Evaluation of Bacterial Treatment on the Flexural Rigidity and Light Fastness Properties of Coir Fibre

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Coir is a versatile hard vegetable fi bre with diversified end-use. Conventional monitoring methods for coconut husk retting are subjective; often more of an art than a technology. An effective retting measurement method is required for optimizing the retting process. In order to improve its texture and feel the coconut husk is subjected to retting which is a bacterial intervention. The Flexural Rigidity and light fastness test have been applied to the coir fibre extracted after retting for assessment of fibre quality. There is an improvement in the light fastness properties and Flexural rigidity properties on treatment with a bacterial consortium of selected phenolytic strains.

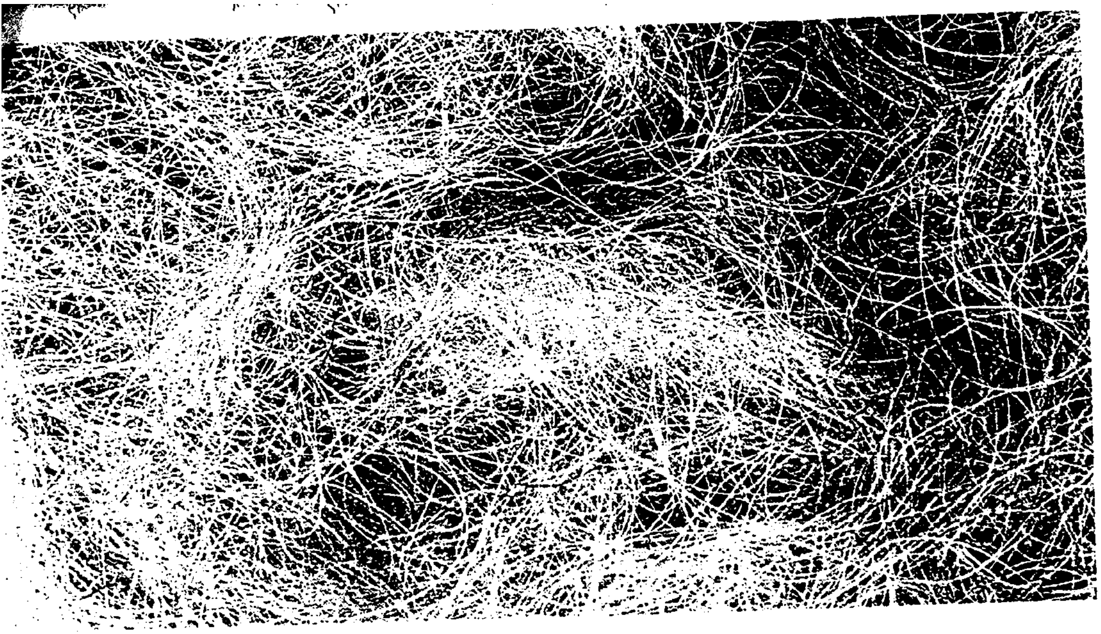
Keywords : Bacterial consortium, Coir, Flexural rigidity, Light fastness, Retting

The coir industry is an export and employment oriented one and the annual global requirement of coir fibre is about 78900 metric tons. It fetches a foreign exchange earning of over 400 crores of rupees per annum for India and is very important in the national context on account of the employment that it provides in rural areas to the economically weaker sections of the population. The coir sector provides employment to over five lakh households in Kerala alone, the majority being women engaged in the spinning of fibre to yarn.

The husk potential utilized in India for coir production presently is only 35%. Most analysts forecast long-term increase in world demand for all types of fibrous materials, at the same time limitations in production capacity is also predicted

The fibre is consumed both in the domestic and international market as fibre, yarn, coir products, rope, curled coir and rubberized coir. Other diversified applications include use of coir netting and matting as geotextile material to prevent soil erosion[1], and in roof surface cooling, as drainage filter material. Needled coir felt also has been observed to possess properties for reinforcement function in cohesion less soils and as filter fabric in cohesive soils.

Coir having a greater aspect ratio



(length: diameter), can be used successfully in filling or reinforcing thermoplastics with an improvement in flexural properties, toughness and reduction in the cost as compared to the pure thermoplastic. For aesthetic qualities, polypropylene composites with coir and sisal have been stated as the best.

The colour of the fibre apart from the maturity of the husk, is also influenced by the nature of the retting process, environmental conditions and duration of retting (Ref 2). The physical appearance and quality of fibre varies widely with respect to colour, length and percentage of impurities. The best quality fibre is bright in natural colour possesses good staple length (between 15-20 cms) and is comparatively free from pith and impurities.

The husk potential utilized in India for coir production presently is only 35%. Most analysts forecast long-term increase in world demand for all types of fibrous materials, at the same time limitations in production capacity is also predicted. New fibre crops, new industrial uses of non-wood fibers, and agricultural diversification in conventional and novel markets, in general, are therefore subjects of widespread interest for plant fibre. For annually harvested fibre production to be an attractive proposition, the three essential requirements are that the material be produced at a large scale, at a low enough price, with fibre characteristics being adequate for the end use in question. Equally important is that should be a proven technology available for the processing of the new raw material (Ref 3-5). The present study was aimed at assessing fibre properties viz. the flexural rigidity and light fastness ratings on naturally retted and bacterial consortium treated coconut husk.

For preparing inoculum, surface sterilized husk (50g) was taken in each of four round bottom flasks (5L capacity). To this 2L of sterile mineral medium was added and allowed to stand for 48 hours. During this period the leachate containing phenolic and other compounds would comprise the nutrient

Table 1. **Light fastness Studies on Coir Fibre**

Test Method - Exposure to Xenon Arc Lamp Quarzlampen Gesellschaft M.B.H. Hanau FRG
Light and Dark Method
Humidity : 70%
Temperature : 37°C
Test : 1006 : 1955

Sample	Description	Grade*
A	Fibre from 5% consortia treated husk	II
B	Fibre from 10% consortia treated husk	II
C	Fibre from untreated husk	I
D	Fibre from naturally retted husk	II

*Grades were determined by comparing with the fading time of grey scale standards.

Table 2. **Flexural Rigidity Gf of Fibre samples**

Fibre Sample	Average deformation d" cms	θ	Flexural Rigidity G_f
Naturally retted	0.87	22.69	1.47
5% consortium treated husk	1.00	34.13	1.19
10% consortium treated husk	1.03	35.13	1.13
Untreated control husk	0.71	24.2	2.00

medium for proliferation of the consortium of bacteria enriched in husk leachate. The medium was decanted aseptically into sterile flasks and was inoculated with 5% (v/v) of the bacterial consortia and incubated at room temperature for 24h. This was used as inoculum for the laboratory scale retting experiment.

Mature coconut husks from 11-month-old nuts, which are normally utilized for coir extraction, were used for retting. Three tanks A, B, C were set up with 10 husks immersed in tap water. After 24 hours of soaking, tanks A and B were inoculated with the consortium grown in Husk Leachate Medium in concentrations of 5 and 10 per cent respectively. Tank C was maintained as the untreated control. In all the three sets the final husk : liquor ratio was maintained at 1:5 . A periodic flushing of the water in all the three tanks was carried out by removal of the steep liquor and refilling with tap water at fortnightly intervals. This was done to simulate the flushing action in the environment which gives a brightening effect on the fibre and also exerts a beneficial influence in retting. In order to supplement the loss of organisms due to flushing, tanks A and B were reinoculated with the consortium in the concentration of 5 and 10% respectively after one month of the first inoculation.

The degree of softness imparted to coir by a treatment can be measured by the Flexural Rigidity Tester (Model 1996). This is a device developed by the loop methods to determine the flexural rigidity of the fibre. In this method, a ring of radius 'r' formed by a fibre is allowed to deform with the help of a fixed weight and the amount of deformation with a fixed weight depends upon the softness of the fibre.

Flexural rigidity $G_f = 0.0047\ Mg\ (2\pi r)^2 \cos\theta / \tan\theta$

where

r = radius of the ring

mg = weight of load applied

$\theta = 493/2\pi r$

d = deformation of lower end of ring

Fifty samples of the ratted fibre was tied up on a PVC rod to attain the form of a ring having a radius of 2.3 cms and allowed to remain for 24h. The rings were then tested on a flexural rigidity tester with and without load and the flexural rigidity (G_f) calculated.

The quality of coir fibre can also be determined by assessment of light fastness ratings using the Xenotest (Xenon Arc Lamp Quarzlampen Gesellschaft M.B.H Hanau FRG.) This is a uniform specification for rating the light fastness and weather fastness of materials more quickly than naturally. It has a 1500 watt Xenon arc lamp as a source of radiation; the filtered spectrum of this lamp when used in the Xenotest is the same as sunlight. The samples were subject to alternate periods of light and dark. This mimics conditions of day and night approximately. A test time of 24 hours in the Xenotest was roughly equivalent to the radiation received over 10 days in the open air averaged throughout the year.

The fibre extracted from A, B&C together with fibre extracted from naturally retted husk (D) were subjected to the Xenotest which rated the fibre from consortia treated husk as Grade II whereas the fibre from the untreated husk showed a rating of Grade I (Tab 1). The Flexural rigidity of the fibre extracted from tanks A, B and C were tested for the degree of softness and were found to be 1.19, 1.13 and 2.00 gcm^2 respectively. (Tab 2)

The degree of softness of the fibre in the tank with 10% inoculum, B was slightly greater than A indicating the possibility that the quantity of the consortium inoculated may be important in determining the softness of the fibre.

The fibre extracted from both the tanks inoculated with the consortium were observed to possess characteristics (light fastness rating and degree of softness) comparable to that of the fibre retted in a natural system for 11 months within a much shorter period of three months.

The study reveals that the quality of coir fibre can be assessed by applying the xenotest and flexural rigidity test for evaluating the effect of any treatment on the coconut husk. The treatment of a phenolytic bacterial consortium on coconut husks soaked in tanks can reduce duration and improve the quality of the coir fibre.

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