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Physico-chemical and microbiological studies of jute retting water of four jute growing districts of West Bengal

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Jute fibre is obtained from the bark of two species of genus *Corchorus* viz. *C. capsularis and C. olitorius* known respectively as white and tossa jute in trade. The process of separation and extraction of fibres from non-fibrous tissue and woody part ofthe stem through dissolution and decomposition of pectins and other gummy substances is called retting. Retting is effected by the combined action of water and microorganisams present in water after the jute plants nave been submerged in water. Quality of jute fibre is primarily dependent on retting. The quantity, quality and nature of water, temperature of water during retting and presence of relevant microorganisms are some of the controlling factors which determine the quality of the retted fibre. In West Bengal, which is the main jute growing state in India, there are areas where good quality as well as bad quality fibres are produced. There is no systematic study to know the actual effect of the above mentioned factors on the production of good or bad quality fibres in a particular area. In the present paper, attempts have been made to study the properties of retting water and the microflora present in them. In all, nine water samples have been collected from four jute growing districts of West Bengal and analyzed for different parameters which are supposed to be responsible for production of good or bad quality of fibres.

Key words: Jute plant, jute retting procedure, microbial process

INTRODUCTION

Jute is cultivated in India for centuries. Before 1947 India exercises a monopoly in raw jute export. After partition of the country, the centres of production of jute goods remain in West Bengal while the fields are clustered in Bangladesh. Post partition India starts with 0.652 million acres, producing 1.658 million bales (1 bale = 180 Kg.), providing 108 jute mills requiring 7.2 million bales and resulting shortfall leading to one working shift and closure of some mills. India gradually increase jute production. In the first year of Ninth Plan (1997-98), coverage under jute increases all time highest at 9.20 lakh hectares with fibre production of 97.25 lakh bales in the country (Table 1) (Pathak, 2001). Jute occupies the most important place among various other bast fibre crops in India. The share of jute is hardly 1.4 per cent of the total cropped area of the states in the eastern and north-eastern parts of the country where its cultivation is confined. Nevertheless, jute plays a predominant role in the country's economy in general and that of the eastern region in particular, where more than four million farm families, majorities of which belonging to small and marginal categories, are involved in the occupation of the jute farming. About 250 thousand workers are employed in the century-old jute industry and another about half million people are involved in the ancillary activities in raw jute and finished goods trade. Despite tremendous competition from synthetic materials as well as handling system in the global market, jute is considered to be one of the vital packaging materials for a wide range of commodities like food grains, sugar, cement, fertilizers, salts, vegetables, etc.

Retting is a process employed to extract jute fibre from the bark of two species of genus *Corchorus* viz. *C. capsularis* and *C. olitorius* known as white and tossa jute respectively in trade by decomposition or dissolution of the materials which cement them

together, thus allowing fibre separation simply by washing. Retting is defined as the process of separating the embedded fibre from the stem through partial rotting by immersion in water; this rotting is brought about be a complex enzyme action of microbes naturally present in retting water. Retting ranks as the single most important factor governing the quality of fibre. At the appropriate temperature, bacteria of the reting water present on the stem attack the plant tissues surounding the fibres, softening them so that they can be washed away, leaving the fibres intact. Although the process is basically a simple one, timing is important in obtaining good quality fibres.

Process of retting is again controlled by the type of organisms present in the retting water, pH and temperature of the water as well as its B.O.D. and C.O.D. status. Normally, with the progress of retting process, B.O.D. and C.O.D. of retting water increase due to release of decomposed organic matter in the water. It is usually observed that after two or three charges, water becomes very dark with full of orgnic load and as a result retting process becomes slower and the quality of fibre deteriorates. Present paper will give an idea of the quality of retting water while retting is being carried out in eight waterbodies in four jute growing districts of West Bengal. The paper also reports the physical and biochemical characteristics of sixteen bacterial strains isolated from these waterbodies which actually act as retting agents in the water

MATERIALS AND METHODS

Retting water

Retting water was collected in the month of August and September from eight ponds of four districts of West Bengal viz. Hooghly, Howrah, Nadia and 24 Parganas (North) while retting work was being carried out by the jute cultivators. Water was collected in sterilized polythene bottle (Tarson make) from the middle of the 'jak'.

Enumeration of total bacteria and fungi

Number of bacteria and fungi present in retting water was counted following serial dilution plate technique. Nutrient agar and potao-dextrose-agar media were used for count of bacteria and fungi respectively. After counting, the bacterial and fungal colonies were isolated in pure culture and transferred to respective agar slants for preservation and further work.

Physical characteristics of bacteria isolated from retting water

Appearance of the bacterial colony was observed on agar plates of 48 hrs of growth and their shape, size and colour were noted. Gram staining of the isolated strains were carried out following normal procedure and the slides were observed under the microscope for determining the Gram reaction. Standard methods were employed to ascertain the presence or absence of spores and capsules on bacterial cell.

Biochemical characteristics of bacteria isolated from retting water

All the bacterial strains were subjected to biochemical tests such as starch hydrolysis, H_2S production, urea degradation, cytochrome oxidase activity and H_2O_2 degradation. In all these biochemical tests AR grade chemicals were used and tests were carried out following standard methods using freshly grown cultures.

RESULTS AND DISCUSSION

The data in Table 1 show the progressive increase in the production, area and productivity of jute fibre in different plan period of India. It could be seen that after ninth plan, the area and the production of jute fibre has almost been doubled than what wa sin pre-plan period.

From Table. 2, it was evident that the total number of bacteria and fungi present in the retting water varied from locality to locality. Even in the same locality, numbers varied from pond to pond. As for example, in Hooghly districts in the Tarakeswar area both bacterial and fungal populations were higher than Champadanga area which is adjoining to Tarakeswar. Similar situation could be seen in Habra in 24 Parganas(N) and in Chakdah in Nadia district.

The data in Table 3 described the properties of retting water collected from four different districts.

Table 1 : Average area, production and yield of jute during different plans in India

Five Year Plan	Period	Area (lakh ha)	Production (lakh bales)	Yield (Kg/ha)
Pre-Plan	1947-51	4.11	25.41	1120
I Plan	1951-56	6.46	39.29	1096
II Plan	1956-61	7.04	44.41	1137
III Plan	1961-66	8.47	56.84	1208
Plan Holiday	1966-69	7.35	48.70	1168
IV Plan	1969-74	7.65	54.95	1292
V Plan	1974-78	6.96	49.06	1274
Annual Plan	1978-80	8.59	62.71	1314
VI Plan	1980-85	8.18	64.20	1411
VII Plan	1985-90	8.03	75.63	1696
Annual Plan	1990-92	8.27	84.27	1835
VIII Plan	1990-92	8.27	84.27	1835
IX Plan	1997-98	9.20	97.25	1962
	1998-99	8.22	86.15	2034

X Plan, XI Plan

Table 2 : Count of total bacteria and fungi present in retting water collected from different districts

Place of collection	Date of collection	No. of bacteria (per ml)	No. of fungi (per ml)
Tarakeswar, Hooghly	17.8.05	21×10^6	34×10^1
Chapadanga, Hooghly	17.8.05	4×10^5	11×10^1
Habra, 24-Parganas (North)	19.8.05	29×10^5	18×10^1
Habra, 24-Parganas (North)	19.8.05	4×10^5	6×10^1
Amta, Howrah	22.8.05	11×10^6	20×10^1
Amdanga, 24-Parganas (N)	26.8.05	12×10^6	12×10^1
Chakdah, Nadia	6.9.05	8×10^4	5×10^1
Chakdah, Nadia	6.9.05	6×10^6	27×10^1

The pH of the water in all the area was more or less neutral. Conductivity, B.O.D. and C.O.D. varied widely from pond to pond. In one pond in Amdanga, B.O.D. as well as C.O.D. were maximum. Tarakeswar and Champadanga which usually produced good quality fibre, B.O.D. and C.O.D. of water were low though retting work ws being carried out repeatedly in the same pond without any gap between the charges. This observation revealed the fact that extensive study should be conducted in one particular village with two or three designated ponds from the beginning of the retting season and also quality of fibre produced from each charge should be monitored. This would establish a relationship between the quality of retting water and the quality of fibre produced in a particular jute cultivated area.

The date in Table 4 and Table 5 described the physical and biochemical characteristics of sixteen different strains of bacteria isolated from retting water of eight ponds. From the result it was observed that the cells of all isolates were Gram positive and coccus in shape. Three strains had capsules and five strains had endospores. One strain i.e. RWB 3 had both capsule and spore. All other strains did not have either spore or capsule. All the strain varied widely in respect of biochemical

Table 3 : Properties of retting water collected from different districts

pH	Conductivity (μS)	B.O.D. (mg/lt)	C.O.D (ppm)
7.1	243	20.68	50.26
7.2	290	17.90	89.69
7.3	673	13.86	82.89
6.8	684	28.95	86.20
6.8	824	74.91	204.00
6.6	1675	85.58	447.90
6.9	814	42.79	72.66
6.8	1492	70.73	159.60

characters. While only five could hydrolyze starch; eight produced H_2S–two producing more H_2S than the other strain. Seven strains could degrade urea. Hydrogen peroxide was degraded by twelve strains. All the strains were negative to cytochrome oxidase and tryptophane degradation activity tests. It was therefore, concluded that there are several strains of bacteria with divergent type of biochemical activities which are present in the retting water. It will be interesting to see how many of these strains are actually taking part in retting process and how many are only present in water without participation in retting process. This is possible only if a systematic study is undertaken in a particular village selecting two retting ponds and then monitoring the process from beginning to end with regard to quality of water and production of quality fibres.

Table 4 : Physical characters of bacteria isolated from retting water

Isolate No.	Gram reaction	Shape	Capsule	Spore
RWB-1	+	Coccus	–	–
RWB-2	+	Coccus	+	–
RWB-3	+	Coccus	+	+
RWB-4	+	Coccus	–	+
RWB-6	+	Coccus	+	–
RWB-7	+	Coccus	–	–
RWB-8	+	Coccus	–	–
RWB-9	+	Coccus	–	–
RWB-11	+	Coccus	–	–
RWB-12	+	Coccus	–	–
RWB-13	+	Coccus	–	+
RWB-14	+	Coccus	–	+
RWB-15	+	Coccus	–	–
RWB-16	+	Coccus	–	–
RWB-17	+	Coccus	–	–
RWB-18	+	Coccus	–	+

Table 5 : Biochemical characters of bacteria isolated from retting water

Isolate No.	Starch hydrolysis	H_2S production	Degradation of urea	Cytochrome oxydase	H_2O_2 degradation
RWB-1	–	–	++	–	+
RWB-2	–	–	++	–	++
RWB-3	–	++	–	–	++
RWB-4	–	–	–	–	+
RWB-6	–	–	–	–	+
RWB-7	–	–	–	–	–
RWB-8	–	++	+	–	++
RWB-9	–	–	–	–	–
RWB-11	++	+	++	–	++
RWB-12	++	+	–	–	++
RWB-13	++	+	+	–	+
RWB-14	–	–	–	–	–
RWB-15	++	+	+	–	+
RWB-16	–	–	–	–	–
RWB-17	++	+	+	–	+
RWB-18	–	+	–	–	++

Quality and quantity of water play an important role in the conventional retting process which is followed by the jute cultivators. Quality of retting water varies from place to place in respect of its properties and the microbial population. Different types of bacteria and fungi comprise this population. It has been found that microbial population in a particular retting pond depends on the properties of water such as pH, conductivity, B.O.D. and C.O.D.. More indepth study is needed to find out a possible correlation between the properties and microbial population of retting water and the quality of fibre produced.

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REFERENCES

Basak, M. K. Roy, A. R. and Sasmal, B. C. 1988. A study on the variation in quality of jute fibre due to retting factors. *Jute Dev. J.* **8(1):** 1-3.

Basak, M.K. and Paul, N.B. 1988. An improved method of retting of green jute plants at farmers' level. *Indian agric,* **32(2):** 87-91.

Pathak, S. 2001. *Technology for Increasing Jute Production in India.* CRIJAF, Barrackpore, West Bengal.

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