*Ceylon Cocon. Q.* (1976), 27, 26-34
*Printed in Sri Lanka*

# PRODUCTION LEVELS AND OPTIMUM PERIODS OF RETTING FOR WHITE FIBRE PRODUCTION IN THE RATHGAMA— DODANDUWA AREAS

P. V. S. DAYANANDA*
*Coconut Processing Board Colombo, Sri Lanka*

## ABSTRACT

Dayananda, P. V. S., (1976). Production levels and optimum periods of retting for white fibre production in the Rathgama—Dodanduwa areas. *Ceylon Cocon. Q.* 27, 26-34.

The optimum periods for seven types of retting commonly practised in the Dodanduwa—Rathgama area were evaluated for the mechanical extraction of fibre on *Ceylon type* of fibre extractor.

Each method showed production patterns characteristic of the type of retting. A strong and reciprocal relationship was observed between bristle and mattress fibre production. Lagoon retted samples showed regular and closely related production patterns, while tank retting produced irregular and distinctively different patterns.

In determining the optimum period of retting for each method the point of retting at which maximum bristle fibre coupled with minimum mattress fibre resulted was considered the best. This was further justified by the dust production patterns and visual observations on the colour of the product.

The investigations reveal that the optimum period of retting for uncrushed husks retted in the lagoon to be around 150 days. The ratio of Bristle to Mattress Fibre at the optimum period of retting was established at 1 : 1 for which the actual production level was found to be 1.8 kg each for Bristle and Mattress Fibre at 15% moisture content per 25 green husks.

The fluctuations of production at the initial and final stages were mainly due to breakages of fibre as a result of mechanical friction imparted by the defibering drums on under retted and over retted husks. Impaired separation of dust and baby fibre from bristle and mattress fibre under above conditions of retting was considered as another contributory factor for the observed fluctuations.

## INTRODUCTION

The possibility of extraction of white fibre from retted husks using the brown fibre drum was examined and found to be feasible. This has necessitated the evaluation of optimum periods for various types of retting employed to produce white fibre.

It is important to know whether the husks being retted in the lagoon for defibering are properly retted. The feel of the husk was found to be inadequately informative for this purpose since the period of retting in a given environment is a crucial factor that determines the degree of retting.

It has been established that the period, temperature and wave action are the major factors that affect the degree of retting—(Fowler and Marsden, 1924). Among them the period of retting is considered most important, as the rest of the limiting factors could be controlled within reasonable limits. Production cannot be properly programmed and husk requirements cannot be properly assessed without a knowledge of retting periods under various conditions.

*Present address: Fibretex Ltd., Colombo, Sri Lanka

## MATERIALS AND METHODS

### Sample Structures and Preparation of Samples for Retting

Seven different methods (Figure 1) were employed during the experiments and uncrushed husks were used. The husks were weighed and torn into standard 4 - 5 pieces manually within 24 hours of plucking. All the husks selected for the experiment were from 11 months old nuts plucked from average trees from the same locality.

EXPERIMENTAL SERIES NO. 1 (UNCRUSHED HUSKS)

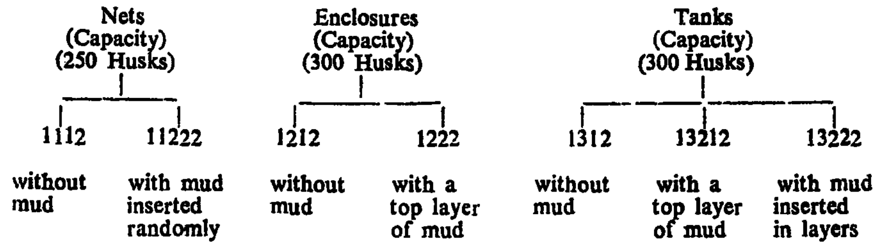


Fig. 1. Distribution and Labelling of Samples.

Twenty five green husks constituted what is referred to as a "sub-sample". Seven of such sub-samples constituted a "major sample" for a given method for retting. These seven major samples were retted each for different periods as shown in Figures 2, 3, and 4.

### Retting in Nets, Enclosures and Tanks

Specially woven coir nets each of which is capable of accommodating a major sample with its constituent seven sub-samples were submerged in the lagoon. Two such major samples—1112 and 11222 were used for the two types of net retting commonly employed in the area. One major sample 1112 contained untreated husks, while the other sample 11222 comprised husks into which mud had been randomly inserted. All the samples were submerged one foot below the surface of the water in the lagoon by weighing down with lumps of granite, To keep the samples in place, All the nets were secured to wooden posts.

Two types of retting enclosures were tested. An enclosure is essentially a rectangular space of lagoon varying in sizes and separated from rest of the lagoon by a wooden fence. The vertical wooden poles of the fence are connected horizontally at regular intervals by wooden beams so that it forms a lattice through which the natural movements of the water gain access into the enclosure. Each enclosure had a capacity of 1.812 cubic metres and were capable of holding 250 husks. Two major samples were used for these expeiriments. One (1212) contained untreated husks covered by cadjan leaves and weighed down with granite. The final step was to submerge this sample to a depth of 0.30 metres below the surface. The other sample 1222 was treated with mud to form a topmost layer and finally covered with cadjan leaves and was weighed down in the same manner.

Three types of tank retting were tested. The tanks were identical in sizes each having a capacity of 0.875 cubic metres. In one of the tanks (Sample No. 1312) samples of husks were covered with cadjan leaves and weighed down in the usual manner. The water level was maintained at 10 cm above the level of the husks. The other two tanks contained husks treated with mud in two different ways. In one (No. 13212) tank a layer of mud was placed over the whole sample, while in the other tank (No. 13222) husks were arranged in layers alternating with layers of mud.

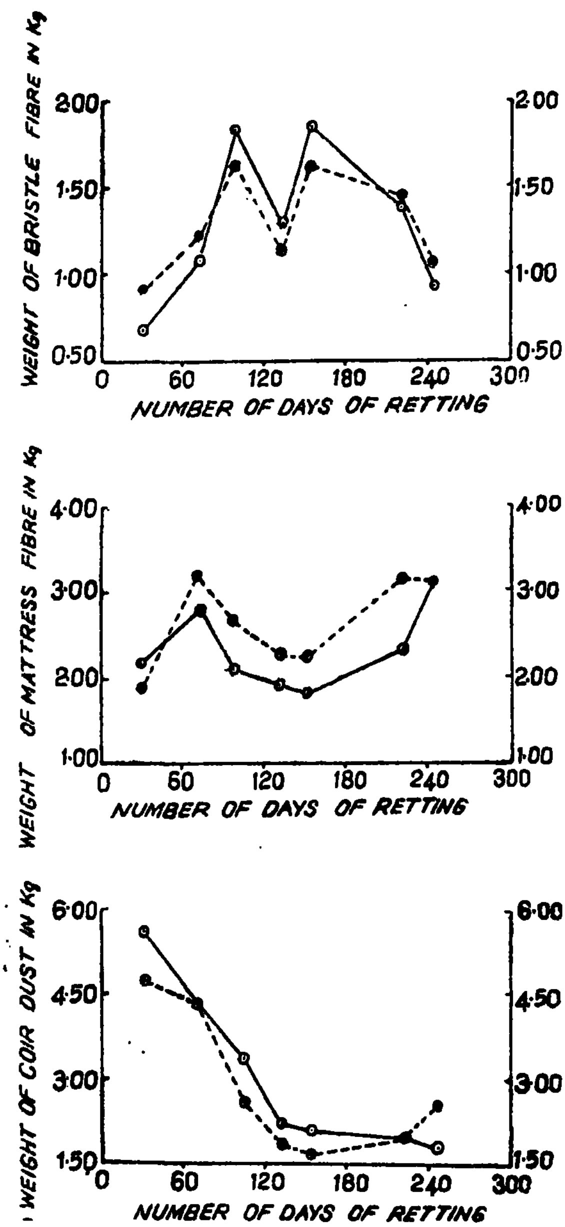


Fig. 2. **Variation of Fibre and Dust content in relation to the period of retting in nets.**

(.) ——— (.) without mud (1112)

(+) ------ (+) with mud random (11222)

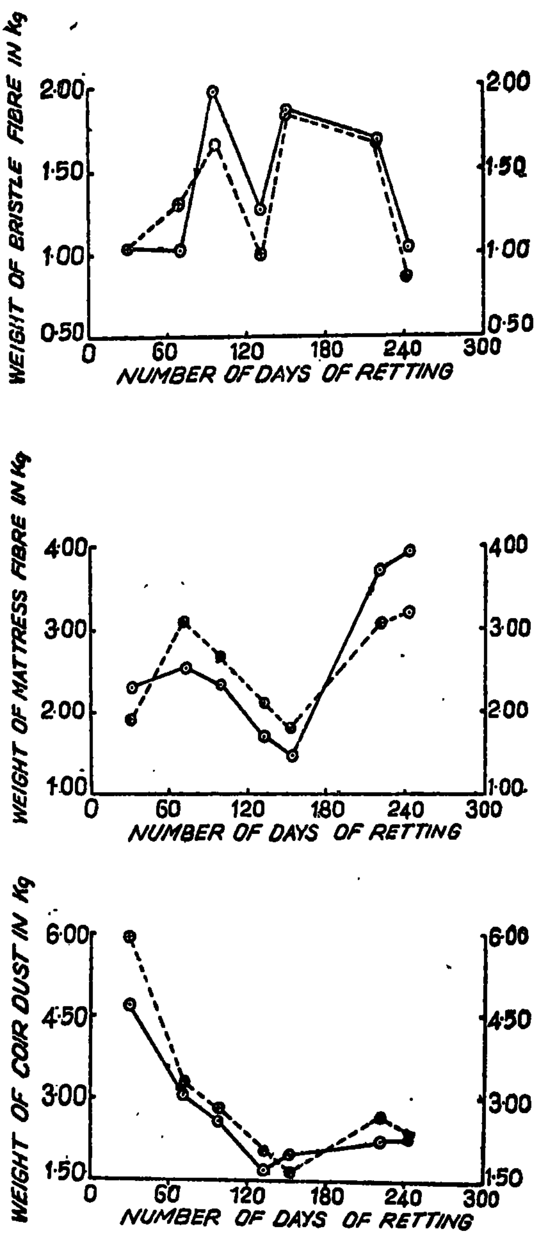


Fig. 3. Variation of fibre and dust content in relation to the period of retting in enclosures.

(.) ———(.) without mud (1212)

(+) -----(+) with mud as top layer (1222)

Sub-samples (comprising 25 husks) were taken out at different intervals from each major sample for extraction of fibre. During the extraction process, the long stapled (bristle) fibre remains in the hands of the operator, while the short fibre (mattress) and pith are separated by the combing action of spikes of the rotating drums. The sub-samples were first washed in lagoon water to remove adhering particles and mud. Then bristle and mattress fibre were extracted by using Ceylon type drums. The wet weights of bristle fibre. mattress fibre and pith were separately determined on the spot after sifting to separate the pith from mattress fibre. A normal rotary sifter was used.

After weighing, sample characters such as colour, staple lengths, impurities and other visual characteristics were noted while the fibre was still wet. Samples of 0.908 kg each were taken from bristle and mattress fibre and washed and dried in the sun in blackened galvanized trays. When the moisture content decreased to 15% (measured by a moisture meter) the samples were immediately weighed and packed in polythene containers.

Dry weight determination of dust samples were carried out by drying 1.816 kg of wet dust samples. These dust samples were dried only up to 20% as any attempts to dry beyond this was found to be time consuming and ineffective.

### Visual Observation of Colour Characteristics

Small specimen samples of mattress fibre were extracted for visual observation from the washed and dried samples before packing. For ease of comparison these specimen samples were arranged according to periods of retting. Samples from various methods but with the same retting period were arranged in horizontal rows and the vertical columns represented samples for various periods of retting under each method.

The colour intensity was noted and the stages at which a significant colour improvement had taken place could be decided for sub-samples constituting a major sample (Figure 5). These observations were made by a test panel consisting of three individuals including the experimentor himself.

## RESULTS AND DISCUSSIONS

### Effect of the Retting Method on Bristle Fibre Production

Variation of bristle, mattress and dust production with the period of retting differs from each other. There is a tendency to follow a pattern characteristic to each type. The characteristic variation pattern of bristle fibre production is shown in Figures 2 - 4. In both net and enclosure retting the production of bristle fibre drops to the initial values after 240 days of retting. These initial and final production values in most instances for bristle fibre lie between 0.031—0.037 kg/kg of green husk at 15% moisture. The peak production values lie between 0.061—0.074 kg/kg of green husks at 15% moisture. Another important observation is that all the peak production values occur within the same periods of retting for both net and enclosure retting experiments. The intermittent drop between the two peaks also occur after the same periods of retting. This strongly suggests that both net and enclosure retting undergo a remarkably similar process of retting.

Bristle fibre graphs for tank retting, although tend to give a glimpse of lagoon retting patterns they are incomplete and irregular in many ways. In all three tanks the rettings tested closely follow the pattern of that of lagoon retting up to 120 days. After 120 days of retting instead of givig rise to a second peak production of bristle fibre by ascending through a high gradient, it slows down to a long retarded ascent, Even before the ascent, maximises fibre becomes so dark and weak and the tank retting experiments were stopped after 240 days.

**Effect of the Retting Methods on Mattress Fibre Production**

The characteristic pattern for mattress fibre production graphs as stated above, is different from that of bristle fibre. But there seems to be a strong and close relationship between various peak and depression patterns of bristle fibre graphs and that of mattress fibre graphs. The average lowest production level of mattress fibre which is important in deciding the optimum period of retting (to be discussed later) was found to be 0.066 kg/kg of green husks. The descending part of the second peak is absent in most of the cases due to the inability of obtaining production figures during this period, as most of the samples were over-retted. As indicated by extrapolation of graphs the production of mattress fibre reaches its maximum in the second peak in all the types of lagoon retting. In the tank retting experiments the retting seemed to be prolonged after 160 days and this is further manifested by a slower gradient towards a second peak.

**The Relationship among Production Patterns**

As indicated earlier within the first 120 days all types of retting methods employed have produced similar peak patterns. At the initial stages husks are under-tetted. At this stage ground substances are still firmly cemented to the ffibre. Therefore the mechanical friction imparted by drums on the husks in the extraction procedure breaks the fibre, (at first being both the long and short staples and later confines only to the long stapled bristle fibre). As a result mattress fibre production increases at the expense of bristle fibre as the broken fibre forms mattress fibre which are shorter in length.

With the passage of time when the microbiological action sets in the fibre becomes less attached to the ground substance. Therefore it facilitates the mechanical separation with less damage to long staples. As a result bristle fibre gtaphs ascent from an initial lag phase (comprised of first 80 days of retting) to a first peak production level through a high gradient. A similar descent in the production of mattress fibre within the same period confirms the relationship.

Mattress fibre production continued to drop even after the bristle fibre production is maximised. Between 100 to 140 days of retting the reduction of both bristle and mattress fibre occurs simultaneously in all the lagoon samples and in most of the tank samples. This phenomena deserves further examination before trying to attempt any explanation. However, close observation of bristle fibre samples during the first peak production reveals that they contain many impurities such as adhering dust and baby fibre particles. Therefore it would not be unfair to assume that the subsequent drop in bristle fibre is due to the loss of these impurities by improved retting conditions with the advance of time. When the impuritties are remove after around 130 — 140 days of retting the bristle fibre achieves a true and stable maximum production level followed by a gradual decrease of mattress fibre production to a minimum.

**Retting under Inhibited Conditions**

The tank retting in stagnant water does not follow the pattern of retting that has been observed in lagoon retting samples. Upto the first 150—160 days both lagoon as well as tank retting progressed in a closely related pattern. This similarity at the initial stages up to 160 days may be due to uninhibited microbial action coupled with waste product removal beyond the margins of biochemical retardation. But after 160 days the phase of microbial action becomes significantly different in lagoon and tank retting. The phase change is due to the comparative lowering of microbial action as a result of waste product accumulation in stagnant tanks. This arrest of microbial action is premature and results in an irregular retting, as shown by all the tank retting graphs (Figure 4).

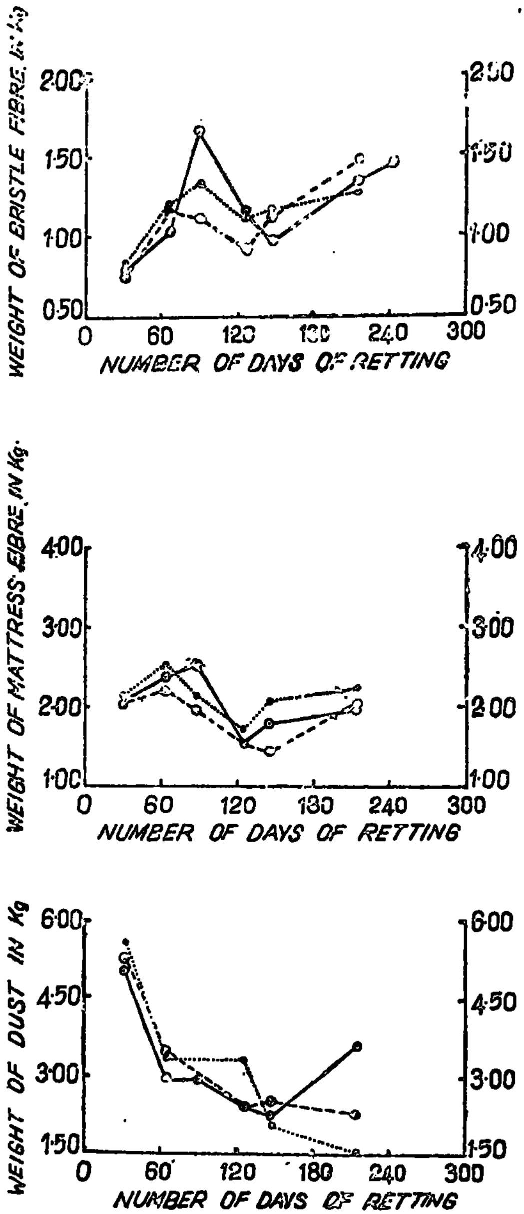


**Fig. 4.** Variation of fibre and dust content in relation to the period of retting in tanks.

(.) ——— (.) without mud (1312)
(+) ----- (+) with mud as top layer (13212)
(.) ..... (.) with mud in layers (13222)

### Effect of the Retting Method on Dust Production

The production pattern for coir dust is consistent throughout most of the retting experiments. In almost all the cases the initial dust content lies between 0.167 — 0.208 kg/kg of green husks at 20% moisture content. The average loss of dust content through the retting period is around 0.083 kg/kg of green husks. The rate of loss of dust content is logarithmic. When these curves are extrapolated they show a total loss of 64% of the coir dust during the process of retting.

During the initial stages of retting the ground substance (Singh, 1976) consists largely of chemicals like pectins and hemi-celluloses which are either soluble or which may break down into soluble products. With the progress of retting this soluble or decomposable fraction gradually diffuses away resulting in a gradual loss of the total dust content. Therefore when almost all the soluble or decomposable ground substances have diffused out in this manner no further reduction of dust content could occur.

Further it has been observed that the rate of change of colour of the extracted dust gradually decreased with the progress of retting. After about 160 days of retting where the graphs indicate no further loss in the dust content only a slight change in colour has been observed. Since the colour change indicates the presence of oxidisable matter, this further confirms that the disposable and oxidisable fraction has been leached out considerably at this stage. After 110 days of retting the dust content remains constant to further retting until about 200 days. After 200 days the dust content shows a gradual and slight increase due to breakages of mattress fibre as a result of over retting. This is further evidenced by the presence of increased baby fibre content in all the dust samples after 200 days of retting. The fibre content in dust further increased by impaired separation of dust by formation of lumps of pith with entangled mattress fibre.

### Evaluation of the Optimum Period of Retting

When the bristle fibre production achieves the second peak production, mattress fibre records the lowest. Since the total quantity in weight of bristle and mattress fibre is constant allowing for natural and experimental error fluctuation in a given sample, the lowest production of mattress fibre implies that the bristle fibre no longer breaks to produce mattress fibre. This is further confirmed by the above verification on the relationship among production patterns. Therefore at this point the retting could be considered optimal and production levels of bristle to mattress fibre is closer than ever to their natural ratios. The experimental inferences established this ratio to be 1:1 at the production level of 1.80 kg of bristle and 1.82 kg of mattress after 150 days of retting for all the lagoon retted samples. In all types of lagoon retting methods under observation this optimisation occurs after 150 days of retting whereas tank retting fails to achieve such a result. In all the lagoon retting methods the points of optimisation coincide with the points at which the dust content stabilizes to further decrease.

### Colour Comparison Results

The optimum retting position for various methods of lagoon retting as evaluated above appears within the improved colour positions as shown in Figure 5. Except for two types of retting (1112 and 1212) all the other types show the colour improvement just after 100 days of retting. In these exceptions colour improvement appears one month prior to the usual period. After 100 days the colour continued to improve until the retting experiments were stopped. But in tank retting the colour was observed to improve only slightly even after 200 days of retting. Therefore it is concluded that the optimisation of retting as evaluated above would always take place after the colour of fibre has been significantly improved.

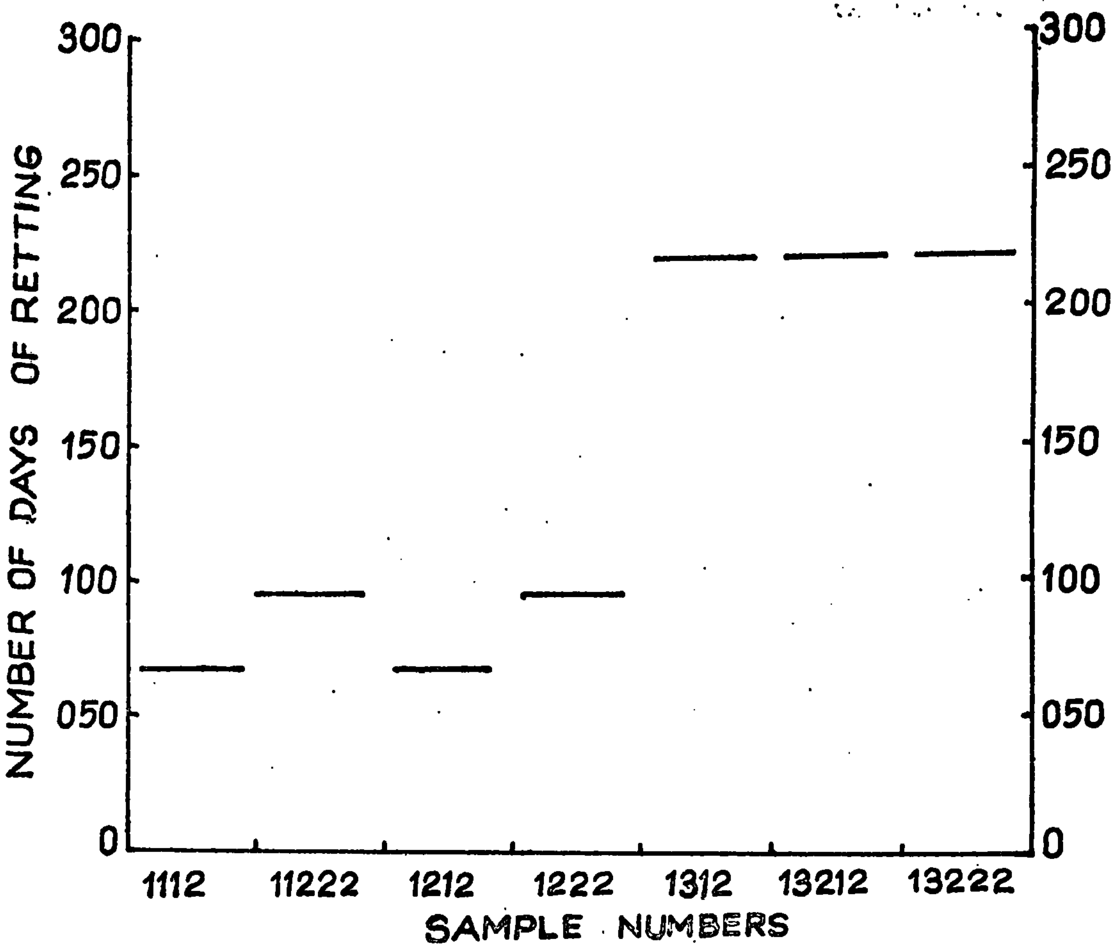


Fig. 5. Variation of the period of retting at which a significant colour improvement had been observed in relation to the the type of retting.

## ACKNOWLEDGEMENT

My thanks are due to Mrs. K. Vitarana, General Manager, Coconut Processing Board for the guidance and constructive criticism of the material.

I am also indebted to the officers of the White Fibre Research Institute, Rathgama, for the assistance extended to me in conducting this experiment.

## REFERENCES

Fowler, G. J. and Marsden, F., (1924). Retting of Coconut Husks for the Production of *Coir. J. Ind. Inst.* **7**, 39—41.

Jayasankar, N. D., (1977). Prospectives on the Biological Extraction of Coir. *Coir*, **22**, (1) 6-9

Singh, S. M., (1976).—*Hard Fibre Research Series No.* 20.