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## Functional aspect of eco-friendly banana fibre as textile

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### Abstract

Today, we are witnessing the impact of COVID on fashion and textile industry. Now in the post COVID period, we are observing fast fashion collapsing. Instead of messing up with the losses, to bring back this industry; efforts are being made towards reducing negative impacts on the environment and finding more eco-friendly and sustainable options. The aim of this study is to explore the applications of eco-friendly fabric in textile and fashions field. In today's situation of global warming and declining trend towards fast fashion, it is very good opportunity to focus on more sustainable and eco-friendly fibres and their applications in textile and fashion industry. This study was undertaken to be aware of the functional aspect of speciality fibre and its application in textile and apparel industry. The study was based on secondary data collection. Data is collected from journals, books, websites, newspapers, published and unpublished thesis, etc. The properties and extraction of fibre, functional aspect of fibre and application of banana fibre in textile and fashion industry were studied. It was found that banana is shiny, finer and smoother fibre similar to linen and fabric made from banana fibre is completely eco-friendly and sustainable.

**Keywords:** Eco-friendly, sustainable, extraction

### Introduction

Research findings shows that India is the world's largest producer of banana crop with an annual output of 24.8 million tonnes followed by China, Philippines, Ecuador and Brazil. India contributed 22 per cent of the global banana production. In India the banana plant, commonly found in hot tropical regions. Its production need not requires any chemicals or pesticides. The leading producer of banana in India is Tamil Nadu, followed by Maharashtra (Debabandya Mohapatra, *et al.*, Feb. 2010) [8]. Banana plant is known as Kalptaru as every part of banana tree that are, fruit, leaves, flower bud, trunk, and pseudo-stem can be used (Asmanto Subagyo and Achmad Chafidz, Nov. 2018) [5]. It is mostly known for its fruit yielding. Banana Fruit is an ideal food containing various nutrients. Banana peel can be used as cattle feed, and also base material for alcohol production and biogas production (Debabandya Mohapatra, *et al.*, Feb. 2010) [8]. Leaves are used as bio-plates for serving food. Pseudo- stem is major part of banana waste biomass which gives good quality fibres that has great demand in various industries (Sanjeev Badla *et al.*, 17 Feb. 2021) [29]. The fibres are obtained from the stem of the banana plant after the fruit harvested. (Upendra Sharan Gupta, *et al.* September 2020) [35]. The innermost part of the stem, also edible, is used for medicinal purposes. Food items like for making pickle, candy, and soft drink central core can be used. In textile industry, banana pseudo-stem sap can be used as mordant in dyeing procedure.

Banana fibre considered as one of the strongest natural fibre, durable & biodegradable as it is recycled product from stem of banana plant (Simone Preuss, Oct. 9, 2017) [30]. Banana plant grows all along the coastal and tropical regions abundantly in India. Banana plant can be harvested twice or four times in a year. There remains huge amount of wastage after harvesting the banana fruits. To overcome this major issue of environmental pollution, manufacturing of fibres from this wastage will be the best solution (Asmanto Subagyo and Achmad Chafidz, Nov. 28<sup>th</sup> 2018) [5].

Research study shows that Banana is one of the earliest and important fruit crops cultivated by man in tropical parts of the world (Preethi P. *et al.*, 2013) [26]. According to archaeologists, around 8,000 BCE, the banana plant was first grown in the Kuk valley of New Guinea. Historical evidences shows that in the 13<sup>th</sup> century, banana stems had been used as a source of

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fibre but later on with the popularity of conventional fabrics like cotton and silk, the application of banana fibre declined. Research findings shows that the use of banana fibre is not new, for almost 800 years Japanese and Nepalese processing banana fibres and got proficiency in making banana clothing as well as luxurious rugs. In India it is mostly used for making ropes, handmade paper, mats and baskets (Avneet Kaur, Nov. 2015) [6]. Banana fibre also known for its good qualities and therefore it is now greatly recommended for textile and apparel industry. Nowadays, many researchers are working on banana fibre as textile fibre to create awareness and to make especially available to our market (Mohammad Billal Hossain *et al.*, July 2017) [22].

## Review of Literature

### Banana Fabric Manufacturing

Banana tree can be harvested four times in a year. Once it gives fruits the plant needs to be disposed off. The pseudo stem of banana plant supplies nutrients to the fruits from soil. After ripening fruits once, plant needs to cut down. Banana fibre is obtained from this wastage pseudo stem, which looks like a trunk. The trunk consists of up to 25 leaf sheaths wrapped around the central core. These leaf sheaths when matured, unwrapped from the stem. Abundance of fibre is present in the inner and outer parts of pseudo stem. For producing 120 kg of banana fibre in a day, an acre of pseudo stem is required. And about 1,000 to 1,500 stems can be produced from an acre of land. (M.J. Prabu June 2014) [19].



**Fig 1:** Banana plant or plantain plant (<https://textilelearner.net/banana-fiber-properties-manufacturing/>)

### Banana fibre extraction

Banana stem has coating of some gummy cellulose like substance which requires removing from the stem to separate the fibres from it, this step known as taxing. This can be removed manually as well as mechanically. (Asmanto Subagyo and Achmad Chafidz, Nov. 28<sup>th</sup> 2018) [5]. Separation of fibres properly and easily done when these trunks of plants soaked in nearby rivers for softening, this process is known as retting (Stephanie Steele, 3 June 2019) [31]. Components such as hemicelluloses and lignin that are present in the pseudo-stem of banana plant are significantly reduced by retting. The extracted pseudo stem fibre quality differs according to climatic conditions, soil conditions and irrigation where it grows. (Subashini Balakrishnan *et al.* 2021) [32].

### Manually extraction

Earlier taxing was done manually which is very slow and complicated process. When doing manually, these sheaths are separated and rolled lightly then the covering of stem is

scrapped by a metal scrapper slowly and skilfully (Textile Articles, Banana Fibre, Aug 6, 2020) [34]. After then fibres were cleaned and dried. It needs good care while scrapping otherwise the fibre gets damaged. The extraction of fibre manually is not suited for industry application.

### Mechanically extraction

For extracting fibre mechanically, automated manner, a special machine is designed and developed. This machine has two horizontal beams and carriage with attachment of special comb which moves back and forth. Cleaned banana sheath is placed on the platform which is fixes to the machine and this sheath is then clamped by jaws at both ends. With this method damage to the fibres can be avoided. Afterwards fibres are cleaned and dried in chamber at 200\* C (Mazharul Islam Kiron, Feb. 18, 2021) [20].

Mechanical extraction of banana fibre is the eco-friendly way to obtain fibre good in quality and quantity. (Kazi Md. yasin Arafat, May 2018) [17].



**Fig 2:** Extraction of Banana Fibre

### Chemically Extraction

For chemical extraction, banana sheaths are boiled in an alkaline solution. These sheaths are softened and fibres are

separated from the cellulose. Then the fibres are joined together to get long thread in spinning.



**Fig 3:** Banana Fibres (<https://textilelearner.net/banana-fiber-properties-manufacturing/>)

### Banana yarn spinning

Various softening processes have been carried out to make naturally coarse banana fibres more suitable for spinning operations (Gokarneshan N, *et al.* 2021) <sup>[23]</sup>. Collected and dried fibre is then goes for spinning. These fibres are cut into 3 cm length and yarn can be better spun by open-ended spinning process (Mazharul Islam Kiron, Feb. 18, 2021) <sup>[20]</sup>.

### Weaving

Yarns are set on the looms for weaving process. Banana fabric can be made in different types of textiles. The thickness properties, texture of banana fabric depends on what part of the banana stem used for extraction. Fibres extracted from outer coating of stem are coarse while fibres extracted from inner surface are fine, shiny and smooth.



**Fig 4:** Spun yarn, weaving and banana fabric

### Properties of banana fibres

Banana fibre is composed of cellulose, hemicelluloses and lignin. The quality of fibre varies according to what part of stem it is extracted from. Banana fibres are very fine and smooth and have a natural shine when obtained from inner part of the stem (Arafat, *et al.* 2018) <sup>[3]</sup>. Outer strands of stem gives coarse and rough fibres which are mainly used for making ropes, rugs and basket weaving.

Being a 100% natural fibre, banana fibre is very strong and durable.

When compared to bamboo and ramie fibres, appearance is similar but fineness and spin ability is more than these two (Mazharul Islam Kiron, Feb. 18, 2021) <sup>[20]</sup>.

Banana fibre possesses very good mechanical properties. These fibres are light in weight, high strength and fire resistant. (R. Vinoth, *et al.*, Sept. 2018) <sup>[28]</sup>.

Banana fibre is somewhat shiny in appearance mainly depends on what part of stem it is made from.

Banana fibre has strong moisture absorption quality as well as moisture releasing property. Hence it is mainly used as summer wear.

Harvesting and manufacturing of banana fibre doesn't require any chemicals. Being 100% natural fibre, banana fibre is biodegradable and no negative impact on environment.

Banana fibre can be blended easily with cotton, silk or other natural fibre to give variety of fabrics and improve properties.

### Why it is eco-friendly and sustainable?

Banana fibre is a natural bast fibre. Banana fibre is obtained from pseudo stem of banana plant. (Tarikul Islam, *et al.*, October 2019) <sup>[33]</sup>. After yielding fruits, banana tree needs to be disposed off as it is unusable to produce the fruit again. With the boost in population will add to more demand for

banana and with more banana tree plantation there will be always on increase yearly banana plant waste. Therefore efforts should be made to transfer this waste into wealth. (Ebisike K., *et al.*, Sept. 2013) <sup>[11]</sup>.

The concept of environmental-friendly and sustainable development leads towards the processes of production. To extract natural fibres now waste biomass of various plants are broadly used (Priyadarshana, *et al.*, December 2021) <sup>[27]</sup>. According to research study, billion tones of banana plant stems are wasted every year. After taking fruits, usually farmers disposed this wastage into rivers and lakes or burned out and it can be most hazardous to environment if not properly done.

The cultivation of banana tree does not require use of chemicals or pesticides. According to research study, banana fabric if produced in large scale can be cheaper than cotton and linen. Also banana fabric possesses good moisture absorbility and good shine similar to linen.

For the preservation of resources and environment in the world of fashion, many people realize the need of sustainable and eco-friendly options. The aim of promoting eco-friendly fashion and textile is to take care of the social and ecological impact which includes carbon footprints from textile production (Apexmills Blog, March 5, 2020) <sup>[2]</sup>. Banana fabric promotes the use of agricultural wastage as raw material which otherwise can pollute the environment. Also it will give benefits to the farmers. Research findings shows that increase in farmer's income up to 300% in India. Also it gives opportunity to increase livelihood in remote villages and hilly areas as well as women from the villages can also be occupied in making of diverse bio-products from banana waste (AKM Mohiuddin, *et al.*, 2014) <sup>[1]</sup>.



## Objective

The objective of this paper is to know the functional properties of banana fibre and applications of banana fibres in innovative eco-friendly products.

Another objective of this study is to explore the application of eco-friendly banana fibre in textile and fashions field.

## Research methodology

The research methodology of this paper is based on secondary data collection. Data is collected from journals, books, websites, newspapers, published and unpublished thesis, etc.

## Functional aspect of banana fibre

Traditionally, banana fibres are used in the manufacturing of paper (MJ Prabu, June 2014) [19]. Banana paper has a wide variety of applications. Variety of paper products like tissue paper to a thick card sheet can be produced by changing the thickness of the paper (Article Banana Fibres: The Unknown Green Feb 4, 2021) According to Gujarat based Navsari Agriculture University Research, paper made from banana fibre can have existence over 100 years, and also this paper can be folded over 3,000 times.

By reducing the thickness of banana paper to minimum, Tea bag paper is made Banana fibre is tested for filtration by the Department of Science and Technology and it has been proved that banana paper filtration rate is seven times better than cloth. Recently banana paper is used by a firm in Philippines for making face masks, while another firm is

making face masks by using banana textile.

Banana fibre has very good potential in exporting. The Yen, Japan's currency is made out of banana fibre. In Germany also banana fibre is used in making currency notes and in India trial is going on.

For the development of innovative and new products in today's modern world, there is need for more efficient resources. For this use of composites with the natural fibres like banana is underway in various researches. (J Santosh, *et al.*, Nov. 2014) [15]. The Mercedes-Benz A class used banana fibres in designing their spare tyre. These fibres surrounded the polypropylene and thermoplastic covered tyres which can bear stone hit and exposure to the environment.

Banana fibres notably used in handicraft industry and home decoration items. Various types of ropes and cordage are the main products made from banana fibre today.

Recently, Sanitary Napkins are also one of its functional aspects; and to make it as domestic product, a lot of research is going on.

Banana pseudo-stem can be meandering income source to the agriculture sector as it can be used as a very good source of sustainable and eco-friendly raw material for the textile and packaging industry. Research findings prove that packaging with banana pseudo stem help the farmers to increase the life period of their produce because of the beneficial physical and chemical properties banana fibres possess (Parthiban Manickam, *et al.*, 31 Dec. 2020) [24].



Fig 5: Uses of banana fibres

## Banana fibre as a textile

Today fashion and textile industry is facing the huge challenge of environmental pollution. To overcome this, the use of natural fibres has increased tremendously to produce clothes, carpet and other handicraft products. To fulfil the consumer demands different plants are used as a source to obtain the fibres. (Pedrito M Tenerife Jr. June 2019) [25].

Since banana fibre can be produced in their household and that too using left-over banana trunk without using extra chemicals and fertilizers, will promote sustainable development in the textile industry as well as in the society. (Uraivan Pitimaneeyakul, 2009) [36].

Banana fabric is beautiful natural shiny fabric which resembles like real silk, if obtained from inner fibres of stem. These fibres are very smooth & very fine in texture which can be used to produce textile.

There is a great potential of banana as textile fibre in apparel industry as banana fibre is extremely durable and a low maintenance with minimal wear and tear strength. (Asabe Popat B and Bhosale SB, June 2017) [17]. The banana fibres are found to be highly elegant and versatile. These fibres do not crumple easily hence these fibres have been used in dress materials, wedding gowns and shirts. Their fineness depends on quality of fibres used. (Apparel Views, June 2012, [www.vasantkothari.com](http://www.vasantkothari.com)).

Various researches are carried out in a view to impart the

value addition on blending banana fibre with other natural fibres. Efforts are being made to make utilization of banana fabric easily into garments (J Kanimozhi *et al.* 2020) [14]. As the banana fabric is completely biodegradable, and with the increasing awareness towards sustainable and eco-friendly fabrics, application of these fibres increasing in the field of apparels, and home furnishing. Banana fibre as a textile material and in apparels is very commonly used in Japan for making traditional Kimono and Kamishimo dress. Since banana fibre has similar properties of linen people still choose to wear dresses made from banana fabric as summer wear in Japan. (C Vigneswaran, V Gayathri, *et al.*, spring 2015) [7]. Banana fibres have higher market value compared to fibres obtained from flax and hemp.

Research studies shows that banana fibres can be explored to manufacture various technical textiles which can provide multipurpose applications like soundproof, fireproof and antimicrobial at the same time (M Jaykumari, *et al.*, March 2018) [18].

Being sustainable, eco-friendly natural and strong fibre, banana fibre has great potential to be alternative face mask. Recent developments in mask making with new discoveries of materials, banana pseudo stem masks can protect us from virus to a large extent and can be cheaper than usual surgical masks. Thus it can be rising business venture at post pandemic (Jennifer A Carag, 2021) [16].

Banana pseudo-stem sap in composition with cotton fibre-based textile materials improves the fire retardant properties (Ifeanyi Charles Okoli, August 17, 2020)<sup>[13]</sup>.

### Conclusion

This paper concludes that billion tones of banana plant stems are wasted every year. After taking fruits, usually farmers disposed this wastage into rivers and lakes or burned out and it can be most hazardous to environment if not properly done. However, each element of the banana pseudo-stem can be changed into functional by-products.

Today banana fibre has been known commercially. For multiple purposes banana fibre is used in all over the world. Banana fibre has a great potential in making innovative eco-friendly products like in making of sanitary pads, masks and in textile and apparel industry besides traditional use in paper and pulp industry and reinforced composite materials for automobiles and construction material.

There is a great potential of banana as textile fibre in apparel industry as banana fibre is extremely durable and a low maintenance with minimal wear and tear strength.

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