PERSPECTIVES ON THE BIOLOGICAL EXTRACTION OF COIR

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ABSTRACT

The age old practice of biological extraction of coir consists essentially of soaking coconut husks in water for varying lengths of time. Salinity and periodical flushing of the ret liquor are considered by the retters as pre-requisites for the production of good quality of coir fibre. Vast amount of data is available on the bacteria and yeasts associated with the process of retting of the coconut husk and degradation of the natural binding materials leading to liberation of the fibre. Evidence indicates the involvement of the polyphenols of the coconut husk as the possible reason for the undue delay in the completion of the process. This is yet another cause for the insufficiency of stagnant water for the production of quality fibre. Results are suggestive of the non-requirement of brackish water for this retting process. The need of the moment is to translate the basic information available on the process to the retting community and to relieve them of the existing maladies.

INTRODUCTION

Coir fibre is extracted from the mesocarp of the fruit of *Cocos nucifera* Linn. The firmly cemented fibres in its natural setting can be extracted by biological, chemical or mechanical means. The commercial method followed in the State of Kerala, is the traditional method of natural retting which consists of soaking the husks in saline backwaters. The duration of the retting varies normally from 4 to 12 months after steeping the husks. On completion of the process, the fibres are separated by beating the retted husks with wooden mallets on logs or stones until the adhering pith is removed. This age old practice of biological extraction of coir is in existence since several centuries. The oldest available document on the extraction of coir followed in Kerala is perhaps that of the 14th century Persian traveller Ibn Batuda. From the vivid description provided in his travelogue it is apparent that hardly few improvements have been accomplished in the present day retting process.

GENERAL CONCEPT OF RETTING

The concept of retting in general as due to the agency of microorganisms has been accepted by scientific workers ever since the first isolation of a bacterium from the rets of flax by Winogradsky and Friebes in 1895. Retting in a general sense can be achieved by either land retting or water retting. Land retting is believed to be the result of fungal activities whereas water retting is facilitated by bacteria.

A review of literature indicates the vast amount of information available on the microbiology of retting of flax, hemp, jute and coir. In flax retting different investigators from different countries have implicated several bacteria and yeasts as the dominant microflora. The consensus seems to be the association of *Bacillus*, coliform bacteria, *Micrococcus*, *Pseudomonas*, *Flavobacterium* and *Achromobacter* in the flax rets. Gram positive cocci and species of *Bacillus* dominate the rets of hemp while *Bacillus*, *Pseudomonas* and *Micrococcus* seems to be the dominant flora in the retting of jute.

RETTING OF COIR

Kluyver and Reksohadiprodjo (1923) were the first to presume a microbiological retting of coir but Fowler and Marsden (1924) were the pioneers to initiate investigations in this direction. Their studies were limited to the mere isolation of a bacterium closely related to the genus *Sphaerotilus*, an unidentified short bacterium and an yeast from the retting pits. Subsequently Heyn (1951) isolated from the soaking husks in Java six strains of bacteria of the genera *Diplococcus* and *Vibrio* three strains of clostridia and two types of unidentified yeasts.

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However, a systematic and comprehensive approach to the problem of the biological extraction of coir has been provided by Jayasankar (1966). In a sequential order it was observed that the natural ret liquor appeared clear to turbid with the colour varying from yellowish to dark brown. Microscopic observations of the natural ret liquor showed the consistent presence of *Bacillus* Sp., gram positive cocci and gram negative rods in the natural retting environment. The pH of the samples varied between 5.8 and 6.8. The bacterial populations in the different samples were in the order of 1.92×10^5 to 10.8×10^8 per ml. Observations also revealed that the samples consistantly harboured an yeast population (1.63×10^2) to (1.80×10^4 per ml) that merit consideration. Qualitatively the dominant aerobic bacteria of coir rets comprised of *Escherichia, Pseudomonas, Micrococcus, Bacillus, Paracolobactrum* and *Alcaligenes*. The dominant yeast flora of coir rets were found to be species of *Saccharomyces, Debaryomyces, Cryptococcus* and *Rhodotorula*.

Ecological considerations based on artificial rets set up in the laboratory as also an analysis of the natural retting yards showed a marked difference in the pattern of flora in the brined and unbrined rets. Conspicuous was the absence of *Micrococcus* sp. in distilled water rets as compared with salted rets. A larger occurrence of *Alcaligenes* sp. was recorded in the distilled water rets. In the natural rets *Bacillus* species formed the largest individual isolates encountered. The uniformly high incidence of *Escherichia* in the laboratory and natural rets alike indicated its adaptability to this ecosystem irrespective of the mode of soaking and source of sampling of husks. Species of *Pseudomonas* also showed themselves to be pre-ponderant. In general natural rets revealed a clear cut selective bacterial load. The qualitative picture of the yeast flora did not show any difference with respect to addition or omission of sodium chloride in the laboratory rets. As in the case of bacteria the yeast flora of the natural rets differed broadly from those set up in the laboratory.

PECTINOLYSIS IN COIR RETTING

The principal changes brought about in the plant tissues during retting is the breakdown of pectic substances which form the chief constituent of the middle lamellae between the fibre cells and the retting of coir is no exception. Mitscherlich (1859) was perhaps the first to have attributed the change in the pectinolytic enzymes produced by micro-organisms, a view which is still held good. Therefore one of the major factors involved in biological retting is the activity of microorganisms in relation to the decomposition of pectic substances which hold fast the fibres together. It was observed that the ret effluents of coconut husk are fertile ecological niches for the isolation of pectinolytic microflora. By using a selective medium containing pectin as the source of carbon the pectinolytic bacteria of the coir rets were observed to be species of *Achromobacter, Aerobacter, Bacillus, Escherichia Paracolobactrum, Pseudomonas* and *Arthrobacter*. Among the yeasts encountered from the coir rets only *Cryptococcus* and *Rhodotorula* exhibited pectinolytic properties.

PHENOLIC DEGRADATION IN COIR RETTING

Many bacteria and fungi possess the ability to degrade phenolic constituents. This property is of considerable significance in the maintenance of the economy of carbon as an appreciable amount of carbon atoms gets locked up in plants in the form of benzene rings in compounds like polyphenols. Studies relating to the distribution and characteristics of phenol utilising microorganisms in coir rets revealed the consistent presence of phenol utilising flora in coir rets. The organisms mainly bacteria fell into the genera *Pseudomonas* or *Micrococcus* (Jayasankar and Bhat 1966). An interesting feature was the mode of action of the *Micrococcus* isolates on the aromatic ring. As still culture, instead of cleaving the benzene ring the isolates elaborated polyphenon oxidase converting the catechol formed as an intermediate in the phenol metabolism to a melanin-like compound identified as 3, 4, 3, 4, Tetrahydroxy diphenyl (Jayasankar and Bhat, 1966). The phenol degrading yeasts of the coir rets seem to prefix catechol to phenol as a better substrate (Jayasankar and Bhat, 1966). Though lacking polyphenol oxidase the yeast *Debaryomyces hansenii* cleaved catechol with the aid of pyrocate-chase (Jayasankar and Bhat, 1966).

PERIODICAL FLUSHING AND REQUIREMENT OF SALINITY

Investigations carried out on the influence of periodical flushing of the ret liquor at different stages of retting and on the requirement of sodium chloride in the rets indicated that a periodical flushing of the ret water at the optimal level was vital for an ideal retting. The criteria employed for assessing the merits and demerits of each retting system was the determination of the residual pectin and polyphenol content in the coconut husk at different stages of retting and checking the colour of the retted fibre. It was observed that the removal of pectic substances and polyphenols in fresh water rets was more or less comparable to that of brackish rets. Results were confirmatory that the fibres obtained from the different stagnant rets were alike and of an inferior colour. Renewal of ret liquor facilitated faster removal of the polyphenols of the husk; however, it affected adversely the residual prectin content. The rate of degradation of the pectic substances necessitated a particular frequency of renewal for maximal efficiency. More frequent renewals proved in fact less efficient than stagnant rets. Depending upon the material liquor ratios in the retting systems it will become necessary to arrive at the optimal flushing of the ret liquor.

NOTE ON PRACTICAL APPLICABILITY

Coir retting has by and large remained an art acquired by retters over generations and no scientific improvement have been applied in the process. It will be rewarding if the basic information available on the process is brought to the convenience of the retting community. The non-requirement of salinity for an efficient retting may not be conceived by the conventional retters. Large scale field trials seem to be the most appropriate need at present. It will be possible to enrich the systems with a heavy dose of pectinolytic bacteria, preferably a faculative anaerobe adaptable this ecosystem. It seems desirable to rely on the leac ing of polyphenols of the coconut husk without depen ing much on a microbial degradation of the phenoli Retting under controlled conditions combined possit with a chemical treatment of the retted fibre can ensu quality product of uniform standard.

The existing conditions in the retting centres demar detailed examination. The surroundings are oft found contaminated with the husk leachates. The a mosphere is polluted with foul odours. The peop engaged in the trade are constantly under the influen of these hazards. It will be worthwhile to assess th influence of these factors on the inhabitants in the re ting centres.

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Eleven-month-old coconuts are as good as twelve-month-old ones for seed purposes. Seednuts that float vertically in water give rise to more vigorous seedlings in nursery than those which float in oblique or horizontal positions.