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MARINE SCIENCE AND TECHNOLOGY BULLETIN

Seasonal variation in ash, lipid and protein contents of *Scytosiphon lomentaria* Lyngbye and *Palisada perforata* Bory de Saint-Vincent along Çanakkale Strait (Dardanelles), Turkey.

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ABSTRACT

Algae are important components of the marine ecosystem community and have been a popular subject of research because of their biological and ecological roles in the ecosystem and several active algal-derived compounds. Nowadays, agricultural and industrial resources cannot meet the needs of rapidly increasing human population. In countries especially where agricultural production is insufficient, seafood utilization gains importance. Today, the focus of algal research is the utilization of algae as a rich protein source due to their high protein contents and for their nutritional values. Moreover, regular consumption of algae may prevent some diseases and may be important in the treatment of diseases. In the present study, seasonal and geographical changes in the lipid and protein content of two macro algae from Dardanelles were investigated. According to the results, for *Scytosiphon simplicissimus*, the highest protein level ($23.56 \pm 0.54\%$) was recorded in Gelibolu and the minimum protein level ($9.87 \pm 0.52\%$) was recorded in Eceabat. The minimum ash amount ($20.40 \pm 0.44\%$) was recorded in Eceabat, the highest ash amount ($53.05 \pm 0.13\%$) was recorded in Gelibolu. The highest lipid amount ($3.53 \pm 0.87\%$) was recorded in Eceabat, the minimum lipid amount ($1.19 \pm 0.28\%$) was recorded in İntepe. For *Palisada perforata*, the highest protein amount ($14.81 \pm 0.73\%$) was recorded in winter in Eceabat. The highest lipid level ($5.59 \pm 0.11\%$) was recorded in winter in Eceabat. The minimum lipid amount ($0.33 \pm 0.88\%$) was recorded in winter in Yapıldak. The minimum protein level ($7.74 \pm 0.34\%$) was recorded in summer in Yapıldak. The highest ash amount ($33.52 \pm 0.66\%$) was recorded in winter in Yapıldak and the minimum ash amount ($22.47 \pm 0.86\%$) was recorded in summer in Eceabat.

Introduction

The shortage of food and raw materials are the two most important problems we face nowadays. Due to the development of technology, not only terrestrial species but also marine products have many advantages as food sources. Algae are one of the wealth of the aquatic ecosystem and the investigations about these species

continue for many years and Japanese and Chinese had begun using algae economically (Güner and Aysel 1999). The industrial usage of algae started with production of soda, iodine and agar extracted as the alginate (Santelices 1989). Nowadays, agar agar, alginates and carrageenan are the main algal products. Algae are rich in protein and due to the amount of these nutrients, they have been consumed frequently. Regular consumption of algae is very important for human health for prevention and treatment of some certain diseases (Southgate 1990). Fifty percent of cultivated and collected algae are used in food industry, 40% are used in pharmaceutical industry and 10% are used in other industries (Chapman and Chapman 1980; Güner and

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Aysel 1999). Wong and Cheung (2000) studied *Hypnea charoides* J. V. Lamouroux, *Hypnea japonica* Tanaka and *Ulva lactuca* Linnaeus. They found the amount of fiber was (50.3 – 55.4%) and ash was (21.3 – 22.8%) the amount of crude fat was (1.42 – 1.64%). They also found the protein and fiber contents of red algae were higher than green algae. McDermid and Stuerckke (2003) investigated the amount of protein, lipid, carbohydrate, ash, vitamins and minerals in 22 macroalgal species. They determined high protein levels in *Halymenia formosa* Harvey ex Kützinger and *Porphyra vietnamensis* T. Tanka and PhamHoang Ho. Rodde et al (2004) investigated the chemical composition of red algae *Palmaria palmata*. They determined the amount of protein, ash and carbohydrate were in the ranges of 15 – 27%, 14 – 30% and 3.3 – 25% respectively.

Fonseca et al. (2005) studied the chemical composition of red algae *Gracilaria cervicornis* (Turner) J. Agardh and brown algae *Sargassum vulgare* C. Agardh. They found the amount of protein to be in the range of 15.97 – 23.05%. The highest protein level was observed in *G. cervicornis*. Lipid level for both species was lower than the protein amount. Amount of ash (14.20%) was higher in *S. vulgare*.

Renaud and Luong-Van (2006) investigated seasonal variation of chemical composition of 30 macro algae. The highest protein levels were in red algae (4.8 – 12.8%). Samples collected in winter have higher energy level and inorganic matter. In view of the previous studies, the results in this study are similar to the results of other surveys. Samples collected in winter have higher energy level and inorganic matter than the samples collected in summer. Low lipid amount and high protein levels were observed in all samples. Due to these important nutrients algae have, the areas of usage of algae will increase rapidly.

Material and methods

In this study, *S. lomentaria* from Ochrophyta (brown algae) were used (Figure 1) and *P. perforata* from Rhodophyta (red algae) (Figure 2). Samplings made seasonally at seven localities (Gelibolu, Eceabat, Havuzlar, Soğandere, Lapseki, Yapıldak and İntepe) along Çanakkale Strait (40°02' – 40°30'N, 26°10' – 26°45'E) between September 2007 and June 2008 (Figure 3). Collected samples were separated from epiphytes and carefully washed with tap water. Examples were allowed to dry naturally between 7-10 days. Afterwards the samples were dried in a fume hood at 70°C to a constant weight. The dried samples were powdered using a rotatory grinder. These samples were then used for nutritional analyses such as crude protein, crude lipid and crude ash contents. Lipid analyses were conducted according to Folch et al. (1957), protein and ash were analyzed in duplicates according to AOAC (2000).

Dried materials were calculated by standard methods. The tare weight of porcelain crucibles was measured. 0.5 g material was put in porcelain crucibles at 525°C for 12 hours. Then the porcelain crucibles were scaled by assay balance. The amount of ash was measured by the formula below.

$$\text{Crude ash amount (\%)} = \frac{(\text{tr} - \text{tf})}{m} \times 100 \quad (1)$$

tr: recent rhythm, tf: first rhythm, m: sample weight



Figure 1. *S. lomentaria*, Lyngbye.

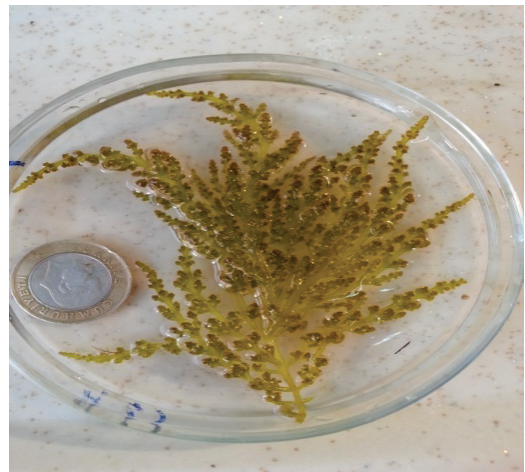


Figure 2. *P. perforata*, Bory de Saint Vincent.

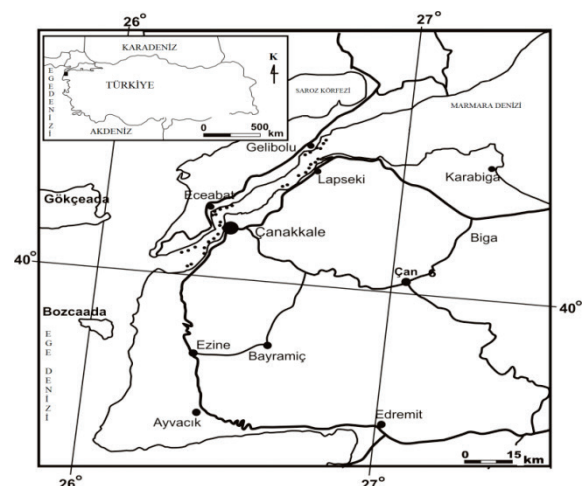


Figure 3. Location of sampling sites in the Çanakkale Strait (Dardanelles).

Lipid analyses were carried out with the method of Folch (1957). 0.5 g material was measured and put in volumetric flask. Than 10 ml 2:1 methanol- chloroform solution was added. The samples were kept for 24 hours at room temperature. Samples were leached and put in

evaporator at 60°C. Then volumetric flasks were put in stove at 103°C for 2 hours. Volumetric flasks were scaled by assay balance. The amount of lipid was measured by the formula below.

$$\text{Crude lipid amount (\%)} = \frac{(tr - tv)}{m} \times 100 \quad (2)$$

m= sample weight, tv= first weight of volumetric flask, tr= recent weight of volumetric flask and the weight of lipid

Protein analyses were carried out with the method of Kjeldahl (AOAC, 2000). 0.5 g material was measured and put in Kjeldahl tube. One piece of Kjeldahl tablet was put in each Kjeldahl tube as catalyzer. Than 96 % H₂SO₄ 15 ml was added in each tube. Afterwards each tube was put in wet decomposition for 2 hours. After 2 hours samples were put to distillation. At the end of the distillation, samples were standardized with HCl. The amount of protein was measured by the formula below.

$$\text{Crude protein amount (\%)} = \frac{(tt - tk) \times 14.007 \times 6.25}{m} \times 100 \quad (3)$$

tt: amount used in titration, tk: amount used in titration of blank sample, m: sample weight

Results

Results are shown in Tables 1 and 2. The chemical compositions of the samples were different from each other for each location (Table 1 and 2).

S. lomentaria was collected from 6 locations in Çanakkale Strait in spring. Results were shown at Table 1. According to the results, the highest protein level (23.56 ± 0.54%) was recorded in Gelibolu and the minimum protein level (9.87 ± 0.52%) was recorded in Eceabat. The highest lipid amount (3.53 ± 0.87%) was recorded in Eceabat, the minimum lipid amount (1.19 ± 0.28%) was recorded in İntepe. The minimum ash amount (20.40 ± 0.44%) was recorded in Eceabat, the highest ash amount (53.05 ± 0.13%) was recorded in Gelibolu.

Table 1. Seasonal changes of chemical composition of *S. lomentaria* in various locations of the Çanakkale Strait.

Locations	Lipid (%)	Ash (%)	Protein (%)
Gelibolu	1.96 ± 0.22	53.05 ± 0.13	23.56 ± 0.54
Eceabat	3.53 ± 0.87	20.40 ± 0.44	9.87 ± 0.52
Havuzlar	1.90 ± 0.16	26.10 ± 0.34	14.03 ± 0.75
Lapseki	1.76 ± 0.64	22.70 ± 0.92	14.64 ± 1.14
Yapıldak	2.09 ± 0.82	28.09 ± 0.44	12.32 ± 0.67
İntepe	1.19 ± 0.28	24.15 ± 0.15	11.91 ± 0.54

P. palisada was collected from 3 locations in Çanakkale Strait in different three seasons. From Yapıldak, Eceabat

and Soğandere. Results were shown in Table 2. According to the results, the highest protein amount (14.81 ± 0.73%) was recorded in winter in Eceabat. The minimum protein level (7.74 ± 0.34%) was recorded in summer in Yapıldak. The highest lipid level (5.59 ± 0.11%) was recorded in winter in Eceabat. The minimum lipid amount (0.33 ± 0.88%) was recorded in winter in Yapıldak. The highest ash amount (33.52 ± 0.66%) was recorded in winter in Yapıldak and the minimum ash amount (22.47 ± 0.86%) was recorded in summer in Eceabat.

Table 2. Seasonal changes of chemical composition of *P. perforata* in various locations of the Çanakkale Strait.

Season		Locations		
		Eceabat	Soğandere	Yapıldak
Winter	Lipid	5.59 ± 0.11		0.33 ± 0.88
	Ash	32.01 ± 0.68		33.52 ± 0.66
	Protein	14.81 ± 0.73		12.73 ± 0.27
Spring	Lipid	2.22 ± 0.52		
	Ash	24.85 ± 0.14		
	Protein	10.34 ± 0.94		
Summer	Lipid	2.27 ± 0.77	1.19 ± 0.46	1.69 ± 0.43
	Ash	22.47 ± 0.86	32.15 ± 0.46	29.6 ± 0.51
	Protein	11.94 ± 0.92	8.69 ± 0.70	7.74 ± 0.34

Discussion

In the present study, seasonal evaluations of chemical compositions of two different species distributed in the Strait of Çanakkale were conducted at seven different stations. At the end of the one year field study, it has been recorded that protein contents varied according to seasons and experimental locations.

Protein contents of algae were reported to be between 10 – 26 % (Arasaki and Arasaki 1983; Darcy-Vrillon 1993). The findings in the present study showed similar results with previous studies. Lipid contents of algae are relatively low compared to those of other marine products, and differ between 1 – 5% in almost all algae species (Morales et al. 2005).

In algae however, lipid levels are reported between 0.6 and 4.30% (Parekh et al. 1977). These values also showed similarities with the findings in the present study. Ruperez et al. (2002) reported that the ash contents of algae are considerably lower than those of terrestrial plants.

The chemical composition of marine vegetation is different from terrestrial vegetation and is affected by the combination of physico-chemical properties of water. Chemical structures of the algae also reflect the chemical properties of the water seasonally. To determine the most effective area of utilization, the differences between chemical compositions of species must be investigated.

Aquaculture production of our country has increased during the last two decades. The importance of algae

should be realized under favor of the essential nutrients that algae have.

Algae are an important link of the food chain. They can also be used as nutritional animal feed, fertilizer, pharmaceutical and cosmetic products. On the other hand, algae are used as antifungal, antibacterial and antiviral agents for some certain disease.

It is possible that the season and the chemical content of species that is more efficient can be determined with the results of these analyses.

Research can also be performed for different species or the same species but in different periods of the year and different locations. For this reason, in this study the chemical composition of two different macro algae for different seasons and different locations were investigated.

Results obtained on the lipid and protein content of the algal taxa studied can be used to determine the most efficient time and location choice for further similar studies.

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