

Evaluation of Anti-Bacterial Properties of Palmyra Palm Fiber with Different Natural Dyes

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Abstract: Asian Palmyrah Palm (*Borassus flabellifer* L) which grows widely in dry arid land is a multipurpose, economically important tree widely distributed in Indian sub-continent and South Asia. The tree has multiple uses and serves various climatic conditions and withstand Natural calamities. The tree has edible, non-edible and value-added uses linked with livelihood. The tree has a long juvenile phase of 12 – 20 years to initiate flowering which is an unbranched stout and can grow 25 – 30 meters in height with trunk diameter of 1 mt at base. Fruits which fall down have limited commercial usage. This research focuses on the use of fiber extracted from fruits, analyzing the anti-bacterial properties of raw fiber, which is naturally tan and brown in color. Palmyra Palm fiber is 53% cellulose and dyed with different natural dyes, the anti-bacterial properties are evaluated.

Keywords: Palmyrah Palm, *Borassus flabellifer*, Anti-bacterial, Natural dye, Fiber extraction.

1. Introduction

Global fiber production increased to 113 million tons in 2021 and in the last 20 years, it had almost doubled from 58 million tons in 2000 and expected to grow to 149 million tons in 2030. The fiber production per person increased from 8.4 kilograms in 1975 to 14.3 kilograms in 2021. Polyester dominating with 54% of the share followed by plant fiber 28% and other plant-based fibers contributing to 6% (Jute, coir, flax, hemp, sisal, abaca, kapok, ramie, agave fibers, and henequen falls under the category) and estimated that more than 8 million households involved in the production.

Palmyrah (*Borassus flabellifer* L.) is a perennial plant that grows 30 meters and has a maximum life span of 100 years. The tree starts yield from 15 years under irrigated or area with plenty of water source and within 25 years in the arid region. Researchers have investigated and compiled data on Palmyra palm fiber strength [1] better than natural & manmade cellulose and below polyester, elongation [1] better than Cotton, viscose and lower than silk, Wool, Polyester and moisture regain [1] better than cotton, silk viscose and lower than wool.

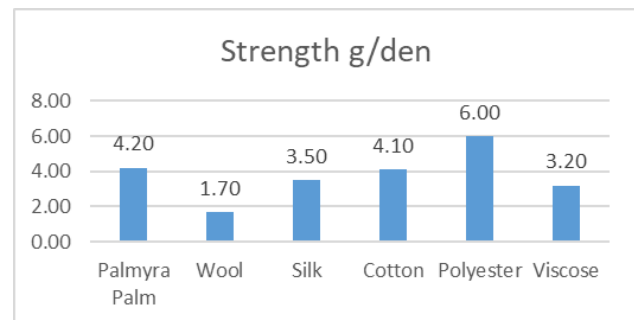


Fig. 1. Palmyra palm fiber strength comparison

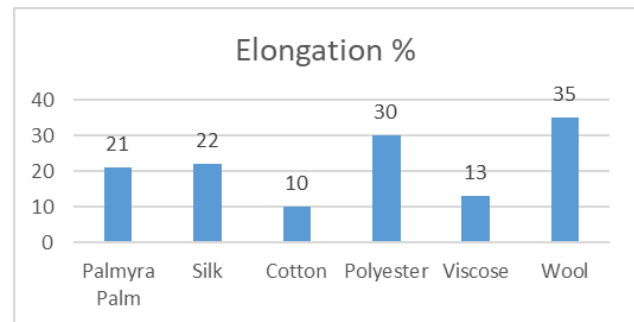


Fig. 2. Palmyra Palm fiber elongation comparison

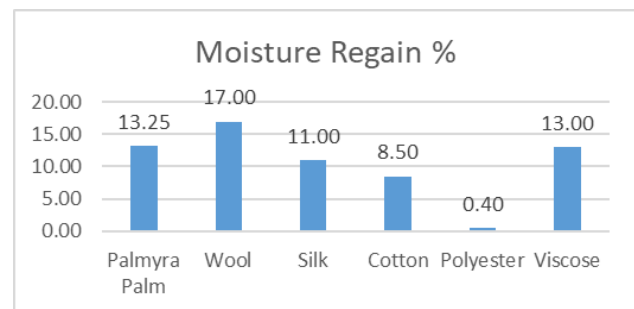


Fig. 3. Palmyra palm fiber moisture regain comparison

2. Material and Methods

A. Material and Methods

Palmyra palm fruits are collected from the field and fiber extraction is done manually. The process starts with peeling of the black outer layer and rinsing in cold water to separate the

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Table 1

Part of the Plant	Pharmacological properties
Seed and seed coat extract	Antimicrobial activity
Male inflorescence	Anti-inflammatory activity
Young roots	Diuretic, anthelmintic, coolant and to treat respiratory issues
Palm fruit	Anti-inflammatory, antioxidant and hydrant
Spadix	To treat heartburn and enlarges spleen and liver
Flower sap Tonic	Laxative, diuretic agents, stimulant, laxative and anti-phlegmatic and amebicide
Palm sugar	Counteracting agent for poison and to treat liver disorder
Toddy	To treat ulcer
Neera	Controlling gastric troubles and ulcers

seeds (single, double or triple seeded). Washed seeds holding the fiber are scrapped manually with a sharp knife. The fiber with orange color juicy starch is rinsed in water and subjected for subsequent wet processing – removal of mesocarp.



Fig. 4. Palmyra palm fruits

Desizing is done to remove the start with below recipe and washed in cold water.

Amylase	- 1 g/l
Temperature	- 55 - 60 degree
Time	- 30 minutes
Hot wash	- 80 - 90 degree 2 times
Cold wash	- room temperature 1 time

Scouring is done to further remove the residues.

Pectinase enzyme	- 1gpl
Temperature	- 60 degree
Time	- 30 minutes
Hot wash	- 80 - 90 degree 2 times
Cold wash	- room temperature

The scoured fibers are tested for Anti-Bacterial properties and then subjected for further Natural dyeing.

1. Bio indigo - dye from plant *Indigo ferra tinctoria*
2. Mallow - dye from plant *Punica granatum*
3. Rennet - dye from *Quercus Infectoria*
4. Leafy green - dye from *Morus alba*
5. Kareel - dye from *Terminalia chebula*
6. Bee - dye from *Acacia catechu*
7. Yeliona - dye from *Tegetas erecta & Butea Monosperma*
8. Rubia - dye from *Rubia cardifolia*

Post natural dyeing, the fibers are again tested for antibacterial properties and compiled.

3. Results and Discussion

A. Various Medicinal Properties of Palmyra Palm Tree

Earlier studies proved valuable benefits (Table 1) of various parts of the tree.

B. Scoured Fiber Anti-bacterial Properties

The scoured fiber is tested at Calantha Biotech private limited using ASTM E 2149 and the results are compiled.

S.aureus	- reduction of microorganisms - 99.85%
K.pneumoniae	- reduction of microorganisms - 99.71%

C. Natural Dyed Fiber Anti-Bacterial Properties

The natural dyed fibers are tested at SITRA using ASTM E 2149 and the results are compiled.

Escherichia coli	- reduction of microorganisms - 99.99%
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4. Conclusion

The production, use and disposal of fibers has considerable impact on the people and planet. Textile industry should focus on a major acceleration of transition to preferred fiber, material and innovation to be in line with the commitment of 1.5-degree pathway without reducing growth. Every year the volume of fiber consumption grows sizeable which have impact on economy and environment. Not only the adoption of Circular Economy principles in Textile value chain but need to accelerate on new plant-based fiber elevation. The usage of Palmyra palm fiber in the value chain help in adopting a new natural fiber with medicinal value and helps in elimination of deforestation – rejuvenation of Palmyra palm trees. Palmyra fibers are sustainable and renewable in application and can be used for apparel grade and also for natural reinforcement material for composites.

References

- [1] MT Rasnatun Ferdous, Eaty Rani Halder, Lu Jianjun, "Introduction of Palmyra Palm fiber as an Alternative Natural Fiber in Textile Industry," North American Academic Research (NAAR) Journal, vol. 4, no.12, pp. 48-57, Abbrev. December, 2021.
- [2] Md. Raju Ahmed, ANM Ahmed Ullah, Arun Kanti Guha and Md. Salim Azad Didar, "Palm fruit Fiber extraction, spinning, dyeing and characterization."
- [3] A.S. Ahmed Amin Haris and Md. Rafiqzaman, "Mechanical Behavior of Palmyra Palm Leaf Stalk Fiber Based Polymer Composites" European Journal of Advances in Engineering and Technology, 5(11): 837-842, 2018.
- [4] Nadendla Srinivasababu, J. Suresh Kumar, K. Vijaya Kumar Reddy, "Manufacturing and Characterization of Long Palmyra Palm/Borassus Flabellifer Petiole Fibre Reinforced Polyester Composites," 2nd

- International Conference on Innovations in Automation and Mechatronics Engineering, ICIAME 2014.
- [5] K. S. Saravanya, S. Kavitha & M. Parthiban, "Thermal properties of natural fibres extracted from Palmyra sprouts," *Indian Journal of Fibre & Textile Research*, vol. 45, pp. 488-494, December 2020.
- [6] Pradeep P., and Edwin Raja Dhas J., "Characterization of Chemical and Physical properties of Palm fibers," *Advances in Materials Science and Engineering: An International Journal (MSEJ)*, vol. 2, no. 4, December 2015.
- [7] Chilukoti, Govardhana Rao, Venkatesh B, Kumar M., Siva Jagadish Kumar, Kubera Sampath, Prakash C., Periyasamy, Aravin Prince, "Study of Alkali Treatment and its Influence on Characteristics of Borassus Palm Fiber," *Journal of Natural Fibers*, 2022.
- [8] Jitesh Kumar Singh, Arun Kumar Rout, "Characterization of raw and alkali – treated cellulosic fiber extracted from *Borassus flabellifer*.L." [9] <https://textileexchange.org/knowledge-center/reports/preferred-fiber-and-materials/>