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Economic Utilization of Effluent From Sheet Rubber Processing Factories

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Abstract

Laboratory investigations were carried out on the utilization of effluent from sheet processing factory for Single Cell Protein (SCP) production and for irrigation. Addition of sucrose favoured the growth of *Torulla utilis* and *Saccharomyces cerevisiae*. Effluent as such did not favour the growth of *Chlorella vulgaris*. Dilution at different levels with tap water resulted in the growth of *C. vulgaris* and prevented the production of Hydrogen sulphide and reduced the bacterial population. Soil microbial population in general increased due to irrigation with the effluent from sheet rubber processing factories.

Introduction

The rubber processing factory effluent contains substrates such as small quantities of rubber, varying quantities of proteins, sugars, lipids, carotinoids, inorganic and organic soils[1]. Therefore, it forms an excellent medium for various types of bacteria, yeasts, fungi and algae[2]. Reuse of waste water for Single Cell Protein (SCP) and irrigation is given much importance in modern research on waste water management[3,4]. Hence, a preliminary study was initiated to find out the possibilities of growing yeast and algae in the effluent of rubber sheet processing factory and the effect of irrigation with effluent on soil microflora.

Materials and Methods

Sheet serum was collected from four small units of sheet rubber processing centres around RRII experimental station and analysed for the physical, chemical and biological properties using standard methods[5].

Culturing of Yeast : Sheet serum from the factory outlet was collected and heated to remove traces of rubber particles which form lumps on heating. These rubber particles were removed by filtration and the pH was adjusted to 5. 0. 150 ml. aliquotes of the serum were dispensed into 500 ml Erlenmeyer flask and sterilized. Sucrose at 4% level was added to one part of this serum. 1 ml culture each of *Torulla utilis* and *Saccharomyces cerevisiae* containing 10^5 cells/ml were added to the medium and incubated for 4 days. After the incubation period, the yeast cells were filtered, dried and weighed.

Culturing of Algae : In order to grow algae, sheet serum was diluted with water to different levels and 50 ml aliquotes in 250 ml Erlenmeyer flasks were inoculated with *Chlorella vulgaris* (5×10^4 cells/ml) and incubated in light with aeration. After incubation the cell counts of *C. vulgaris* was taken.

Irrigation of the Effluent : Soil samples were collected from the effluent irrigated fields near the four rubber sheet processing factories. Simultaneously, soil samples were also taken from adjacent non-irrigated fields. From each location 10 samples were collected and pooled for estimating the populations of bacteria, fungi, actinomycetes, phosphate solubilizers and non-symbiotic nitrogen fixers by dilution plate technique using appropriate medium.

Results and Discussion

The results of analysis of the effluent for microbiological, physical and chemical properties are presented in table-1. It clearly shows that the effluent from sheet rubber processing factories contains sugars, nitrogen and phosphorus which result in augmented microbial population and Biological Oxygen Demand (BOD). Chemical Oxygen Demand (COD) is also very high and the same may be due to dissolved and suspended solids including traces of rubber.

TABLE 1 - Characters of Sheet Serum Effluent

Characteristics*	Value
pH	4 8
Total solids	329.5
Total Volatile solids	125.0
Dissolved oxygen	5.8
B. O. D.	3380
COD	9925
Phosphate	127.5
Protein	220
Total nitrogen	394.5
Tanin	190.
Reducing sugar	200
Total bacteria	45.4×10^5

* All values except pH are indicated in mg/l and the total bacteria as number/ml.

On culturing *T. utilis* and *S. cerivisiae* in sheet serum under sterile condition, a little growth of the former was noticed, while the latter did not show any sign of growth. On the other hand, in the effluent enriched with 4% sucrose, both *T. utilis* and *S. cerivisiae* grew well and yielded 4.8 g and 4.6 g of dry cells per litre of serum respectively. Yeast, in general, require large amount of sugars. Obviously, the lack of sugar in the serum limits the possibility of using this substrate for SCP production. However, the increased growth of the yeast in sucrose-enriched serum indicates the scope for using cheap carbon source like molasses for fortifying serum in SCP production.

C. vulgaris, a potential SCP producing alga failed to grow in sheet serum (Table 2). However, algae grew on diluted serum and the growth increased with the increase in dilution. The pH of the culture solution increased with the growth of algae and the extent of increase being more at higher dilutions. The total bacterial count in the algae grown media was low when compared to that which did not promote the growth of algae. Corresponding to the increase in algal population, there was a decrease in bacterial count. Foul smelling hydrogen sulphide was produced in undiluted serum, and that diluted with equal quantity of water. The growth of *C. vulgaris* in the effluent arrested the

TABLE 2 – Effect of Dilution on Algal Growth in Sheet Serum

Dilution		pH	*C. vulgaris* population 10^6/ml	Bacterial population 10^3/ml	H_2S production
Effluent	Water				
100	900	8.0	32.3	2.9	–
200	800	7.8	64 6	1.8	–
300	700	7.5	72.2	1.4	–
400	600	6.6	56.8	2.8	–
500	500	6.1	6.4	380	+
1000	0	5.7	0	430	+

– not noticed + noticed

production of hydrogen sulphide. Absence of hydrogen sulphide in *C. vulgaris* culturing media may be due to the selective inhibition of sulphate reducing bacteria or creation of unfavourable condition for them.

Irrigating the fields with effluent from sheet processing factories resulted in a hike in soil pH (Table 3) and microbial population. Among different microbial groups investigated the increase in fungal and phosphate solubilizing microbial population was much pronounced. Incorporation of organic compounds in soil resulted in enhanced microbial activity, thereby providing favourable condition for the growth of plants. The augmented microbial population in effluent irrigated soil was obviously due

TABLE 3 – Changes in Microbial Population in Soils Treated with Effluent

Location	Treatments	pH	Microbial population			
			Bacteria 10^5/g	Fungi 10^4/g	Actino- 10^3/g	PO_4 Solubilizer 10^3/g
A	I	7.5	108.3 (23.9)	24.2 (79.2)	47.4 (53.8)	171.2 (98.3)
	C	5.3	87.5	13.5	30.8	86.3
B	I	7.3	110.4 (119.9)	52.1 (285)	160.3 (52)	217.8 (85.5)
	C	5 9	52.1	13.5	105.4	117.4
C	I	7.3	150.7 (32)	26.6 (153.3)	113.7 (8)	253.0 (78.5)
	C	6.1	82.8	10.5	105.2	141.7
D	I	6.6	131.6 (58.9)	24.3 (219.7)	135.6 (28.2)	135.5 (166.7)
	C	6.2	82.8	7.6	105.7	50.8

I – Irrigated
C – Control

Values in paranthesis indicate the percentage of increase

to the addition of organic compounds present in the effluent which resulted in better growth and yield of plants[3].

The present study clearly indicates that effluent from sheet processing factories could be used for field irrigation without adversely affecting the soil microbial population. However, before arriving at definite conclusion and recommendation, detailed investigation on the safe limit for irrigation and the nutrient status of the effluent irrigated soils are to be investigated.

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