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Biochemical Compositions of Mussels (*Mytilus galloprovincialis* L. 1819) in the Dardanelles

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Abstract: This study was carried out at three different location (Kepez Harbour, Kilya Bay and Canakkale Harbour) in the Dardanelles between October 1999 and July 2000. Obtained data revealed that while at lowest levels in December, dry meat rates were found at highest levels in February, hence carbohydrate (glycogen) rates reached highest levels and protein rates were at lowest levels in February. No significant differencies were found in biochemical parameters (protein, lipid, ash, carbohydrate) among three stations ($p>0.05$). According to the biochemical parameters, The data, also, indicated that biochemical parameters in the Dardanelles were convenient for mussel culture.

Key words: Biochemical composition, *Mytilus galloprovincialis*, Dardanelles

INTRODUCTION

Mussels, represented by a variety of species within the bivalve mollusc family Mytilidae, are cultured in both marine and estuarine environments in numerous countries throughout the world. Mussels distributed in coastal environments where phytoplancton, detritus, bacteria and nanozooplancton contribute substantially to the composition of an abundant food load[1].

The quality requisites of bivalve molluscs are primarily dependent on the quality of the aquatic environment, assuring a healthy product and a safe consumption. However, from a nutritional standpoint of view, other characteristics may influence the product quality[2,3]. It is known that water temperature, food availability and reproductive cycle of animals may influence the meat yield and biochemical composition of mussels[4,5]. However, poor information is available from the literature on the nutritional characteristics of *Mytilus galloprovincialis* cultured in the Turkey coasts and on their seasonal variations.

The aim of the present study was to determine seasonal biochemical compositions of mussels (protein, lipid, crude ash, carbohydrate) and some environmental parameters of water (temperature, dissolved oxygen, pH, salinity, calcium carbonate, phosphate and nitrogen) in the Dardanelles.

MATERIAL AND METHODS

The present study was conducted in three sites (Kepez Harbour, Kilya Bay ve Çanakkale Harbour) (39° 58' 20'' N, 40° 37' 17'' N longitude 26° 09' 50'' and E, 26° 41' 00'' E) in the Dardanelles (Fig. 1).

Mussels (commercial size, >50 mm) were collected seasonally in October 1999, December 1999, February 2000 and July 2000. Samples (50 individuals for per station) were immediately transported under refrigeration to laboratory. Upon arrival, mussels were rapidly washed and shucked by cutting the adductor muscle with a knife. Wet meat and dry meat was weighed with Scaltec scale (In 0.01 g) sensitivity and mussel shell lenghts were measured with compasse (In 0.01 mm) sensitivity.

Temperature, salinity, dissolved oxygen, pH, calcium carbonate ($CaCO_3$), phosphate (PO_4) and nitrogen (N) were determined seasonally. Temperature and salinity was measured with mercury thermometer and refractometer,

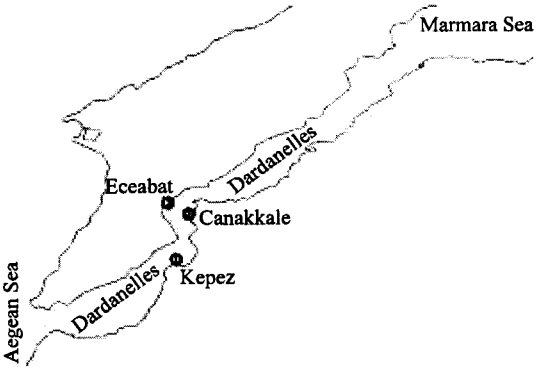

Fig. 1: Map of the study area

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respectively. pH and dissolved oxygen were read in a Dr. Large spectrophotometer. Calcium carbonate (CaCO3), phosphate (PO4) and nitrogen (N) measured by Palintest Interface 7000 photometer at 640 nm (CacO3) and 400 nm (PO4 and N).

The moisture content was determined by drying the accurately weighed triplicate samples at 80°C for about 24 h to a constant weight and the percentage of moisture was calculated as follows:

Moisture (%) = [(WMW- DMW) / WMW] * 100

WMW and DMW are wet and dry meat weights (g), respectively.

Protein, lipid and ash rate tests were carried out according to the method by[6] and carbohydrate rate test by Albercht and Breitsprecher,[7].

The influence of the station and season of sampling on the levels of the different biochemical compositions was assessed using analysis of variance (ANOVA).

RESULTS

Some environmental parameters (temperature, dissolved oxygen, pH, salinity, calcium carbonate, phosphate and nitrogen) in the water samples from three different stations in the Dardanelles were monitored in October, December 1999 and February, July 2000. While water temperature was found at highest in summer, low levels in autumn and lowest levels in winter. Notwithstanding salinity and dissolved oxygen levels were descended to lower levels, there was no significant variations in other seasons. pH and $CaCO_3$ varied between 8,0-8,5 and 140-165 mg L^{-1}, respectively. Phosphate levels were reached highest levels in December 1999 and decreased lowest levels in February 2000. Nitrogen amount was at highest levels (1,65 mg L^{-1} at station I in December 2000 and lowest (0,13 mg L^{-1}) at station III in February 2000, (Table 1).

Analysis of the data revealed that there was no significant variations in meat moisture levels between stations. But there was significant variation dependin upon seasons; while at low levels in December, dry meat rates reached highest levels in February, (Table 2).

Table 3 shows protein, lipid, ash and carbohydrates (glycogen) percentages of dry meat in stations.

Both protein and carbohydrate (glycogen) percentages were not varied significantly between stations but there was an inverse seasonal relationship between them. While the protein rates were reached lowest levels in February and highest levels in December (Fig. 2), carbohydrate the protein rates were reached lowest levels

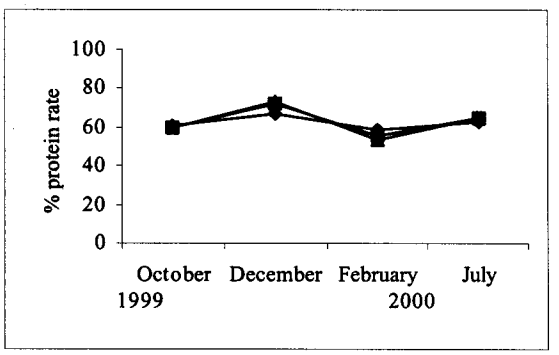

Fig. 2: Percentage of protein rates of mussels in Dardanelles

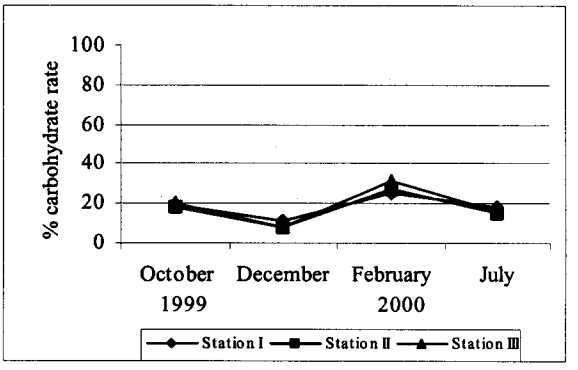

Fig. 3: Percentage of carbohydrate rates of mussels in Dardanelles

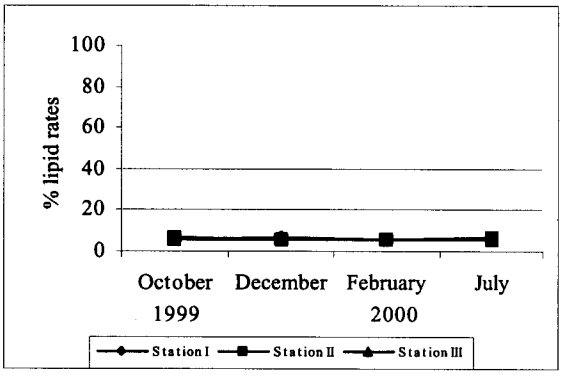

Fig. 4: Percentage of lipid rates of mussels in Dardanelles

in February and highest levels in December (Fig. 2), carbohydrate (glicogen) rates were found at lowest levels in December and at highest levels in February (Fig. 3). There were not significant changes in lipid rates depending on stations and seasons (Fig. 4). Ash rates

Table 1: Environmental parameters at different three stations in Dardanelles

Environmental parameters	October 1999			December 1999			February 2000			July 2000		
	I*	II*	III*	I	II	III	I	II	III	I	II	III
Temperature (°C)	17.0	18.0	18.0	13.6	13.3	13.2	8.2	8.0	8.0	24.0	24.0	24.2
dissolved oxygen	10.6	10.6	10.6	11.2	11.2	11.2	10.5	10.5	10.5	8.2	8.2	8.2
pH	8.3	8.4	8.4	8.0	8.3	8.3	8.5	8.5	8.5	8.4	8.2	8.4
salinity (‰)	26.2	25.5	24.4	27.8	28.1	28.3	29.0	29.2	29.1	23.4	22.4	22.8
$CaCO_3$ (mg L^{-1})	155.0	170.0	150.0	140.0	150.0	145.0	140.0	145.0	165.0	165.0	165.0	150.0
PO_4 (mg L^{-1})	1.0	2.0	1.1	1.5	2.2	1.19	0.9	0.66	0.4	1.2	3.0	0.9
N (mg L^{-1})	0.33	0.33	0.66	1.65	1.32	0.33	0.93	0.22	0.13	0.8	0.16	0.25

(*I: Kepez Harbour; *II: Kilya Bay; *III: Çanakkale Harbour)

Table 2: Percentage of moisture-dry meat rates of mussels in the Dardanelles

Moisture and dry meat	October 1999			December 1999			February 2000			July 2000		
	I	II	III	I	II	III	I	II	III	I	II	III
% moisture	85.72	83.85	83.89	87.28	89.59	87.89	79.61	79.20	77.67	86.31	86.11	85.96
% dry meat	14.28	16.15	16.11	12.72	10.41	12.11	20.39	20.8	22.33	13.69	13.89	14.04

Table 3: Percentage of protein, % lipid, % ash, % carbohydrate rates in dry mussel meats

Biochemical parameters	October 1999			December 1999			February 2000			July 2000		
	I*	II*	III*	I	II	III	I	II	III	I	II	III
% protein	61.06	59.94	60.03	67.51	72.62	72.84	58.47	55.79	53.92	63.09	64.70	65.42
% lipid	5.50	7.02	6.10	6.74	5.98	5.85	6.09	5.96	5.69	5.83	6.51	6.08
% ash	14.55	14.85	13.56	14.42	13.12	13.48	10.22	10.73	9.38	13.38	13.76	12.83
% carbohydrate	18.89	18.19	20.31	11.33	8.28	7.83	25.22	27.52	31.01	17.7	15.03	15.67

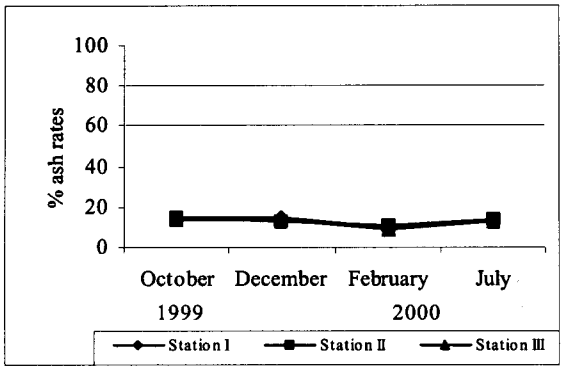

Fig. 5: Percentage of ash rates of mussels in Dardanelles

decreased in February, but there was no significant changes in other periods, (Fig. 5).

The protein and ash percentages in February were occurred lower than other periods and statistically significant; (ANOVA, p=0,038) and (ANOVA, p=0,034), respectively. Lipid and ash percentages did not vary significantly (P>0,05). Carbohydrate (glycogen) percentages reached highest levels in February, which was statistically significant (ANOVA, p= 0,019). No significant differencies were found in biochemical parameters (protein, lipid, ash, carbohydrate) among three stations (p>0.05).

DISCUSSION

Being filter feeding organisms, mussels directly affected by environmental parameters. Numerous studies showed that environmental parameters such as temperature, salinity, food availability, pH, phosphate, nitrogen and dissolved oxygen have great effects on mussel growth, condition indices and biochemical compositions[8-11].

Various authors have suggested that the seasonal variations observed in the levels of protein, lipid, ash, carbohydrate (glycogen) of mussels are intimately related to the nature of their food[2-13].

Proteins have many different biological functions: they are associated with enzymatic reactions, transport, regulation of metabolism, defence, structural elements, storage. This means that a pattern can be expected, depending on the different physiological activities of individuals throughout the year. Carbohydrates have two major biological functions: as a long-term energy store and as structural elements with lipids[14]. There was a clear seasonal pattern in the total carbohydrate concentration of mussels. The values were lower in December and reached highest levels in February. This high levels coincided with the poorest condition indices, perhaps because spawning had just finished and mussels would

need store energy for the next gametogenesis. Lubet [15] described the occurence of several sheddings of eggs during the spring for a population of *Mytilus galloprovincialis* on the west coast of France. This phenomenon of repeated release of gametes could be detected owing to sudden strong decreases of protein, glycogen and lipids, which were always followed by short-term increases[16]. Yıldız[17] stated that spawning of mussels in the Dardanelles prolonged throughout the year, but main reproduction season was in March and April. Therefore, high carbohydrate in mantle tissues of mussels in February can be considered as maturation of gonads before spawning.

Highest carbohydrate levels coincided with lowest protein and water levels and in consequence the seasonal carbohydrate cycle alternated with the protein and water content cycles. In addition, a simple positive relation between seasonal changes in dry meat weight and percentage glycogen has been observed in this andprevious studies[18-19] since both the period of meat increments and the carbohydrate accumulation coincide with the main growth season and change in dry meat weight result mainly from changes in carbohydrate content[18-19].

According to obtained results, the samples from coastal line to depths in the Daedanelles, revealed that there were seasonal variations in biochemical composition rates. But there was not considerable biochemical variations between stations. While mean moisture percentage was 84.42%, in mussels, mean protein, lipid, ash and carbohydrate rate were 62.95%, 6.11%, 12.85%, 18.09%, respectively. Yıldız[17] showed that growth performance and condition indices of mussels *Mytilus galloprovincialis* in the Dardanelles were suitable for mussel farming. The biochemical parameters were also suggested that the Dardanelles is suitable for mussel culture.

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