J. Farm Sci., 37(2): (202-204) 2024

RESEARCH PAPER

Influence of wet processing treatments on physical properties of banana fibre

*REENAWANTI[1], K. J. SANNAPAPAMMA[1], SADHANA D. KULLOLI[1] AND T. R. SHASHIDHAR[2]

[1]Department of Textile and Apparel Designing, College of Community Science, Dharwad
[2]Department of Horticulture, College of Agriculture, Dharwad
University of Agricultural Sciences, Dharwad - 580 005, India
*E-mail: reenawantigurjar8059@gnail.com

(Received: November, 2023 ; Accepted: June,2024)

DOI: 10.61475/JFS.2024.v37i2.21

Abstract: Banana fiber is one of the natural, strong, ligno-cellulosic and lustrous bast fiber obtained from the pseudo-stem of the banana plant. The individual cells of banana fibre are cemented with hemicellulose, lignin and forms a complex fibre. It is very difficult to spin the fibre with 20-30% of adhere lignin hence lignin needs to be removed by treating the fibre with various alkali treatment, enzyme treatment and softening treatments. The objective of the research paper focused on influence of pre-treatments on physical properties of banana fibre. The banana fibre was procured from local farmers subjected to fibre extraction process. The extracted fibre processed with different pre-treatment *viz;* scouring, bleaching and softening. The treated fibres were assessed for various physical properties *viz;* fibre weight loss, fibre length, fibre fineness, fibre strength and fibre elongation. The findings of the study stated that pre-treated fibre was found to be more finer and softened. The processed fibre can be suitable for the production of varigated plain and complex yarns.

Key words: Fibre elongation, Fibre fineness, Fibre strength, Fibre weight loss, Pre treatment, Wet processing

Introduction

Rapid population growth in developing countries like India has resulted in increased utilization of natural resources and the generation of substantial amounts of waste material. Effective waste management, especially concerning horticulture by-products, is crucial in such contexts. However, the potential of horticulture bio-waste remains largely untapped due to the lack of information, technological advancements and physical infrastructure required for processing and product development.

Banana fiber is a natural, strong and lustrous bast fiber obtained from the pseudo-stem of the banana plant. It exhibits relatively good mechanical properties. The individual cells are held together by hemicellulose and lignin, forming a complex fiber structure. This complexity makes it challenging to spin the fiber in textile processes when approximately 20-30% of adhered lignin is present.Therefore, the removal of lignin is essential to achieve a higher quality end product. This removal process is known as degumming.Various treatments are employed to remove lignin and impart pliability to banana fiber. Some of these treatments include alkali treatment, acetylation, benzoylation, enzyme treatment and softening. Among all these methods, mercerization or alkali treatment is particularly versatile and effective in removing the non-cellulosic content, lignin (Velumani *et al* 2020). Through mercerization or alkali treatment, the non-cellulosic components lignin are eliminated enhancing the fiber's quality and performance. This alkali treatment process significantly improves the fiber's mechanical properties, spinning ability and ensures the production of higher-quality yarns and textile (Monzon *et al.* 2019). Hence, present study was undertaken to study the influence of wet processing treatment on the banana fibre.

Material and methods

A research was carried out during the year 2021-23 to identify the influence of pre-treatments on banana fibre in the Department of Textile and Apparel Designing, College of Community Science, UAS, Dharwad.

Raw material

The "Ney Poovan" (*Yelakki bale*) of banana pseudo stem was procured from the local farmers of Hangal taluk, Haveri district, Karnataka.

Extraction of banana fibre

Extraction of banana fibrewas done with the help of Phoenix banana extraction machine certified by ISO-9001:2008. After fibre extraction, the fibre was cleaned under tap water for degumming of the banana fibre and dried under shade for wet processing. Extracted banana fibre was processed with different wet processing treatments - scouring, bleaching and softening.

Scouring

Scouring process helps the fibre to remove various impurities.The fiber is immersed in a solution containing an alkali, such as sodium hydroxide. For the process of scouring, extracted fibre was treated with optimized concentration of NaOH at different intervals with required amount of time.

Bleaching

Bleaching helps to lighten the color of the fibres and remove any remaining impurities.The bleaching was done by treating scoured fibre with optimized concentration of H_2O_2at different intervals with required amount of time.

Softening

The process of softening is to make the fibre soft and finer. Bleached fibre was treated with optimized concentration of

cationic softener at room temperature for required amount of time.

Physical properties

In addition to this, pre-treated banana fibre was assessed for physical properties like

Fibre weight loss

Fibre fineness (Standards: IS 235:1989)

Fibre length (Standards: IS 235:1989)

Fibre strength (Standards: IS 235:1989)

Fibre elongation (Standards: IS 235:1989)

Physical properties were assessed at ICAR- National Institute of Natural Fibre Engineering and Technology research institute in Kolkata, West Bengal.

Results and discussion

Influence of wet processing treatments on fibre weight loss (%)

Banana fiber is one of the most important natural fiber. Scouring is the process by which all natural and adventitious impurities such as oil, wax, fat *etc*. are removed to produce hydrophilic and clean textile materials.

The initial weight loss after boiling was found to be 3 per cent in banana fibre boiling with plain water which may be due to removal of water-soluble substances, such as sugars, starches and other readily detachable impurities, that might be present on the surface of the raw fibre.The subsequent weight loss after scouring (16% of the initial weight) underscores the effective removal of additional impurities, such as dirt, oils and natural waxes, which can coat the fibre and hinder its performance in various applications (Tholkappiyan 2016). The weight loss after bleaching was found to be 20 per cent of the initial weight which signifies the successful removal of colorants, lignin and residual non-cellulosic materials that could have been present even after scouringTable 1.

Influence of wet processing treatments on fibre length (cm)

Fiber length refers to the measurement of the longitudinal dimension of a fiber, typically in materials such as textiles, paper, or composites. Fiber length can be a critical factor in processes like spinning textiles, manufacturing paper, or creating composite materials, as it can affect the strength, durability, and other characteristics of the final product.

The untreated banana fibre possessed 173.10 cm fibre length. Processed banana fibres exhibited significant reduction in fibre length after every treatment. Among the treated samples,

Table 1. Influence of wet processing treatments on fibre weight loss (%)

Treatments	Total weight before treatment (g)	Total weight after treatment (g)	Per cent weight loss (%)
Banana fibre with plain water boiling	100	97	3.00
Scoured banana fibre	100	84	16.00
Bleached banana fibre	100	80	20.00

Table 2. Influence of wet processing treatments on fibre length (cm)

Banana fibre	Fibre length (cm)
Raw banana fibre	173.10
Sample 1	170.00
Sample 2	155.70
Sample 3	150.20

Note: Sample details
Controlled sample
Scoured sample (@ 3 and 2 percent)
Bleached sample (@ 6 and 4 percent)
Softened sample(@ 6g + @4g+ @ 6g)

a significant reduction of fibre length was noticed *i.e.* scoured sample (170.00 cm) followed by bleached sample (155.70 cm) and softened (150.20 cm), respectively this may be due to elimination of hemicelluloses component and other cementic substances fibre got shrinked and length reduced (Brindha *et al.*, 2019) (Table 2).

Influence of wet processing treatments on fibre fineness (tex)

Fibre fineness is a very important property of the textile fibres. Fineness will decide the nature of yarn and fabric. The fibre fineness is expressed in weight per unit length or length per unit weight.

It was found from table 3 that, the fineness was improved significantly in all the treated banana fibres as compared to control sample *i.e.,* sample1with fineness of 5.50 tex followed by sample 2 (6.90 tex) and sample 3 (8.20 tex), respectively. The scoured + bleached + softened sample exhibited greater fineness than the other samples. It was noticed from the table that, the raw banana fibre exhibited the coarser texture (5.4 tex) which may be due to presence of wax, gummy substance and other impurities present on the fibre surface contributes to the coarseness of the fibre even after boiling (Dharun *et al.*, 2014).

Influence of wet processing treatments on fibre strength (cn/tex)

The tensile strength is commonly used as an index of quality of fibre. Single fibre strength was carried out for banana fibres. The strength of the treated fibres had a significant decrease when compared to raw fibre. The softening treatment has reduced fibre strength more than ten per cent.

It is stated in the Table 4 that, the raw banana fibre exhibited greater fibre strength than the treated samples. This may be due to the, partial removal of impurities present in the fibre surface it may yields higher strength than the other samples

Table 3. Influence of wet processing treatments on fibre fineness (tex)

Banana fibre	Fineness (tex)
Raw banana fibre	5.40
Sample 1	5.50
Sample 2	6.90
Sample 3	8.20

Note: Sample details
Controlled sample
Scoured sample (@ 3 and 2 per cent)
Bleached sample (@ 6 and 4 per cent)
Softened sample (@ 6 g + @4 g+ @ 6 g)

Table 4. Influence of wet processing treatments on fibre strength (cn/tex)

Fibre details	Tenacity (cN/tex)
Control sample (raw banana fibre)	38.54
Sample 1	36.38
Sample 2	33.74
Sample 3	31.93

Note: Sample details
Controlled sample
Scoured sample (@ 3 and 2 per cent)
Bleached sample (@ 6 and 4 percent)
Softened sample (@ 6 g + @4 g+ @ 6 g)

Table 5. Influence of wet processing treatments on fibre elongation (%)

Fibre details	Fibre elongation (%)
Control sample	3.05
Sample 1	2.74
Sample 2	2.60
Sample 3	2.59

Note: Sample details
Controlled sample
Scoured sample (@ 3 and 2 per cent)
Bleached sample (@ 6 and 4 per cent)
Softened sample(@ 6 g + @4 g+ @ 6 g)

(Renuka 2016). Among the treated samples, scoured and bleached sample (@ 3 and 2 per cent possessed greater fibre strength (36.38 cn/tex) followed by sample 2 (33.74 cn/tex) and sample 3(31.93 cn/tex), respectively. However, the strength reduction was significantly more in scoured + bleached and softened banana fibre than the other fibres. Due to the removal of certain amount of lignin, wax and oils covering the external surface of the fibre cell wall, the fibre strength was reduced from 38.54 to 31.93cn/tex after wet processing (Khan *et al.,* 2019).

Influence of wet processing treatments on fibre elongation (%)

The amount of extension or stretch that a fibre accepts is referred to as elongation. Elongation at break is the amount of stretch, a fibre can take before it breaks. Elastic recovery indicates the ability of fibres to return to their original length after being stretched.

Table 5, explains fibre elongation outcomes, revealing variations based on the different treatments applied to banana fibre samples. The highest elongation (3.05%) found in the control sample may be due greater tensile strength as indicated in the table 4 (38.54 cn/tex). Among the treated sample banana fibre treated with scoured + bleached + softened sample showed slightly greater per cent of elongation *i.e*., 2.74 per cent followed by scoured and bleached sample @ 3 and 2 per cent showed 2.60 per cent of fibre elongation and sample 2(2.60%), respectively. The slight increase in fibre elongation percentage after softening treatment may be attributed to the flexibility and mobility among the fibrils to reposition themselves in the direction of loading (Velumani *et al.,* 2021).

Conclusion

Banana fibre is widely available natural, ligno-cellulosic, strong, lustrous and fine bast fibre obtained from the pseudo-stem of the banana plant with relatively good mechanical properties. Unfortunately majority of the farmers are not known the importance of by-products which have high economic value like banana pseudostem fibre. Various wet- processing treatments were carried out on extracted banana fibre to remove cementic matter.The findings of the study showed that after wet processing fibre weight loss was found 20%. Wet processed banana fibre showed significant decrease in fibre length, fibre strength and fibre elongation. After softening treatment fibre evenness increases and fibre became more softened and finer. From the study it can be concluded that the pretreated samples were found to be more softened, finer and even further suitable for the production of variegated plain and complex yarns.

References

Brindha R, Narayana C K, Vijayalakshmi V and Nachane R P, 2019, Effect of different retting processes on yield and quality of banana pseudostem fiber. *Journal of Natural Fibers*, 16(1): 58-67.

Dharun V S, Kumar M and Dhanapriya V, 2014, Improvement of mechanical properties of banana and kenaf fibers and fabrication and testing of banana/epoxy composites. *International colloquium on materials, manufacturing and Metrolog*, August 8-9, 2014, IIT Madras, Chennai India, pp 81-84.

Khan M, Rahamathbaba S, Mateen M A, Ravi Shankar D V and Manzoor Hussain M, 2019, Effect of NaOH treatment on mechanical strength of banana/epoxy laminates. *Polymers from Renewable Resources*, 10(1-3): 19-26.

Monzon M D, Paz R, Verdaguer M, Suarez L, Badallo P, Ortega Z and Diaz N, 2019, Experimental analysis and simulation of novel technical textile reinforced composite of banana fibre. *Journal of Material Environment Science*, 12(7): 1134.

Renuka, 2016, Extraction, characterization and value addition to banana pseudostem fibre, *M.Sc. (Csc.) Thesis,* University of Agricultural Sciences, Dharwad, Karnataka, India.

Tholkappiyan E, 2016, A preliminary study for improving the banana fibre fineness using various chemical treatments. *Global Journal of Researches in Engineering*, 16(3): 17-22.

Velumani A, Kandhavadivu P and Parthiban M, 2021, Influence of blend proportion on mechanical properties of banana/cotton blended knit fabric. *Indian Jounal of Fibres and Textile Research*, 46; 41-47.