EFFECT OF DOMESTIC SEWAGE ON MARINE SEAWEEDS

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ABSTRACT

Domestic sewage contains a wide variety of dissolved and suspended impurities and it affects the growth of seaweeds. In the present investigation, effect of different concentration of domestic sewage [1%, 5% and 10%] was studied on the daily growth rate (DGR), total chlorophyll, carotenoids, sugar, protein and phycocolloids of *Ulva lactuca*, *Padina tetrastromatica* and *Gracilaria corticata* cultured in the laboratory. These cultures were incubated at 28$\pm$2 ^{0}C under 16:8 LD cycle of 800 lux light intensity for a period of 21 days. *Ulva lactuca* and *Gracilaria corticata* responded well to sewage in all concentration by exhibiting enhanced DGR and other biochemicals. In *Padina*, at 1% concentrations of domestic sewage, the DGR and photosynthetic pigments were exceeded over the control.

Keywords: Domestic sewage, seaweeds, pigments, biochemicals

Introduction

Seaweeds are a heterogeneous group of phytoplankton that generally occurs in the intertidal and subtidal region of marine habitat where a very little photosynthetic light is available. On the basis of chemical composition they are classified into green algae (Chlorophyceae), red algae (Rhodophyceae) and brown algae (Phaeophyceae). They have been utilized for the extraction of phycocolloids as alginates from brown algae, agar and carrageenen from red algae. They are the only source of phytochemicals (agar, algin and carrageenan) which are widely employed as gelling, stabilizing and thickening agent in many industries (Sornalakshmi *et al*., 2018). The major stress on seaweeds in the coastal zone of Tamil Nadu is pollution, through various means (Sornalakshmi and venkataraman Kumar, 2014).

Untreated domestic sewage, industrial effluents are discharged into the sea. All these heavily pollute seaweeds. Sewage pollution effects were studied on macro algae by assessing the changes in species composition and abundance in many coastal areas of the world (Borowitzka, 1972; Fletcher, 1974; Edwards 1975; Littler and Murray, 1975, Steffenson, 1976 and Smith, 1997) and also by conducting bioassays under laboratory conditions with marine algae as test organisms (Burrows, 1971 and Guist and Humm, 1976). But field and experimental studies on marine algae affected by sewage are very limited in India. (Tewari, 1972; Sreeramulu *et al*, 1977; Tewari and

Joshi, 1988; Dhargalkar, 1986; Sasikumar and Rengasamy, 1994; Gulshad Mohammed *et al*, 1999; Dhargalkar and Komarpant, 2003. and Umamaheswara Rao and Premila. 1996, 2003).

Laboratory experiments using seaweeds as test organisms to assess the impact of untreated sewage are meagre and above all there is no report from Tuticorin coast regarding field and experimental studies on marine algae affected by sewage. In fact domestic sewage from the coastal town is let in to the Tuticorin Bay (Venkataraman Kumar and Anandhavalli Mahadevan, 1993). So in the present study, the domestic sewage has been employed to assess the effect in the bioassay experiments of three commonly available seaweeds of Tuticorin coast used as test organisms.

Materials and methods

Collection of seaweeds

Three species of seaweeds representing Chlorophyceae (*Ulva lactuca* Linnaeus, Phaeophyceae (*Padina tetrastromatica* Hauck and Rhodophyceae *(Gracilaria corticata* (J. Agardh) were collected in the early morning low tide period from the red gate end of the Hare Island, Tuticorin. These were transported to the laboratory in polyethylene bags filled with seawater. The macroscopic epiphytes and other contaminants were carefully removed and used for bioassay test. Herbarium specimens were also prepared and identified based on the keys given by Umamaheswara Rao (1970 and 1987).

Laboratory culture experiments

The afore said seaweeds were cultured in the Botany Research Laboratory for studying the impact of domestic sewage. Raw sewage collected from the point of discharge at old harbour area was brought to the laboratory, filtered to remove the particulate matter and diluted with sterilized seawater to achieve 20% concentration of stock solution. From this 1.0, 5.0 and 10% concentration of sewage mixed sterilized seawater culture media were prepared.

30.0 g fresh weight of each macro alga/seaweed was inoculated into cotton plugged 1 litre conical flasks containing 700 ml of sterilized seawater mixed with appropriate amount of the sewage. After 21 days of culture in the laboratory at 28± 2^{o}c, 800 lux light intensity under 16:8 LD cycle and periodical aeration from an aerator, the algae were harvested for the estimation of various growth and biochemical parameter like Daily Growth Rate (DGR (%) = $w_t/w_o/t$ x 100) (Huglund *et al*, 1996) where w_o is the initial weight and w_t is the weight at day t, chlorophyll a, b and carotenoids (Arnon 1949) as modified by Harborne (1973), chlorophyll c (Reeta Jayasankar and Ramalingam, 1993), Protein (Lowry *et al.*, 1951), sugar (Seifter *et al.*, 1950), Lipid (Bligh and Dyer, 1959). Control was maintained by culturing the algae in sterilized seawater.

Results and Discussion

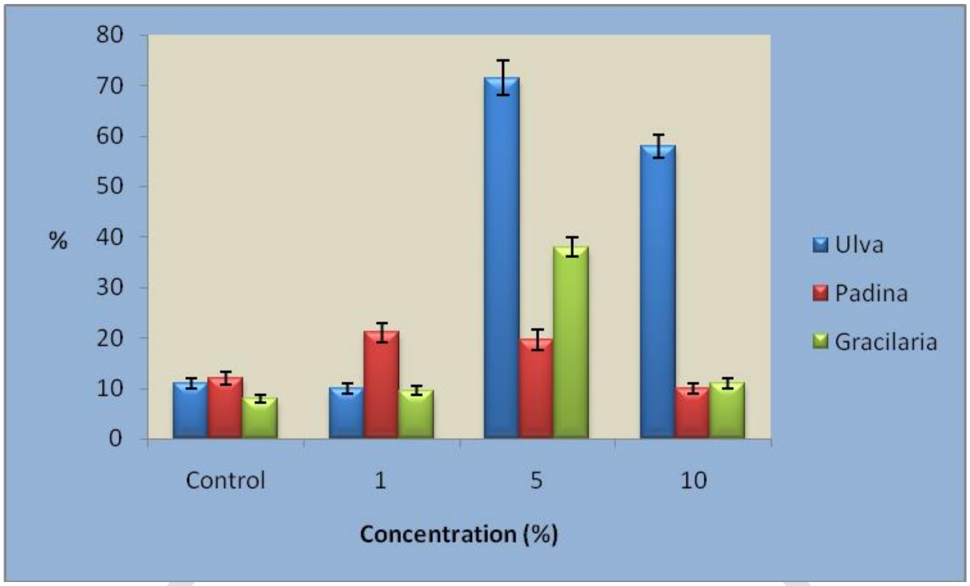

Fig.1 Effect of sewage (domestic) on the growth of seaweeds

Except at 1% concentration of the domestic sewage, rest of the concentrations (5 and 10%) showed increased growth of *Ulva lactuca* over the control. *Padina tetrastromatica* showed a growth more than that of the control at 1 and 5 % of sewage. At all the three concentrations of sewage, 1, 5 and 10%. *Gracilaria corticata* showed higher growth than the control with the maximum growth attained at 5% of sewage. In previous studies too, these three genera showed good growth as compared to the control. The reason quoted in these studies was that the nutrients present in the diluted sewage could be responsible for their enhanced growth (Dhargalkar, 1986; Dhargalkar and Komarpant, 2003).

Ulva lactuca showed lesser content of chlorophyll a, chlorophyll b, Total chlorophyll and carotenoids at 1 % sewage but at 5 and 10 %, the concentration of the photosynthetic pigments was found to exceed that of the control.

Whereas in the case of *Padina tetrasromatica* and *Gracilaria corticata*, the amount of photosynthetic pigments was found to be lesser than that of the control at higher concentrations of sewage (5 and10%).

At 5 % concentration of domestic sewage, the amount of sugar and at 1 and 10%, the amount of protein were found to be lower than that of the control in *Ulva*. In the case of *padina*, the amount of sugar was found to be more than that of the control whereas protein content at 5 and 10 % of domestic sewage was lower than that in control. In *Gracilaria*, in some of the concentration, both sugar and protein content was less than that of the control. Previous study on sewage discharges in reef ecosystem have indicated an increase in phytoplankton biomass, enhanced productivity by algae and reduction in water clarity (Laws and Redalje, 1979).

Not much of studies have been undertaken to study the effects of domestic sewage on Indian marine macro algae or the so called seaweeds. In the present study, the green macro alga or the green seaweed, *Ulva lactuca* was found to show maximum growth in domestic sewage treated cultures. This observation of our present study is in consonance with the earlier studies. In the coastal areas of Gujarat, Tewari and Joshi (1988) reported *Ulva lactuca*, as the most resistant form to chloralkali industry effluent. In another study by Premila and Rao, 1998, the green alga *Ulva fasciata* was found to be more resistant to effluent, the growth inhibition observed at 20% level was less in *Ulva fasciata* than in brown and red algae, indicating the tolerance capacity of this green alga (Premila and Rao, 1998).

Conclusion

The present results clearly showed that *Ulva lactuca, Padina tetrastromatica* and *Gracilaria corticata* can be cultivated in dilute sewage, which are sources of protein, algin and agar respectively. These views are in agreement with the observations made in the previous study (Dhargalkar, 1986).

Table 1. Effect of sewage on photosynthetic pigments of seaweeds

Pigments (mgg^{-1})	Concentration (%)	Seaweeds		
		Ulva lactuca	*Padina tetrasromatica*	*Gracilaria corticata*
Chlorophyll a	Control	0.238±0.038	0.235 ±0.031	0.210 ±0.032
	1	0.228±0.035	0.250 ±0.027	0.230 ±0.030
	5	0.308±0.038	0.189 ±0.015	0.260 ±0.035
	10	0.292±0.028	0.149 ±0.022	0.195 ±0.028
Chlorophyll b	Control	0.202 ±0.020	0.192 ±0.024	0.190 ±0.020
	1	0.192 ±0.018	0.195 ±0.020	0.201± 0.030
	5	0.342± 0.040	0.155 ±0.018	0.220 ±0.033
	10	0.282± 0.024	0.132 ±0.017	0.175 ±0.026
Total Chlorophyll	Control	0.395 ±0.050	0.345 ±0.036	0.350±0.031
	1	0.308 ±0.044	0.398 ±0.042	0.370± 0.033
	5	0.496 ±0.056	0.310± 0.031	0.401± 0.038
	10	0.410 ±0.044	0.276± 0.024	0.298 ±0.030
Carotenoids	Control	0.163 ±0.028	0.140 ±0.020	0.125 ±0.017
	1	0.144 ±0.025	0.155 ±0.022	0.130± 0.018
	5	0.222 ±0.022	0.138± 0.020	0.160 ±0.030
	10	0.208 ±0.020	0.120 ±0.018	0.142± 0.022

Table 2. Effect of sewage on biochemicals of seaweeds

Biochemicals (mgg^{-1})	Concentration (%)	Seaweeds		
		Ulva lactuca	*Padina tetrasromatica*	*Gracilaria corticata*
Sugar	Control	4.81 ± 0.32	3.72 ± 0.40	11.33 ± 1.10
	1	8.01 ± 0.60	3.94 ± 0.50	10.40 ± 0.95
	5	3.82 ± 0.28	4.80 ± 0.65	19.00 ± 2.20
	10	6.28 ± 0.52	4.60 ± 0.70	12.50 ± 1.10
Protein	Control	32.20 ± 3.80	15.50 ± 1.10	40.15 ± 1.98
	1	31.50 ± 2.50	40.60 ± 4.40	39.60 ± 2.85
	5	62.10 ± 4.40	14.60 ± 0.95	51.80 ± 3.50
	10	21.70 ± 0.90	5.66 ± 0.28	29.70 ± 3.15

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