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Product Development from Furcraea foetida fibre: A New Approach

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Abstract: *Natural fibres that are eco-friendly, renewable, and biodegradable have become more and more popular over the past few years. Investigating less-cared-for and higher-yielding natural textile fibres is urgently needed. To extract fibre and develop products, ligno-cellulosic leaf furcraea foetida was used in this work. One mature leaf yielded more than 13 grammes of useful fibre, and the results showed that these fibres had outstanding dye uptake quality. Fibre becomes supple and glossy after desizing. These fibres can be used to create beautiful eco-friendly items.*

Keywords: *Furcraea foetida, natural dye, natural mordant, product development, washing fastness, light fastness, eco-friendly.*

1. INTRODUCTION:

Numerous ligno-cellulosic fibres can be found in abundance in India. Wood, debris from farms or forests, stems and leaves, fruit seeds, and straw fibres are examples of ligno-cellulosic materials. Ligno-cellulosic fibres are biopolymers made from cellulose, hemicellulose, pectin, and lignin. varied types of fibres have varied ratios of each component, but generally speaking, they comprise 60–80% cellulose, 5%–20% lignin, and 20% moisture in addition to hemicellulose and other remaining chemical components.

A ligno-cellulosic plant that can be cultivated on wasteland is called Furcraea foetida. It requires little care and requires little upkeep. Around 329 million hectares make up all of India's land. 90 million hectares of this were designated as "waste land" by the government [5], meaning they are not being used for anything. In order to extract fibre, farmers can grow furcraea plants in their wastelands.

In India, one of the greatest industries in terms of employment creation is the textile sector. However, the textile sector is also one of those with a red listing due to its contribution to air and water pollution. Due to rising environmental consciousness, eco-friendly natural textiles are currently in demand, and greater attention is being paid to the extraction and use of less-cared-for, renewable, and biodegradable fibre, particularly for handicraft and technical textiles.

Leaf fibre

Long leafy plants seemingly have a higher degree of fibre yielding capacity. Leaf fibre is mainly obtained from sword-shaped leaves that are thick fleshy and often hard surfaced. Leaf fibres are mainly employed for cordage, rope and twine. They may also be used for woven fabrics. Many potentially useful leaf fibres remain unexploited because of the limitation of existing cultivation and processing methods and the increased use of synthetic fibres.

The chemical composition of some leaf fibre are shown below

Fibre	Cellulose (%)	Lignin (%)	Hemi-cellulose (%)	Pectin (%)	Ash (%)
Abaca	56 – 63	7 – 9	15 – 17	—	3
Sisal	47 – 78	7 – 11	10 – 24	10	0.6 – 1
Henequen	77.6	13.1	4 – 8	—	—
Cabuya	68 – 77	4 – 8	13	1.5 – 2	—
Pine apple	80	6 – 12	5 – 12	1.0 – 1.2	0.77 – 0.87
Furcraea	68.35	12.32	11.46	0.24	6.53
Source – Reference no. 2 and 4					

Furcraea foetida

This flora is a persistent perennial undershrub measuring approximately 1 metre in height. The foliage is in the shape of a sword, measuring 1-1.8 metres in length and 10-18 centimetres in width at the broadest point, tapering to 6-7 centimetres in width at the leaf base, and possessing a pointed spiny tip at the apex. The margin is equipped with firm and diminutive spines. Green aloe, giant cabuya and Mauritius hemp are alternative names for Furcraea foetida.

Botanical name	Furcraea foetida
Common name	Mauritius hem
Genus	Furcraea
Family	Asparagaceae
Life cycle	Evergreen perennial

The plant is capable of reaching heights of 1-1.5 meters. Non-traditional fibres offer promising prospects for manufacturing items other than textiles, such as handicrafts, home textiles, geotextiles, and for use in horticulture. Therefore, it is necessary to investigate new agricultural-based unconventional fibres and enhance their value for diverse end applications. The potential of Furcraea fibres has yet to be fully utilized, and the current research aims to address this issue.

The objective of the study was to extract the furcraea leaf fibre by water retting method and product development from its fibre.

2. MATERIAL AND METHODS:

Measurement of Furcraea leaf and fibre

Length and weight measurement of Furcraea leaf was calculated and measurement of the widest part was taken. After the extraction of fibres by water retting method, length and weight measurement of fibre was taken. Weight measurement of fibres was taken by the digital weighing balance.

For aesthetic value addition, furcraea fibre was dyed with natural dye extracted from waste litchi leaves, and mordanted with bio-mordant myrobalan, pomegranate rind and areca nut.

Locale

Furcraea leaves and litchi leaves were collected from Dr. Rajendra Prasad Central Agricultural University, Pusa Campus.

Fibre extraction:

Water retting is a more economical and straightforward technique than mechanical and chemical retting.
Furcraea leaf was collected, softly hammered with a wooden hammer, and water retting of the leaf was done. After retting, light cream coloured fibres were extracted, thoroughly rinsed and then partially sun dried.

Preparation of fibres for product development and dyeing

Eco-friendly approach had been adopted for wet processing of the fibre.

Desizing

Fibres desized to remove impurities, starch, dust and oils using 1gm sodium hydroxide and 2gm detergent per litre of water in the material liquor ratio 1:40. Fibres were boiled for 1hr in the solution with occasional stirring. Then, the yarns were washed thoroughly in the water and dried in the shade.

Mordanting techniques

Pre, post, and simultaneous mordanting techniques were carried out and Tanin containing bio-mordants was used for mordanting.

Dye extraction

Powdered litchi leaves were soaked overnight and then boiled for 60 minutes in water, and filtered.

Dyeing variables

Dye material	4%
Dye media	Aqueous
Dyeing time	45 min
Dyeing temperature	80° C
Areca nut	2%
Pomegranate rind	2%
Harda	2%
Mordanting temperature	70°C
Mordanting time	30 min

Dyeing was carried out with MLR 1:30 for 45 min by frequent stirring for even penetration of dye molecules to the furcraea fibre at 80°C.

Evaluation of dyed samples for colour fastness

Evaluation of the dyed sample was done for washing and light fastness, keeping in mind its end uses. The washing fastness of the dyed samples was carried out according to IS:3361-1979, and colour fastness to sunlight was measured by IS:686-1957.

Colour fastness rating

Colour fastness rating was done by grey scale for evaluating changes in colour according to ISO 105-AO2:1993, and for staining according to ISO 105-AO3:1993.

Visual evaluation of fibres after desizing

An interview schedule was prepared and the required information regarding lustre, softness, and smoothness of the fibre after desizing was collected from randomly selected 25 respondents from the College of Community Science and then analysed.

Product development

Utility articles, decorative articles and fibre jewellery were prepared using extracted and braided furcraea fibre.

Cost calculation

The cost of each product was calculated by determining the cost of raw fibre, cost of processing as well as labour charges etc. and the cost of various accessories used for product development was also taken into account to calculate the cost of production.

3. RESULT AND DISCUSSION:

Table 1: Measurement of Furcraea leaf

S.no.	Furcraea Leaf	Length (cm)	Avg (cm)	Width at broadest part (cm)	Avg (cm)	Weight (gm)	Avg (gm)
1	A	120	120.4	15		740	709
2	B	122		18		745	
3	C	119		15	15.4	350	
4	D	120		13		670	
5	E	121		16		740	

It was found from Table 1 that matured furcraea leaf measured around 120.4 cm in length and weight 709 gm with the broadest part measuring 15.4 cm.

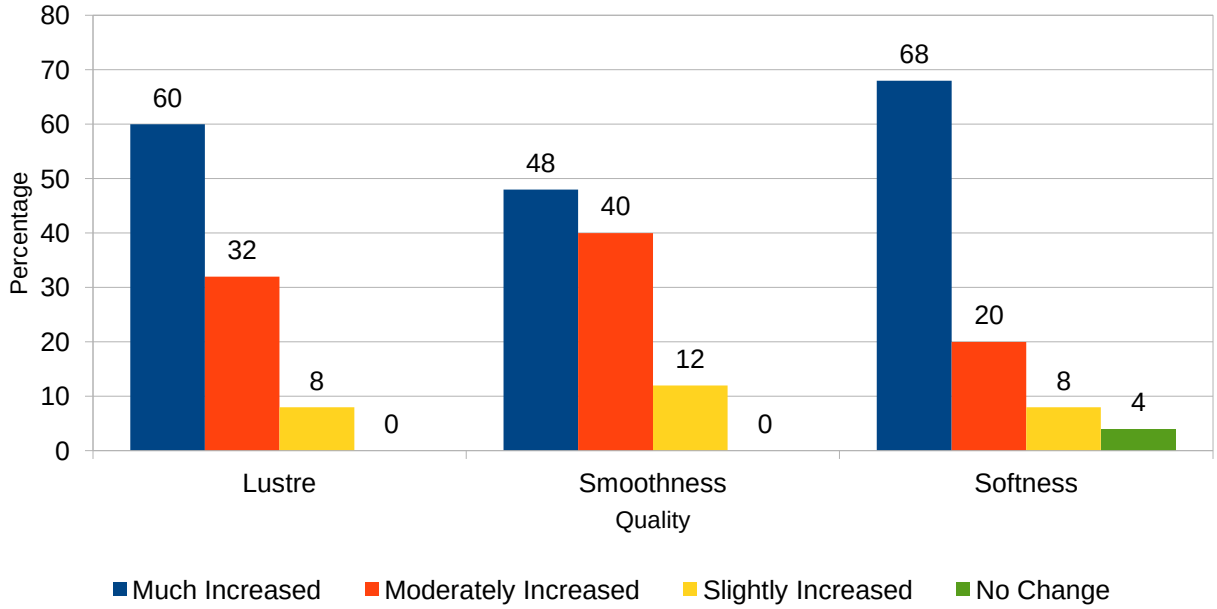
Table 2: Measurement of extracted fibre

S. no.	Leaf fibre	Fibre length (cm)	Avg (cm)	Fibre weight (gm)	Avg (gm)
1	A	130	129	13.57	13.58
2	B	133		13.86	

3	C	126		12.96	
4	D	128		13.76	
5	E	128		13.74	

Above Table 2 indicates that the long and fleshy leaf of the Furcraea leaf had a high fibre yielding capacity. From a single leaf more than 13.58 gm of fibre were extracted which is a good amount of fibre obtained for product development.

Fig 1: Visual evaluation of furcraea fibre after desizing(N=25)



It was observed from Fig 1 that 68% of the respondents felt that after desizing softness of the fibre much increased and it was followed by moderately increased (20%) only 4% of respondents expressed that there was no change in softness. 60% of respondents expressed that lustre of the fibre after desizing was much increased more over 48% of the respondents evaluated that the smoothness of the fibre much increased and 40% mentioned about smoothness of the fibre increased moderately after desizing.

Furcraea fibres produced beautiful shades of fluorescent orange, reddish brown, terracotta to different shades of khaki after dyeing with litchi leaves and mordanting with natural mordants pomegranate rind, areca nut, and harda and among all mordants, areca nut produced the best shades followed by pomegranate rind and harda.

Table 3: Colour fastness properties of dyed furcraea fibre

Dyed and mordanted sample	Pre-Mordanting			Simultaneous Mordanting			Post-Mordanting		
	Light	Wash		Light	Wash		Light	Wash	
	CC	CC	CS	CC	CC	CS	CC	CC	CS
Control	2	4-5	5	2	5	5	2	4-5	5
Areca Nut (Betel nut)	2-3	5	5	2-3	5	5	2	5	5
Pomegranate Rind	4	5	5	4	5	5	4	5	5
Harda	CI	4-5	4-5	CI	4-5	4-5	CI	4-5	4-5

CC – Colour Change CS-Colour Staining CI-Colour Increase

Many factors influence the light fastness of dyes, including the chemical state of dye, the physical state of dye within a fibre, fibre substrate, environmental factors, intensity of the light source, presence of UV absorbers, etc.

The light fastness value of the dyed sample was poor to fair. The good fastness of light was observed in the case of fibre mordanted with pomegranate rind. The colour of the fibre darkened in the harda mordanted samples after exposure to sunlight (Table-3).

The darkening may be due to the electron stability of the litchi dye and chromophores in harda may be resisted the photochemical degradation of the dye molecules caused by ultraviolet radiation and visible light. Wash fastness values of control and all mordanted sample showed excellent fastness properties.

Table 4: Cost of production

S.no.	Name of Product	Approx Cost (Rs)
1	Tea Coaster	100
2	Planter	200
3	Home decor piece	100
4	Jewellery – I	300
5	Jeweller – II	300
6	Earring	50

It is clear from the above table 4 that various utility articles and fibre jewellery, home decor items could be produced using furcraea foetida fibres with varying affordable cost depending upon the craftsmanship

4. CONCLUSION:

The present study has explored the possibilities of utilizing furcraea fibres for utility product development and fashionable fibre jewellery production which is highly in fashion trend nowadays. The techniques used for making the products were simple and could be adopted by rural artisans easily for their livelihood. Wasteland can be utilized for the cultivation of this plant. If fuller utilization of wasteland carried out by propagation and cultivation of furcraea plant and extract fibre from the leaf, it would lead to huge economical waste to an economical advantage and in turn provide gainful.

5. RECOMMENDATION:

- Wide information dissemination program should be conducted by the research students at the village.
- Government officials may conduct livelihood programs in relation to the product development from Furcraea foetida leaf fibre.
- Government should fully support the rural farmers to propagate and cultivate Furcraea foetida plants in the waste land.
- Training should be given to the rural people on product development by hiring master craftsman for doubling the farmers income.
- Rural youth may be connected with NHDP and CHCD.

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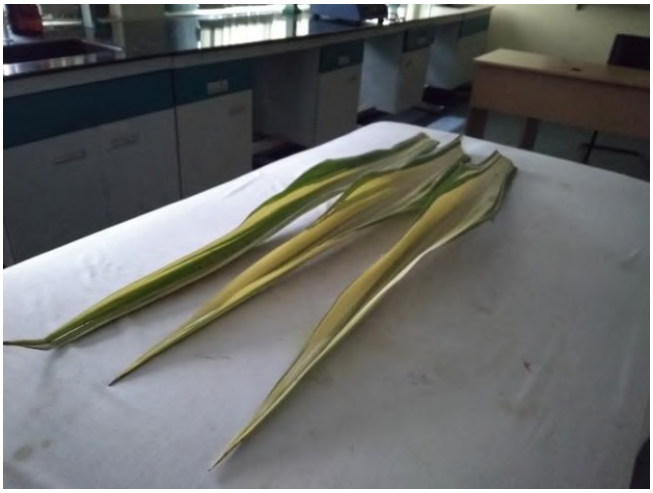
Furcraea foetida plant



Furcraea leaf

Extracted furcraea leaf fibre

Braiding of fibre

Braided fibre

Furcraea fibre planter

Decor piece

Tea Coaster