J. Indian Soc. Coastal agric. Res. 34(1): 77-80 (2016)

Extraction, Characterization and Application of Pineapple Leaf Fibre

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Received: 19. 10. 2015 Accepted: 17.05.2016

Pineapple leaf fibre is more delicate in texture than any other vegetable fibres. It is white, creamy and lustrous as silk fibre and is 10 times as coarse as cotton. Manual extraction by a blunt knife edge or a broken porcelain plate damages fibre. No suitable machine for extraction of fibre is available in the commercial market. Large machines located away from the farm poses problems on freshness of leaves i.e. leaves dry up in the interval between harvesting of fruits and extraction of fibre from leaves. Moreover, traditional system of retting of leaves takes a long duration of 18-20 days and human drudgery and disposal of leaves after harvesting of fruits poses ecological problems. The yield of fibres depends upon various factors, such as type of soil, variety grown, care for the crop, stage of harvesting, incidence of diseases and pests and fibre content.

(***Key words****: Extraction, Livelihood, Pineapple leaf fibre, Strength, Textile, Waste*)

India has a vast resource for different natural fibres *viz*. jute, mesta, sisal, pineapple leaf fibre (PALF), banana, coir, ramie etc., which are abundantly available in many parts of the country. Of these, most important are jute and mesta, which together are called raw jute in the trade circle. Since India is a major producer of these two crops, maximum emphasis has been given on the advancement of these two. Except jute and mesta, allied fibres are yet to find their suitable application due to limited availability and hence belong to unorganized sector (Pandey and Ananthakrishnan, 1998). One of the allied fibres with promising potential in textile and non-textile sector is PALF. Pineapple leaf fibre is obtained from the leaves of the pineapple (*Ananas cosmosus L.*) plant, which belongs to the Bromeliaceous family (Nag and Saha, 2004). The name is derived from the Spanish word 'Pina' meaning cone shaped. The plant is widely cultivated for its fruit in the tropical and sub-tropical regions.

India is one of the major producers of pineapple fruit and its cultivation is spread in various states like Assam, Karnataka, Kerala, Manipur, Meghalaya, Tripura and West Bengal. In other states viz. Maharashtra, Odisha and Bihar it is grown in very small area. The total area under pineapple fruit cultivation is approximately 90,000 hectare out of which in West Bengal alone the area under pineapple fruit cultivation is 12,500 hectares.

PALF is obtained from matured green pineapple leaves. It contains around 1% of dry fibre on weight basis of the green leaves weight. Though PALF has no separate spinning system of its own, it is combined with silk or polyester to develop textile fabrics. Blended textile fabric can also be produced from cotton-pineapple leaf fibre combination with the use of cotton spinning machinery. PALF has enormous potential for development of diversified products as mentioned below.

Woven fabrics from PALF/polyester/acrylic blends are used for knitting women's outer garments, socks etc. Using PALF yarns developed in a coir spinning system, products like rubberized doormats, tufted carpets (using PALF yarn and coir yarn), bathroom mats and floor mats (using PALF yarn and jute yarn) are developed. PALF yarns alone and PALF blended yarns spun on cotton and jute spinning system are suitable for the production of curtains, bed spreads, carpets, furnishing fabrics, towels etc. Using chemically treated PALF, needle-punched non-woven felts can be developed. These felts are being used for geo-textiles applications viz. erosion control, road construction, river bank protection etc. PALF serves as an excellent raw material for the manufacture of V-belt cord, conveyor belt cord, lightweight duck cloth etc. It imparts additional strength and an extra degree of dimensional stability. PALF can be pulped chemically or

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with the application of enzymes. The pulp is then used in making industrial paper having many potential applications.

MATERIALS AND METHODS

Scrapping of pineapple leaves

The machine used for scrapping the green pineapple leaves (Fig. 1) is designed and developed at ICAR-NIRJAFT Kolkata. It consists of three different kinds of rollers viz. (i) feed roller (ii) scrapping roller and (iii) serration roller. The leaves were fed through the feed roller and then passed through the scratching roller. The upper surface of the leaves is first scratched by scratching roller blades to remove the waxy layer and then passed through the serrated roller where the closely fitted blades of the roller macerates the leaf and produces several breaks on the leaf surface for easy entry of the retting microbes (Fig. 2).

Retting of Scratched Pineapple Leaves

The scratched pineapple leaves were tied in small bundles and immersed in the retting water enriched with two different bacterial cultures. A control sample where the retting was done in plain water was also taken. The leaves from retting tanks were regularly checked by passing them within fingertips to see whether the fibres are loosened and can be extracted. At the end of retting, the leaves were taken out and the fibres were manually extracted by washing in plain water.

Fig. 1. *Scratching of Green Pineapple Leaf*

Fig. 2. *Scratched Green Pineapple Leaf for Retting*

RESULTS AND DISCUSSIONS

The control sample took five (05) days for retting in comparison to three (03) days in the case of bacterial culture. The mechanical properties of the fibre obtained from controlled and bacterial culture retted samples are given in Table 1. It reveals that, with more time taken by the control sample for retting, the fineness of the fibre improved but the strength was reduced. In consideration of its mechanical characteristics, it can be placed in between jute and cotton or jute and ramie (Banik *et al*., 2011). Moreover it can be blended with jute, cotton, ramie and some synthetic fibres, viz. acrylic, viscose and polypropylene for improvement in fabric quality (Ghosh *et al*., 1982; Sinha *et al*., 1977). The retting period, tenacity & fineness of the fibre obtained in the present study was compared with that of fibre obtained from other pre-retting and retting combinations (Banik *et al*., 2011) and reported in Table 2. It shows that, the tenacity of fibre obtained in the combination of ICAR-NIRJAFT extractor & both plain water and bacteria enriched retting were much higher than in comparison to the other combinations. However, the highest fineness (6.50) among all combinations were found in the case of enrichment culture retting, E2. The SEM photographs of controlled sample (Fig. 3) shows the presence of gummy

Table 1. *Mechanical properties of extracted pineapple leaf fibre*

Sample	Tenacity (g tex^{-1})	Strain (%)	Fineness (tex)	Maximum Load (N)
E1	30.66	6.07	5.50	1.69
E2	30.89	3.62	6.50	2.01
C	29.37	2.79	4.25	1.25

E1 & E2: Samples retted with bacterial culture, C: Control (without bacterial culture)

Table 2. *Comparative strength and fineness of pineapple leaf fibre*

Pre-retting and retting combinations Retted in the 1:20 substrate: liquor ratio with nutrient supplements, such as 0.5 % urea or 0.5% di-ammonium phosphate (DAP)	Retting period (Days)	Tenacity (g tex^{-1})	Fineness (tex)
Manual combing	10	7.8	Variable
Machine scrapping (One side)	8	11.1	4.3
Machine scrapping (Both side)	8	11.6	5.0
Machine scrapping + Combing (One side)	6	9.7	5.7
Machine scrapping + Combing (Both side)	6	16.7	3.4
Retted in the 1:10 substrate: liquor ratio in plain water			
Scratched in ICAR-NIRJAFT extractor	5	29.37	4.25
Retted in the 1:10 substrate: liquor ratio in plain water with enriched bacterial culture			
Scratched in ICAR-NIRJAFT extractor +E1	3	30.66	5.50
Scratched in ICAR-NIRJAFT extractor +E2	3	30.89	6.50

materials in between the individual fibres, where as the gummy materials are removed after the application of enrichment bacterial cultures in the retting process (Fig. 4 & Fig. 5).

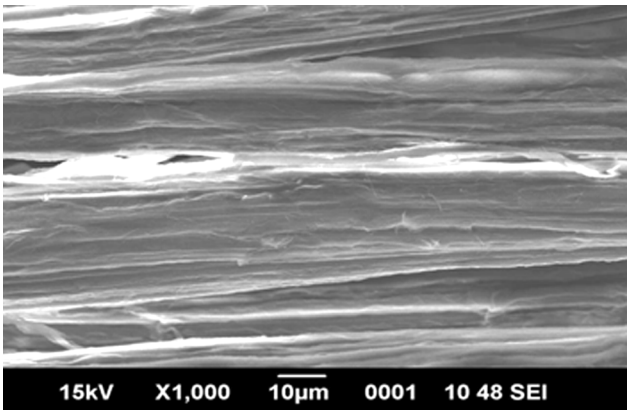

Fig. 3. *SEM Photograph of controlled PALF samples*

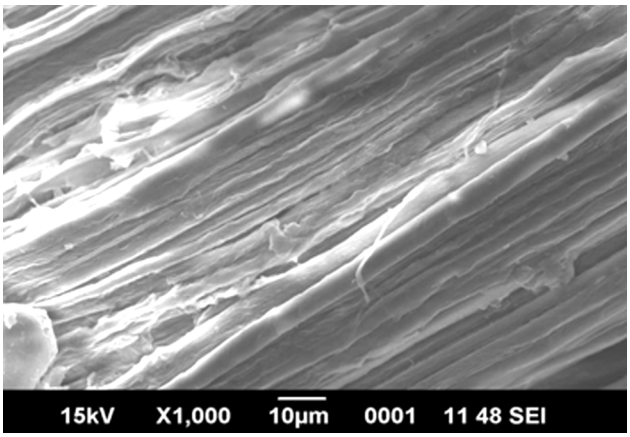

Fig. 4. *SEM Photograph of samples extracted by enrichment culture (E1)*

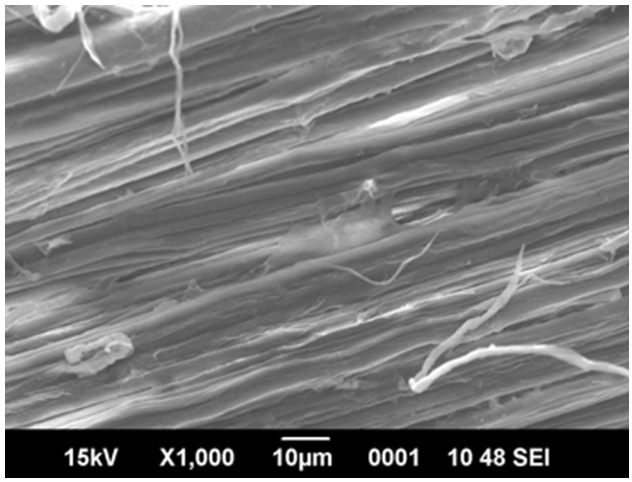

Fig. 5. *SEM Photograph of samples extracted by enrichment culture (E2)*

CONCLUSIONS

Retting period of scratched pineapple leaves can be reduced (from 05days to 03 days) with the application of bacterial culture. The tenacity of the bacterial culture retted fibre was found to be highest among all. The gummy material present over the fibres are removed during the retting by bacterial culture. Pineapple leaf fibre can be placed in between jute-ramie or jute-cotton; based on its inherent properties. It can serve as a potential raw material for production of blended yarn and fabric with combination of other plant based natural fibres.

ACKNOWLEDGEMENT

The author is grateful to the Director, ICAR-NIRJAFT, Kolkata for rendering support and assistance to carry out the work.

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