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A note on the chemical composition of some common benthic algae from a polluted area in the Northern Adriatic (Rovinj)

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Environmental parameters exhibit pronounced influences on the chemical composition of seaweeds. Organic pollutants, excess nutrients and heavy metals dissolved in the sea alter the metabolic processes and hence the chemical composition of marine plants (Munda,1974,1982).

With this in mind the protein and mannitol content of some common brown algae was studied . The algae were collected in differently polluted habitats. The protein content of some common red and green algae was studied simultaneously. Results indicated relatively high protein and mannitol contents in Fucus virsoides , which was found only in relatively unpolluted sites. Observations carried out on Cystoseira species (C. compressa and C. stricta) have revealed a general trend of increased protein and decreased mannitol content under unfavourable growth conditions, such as pollution impact or conditions in rock-pools.Brown algae , other than fucoids were collected in polluted sites near the Rovinj hospital and Lone Bay i.e. sites where fucoids were absent. These samples revealed a rather high protein content , whereas the mannitol content was low, with exception of Punctaria latifolia and Dictyopteris membranacea.

In the red algae, collected in the unpolluted Faborsa Bay, the protein content was high.The highest value was found for Catenella caespitosa, which grows under stress conditions in the level of the littoral fringe. Most of the red algae avoid heavily polluted habitats, with exception of Gelidium spinulosum, which was prolific near the Rovinj hospital. Among the green algae the highest protein content was found in Cladophora ruchingeri cf. from a heavily polluted site.

Protein and mannitol content (g/100 g dry weight) in seaweeds from Rovinj.

PHAEOPHYTA	protein	mannitol
Fucus virsoides- Faborsa	10.2	7.6
Cystoseira compressa - Faborsa	8.7	10.1
- Figarola	10.0	7.8
- Sturago	8.1	6.4
- Catarina	9.7	6.0
- rock-pool	13.1	5.8
C. barbata- Faborsa	8.7	9.9
- hospital	14.0	4.6
C. stricta- Faborsa	10.0	9.7
- Catarina	9.4	7.5
- Figarola	9.8	6.0
- rock pool	11.7	6.6
Halopteris scoparia-Catarina	10.0	6.4
- -Sturago	11.3	5.3
Dictyota dichotoma-Catarina	13.7	7.7
Dictyopteris membranacea - Catarina	14.3	9.2
Padina pavonica -Sturago	5.6	4.2
Cutleria multifida-Lone Bay	10.0	4.3
Colpomenia sinuosa-Lone Bay	6.2	5.4
Punctaria latifolia-hospital	10.0	9.3
Scytosiphon lomentaria-hospital	15.6	3.2
Stictyosiphon adriaticus-Lone	8.7	5.6
Ectocarpus siliculosus- hospital	13.5	11.3

RHODOPHYTA -Faborsa	protein	CHLOROPHYTA	protein
Ceramium ciliatum	14.2	Ulva rigida- Catarina	9.3
Polysiphonia furcellata	11.9	Cladophora dalmatica- Sturago	8.3
Lomentaria clavellosa	15.0	Cl.ruchingeri- hospital	22.5
Laurencia obtusa	18.2	Enteromorpha clathrata- Figarola	3.5
Alsidium corallinu m	15.6	E.intestinalis-Catarina	9.0
Corallina officinalis	9.3	-hospital	10.0
Gelidium spinulosum-hospital	8.7	Codium vermilara- Lone Bay	11.2
Catenella caespitosa - Sturago	20.6		
Gelidium pusillum-Sturago	6.3		
Porphyra leucosticta- Lim	15.6		

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B-I6

Seasonal variations in biomass and floristic diversity in benthic algal associations from the Northern Adriatic (Piran)

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In the heavily polluted area around Piran,northern Adriatic,the benthic algal vegetation was impoverished both in terms of biomass and floristic diversity.Different algal associations were found if comparisons with less polluted areas were drawn.

Sampling was carried out monthly between February and November in the rocky eulittoral and sublittorally at depths 1m, 3m and 7m. The substratum is flysch and limestone and locally concrete walls. Bellow 7m the slopes are sandy and bare of macroalgae. The tidal range is in average 95 cm. Temperature minima were found in February at all depths and maxima in August, with a range from 7.9°C to 25.5°C at the surface. During February and March the temperature increases with depth.The opposite was found from April to October. The surface salinity ranged from 34.6 ‰ to 37.8 ‰ , with a minimum in June and increase towards autumn and winter. Salinity values increased notably with depth between February and April.This increase was less conspicuous during summer and even less in autumn.

The benthic algal vegetation of this area is exposed to a combination of environmental stresses.In the eulittoral perennial settlements of the endemic Fucus virsoides (Don.) J.Ag. were rare.Spring annuals dominated at this level(Scytosiphon lomentaria (Lyngb.) Link.,Bangia atropurpurea (Roth.)C.Ag., Porphyra leucosticta Thur.,Ceramium spp.) along with mats of diverse green algae,which appeared during the year in several subsequent generations(Ulva rigida C.Ag., Blidingia minima(Näg.ex Kütz.)Kylin,Enteromorpha spp, Ulothrix spp.) .Locally turf-like mats of diverse Gelidium and Gelidiella species were conspicuous. At this level the biomass was low with a maximum in April , which coincided with the highest species diversity. Biomass values ranged between 4o and 612 g per m2 during the seasons.

In the sublittoral Cystoseira species were association-forming and dominated in the biomass (C.barbata(Good.et Wood.)J.Ag. and C. compressa (Esper)Gerloff et Nizamuddin at the upper levels and C. crinita(Desf.)Bory and C. corniculata (Wulf.)Zanard.ex Hauck between 3 m and 7 m). Seasonal variations in biomass were mainly due to the growth, fruiting and partial decay of the Cystoseira thalli and their epiphytic cover. Dense settlements of Dictyota dichotoma(Huds.) Lam.,Halopteris scoparia (L.) Sauv. and Halopitys incurvus (Huds.)Batt. were characteristic for this area. Seasonal variations in biomass and floristic diversity were also due to the appearence and disappearence of diverse tiny Ceramiaceae (e.g. Antithamnion plumula(Ellis) Thur., A. tenuissimum(Hauck)Schiffner , Callithamnion corymbosum(Smith)Lyngb., Ceramium tenuissimum (Lyngb.)J.Ag.,C. gracillimum (Griff.ex Harvey)G. Feldmann,C. codii(Richards)G.Feldmann, C. diaphanum (Roth)Harvey, C. rubrum (Huds.) C.Ag.,Pleonosporium borreri (Smith)Näg.,Ptilothamnion pluma(Dillw.)Thur.,Spermothamnion flabellatum Born.,Griffithsia spp., Compsothamnion thuyoides(Smith) Näg., Spyridia filamentosa(Wulf.)Harvey) along with diverse Polysiphonia species and considerable quantities of Nitophyllum punctatum(Stackh.)Grev. These species were prolific in the upper water layers during spring. Padina pavonica(L.) Lamouroux,Laurencia obtusa (Huds.)Lam. and Wrangelia penicillata C. Ag. were outstanding in summer. The algal biomass was highest between 1 m and 3 m depth. At 1 m depth the maximum biomass was found in April, whereas it was transfered to June at 3 m and 7 m. Pronounced seasonal variations in biomass and floristic diversity were found between 1m and 3 m depth. Biomass values ranged from 3oo to 4200 g per m2 at 1m and from 480 to 6000 g per m2 at 3m. The number of species of these intermediate depths was notably higher than in the eulittoral. At 1 m peaks in species diversity were observed in April and October, and in April and June/July at 3 m.

Further species which contributed to the algal biomass in notable quantities were Codium vermilara (Olivi) Chiaje,Pterocladia capillacea (Gmel.) Born .et Thur.,Jania rubens (L.)Lam.,Cladophora rupestris (L.)Kütz. and locally Corallina officinalis L. At 7 m the floristic composition was changed and seasonal variations in biomass and the number of species less conspicuous. Zanardinia prototypus Nardo,Peyssnnelia squamaria (Gmel.)Decne, Lithothamnion spp.,Pseudolithophyllum expansum (Phil.)Lemoine were conspicuous at this depth and were joined by some tropic floristic elements (e.g. Halimeda tuna (Ellis et Sol.)Lam., Udotea petiolata (Turra) Börgesen,Anadyoneme stellata (Wulf.)C.Ag.).

It is notrworthy that the spring maximum in biomass of the upper water layers was due to spring annuals , whereas it was transfered to June at 3 m and 7 m depth mainly on account of the fully grown Cystoseira thalli.

At 7 m depth conditions are more stable and crustose floristic elements dominate in the vegetation. By this reason seasonal variations in biomass and floristic diversity were inconspicuous at this depth.