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Full Length Article

Effect of fly ash on the growth and biochemicals of some Seaweed

Sornalakshmi V and Venkataraman Kumar

PG and Research Department of Plant Biology and Plant Biotechnology,
V.O.Chidambaram College, Tuticorin-628008, Tamil Nadu, India.
sandronarumugam@gmail.com

ABSTRACT

The effect of industrial waste fly ash was studied on daily growth rate (DGR), chlorophyll, carotenoids, protein, carbohydrate, lipid and phycocolloids (agar and algin) content of four economically important seaweeds, *Ulva lactuca, Caulerpa scalpelliformis*, *Padina tetrastromatica* and *Gracilaria corticata.* The seaweeds were cultured in different concentration of fly ash mixed sterilized seawater. In *Ulva lactuca*, at lower concentrations of fly ash, the carbohydrate content was found to be more than the control. Protein content was slightly more than the control at 0.25% fly ash while that of lipid at 0.5 and 2.5% concentrations. In *Caulerpa scalpelliformis,* fly ash at all the concentrations induced reduced DGR and lipid content but increased chlorophyll a and chlorophyll b amount. The amount of protein was more than the control at 0.25, 0.50 and 1.0% fly ash. In *Padina tetrastomatica*, at almost all the concentrations of fly ash, the amount of Chlorophyll a, chlorophyll c and protein exceeded over the control. In the present study, of the four experimental seaweeds, the red seaweed *Gracilaria corticata* was found to be most tolerant as this exhibited enhanced growth and biochemical content at most of the concentrations of fly ash.

Key words: **:** carbohydrate, flyash, lipid, phycocolloids, protein, seaweeds

INTRODUCTION

Seaweeds are major coastal resources which have been utilized for the extraction of phycocolloids as alginates from brown algae, agar and carrageenen from red algae. The major stress on seaweeds in the coastal zone of Tamil Nadu is pollution, through various means. 90 species of seaweeds belonging to chlorophyceae, phaeophyceae and rhodophyceae were identified from Hare Island of Tuticorin (Mary Josephine *et al*., 2013). In Tuticorin, untreated domestic sewage, effluents like fly ash waste from thermal station and effluent from petrochemical industries are discharged into the sea. All these heavily pollute seaweeds. Oil spills from boats cover these organisms in localized areas. Dredging of sand for construction of jetties also result in destruction of seaweeds and coastal erosion. The removal of coral reefs seriously affects the ecosystem and also causes coastal erosion. So there is a great threat of desertification of the coastal vegetation of Tuticorin by the industrial complex of Tuticorin (Sarojini Menon *et al.,* 1993). Many of the seaweeds of Tuticorin coast have decreased in frequency and diversity. Some of them are completely eliminated from the area (Sarojini Menon *et al.,* 1993). The effect of industrial wastes (Zincsmelter and Alum factory) on the growth and reproductive stages of 9 microalgae of the Visakhapatnam coast have been studied by Murthy and Umamaheswara Rao,2003. The impact of the effluent released by the soda ash industry on important red and brown macro algae has been reported by Jadeja and Tewari, 2009.

A study on algal flora of certain factory effluent in Dhule District of (MS) India was carried out by Nerpagar, 2011. One of the major industrial

wastes let in to the Tuticorin Bay is the fly ash from the Tuticorin Thermal Power Station. This fly ash waste is first let into a creek from where it seeps into the main bay (Venkataraman Kumar and Mahadevan, 1993, 95) Fly ash is an industrial waste let out by coal fire power plants. In general it contains substantial amount of silicon dioxide (SiO_2),Calcium oxide(CaO_2) and a plethora of trace elements of which some are toxic (Rai *et al.,* 2000). So in the present study, the fly ash waste has been employed to assess the effect in the bioassay experiments of commonly available seaweeds of Tuticorin coast used as test organisms.

MATERIALS AND METHODS

Four species of seaweeds representing Chlorophyceae (*Ulva lactuca* Linnaeus, *Caulerpa scalpelliformis* (R.Brown ex Turner) C.Agardh), 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. Fly ash waste from Tuticorin Thermal Power Station was brought to the laboratory and used in the preparation of fly ash mixed sterilized seawater culture media of 0.25, 0.50, 1.00, 2.50 and 5.00% concentrations.

30.0 g fresh weight of each macro alga/seaweed was inoculated into cotton plugged 1 litre conical flasks containing 700 ml of different concentration of fly ash mixed sterilized seawater. 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. Experiments were carried out in triplicates. Control was maintained by culturing the algae in sterilized seawater. After 21 days the alga was harvested and used for the estimation of 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), Carbohydrate (Seifter *et al.,* 1950) Lipid (Bligh and Dyer, 1959) and Phycocolloids; agar in red seaweed and algin in brown seaweed (kaliaperumal and Ramalingam, 2002).

RESULTS AND DISCUSSION

In *Ulva lactuca*, DGR, chlorophyll a, chlorophyll b and carotenoid content showed decrement over the control at all the concentrations (0.25 to 5.0%) of fly ash. At lower concentrations (0.25, 0.50 and 1.00%) of fly ash, the amount of carbohydrate was found to be more than the control. Protein content of this green seaweed was slightly more than the control at 0.25% fly ash while that of lipid at 0.5 and 2.5% concentrations (Fig.1-3). Fly ash at all the concentrations (0.25 to 5.0%) induced reduced DGR and lipid content but increased chlorophyll a and chlorophyll b amount in *Caulerpa scalpelliformis*. Fly ash concentration from 0.25 to 2.5% promoted the carotenoid content of *Caulerpa.* The amount of protein was more than the control at 0.25, 0.50 and 1.0% fly ash (Fig. 4-6). In *Padina tetrastomatica*, reduced DGR and algin content were observed at all the concentrations (0.25 to 5.00%). At almost all the concentrations of fly ash, the amount of Chlorophyll a, chlorophyll c and protein exceeded over the control, whereas, carotenoid and carbohydrate levels were found to be more than the control only at certain concentrations of fly ash (Fig. 7-10). In *Gracilaria corticata*, DGR, carbohydrate, protein, lipid and agar content were found to exceed over the control at certain concentrations of the fly ash. The amount of chlorophyll a and carotenoids was lesser than the control at all the concentrations of fly ash (0.25 to 5.00%) (Fig.11-14).

As on date, there seems to be no report on the impact of fly ash on macro algae (seaweeds). In the present study, the response towards fly ash treatment varied between seaweed to seaweed and also with respect to the concentrations. Of the four experimental seaweeds, the red seaweed *Gracilaria corticata* was found to be most tolerant as this exhibited enhanced growth and biochemical content at most of the concentrations of fly ash. This observation is substantiated by reports on the use of diluted fly ash for growth promotion among the higher plants (Mitra *et al.,* 2003; Sharma *et al.,* 2008). Enhancement of certain biochemicals especially the protein induced by fly ash in almost all the four seaweeds, however at some of the concentration,

could be a response to sequester the trace elements present in the fly ash and synthesis of metallothionein (Olfson *et al.*, 1988; Rauser, 1990; Mallick *et al.*, 1994). The practical utility of this type of study is that we can deduce tolerant macroalgal species which could be employed in pollution monitoring programmes.

Fig.1. Effect of fly ash on DGR (%) of *Ulva lactuca*

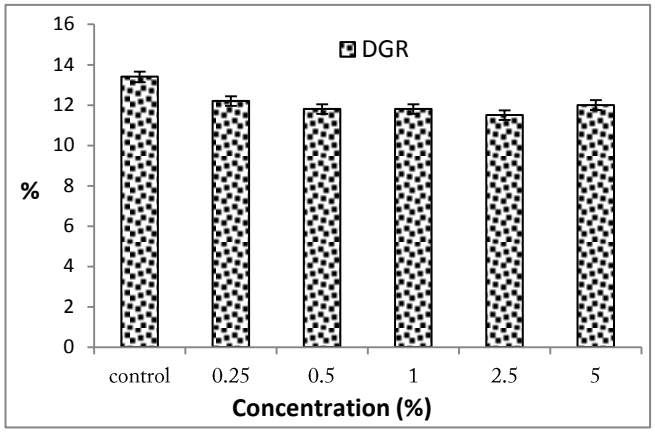


Fig.2. Effect of fly ash on photosynthetic pigments of *Ulva lactuca*

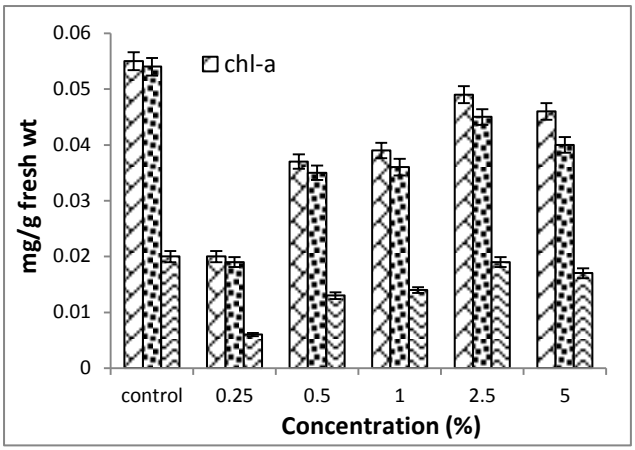


Fig.3. Effect of fly ash on certain biochemicals of *Ulva lactuca*

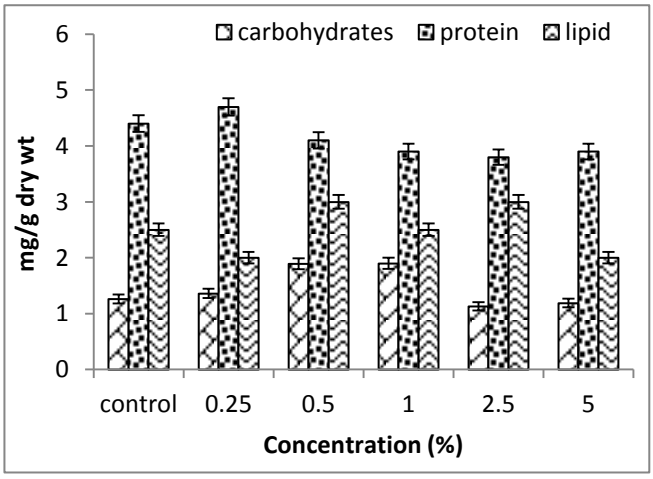


Fig.4. Effect of fly ash on DGR (%) of *Caulerpa scalpelliformis*

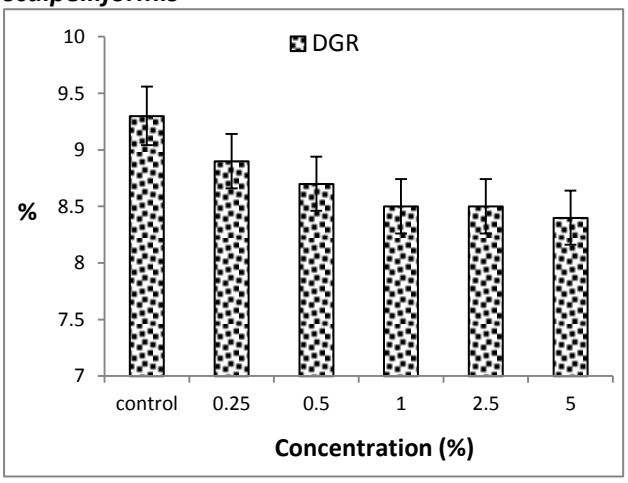


Fig.5. Effect of fly ash on photosynthetic pigments of *Caulerpa scalpelliformis*

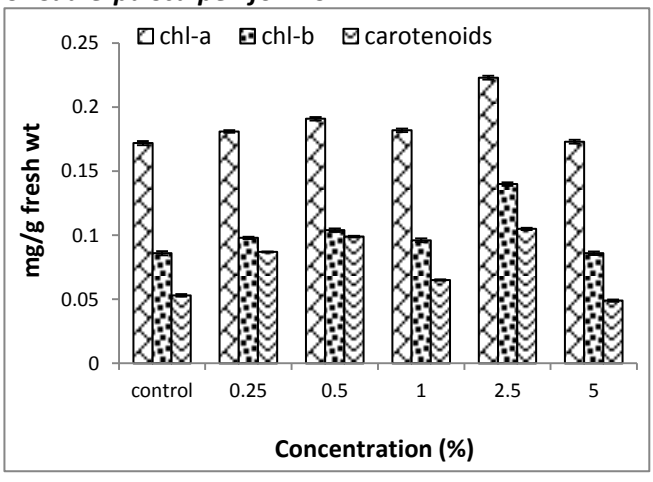


Fig.6. Effect of fly ash on certain biochemicals of *Caulerpa scalpelliformis*

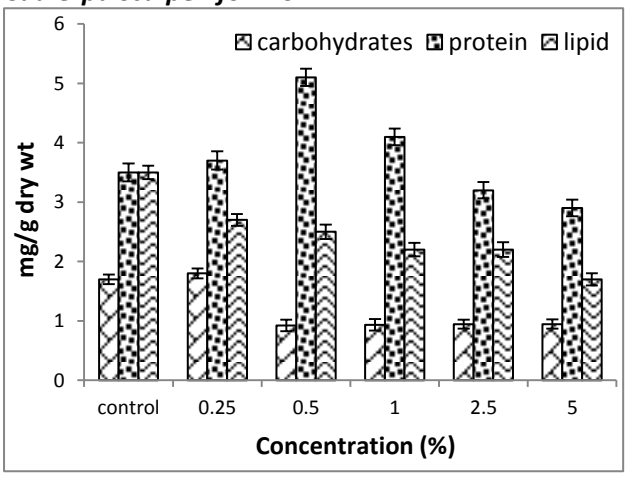


Fig.7. Effect of fly ash on DGR (%) of *Padina tetrastromatica*

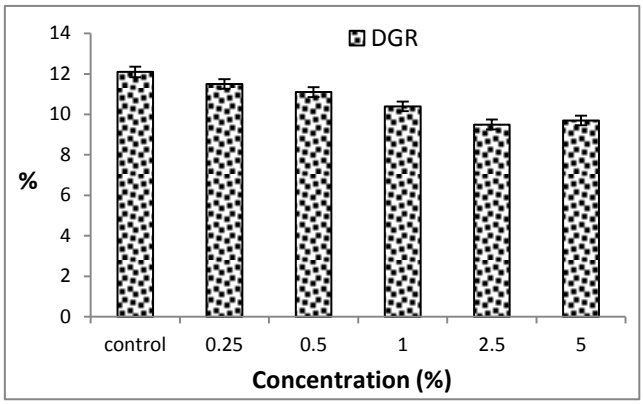


Fig.8. Effect of fly ash on photosynthetic pigments of *Padina tetrastromatica*

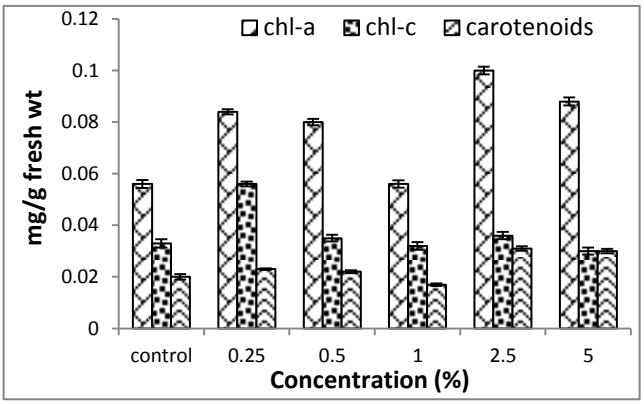


Fig.9. Effect of fly ash on certain biochemicals of *Padina tetrastromatica*

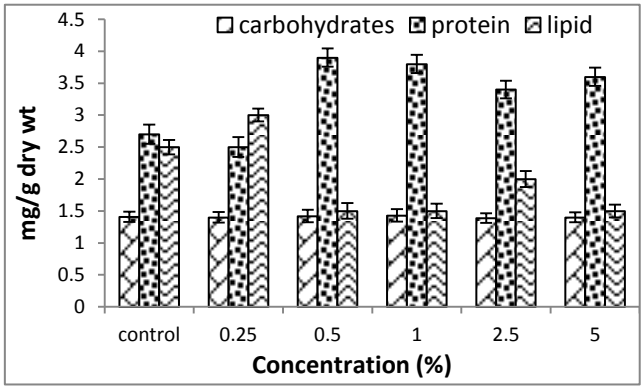


Fig.10. Effect of fly ash on Algin content (%) of *Padina tetrastromatica*

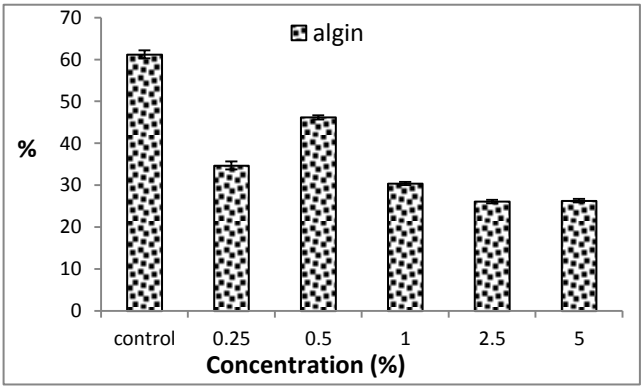


Fig.11. Effect of fly ash on DGR (%) of *Gracilaria corticata*

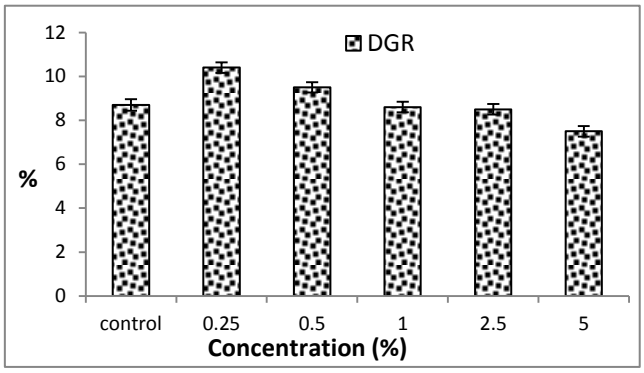


Fig.12. Effect of fly ash on photosynthetic pigments of *Gracilaria corticata*

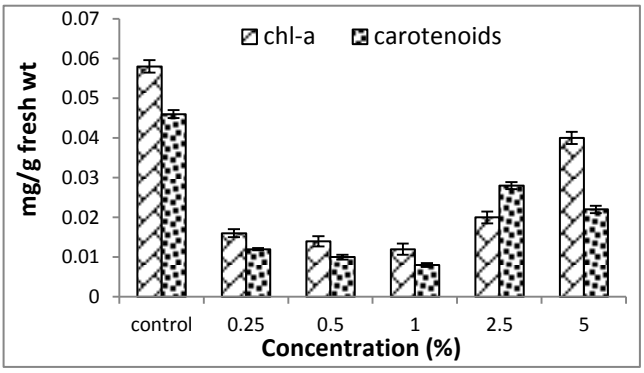


Fig.13. Effect of fly ash on certain biochemicals of *Gracilaria corticata*

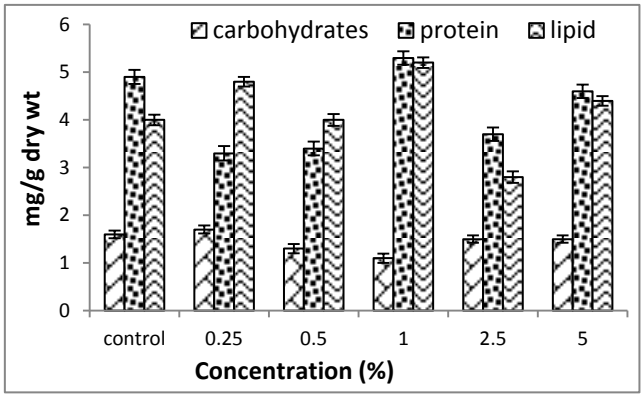
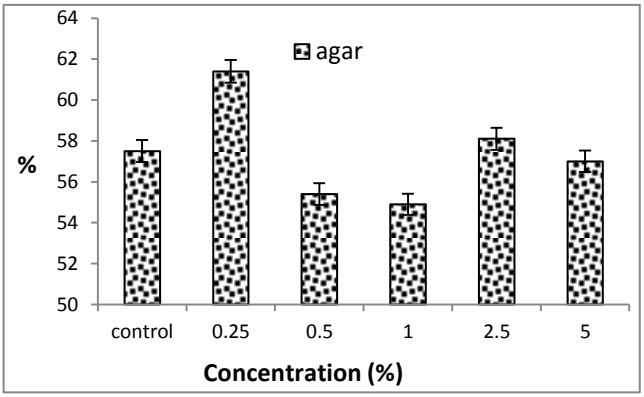


Fig.14. Effect of fly ash on Agar content (%) of *Gracilaria corticata*



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