

**BIOCHEMICAL STUDIES on SCYTOSIPHON SIMPLICISSIMUS
(Clemente) Cremades (PHAEOPHYTA, SCYTOSIPHONALES)**

**SCYTOSIPHON SIMPLICISSIMUS (CLEMENTE) CREMADES
ÜZERİNDE BİYOKİMYASAL ARAŞTIRMA (PHAEOPHYTA,
SCYTOSIPHONALES)**

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Abstract

The extensive pollution arising from industrial and domestic wastes around the port of Izmir is gradually expanding to the middle parts of the bay. Pollution gives rise to many changes in biochemical structures of some algae observed in disturbed ecosystems. Hence, the present study examined the contents of total water, protein, fat, nitrogen, phosphorus, ash, Na, K, Mg and heavy metals (Fe, Cu, Zn, Mn) in *Scytosiphon simplicissimus* (Clemente) Cremades [= *S. lomentaria* (Lyngb.) Link] which showed distribution in Narlıdere Sahil Evleri , a shore of the gulf of Izmir and in Yeni Foça.

As a result, all measurements, except for Na and K, of the samples collected from Narlıdere Sahil Evleri were higher than those from Yeni Foça. However, the accumulation of the heavy metals was arranged in the order of Fe>Zn>Mn>Cu, for both groups.

Introduction

In Turkey, the extent of marine and inland water pollution is gradually increasing, so that it damages the biologic structure of aquatic life and has adverse effects on water products. The biologic nature and the chemical components of organisms alter with the deterioration of ecosystem. The physical and chemical features of the sea water and the changes in chemical structures of algae are interrelated (Zavodnik, 1973). It has been suggested that the levels of inorganic elements, especially heavy metal contents of algae, might be indicators for marine pollution (Markham *et al.*, 1980).

More or less, the heavy metals have inhibitory effects on the metabolism and growth of aquatic plants (Overnell, 1976; Saraçer, 1993). Concentrations of metal ions in algae correlate with those in water (Morris and Bale, 1975). Algae in littoral zones and estuary mouths are more subjected to heavy metal pollution (Preston *et al.*, 1972).

It has been reported that *Ulva rigida* J. Ag., *Enteromorpha* sp., as well as, *Chaetomorpha linum* (Müll.) Kütz., and *S. simplicissimus* (as *S. lomentaria*) are predominant in littoral zones and estuary mouths where domestic pollution is significant (Munda, 1990).

Zavodnik (1979, 1983) noted that the organic pollution had strong adverse effects on the chemical structures and photosynthetic activities of *S. simplicissimus* and some algae, which grew in the media of domestic and industrial waste leakage. According to the recent findings, the phosphate and ammonium levels are over-abundant in the inner parts of the bay of Izmir. A good example for this is that the dissolved phosphate ranged approximately between 37 and 49 μM and ammonium showed a maximum range of 400-460 μM , in the years of 1993 and 1994 (Bizsel, 1996).

In spring, *S. simplicissimus* is observed extensively in the upper gulf of Izmir and its vicinity. The alga is present in the upper infralittoral rocky substrata of Narlıdere Sahil Evleri and Yeni Foça where the marine pollution is intensive. Some workers have examined the chemical structure of this alga (Zavodnik, 1979; Zavodnik, 1983; Wallentinus, 1974; Munda, 1990; Güven *et al.*, 1993). The aim of this study was to examine the impacts of the marine pollution in the bay of Izmir, on the changes of chemical structure of this species collected in the spring when maximum vegetative growth took place.

Material and Methods

Scytosiphon simplicissimus (Clemente) Cremades belongs to Phaeophyta group. In spring of 1996, we collected samples, from Narlıdere Sahil Evleri shores of the bay of Izmir and Yeni Foça and analyzed this species to identify its chemical content.

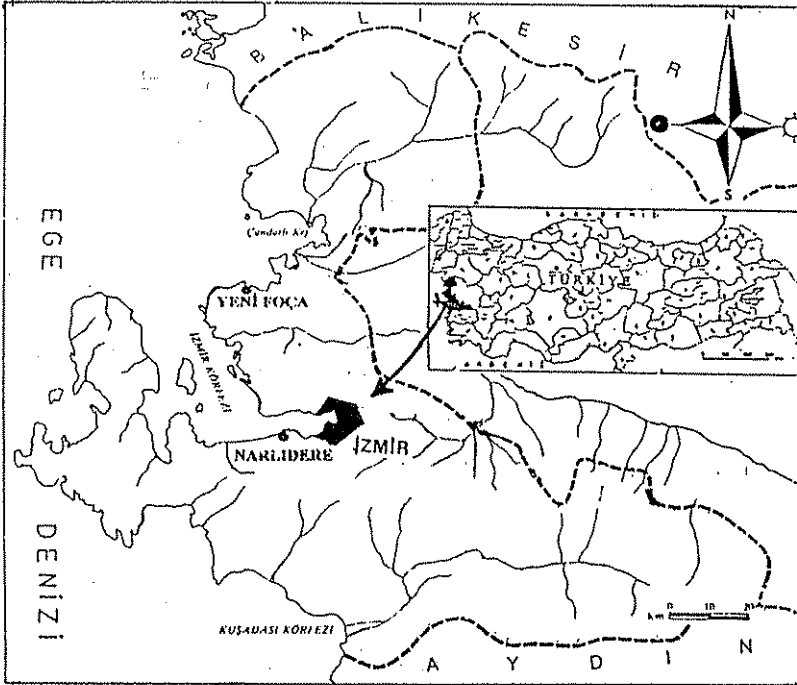


Figure 1. Izmir Bay and sampling stations

The differences between the wet and dry weights were used to determine the total water contents of the samples collected from different regions (İlyas, 1989).

Subsequently the samples were washed with drinking water and with distilled water afterwards and left to dry at room temperature. In accordance with the standard methods, the amounts of ash of the dry samples were obtained by heating the powder material at 600°C for 8 hours (İlyas, 1989).

The micro Kjeldahl method (Bremner, 1965) was used to determine the nitrogen (N), phosphorus (P), sodium (Na), potassium (K) and magnesium (Mg) contents of the alga. Flame photometry was used to determine Na, K, and Mg contents. P amounts were identified on spectrophotometry at wave length of 436 nm.. The total protein content was calculated by multiplying the total N value by 6,25 (Bremner, 1965).

The wet digestion method was used to decompose the samples using the mixture of nitric acid and perchloric acid (5:1) and to Atomic absorption spectrophotometry (AAS) to determine the heavy metal contents of the samples [Iron (Fe), Zinc(Zn), Copper (Cu), Manganese (Mn)] which were dried at room temperature (Bernhard, 1976). The Soxhlet extraction was used for total fats content.

Results

Table 1 and Table 2 show the organic and inorganic components of *S. simplicissimus* samples collected from Narlıdere Sahil Evleri of the bay of Izmir and from Yeni Foça.

The total protein, fats, ash, N, P, Mg, and the heavy metal (Fe, Cu, Zn, and Mn) contents of the samples collected from Narlıdere Sahil Evleri were higher than those of the samples from Yeni Foça, while the latter samples contained higher amounts of total water, Na and K.

Table 1. The organic components of *S. simplicissimus* collected from Narlıdere Sahil Evleri the gulf of Izmir and from Yeni Foça (% of dry weight). * % of wet weight.

Localities Parameters	Sahil Evleri Polluted	Yeni Foça Unpolluted
* Total water	83.13	87.67
Dry material	16.87	12.33
Organic substances	70.9	78.25
Total protein	24.5	10.32
Total fats	3.28	0.4

Table 2. The inorganic components of *S. simplicissimus* collected from Narlıdere Sahil Evleri the gulf of İzmir and from Yeni Foça (% of dry weight and ppm of dry weight)

Parameters	Localities	Sahil Evleri Polluted	Yeni Foça Unpolluted
	Ash (%)	29.1	21.75
	N (%)	3.92	1.65
	P (%)	0.16	0.1
	K (%)	3.8	4.6
	Na (%)	1.7	3.6
	Mg (%)	0.6	0.1
	Fe (ppm)	711	410
	Cu (ppm)	14.23	4.74
	Zn (ppm)	55.26	40.36
	Mn (ppm)	24.83	12.41

Discussion

It is known that the chemical compound of the sea water has greatly changed in the polluted regions of the gulf of İzmir (Parlak *et al.*, 1993; Büyükişik *et al.*, 1993). In this study, the decrease in total water content of *S. simplicissimus* collected from Narlıdere Sahil Evleri was found to be associated with the sea water pollution (Table 1). It is noted that the algae adapted to the media by losing water content due to the permeability in response (Zavodnik, 1987). to the high osmotic pressure induced by the dissolved salts in the environmental water (Chalaupka, 1939). The data may explain the decrease in the water contents of *S. simplicissimus* collected from Narlıdere Sahil Evleri.

The same sample showed an increase in the amounts of ash (Table 2). Zavodnik (1979) also determined an increase in the amounts of ash of the same species in the polluted regions and identified this change as an indicator for pollution. Thus, consistently with the Zavodnik's data, our findings revealed the sea pollution in Narlıdere Sahil Evleri. Moreover, it was noted that increases or decreases in water or ash contents were due to the modifications in the contents of inorganic elements of algae. Therefore, the increase in the amount of ash has been associated with the protein increase, resultant of the enrichment of the environmental nutrient salts (Zavodnik, 1973).

The sample from Narlıdere Sahil Evleri showed a considerable increase in total N, protein, and P contents (Table 1,2). As mentioned above, the cause for this finding may be associated with the increase in the environmental nutrient salts due to domestic and industrial waste. It was observed that the levels of P and N were high in algae which grew in rich nutritive water (Wallentinus, 1979). It is

well known that total protein content of the alga is related to the amount of nitrate in sea water (Munda, 1990).

The ratio of total fats for this species was higher in the samples from Narlıdere Sahil Evleri, compared with the samples from Yeni Foça (Table 1). Collyer and Fogg (1955) observed that water deficiency promoted fat formation. Similarly, Zavodnik (1987) reported that the water deficiency in algal cells could result in further accumulation of fat. Additionally, Zavodnik (1973, 1979, and 1983) concluded that the high rations of fats in the algae samples were related to the environmental fat influx. Our findings also are consistent with the data in literature.

The major elements of sea water, Na, K, and Mg, were observed to be accumulated in various amounts in the samples of *S. simplicissimus*. The levels of Na and K of the samples from Narlıdere Sahil Evleri were lower than those of the other samples (Table 2). Walker (1957) suggested that the plasmolemma worked as a diffusion barrier and it caused over-accumulation of these ions in the cells of algae. Additionally, Sitakararao and Tipnis (1976) stated that the Na and K contents of algae were not related to the seasonal or ecologic factors. These may be explanation for the shortness of Na and K in polluted regions.

There have been investigations on the levels of heavy metals in algae for determination of aquatic pollution due to industrial and domestic waste (Zingde *et al.*, 1976 and Munda 1984). Table 2 presents the Fe, Cu, Zn, and Mn contents of *S. simplicissimus*, as determined in this study. The changes in the degree of heavy metal accumulation in algae depend on the changes in the level of these ions in external water and also on the metabolic activities of the cells. Thus the heavy metal contents of *S. simplicissimus* samples collected from different regions might reflect the level of heavy metals in the gulf of Izmir.

The degree of heavy metal accumulation in the samples differed according to the regions. The samples from Narlıdere Sahil Evleri contained more Fe, Cu, Zn, and Mn than the other samples (Table 2).

The samples of the same species collected from Beykoz, the Bosphorus contained Fe, Cu, Mn, and Zn, in dry weights of 1035 ± 12 $\mu\text{g/g}$, $7,44 \pm 1,07$ $\mu\text{g/g}$, $14,52 \pm 2,17$ $\mu\text{g/g}$, and $81,69 \pm 7,14$ $\mu\text{g/g}$, respectively (Güven *et al.*, 1993). The high level of contamination in the Bosphorus was considered to be related to the pollution due to the local glass and shoe industries.

In our study, the heavy metal accumulations in *S. simplicissimus* were in Fe>Zn>Mn>Cu order and this arrangement is consistent with the order of heavy metal accumulations in the other biologic species (Uysal, 1980).

In conclusion the data presented here uncovers the significant level of marine pollution in Izmir Bay. Pollution is hazardous for aquatic organisms as well as for human, via food chain and it threatens the public health.

The pollution studies are related to the identification of the chemical contents of algae as indicator organisms and follow-up programs for continuity are of further importance for closed bays or gulfs, like the bay of Izmir.

Özet

Izmir Liman kısmında evsel ve endüstriyel atıkların neden olduğu aşırı kirlilik gün geçtikçe körfezin ortalarına doğru yayılmaktadır. Kirlilik, bozulan ekosistemlerde rastlanan bazı alglerin biyokimyasal yapılarında birçok değişiklikler meydana getirmektedir. Bu amaçla Izmir Körfezi Narlıdere Sahil Evleri ve Yeni Foça'da yayılış gösteren *Scytosiphon simplicissimus* (Clemente) Cremades [= *S. lomentaria* (Lyngb.) Link]’un total su, protein, yağ, azot, fosfor miktarları ile kül, Na, K, Mg ve ağır metallardan Fe, Cu, Zn, Mn miktarları incelenmiştir.

Sonuç olarak; Narlıdere Sahil Evleri’nde yayılış gösteren türün Na ve K dışındaki verileri, Yeni Foça’dan toplanan türden fazla bulunmuştur. Bunun yanında her iki örneğin ağır metal miktarları Fe>Zn>Mn>Cu şeklinde bir birikim sırası göstermektedir.

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