J. Phytol. Res. **14** (2) : 175-178, 2001

EFFECT OF DAIRY EFFLUENT ON BIOCHEMICAL COMPOSITION OF CELLS OF SOME CYANOBACTERIA

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Cyanobacteria were grown in different concentrations of dairy effluent. Changes in growth and biochemical profile were studied. All concentrations of the effluent stimulated growth. Maximum stimulation was observed at 80% concentration. Chlorophyll, Carotenoids, and Protein were best stimulated in the cells grown with 80% effluent while 50% effluent was found best for carbohydrate increase.

Keywords : Biochemical profile; Cyanobacteria; Dairy effluent; Growth.

Introduction

The implementation of operation flood programme launched in 1970 under the aegis of National Dairy Development Board has brought about a white revolution. There has been remarkable growth in milk products and milk processing centres in India during last forty years. Milk dairies consume large amount of water in washing of bottles, milk cans, processing equipment etc. and generate roughly 6-10 litres of effluent per litre of milk processed[1]. This effluent consists of substantial amount of fats, milk proteins, lactose, lactic acid, minerals, detergents and sanitizers[2] as well as nutrients such as nitrogen, phosphate, sulphate, calcium, magnesium etc[3]. If this effluent is discharged directly in water stream without any treatment, it can adversely affect the water ecosysten[4] on the other hand, due to its high nutritive value, it can serve as good medium for the growth of Cyanobacteria. Waste water grown algae has been used as feed for fish[5] and poultry[6,7]. Algal biomass is used commercially worldwide as a source of several products[8]. In the present investigation effect of dairy effluent on growth and biochemical composition of cells of *Oscillatoria*, *Aulosira* sp, *Sytonema* sp, *Anabaena* sp, *Tolypothrix* sp has been studied.

Material and Method

Effluent samples were collected from Saras dairy, Govardhanvilas, Udaipur. Sample collection was always done in morning between 9 am-10 am in sampling bottles. The collected samples were brought to the laboratory and analysed within twenty four hours by standard APHA[9] methods. Cyanobacteria were collected from the local lakes and various polluted habitats and inoculated into different liquid mineral salt media like Hughes medium[10], Chu medium[11], and Fogg's nitrogen free medium[12]. Identification of the collected Cyanobacteria was done with the help of the key suggested by Subramanian *et al*[13]. Cyanobacteria growing in medium were adapted for three days in distilled water before inoculation. 500mg of Cyanobacterial mixture was used to inoculate 150 ml of undiluted as well as 10, 20, 40, 50 and 80% dilutions of effluent respectively. Cyanobacteria growing in distilled water was maintained as control. Cells were harvested after seven days. Chlorophyll 'a' was extracted in acetone and estimated by the method suggested by Mackinney[14]. Extraction and estimation of carotenoids was done by the method given by Kaushik[15]. Proteins were estimated by Bredfords method[16]. Anthrone method was used to estimate total carbohydrates[17].

Results and Discussion

Dairy effluent consists of many inorganic and organic substances (Table 1). Effluent hardness ranged from 250-400 mg/l. Hardness is mainly due to calcium and magnesium ions which are essential for the growth of Cyanobacteria as well as higher plants[18]. Effluent contained sufficient amount of phosphates (39-50mg/l) and sulphates (90-102 mg/l) required for growth of Cyanobacteria. Biological oxygen demand (BOD), chemical oxygen demand (COD), and dissolved organic matter (DOM) of dairy effluent were found to be in the range of 340-450 mg/l, 580-780 mg/l and 300-400 mg/l respectivly. This shows that effluent is also rich in organic matter and can support Cyanobacterial growth by providing sufficient nutrition for the growth of Cyanobacteria. Table 2 shows the growth of cyanobacteria at different dilutions. Maximum growth was observed in 80% effluent. Growth of Cyanobacteria was less in 100% as compared to 80% as turbidity and suspended solids were comparatively higher in 100% effluent. Cyanobacteria are also being extensively used as biofertilizers[19,20], since they are important nitrogen fixers. Mass culture of Cyanobacteria in synthetic medium is very costly. As dairy effluent has high organic content and does not contain any toxic matter it can serve as cheap and efficient medium for Cyanobacterial biomass production.

A general increase in biochemical composition was observed in Cyanobacteria (Table 3). Highest concentration of chlorophyll 'a' and carotenoids was recorded in cells grown in 80% effluent. Chlorophyll concentration showed 127.60% increase as compared to control. Effluent stimulated the formation of beta and gamma carotenoids. The order of increase in beta and gamma carotenoids was found to be 10<20<40<50 <80>100. As compared to control, proteins and carbohydrates were found to be increased in all concentrations of effluent. The order of increase in protein and carbohydrates was 10<20<40<50<80>100 and 10<20<40<50> 80=100 respectively. Cells growing in 50% effluent showed 66.61% increase in carbohydrate content as compared to control. Maximum amount of protein (7.12 mg/gm) was observed in cells growing in 80% effluent as compared to control (2.20 mg/gm). Increase in chlorophyll and carotenoid contents of cyanobacteria has also been reported in fertilizer factory effluent[21] and in rubber effluent[8]. Rai *et al.*[22] have reported increase in protein, carbohydrate, chlorophyll and carotenoid contents of cyanobacteria grown in carpet industry effluent. Algae can

Table 1. Physico-chemical characteristics of Dairy effluent.

Characteristics	Average Values
pH	7.47
Temperature	23.75°C
Colour	Milky/Grey black
Smell	Foul
TDS	1155.75
TSS	579.00
Conductivity	1518.25
Turbidity	303.25
Hardness	321.00
Calcium	181.00
Magnesium	140.00
Chlorine	111.85
Alkalinity	350.00
Free CO_2	27.00
Phosphate	45.08
Sulphate	95.25
COD	654.50
BOD	382.50
DOM	335.00
D.O.	2.25
Oil and Grease	25.75

All values are in mg/l except pH, temperature, colour and smell.

also be used as a supplement in animal feed[23] and particularly in aquaculture for feeding fish and crustaceaens[24]. Increased protein and carbohydrate enhance the nutritive value of cyanobacteria. Talbot and Noue[24] have suggested that the biochemical composition of the algae is of prime importance when they are intended to be used for animal feedstock. Laksmi *et al.*[25] reported that it is quite safe to supplement food with algae grown on soak liquor.

In this age of energy crisis, mass cultivation of algae on wastewater offers an alternate source of protein and biomass. Since dairy effluent stimulates the growth

Table 2. Growth of Cyanobacteria in various concentrations of Dairy effluent after 7 days.

S. No.	Effluent Dilutions	Fresh weight of Cyanobacteria (mg)		Increase in Weight (mg)
		Initial	After 7 Days	
1	10%	200	270.00	70.00 ±10.124
2	20%	200	281.60	81.60 ±9.8640
3	40%	200	311.40	111.40 ±12.4418
4	50%	200	340.40	140.40 ±10.3585
5	80%	200	370.40	170.40 ±9.8386
6	100%	200	332.40	132.40 ±16.3340

Table 3. Effect of dairy effluent on the biochemical composition of Cyanobacterial cells.

S. No.	Effluent concentration	Chlorophyll a (mg/gm)	Beta Carotenoids (mg/gm)	Gamma Carotenoids (mg/gm)	Protein (mg/gm)	Carbohydrates (mg/gm)
1	Control	0.1139 ±.0151	0.0117 ±.0005	0.0228 ±.0039	2.20 ±.2000	13.60 ±.4000
2	10%	0.1412 ±.0122	0.0371 ±.0040	0.0386 ±.0019	2.73 ±.1154	15.00 ±.8326
3	20%	0.1660 ±.0171	0.0382 ±.0040	0.0398 ±.0005	3.80 ±.5291	16.40 ±.1.0583
4	40%	0.2192 ±.0170	0.0432 ±.0055	0.0416 ±.0016	4.06 ±.4163	19.86 ±.4618
5	50%	0.2310 ±.0181	0.0438 ±.0016	0.0432 ±.0020	5.93 ±.3055	22.66 ±.6110
6	80%	0.2693 ±.0059	0.0510 ±.0073	0.0477 ±.0018	7.13 ±.7571	21.06 ±.1.0066
7	100%	0.1509 ±.0049	0.0435 ±.0033	0.0372 ±.0026	6.13 ±.2309	18.93 ±.1.5143

of Cyanobacteria and increases its nutritive value, it can serve as cheap and efficient medium for Cyanobacterial biomass production which can serve as a highly nutritive feed for animals. It also results in production of high quality, non-toxic, non-hazardous algal biofertilizer at low cost.

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