى يتم الحصول عليها من المخلفات الزراعية . حيث تنتج مصر سنوياً حوالى 65 ألف فدان من أشجار الموز ويتم التخلص منها بطرق ملوثة للبيئة . ويتم أستخراج ألياف الموز من شجرة الموز بواسطة بعض الأساليب الميكانيكية . والهدف الأساسي من هذه الورقة البحثية هو دراسة كيفية أستخراج ألياف الموز ودراسة الخصائص الميكانيكية والكميائية والفزيائية لهذه الألياف .

**النتائج :-**

من دراسة الخواص الميكانيكية والفزيائية والكميائية لألياف الموز التى تم أستخراجها من اشجار الموز المصرية وجدا أنها لها خصائص متميزة مقارنتاً ببعض الألياف الطبيعية الأخري وخاصتاً التى تستخدم فى تكنولوجيا المواد المركبة . والتى يمكن فيها الجمع بين نوعين من المواد المختلفة والأستفادة من خصائص المادتين معاً وكذلك تقليل التكاليف . حيث يمكن أستخدامها في المجالات الهندسية عالية الأداء . كما يمكن غزل ألياف الموز والحصول على خيوط مخلوطة أو غير مخلوطة مع ألياف أخرى . وإذا كنا نتحدث عن مستقبل ألياف الموز فهو مشرق جداً . لأنها أرخص وأخف وزناً ومتوافقة بيئياً عن بعض الألياف الأخرى وخاصتاً التى تستجدم فى تكنولوجيا الألياف المركبة .

## 1- INTRODUCTION

Mankind has been strongly dependent on plant fibres for all kind of purposes. In earlier days, natural fibres served a crucial role mitigate the everyday needs in a wide range of uses. But in recent years the arrival of synthetic products are dominating over the natural fibre, due to the low cost[3]. But the synthetic fibres are non degradable and causing serious pollution problems. Banana is one of the earliest and important fruit crops cultivated by man in Egypt.

over an area of 65,000 feddans[4], Banana farming generated huge quantities of biomass all of which goes as waste due to non availability of suitable technology for its commercial utilization . Normally this biomass is used for animal feed and fuel. Among its multi faced uses like therapeutic, alcohol, starch extraction and other innumerable uses, they are the best source of fibre[5] . Banana fiber is a lingo-cellulosic fiber, which obtained from
the pseudo-stem of banana plant. Banana fiber is Used for apparels and home furnishings Banana fiber has great potentialities for paper making special demand of handmade paper. Banana fiber is making products like filter paper, paper bags, greeting cards, lamp stands, pen stands, decorative papers, rope, mats and composite material etc[6]. Banana fiber is used in currency notes in Germany and trial run in India also. Polypropylene reinforced with banana fiber is used by automobile companies for making under floor protection panels in luxurious cars like Mercedes. Banana fiber mostly used in making handicrafts and home decorative. Composite material of banana fiber used in buildings boards and fire resistance boards. During the research it was found that paper made out of this fiber has long life of over 100 years as it is strongest of the long fibers over found other natural fibers, which can be folded 3,000 times[7].

## 2. BANANA FIBER EXTRACTION

Banana fibers were collected from waste part of banana tree after cultivation of banana in agriculture . The stem of banana trees were collected and soaked in water for 3 to 4 days. then banana stem was passed between rotating rollers 3 to 4 times. The wet fibers were dried in atmospheric temperature.
**(Fig. 1**) shows Banana trees . **(Fig.2)** Extraction of fibers by rolling process . **(Fig.3**) shows Extracted Raw banana fiber.

**Fig.1** Banana trees

**Fig.2 Extraction of fibers by rolling process**

**Fig.3 Extracted Raw banana fiber**

### 3. COMPOSITION AND PROPERTIES OF BANANA FIBRES

**physical properties of banana fibers**

**(Table 1)** is those of the single cell fibers i.e., the physical properties of banana fibers. Fibers with the highest aspect ratio will exhibit highest tensile properties provide high surface area which are advantageous for reinforcement purposes. (**Fig.4**) shows SEM micrographs of banana fibers . **(Fig.5)** shows fibers with diameters from different micrometers and non-uniformity capillaries of thickness.

**Table.1.Physical properties of the banana fibers**

| | |
|---|---|
| Dia(µm) | 80-250 |
| Length(mm) | 1000-5000 |
| Moisture content | 60(%) |

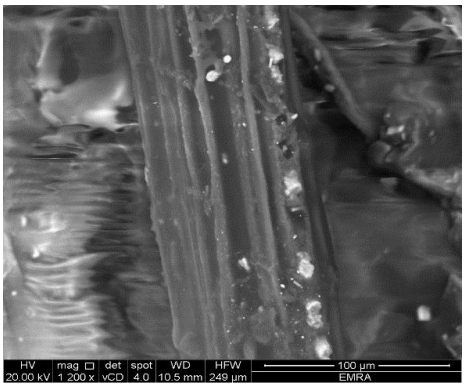


**Fig. 4. SEM micrographs of banana fibers**

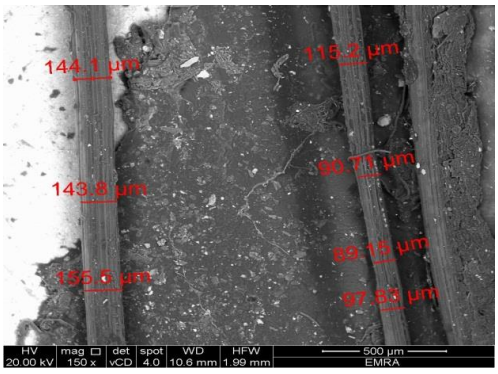



**Fig. 5.fibers with diameters from different micrometers And non-uniformity capillaries of thickness.**

## Chemical properties of banana fibers

**(Table 2**) shows the chemical composition of banana plant fibers, It is noted that cellulose and hemicelluloses the main constituent of plant fibers followed by lignin interchangeably with pectin respectively.Cellulose is also the reinforcement for lignin, hemi cellulose and Pectin . **(Fig.6)** shows SEM-EDX In this figure of the banana fibers containing . **(Table 3**) Elements percentage by the EDx analysis . **(Table 3**) shows the Elements percentage by the EDx analysis .

**Table. 2. Chemical composition of banana fibers**

| | |
|---|---|
| Cellulose and Hemi cellulose (%) | 82-87 |
| Lignin (%) | 7-10 |
| Pectin (%) | 3-5 |
| Wax (%) | 2 - 3.4 |
| Glucose (%) | 0.3- 0.4 |
| Ash (%) | 1-3 |

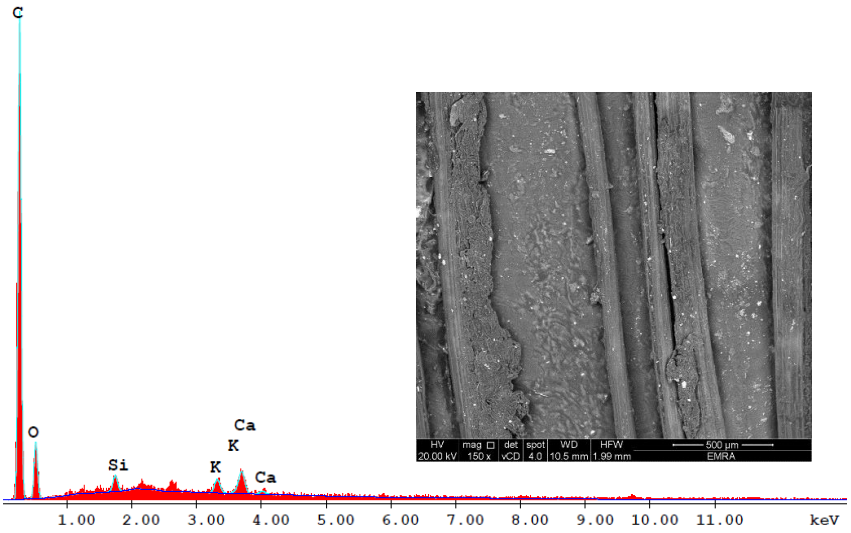



**Fig. 6. EDX for banana fibers shows the SEM micrograph of the banana fibers ×500**

**Table. 3**. Elements percentage by the EDx analysis

| Element | Wt % | At % | K-Ratio | Z | A | F |
|---|---|---|---|---|---|---|
| **C K** | 73.58 | 79.93 | 0.4703 | 1.0053 | 0.6357 | 1.0002 |
| **O K** | 23.16 | 18.89 | 0.0311 | 0.9912 | 0.1354 | 1.0000 |
| **Si K** | 0.85 | 0.39 | 0.0065 | 0.9570 | 0.7937 | 1.0009 |
| **K K** | 0.86 | 0.29 | 0.0083 | 0.9010 | 1.0617 | 1.0084 |
| **Ca K** | 1.56 | 0.51 | 0.0152 | 0.9222 | 1.0590 | 1.0000 |
| **Total** | 100.00 | 100.00 | | | | |

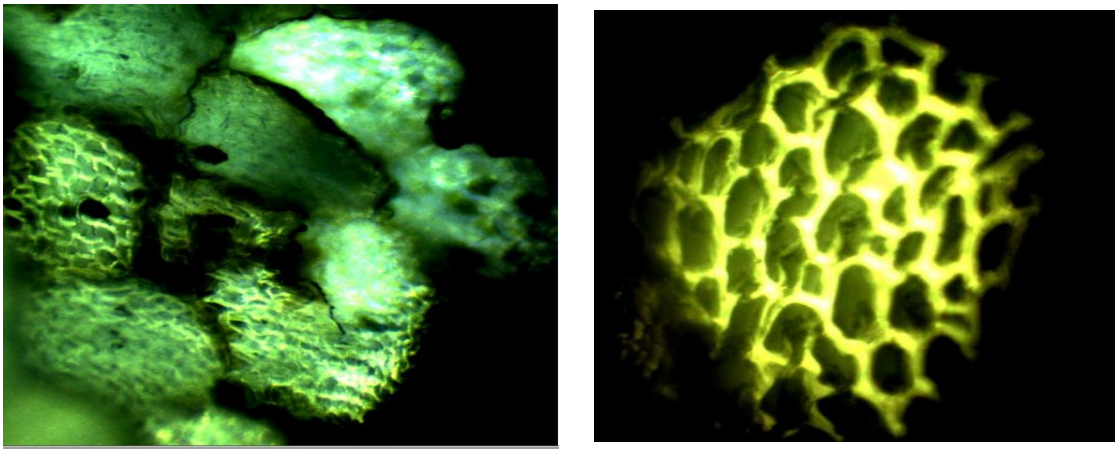
**Mechanical properties**

**(Table 4)** shows mechanical properties of banana fibers, by which we use fibers as reinforcement for a good mechanical properties of composite materials.

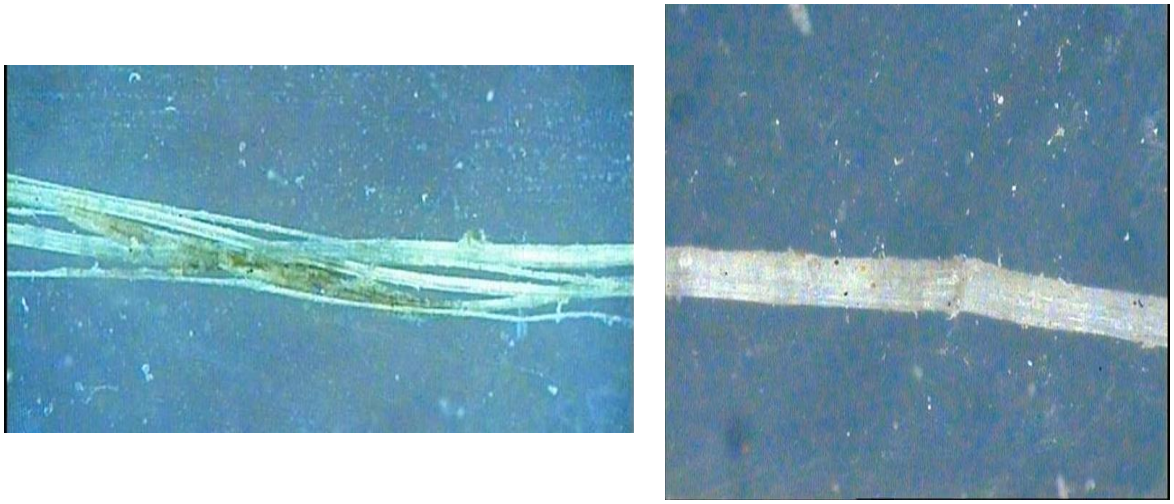
**Table. 4.** Mechanical properties of banana fibers

| | |
|---|---|
| Tensile Strength (Mpa) | 529-914 |
| Specific Tensile Strength (Mpa) | 392-677 |
| Young's Modulus (Gpa) | 27-32 |
| Specific Young's Modulus (Gpa) | 20-24 |
| Density (Kg/m3) | 950 - 750 |

**(Fig.7)** shows SEM cross-section . the cross sectional area of the banana fiber was investigated by using Optical laser beam equipment by shows the cross-sectional area of the banana fiber taken for the analysis is 0.3596mm2. The cross-section dimensions of the fibers are measured at different degrees of orientation of the fiber cross-section. From the investigation it was predicted that the fiber cross-sections, are approximately circular. It was also observed that the magnitude of laser beam diffraction is dependent on the curvature of the cross-section and the fiber variety. Hence, the test gives relative shapes of the fiber rather than the actual cross-section area . **(Fig.8)** shows the vertical cut section of SEM photographs of banana fiber .



**(Fig.7) SEM cross-section**



**(Fig.8) the vertical cut section of SEM photographs of banana fiber .**

## 4- CONCLUSION

of mechanical , physical and chemical Properties . of banana fibe are superior as compare to other natural fibers. The utilization and application of the cheaper goods in high performance appliance is possible with the help of this composite technology. Combining the useful properties of two different materials, cheaper manufacturing cost, versatility etc., makes them useful in various fields of engineering, high performance applications such as leisure and sporting goods, shipping industries, Aerospace etc. Banana fiber can be spun to produce yarns, mixed or not mixed with other fibers, If we talk about the future of banana fibers, are very bright because they are cheaper, lighter and environmentally superior to glass fiber or other synthetic fibers composites in general. Hence, with this back ground, it is concluded that, the composites stand the most wanted technology in the fast growing current trend.

## References

1- A Review on Composition and Properties of Banana Fibers. International Journal of Scientific & Engineering Research, Volume 6, Issue 5, May-2015 ISSN 2229-5518.

2- Physical and Chemical Properties of Banana Fibre Extracted from Commercial Banana Cultivars Grown in Tamilnadu State. Preethi and Balakrishna Murthy, Agrotechnol 2013, S11 . http://dx.doi.org/10.4172/2168-9881.S11-008

3- Studies on The Extraction of Naturally-Occurring Banana Fibers. The International Journal Of Engineering And Science (IJES) 2013 ISSN(e): 2319 – 1813 ISSN(p): 2319 – 1805

4- Mechanical Behavior of Banana Fiber Based Hybrid Bio Composites. J. Mater. Environ. Sci. 3 (1) (2012) 185-194 Singh et al.ISSN : 2028-2508 CODEN: JMESCN.

5- Banana Fiber Reinforced Polymer Composites _ A Review‖ Journal of Renforced Plastic and Composttes, Vol. 29, No. 15/2010, pp.2387-2396.

6- Evaluation of mechanical and thermal properties of banana– flax based natural fibre composite, Materials & Design, Volume 60, August 2014, Pages 620-627, ISSN 0261-3069

7- Study of Banana and Coconut Fibers: Botanical Composition, Thermal Degradation and Textural Observations, Bioresource Technology, August 2007 98(1): 58–68.