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RESEARCH ARTICLE

Amino acid and biochemical composition of Banded Carpet Shell (*Polititapes rhomboides*, Pennant, 1777), collected from the Çardak Lagoon, Turkey

Pervin Vural*

Çanakkale Onsekiz Mart University, Bayramiç Vocational School, Department of Aquaculture, Çanakkale, Turkey

ABSTRACT

Between January and December 2019, banded carpet shell (*Polititapes rhomboides*, Pennant 1777) were gathered from Çardak Lagoon (Çanakkale Strait). The length value was found to range from 32.92 to 36.37 mm, weight between 7.90 and 11.75 g, condition index from 4.44 to 8.70, and meat yield was found to be ranging from 11.95% to 24.95%. Negative allometry was determined in the W/L relationship of *P. rhomboides*. The main meat component of *P. rhomboides* was moisture (54.70-65.57%) and protein (52.89-62.10%) with the other components being carbohydrate (10.95-21.30%), lipid (12.79-17.18%) and ash (7.69-19.93%). The correlation between moisture and carbohydrate was positive, whereas the correlation between moisture and protein was negative ($p<0.05$). The present study not only informs us on composition but also recommends consumption of the species since it is easier to market and consume. Arginine amino acid was found to be the highest in quantity, which was followed by glutamic acid, serine, methionine, alanine, and aspartic acid.

Keywords: Length-weight relationship; Meat yield; Protein; Lipid; Çanakkale Strait

INTRODUCTION

As the human population in the world increases, the consumption of seafood rises rapidly. Thanks to increased awareness of health, today's people care about the consumption of sea foods considering their nutritional quality (Padidela and Thummala, 2015). Bivalves exert great importance in terms of ecology and economy in marine ecosystems (Šatović Vukšić et al., 2019). The biochemical composition of bivalves exert critical importance in terms of awareness of the quality of seafood (Radić et al., 2014). Because bivalves represent cheap protein sources, they can be used as a substitute for fish meals.

Polititapes rhomboides is placed in the *Veneridae* family, the *Venerida* ordo and mollusks taxonomy. *Ruditapes decussatus* (Linnaeus 1758), *Ruditapes philippinarum* (Adams and Reeve 1850), *Venerupis corrugata* (Gmelin 1791), *Venus verrucosa* (Linnaeus 1758) and *Dosinia exoleta* (Linnaeus 1758) species are member of *Veneridae* family.

P. rhomboides is commercially used and known to be of ecologic value as well (Chacón et al., 2021). Individuals are found in various sea bottom environment from gravel to sand (Moreira and Troncoso, 2007). *P. rhomboides* shows a distribution in Adriatic Sea, Aegean Sea, Levantine Sea, Bou Ismail Bay and North-Eastern Atlantic European Waters (Bakalem et al., 2020). In Turkey *P. rhomboides* inhabits Marmara (Albayrak et al., 2004), Aegean (Kocataş, 1978), Mediterranean seas (Albayrak, 2010), and Dardanelles (Palaz and Berber, 2005) in soft substratum with depths of 0- 10 m (Öztürk et al., 2014).

Bivalves possess high nutritional value (Karnjanapratum et al., 2013). Proteins, lipids, minerals, and glycogens increase the nutritional content of bivalves (Orban et al., 2007). On the other hand, their protein, lipid, and carbohydrate values vary depending on the season related to feeding, temperature, and reproduction (Yıldız et al., 2011; Vural and Acarlı, 2021). Gametogenesis could emerge following the energy decrease observed during winter, which may reduce present energy reserves further. Carbohydrates are a long-term source of energy (Robledo et al., 1995). Carbohydrate reserves have been known to be generally consumed in gametogenetic processes once lipids have been insufficient (Yıldız et al., 2021). Lipids represent a significant

***Corresponding author:**
Pervin Vural, Çanakkale Onsekiz Mart University, Bayramiç Vocational School, Department of Aquaculture, Çanakkale, Turkey.
E-mail: pervinvural@comu.edu.tr

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energy reserve considering their high-calorie content. Lipid usually has a cycle involving gametogenesis and spawning in females (Yıldız et al., 2021). Protein is most abundantly found in tissues and can be an alternative energy reserve during gametogenesis in some bivalves (Acarlı et al., 2015).

Condition index indicated the physiological state of bivalves and is directly proportional to stored energy value. Hence, it is often utilized to characterize the health of an organism depending on the environmental conditions (Pestana et al., 2009).

Lagoons are characterized by strong variations in their physicochemical environmental parameters and the richness of nutrient substances in their waters (Pérès, 1967). This richness contributes significantly to the attractiveness of such regions for species of commercial value (e.g., smooth scallop (*Flexopecten glaber*), Mediterranean mussel (*Mytilus galloprovincialis*), manila clam (*Ruditapes philippinarum*), carpet shell clam, (*Ruditapes decussatus*), flat oyster (*Ostrea edulis*), razor clam (*Ensis sp.*) and venerid clam (*Venus gallina*)) (Vural and Acarlı, 2018.

There are studies made concerning genetics (Fernández, 1991; Insua and Thiriot-Quiévreux, 1992), pathology (Villalba et al., 1993), infection (Mariño Balsa et al., 2003), and reproduction of *P. rhomboides* (Blanchard et al., 1986; Morvan and Ansell, 1988). Despite the economic importance of *P. rhomboides*, no studies have been made on its situation in Çanakkale Strait. The present study aimed to provide basic data on this subject (morphometric component and biochemical composition).

Bivalve's morphometrics and biochemistry are crucial for fisheries, stock estimation, stock management techniques, and aquaculture. The studies on the biological and ecological properties of *P. rhomboides* in Turkey are very limited. In this study, it was aimed to evaluate the relationships between length-weight, meat yield, biochemical composition, and condition index of *P. rhomboides*. The outcomes of the study can be utilized as a background informatin to examine its optimum seasonal yield and to establish a management strategy for a commercial production of this species in the Çardak Lagoon and to evaluate its aquaculture potential as welland.

MATERIALS AND METHODS

Study area and sample preparation

This research was conducted in the Çardak Lagoon (Çanakkale Strait) between January 2018 and December 2019 (Fig. 1). The *P. rhomboides* samples were taken monthly from the lagoon and their condition index, meat yield, and biochemical and amino acid composition were examined. The measurement of the *P. rhomboides* specimens was carried out utilizing Vernier calipers to determine the length (L), width (Wi) and thickness (T).

Morphometric relationship

$W=aL^b$ equation was used for the length-weight relationship, while the length, width, and thickness relationships was calculated using the Y=ax+b equation (a: intercept, b: slope). For calculating the statistical significance of the b value, thet- test was utilized (b=1 or b=3 is isometric growth, b>1 or b>3 is positive allometric growth, b<1 or b<3 is negative allometric growth) (Pauly, 1984).

Condition index and meat yield

The *P. rhomboides* specimens were weighed and the meat was removed from the shells to weigh them separately. The following formulas were used to determine Condition Index (CI) and Meat Yield (MY).

$$MY = \frac{Wet\ meat\ weight\,(g)}{Total\ weight\,(g)} \times 100$$

(Freeman, 1974)

$$CI = \frac{Dry\ meat\ weight\,(g)}{Dry\ shell\ weight\,(g)} \times 100$$

(Crosby and Gale 1990)

Biochemical composition

Freeze-dried meat samples were used in the analysis. Protein amount (%) was calculated adopting the Kjeldahl (Nx6.25) method, lipid level was extracted using chloroform-methanol (Erickson, 1993), the ash value was defined by incineration to ash in a muffle furnace (AOAC, 2000), the amount of carbohydrate was estimated according to Çelik et al. (2014) and the moisture was detected according to AOAC (2000).

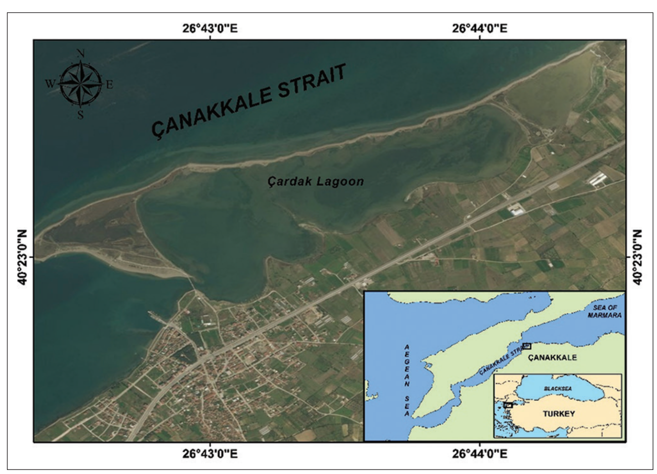

Fig 1. Sampling area.

$$Carbohydrate\ (\%) = 100 - Lipid\ (\%) + Protein\ (\%) + Ash\ (\%)$$

Amino acid composition

The amino acid analysis was performed by adding 20 ml of 6 N HCl to the dry meat samples and passing them through nitrogen gas before the oven procedure at 110 °C. After 24 hours, the samples were derivatized upon filtration through 0.20 μm PTFE syringe filters and read in the HPLC.

Statistical analysis

The statistical evaluations were conducted in triplicate and the results are presented as mean values ± standard deviation (SD). To assess the differences in biochemical composition and morphometric component according to months, One-Way ANOVA was performed, and the mean comparisons were conducted using the post hoc Tukey test. One Way ANOVA or Kruskal-Wallis was utilized to examine the differences in biochemical composition and morphometric component according to months by comparing the mean values utilizing the post hoc Tukey test. The significance level was determined as $p<0.05$. The Kolmogorov-Smirnov test was utilized to assess the normality of the data distribution. The relationship between the morphometric component and biochemical compositions of *P. rhomboides* was examined by adopting the Spearman correlation. The SPSS 23.0 software for Windows was used to conduct all statistical analyses. The strength and the direction of the correlations are indicated in different color tones in the corresponding figure (Fig. 2). The level of significance for correlation analyses was $p<0.05$. The results were also assessed by the Principal Component Analysis (PCA). Accordingly, the R software (v 3.6.1) was employed and the biochemical composition and morphometric components associated with the monthly changes were determined (Fig. 3).

RESULTS

Meat yield and condition index

The monthly differences in CI and MY were statistically significant ($p<0.05$). The mean CI was 6.44±1.36. The highest value of CI was determined in May (8.70±1.21) whereas the lowest was determined in August (4.44±1.17). The mean moisture content was 60.08±2.93%. The relationship between MY and L, T, and CI was positive ($p<0.05$) (Fig. 2). The mean MY value was 17.63±4.37%, in the range of 11.95±2.34 (August) and 24.95±4.39% (February).

Shell dimensions and allometric relations

The length of *P. rhomboides* was observed to range from 32.92±6.23 to 36.37±2.41 mm during the study (Table 1).

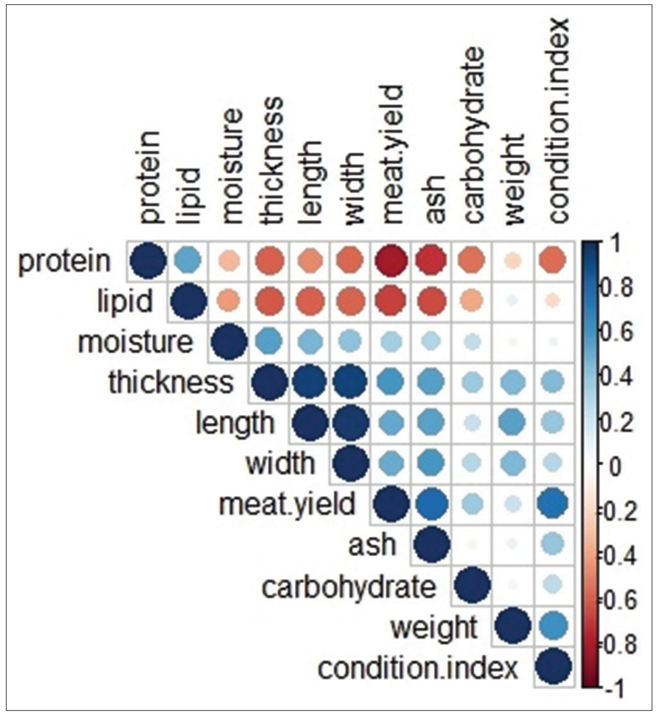

Fig 2. Morphometric and biochemical composition of *P. rhomboides* in correlation plot. (Dark color: Very high correlation, Light color: Very low correlation, Red color: Negative correlation, Blue color: Positive correlation).

The relationship between W and L, Wi, and T was determined to be positive ($p<0.05$). The relationship between L and Wi, T, and W was determined to be positive ($p<0.05$). The differences between L, Wi, and T according to months were statistically significant ($p<0.05$). The study investigated the allometric relationship of *P. rhomboides* between W, L, Wi, and T (Table 2).

Biochemical composition

The mean moisture content was 60.08±2.93%. The basic component of meat was a protein and ranged between 53.47±0.24% in April and 62.10±4.82% in September. The relationship between protein and lipid was determined to be positive ($p<0.05$). The relationship between protein and ash, carbohydrate, L, Wi, T, and MY was negative ($p<0.05$) The average amount of lipid was 14.90±1.79%. Ash content was found to be 12.82±3.72%. A negative relationship was observed between lipid and ash, L, Wi, T, and MY ($p<0.05$). Carbohydrates varied from 10.95±5.37% in September to 21.30±0.56% in January (Table 3). The relationship between carbohydrate values and L and T was determined to be positive ($p<0.05$). The relationship between carbohydrates and protein was negative ($p<0.05$). The changes in protein, lipid, carbohydrate, and ash according to months were statistically significant ($p<0.05$).

The PCA biplot exhibited 66.7% variance (Dimension 1=52.5%, Dimension 2=14.1%) between morphometric

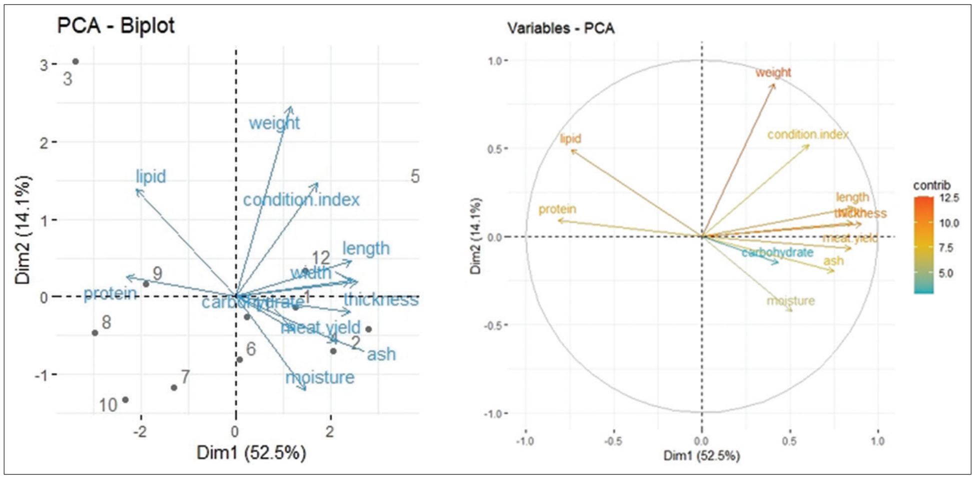

Fig 3. PCA analysis of the monthly changes in morphometric and biochemical composition of *P. rhomboides* A. Ordination plot of the variables showing the contribution of each component. B. Ordination biplot. (weight, length, width, thickness, protein, lipid, carbohydrate, moisture, ash, meat yield, condition index, 1: January, 2: February, 3: March, 4: April, 5: May, 6: June, 7: July, 8: August, 9: September, 10: October, 11: November, 12: December).

Table 1: Monthly changes (Mean±S.D.) in length, width, thickness, weight, meat yield and condition index of *P. rhomboides*

	Length (mm)	Width (mm)	Thickness (mm)	Weight (g)	Meat Yield (%)	Condition index
January	34.02±1.79	25.04±1.38	16.40±0.93	9.20±1.19	21,93±3.01	8.19±2.04
February	34.53±2.58	25.67±1.92	16.48±1.51	9.57±2.21	24.95±4.39	7.96±1.79
March	32.92±6.23	23.97±3.84	14.90±3.28	8.22±2.07	13.30±4.06	7.37±1.51
April	34.45±2.11	25.49±1.37	16.36±1.28	9.56±1.55	23.80±5.78	6.71±1.70
May	36.37±2.41	26.59±1.65	17.89±0.96	11.75±1.59	21.89±2.88	8.70±1.21
June	34.18±1.86	25.21±1.32	16.11±1.49	9.13±1.09	15.96±2.26	5.96±1.17
July	33.86±1.71	24.51±1.17	15.80±0.77	8.70±1.16	15.91±3.75	5.52±1.03
August	33.00±1.90	24.62±1.30	15.64±1.01	8.29±1.31	11.95±2.34	4.44±1.17
September	34.00±2.04	24.93±1.37	15.69±1.08	8.82±1.49	15.48±4.46	6.25±1.69
October	33.08±2.83	24.20±1.72	15.23±1.43	7.90±1.60	15.39±3.80	5.42±1.65
November	34.88±2.01	25.95±1.40	16.68±1.25	10.01±1.72	13.74±3.05	4.86±1.35
December	35.60±1.62	26.41±0.72	16.59±0.62	10.06±1.04	17.30±4.99	5.90±2.16

Table 2: Allometric relationships of *P. rhomboides* between morphometric components (length, thickness, and width) and weight

Relationship	N	a	b	R^2	Relationship (t-test)
W/L	228	0.4072	2.5288	0.7736	- allometry
Wi/L	228	0.7916	0.1880	0.7125	- allometry
T/L	228	0.9454	0.2421	0.6005	isometry

*L: Length; W: Weight; Wi: Width; T: Thickness

components (W, L, Wi, and T), MY and CI, biochemical composition (protein, lipid, carbohydrate, ash, and moisture), and months. PCA variable factor map showed that the contribution of W, L, Wi, T, and lipid was higher than that of other variables. Protein was dominant in September, ash, MY, and carbohydrate in February and April, and L and Wi in December (Fig. 3).

Composition of amino acid

Composition of essential amino acids

Table 4 illustrates the seasonal variation of the essential amino acid composition of *P. rhomboides*. From the grading of essential amino acids of *P. rhomboides* meat in quantity, it is concluded that methionine ranks first. Methionine was found highest in winter and lowest in summer periods. This amino acid was followed by leucine, valine, phenylalanine, threonine, ısoleucine, and histidine lysine amino acids in quantity. Amounts of valine, threonine, methionine, ısoleucine, leucine, and phenylalanine were generally high in winter whereas histidine was observed to be highest in summer periods.

Composition of non-essential amino acids

Table 5 presents changes in amounts of nonessential amino acids in the meat of *P. rhomboides*. Of nonessential amino acids, arginine was found to be the highest in amount, followed by glutamic, serine, alanine, aspartic, proline, glycine, and tyrosine. In general, arginine and tyrosine were highest in summer while serine, glycine, alanine, proline, aspartic acid, and glutamic acid were found in the highest values in winter.

DISCUSSION

The present study revealed that the L and W of *P. rhomboides* ranged from 32.92±6.23 mm (January) to 36.37±2.41 mm (May) and 7.90±1.60 g (October) to 11.75±1.59 g (May),

Table 3: Monthly changes (%) (Mean±S.D.) in protein, lipid, carbohydrate and ash of *P. rhomboides*

	Protein	Lipid	Carbohydrate	Ash	Moisture
January	54.37±0.32	14.23±0.77	21.30±0.56	10.10±1.01	59.84±4.49
February	52.89±0.56	12.79±0.93	14.39±1.71	19.93±2.07	60.24±7.46
March	60.76±0,00	18.75±0.00	12.80±0.00	7.69±0.00	54.70±6.88
April	53.47±0.24	13.63±0.16	15.16±0.93	17.75±0.85	61.42±3.58
May	55.77±0.16	13.93±1.86	13.76±2.46	16.55±0.76	62.76±3.16
June	56.00±0.00	16.13±0.00	15.37±0.00	12.50±0.00	65.57±1.78
July	61.69±1.27	13.73±0.00	13.02±1.72	11.55±0.44	62.15±2.24
August	59.20±1.10	17.18±1.97	12.13±3.12	11.48±0.05	57.08±3.43
September	62.10±4.82	16.39±0.00	10.95±5.37	10.56±0.56	59.90±3.95
October	60,29±0.29	14.26±0.63	13.58±0.42	11.87±1.34	58.26±6.40
November	59.08±1.66	14.23±0.77	17.78±2.45	8.91±0.02	61.65±4.35
December	56.71±0.71	13.59±2.48	14.74±2.72	14.95±0.95	57.36±10.85

Table 4: Seasonally changes (g/100g dry weight) in essential amino acid composition of *P. rhomboides*

	Winter	Spring	Summer	Autumn
Valine	0.0066	0.0006	0.0033	0.0004
Threonine	0.0044	0.0012	0.0003	0.0015
Methionine	0.0155	0.0062	0.0061	0.0089
Isoleucine	0.0017	0.0003	0.0004	0.0002
Leucine	0.0061	0.0015	0.0027	0.0015
Phenylalanine	0.0038	0.0003	0.0010	0.0042
Histidine	0.0003	0.0007	0.0014	0.0005
Lysine	0.0000	0.0000	0.0000	0.0000

Table 5: Seasonally changes (g/100g dry weight) in non-essential amino acid composition of *P. rhomboides*

	Winter	Spring	Summer	Autumn
Arginine	2.9258	8.6121	23.5246	3.7953
Serine	0.0722	0.0186	0.0253	0.0247
Glycine	0.0025	0.0002	0.0015	0.0002
Alanine	0.0194	0.0013	0.0116	0.0011
Proline	0.0162	0.0007	0.0003	0.0000
Tyrosine	0.0005	0.0001	0.0006	0.0002
Aspartic Acid	0.0164	0.0017	0.0028	0.0015
Glutamic Acid	0.9081	0.0602	0.1176	0.2195

respectively. The changes in length values were in line with those reported by (Yamuza-Clavijo et al., 2010; Derbali and Jarboui 2021). The morphometric relationship in L/W and L/Wi was found to be negative allometric in the study. Length growth was seen to be synchronized with growth in thickness. In other words, length growth occurs more rapidly than those of weight and width. Singh et al. (2013) observed a negative allometric growth in length/weight in *Modiolus auriculatus*. Gaspar et al. (2002) found an isometric growth in length/thickness. Various studies have stated that, for most of the bivalve species, depth, levels of shore and tides, water currents and turbulence, exposure to waves, type of bottom, type of sediment, nutrition, season and reproduction affect shell morphology (Seed, 1968; Newell and Hidu, 1982; Hinch and Bailey, 1988; Franz, 1993; Claxton et al., 1998; Fuiman et al., 1999; Akester and Martel, 2000; Gaspar et al., 2002; Lagade et al., 2014). Additionally, depending on the species and environmental factors, the relationship between growth parameters may change. Especially, the capacity to thrust away from predators and the structure of the sediment could cause this species to show negative allometric growth (Akester and Martel, 2000; Gaspar et al., 2002; Leontarakis et al., 2008).

MY and CI serve as indices of the nutritional and commercial quality of bivalves and offer data for sustainable fisheries (Orban et al., 2007; Yıldız et al., 2021). CI is a significant factor to determine the most appropriate time for the harvesting period of bivalves (Okumuş and Stirling 1998). The most suitable period for the harvesting period of bivalves is the time when the CI is maximum just before the reproduction period (Peharda et al., 2007). MY and CI tend to demonstrate alterations in physiology and reproductive activity in response to environmental factors (such as food and temperature) (Vural et al., 2015; Acarlı et al., 2018b; Yıldız et al., 2021). The mean MY increased from 11.95±2.34 (August) to 24.95±4.39 % (February) and the mean CI increased from 4.86±1.35 to 8.70±1.21. Morvan and Ansell (1988) in their study conducted in St. Malo Bay (France), stated that the CI of *P. rhomboides* was minimum in winter, increased in March rapidly, and reached the maximum levels starting from late April to June. However, Yamuza-Clavijo et al. (2010) stated that MY appeared quite variable in months and was not affected by reproduction activity which may have been accounted for by its asynchronous reproduction character rather than environmental conditions. On the other hand, Serdar and Lök (2009) reported that variation in MY in *R. decussusatus* was influenced by reproduction activity. Serdar and Lök (2009) observed that *R. decussatus* variation of MY was between 12.7±0.4% and 26.8±0.5. Villalba et al. (1993) found that gonadal maturity in *P. rhomboides* (Spain-Ria de Arosa) occurred by April, spawning between March and June and resting phase from September to December. Considering the studies by Serdar and Lök (2009) and Villalba et al. (1993), it could be said that the study in Çardak

Lagoon showed reproduction to have an effect on MY and its maturity period was in winter and spring months.

Energy storage and determination of its consumption strategy varies based on the species, environmental conditions, food availability, quality, and geographical location. The main energy reserves for gametogenesis in bivalves are lipid and carbohydrate (Dridi et al., 2007, Acarli et al., 2018a; Machado et al., 2018). Bivalves utilize protein as an alternative energy source when carbohydrate reserves are depleted (Joaquim et al., 2011; Vural and Acarlı 2021). Bivalve eggs mostly consist of protein, which serves as an energy source for the development of the egg (Galap et al., 1997). During gonadal maturationand up. Until spawning, the amount of protein increases; however, during spawning, it decreases (Barber and Blake 1981; Berthelin et al., 2000). The present study found an inverse relationship between protein and carbohydrate. Carbohydrate is consumed as energy whereas protein and lipid are generally stored in the body. In April and June in particular, the amount of protein is estimated to exhibit a decrease due to the spawning period as well. Serdar et al. (2009) found the amount of protein of *R. decussatus* to range from 39.82% to 64.24 % in Çakalburnu Lagoon. Ojea et al. (2004) reported that protein content ranged from 44.7 % in December to 50.8% in June in *R. decussatus* in the Galicia region, Spain. Lök et al. (2011) found that *R. decussatus* protein value ranged from 34.3%-42.7% to 36.55%-50.20% in Izmir Mersin Bay and Musakca, Balıkesir, respectively. Çelik et al. (2014) found the mean protein value to be 54.03±2.82 % in Bandırma, Balıkesir. *P. rhomboides* is phylogenetically related to the venerid *R. decussatus* (Mikkelsen et al., 2006). The present study showed protein content to be higher than in the species *R. decussatus* inhabiting Turkish seas to see the variation in the year to be more limited, which could be caused by protein storage and strategy for consumption as well as other components.

During the gametogenesis of bivalves, lipids are transferred from tissues to gonads and are also stored in digestive glands to be transported to gonads when necessary (Taylor and Venn, 1979; Barber and Blake, 1981; Wenne and Stcynska-Jurewicz, 1987). When nutrition is unsufficient, lipids serve as an energy source (Beukema and De Bruin, 1977). Therefore, the observed decline in lipid levels may be caused by unfavorable trophic circumstances. Ojea et al. (2004) reported that lipid content in *R. decussatus* varied from 4.5%to 6.9% in Galicia, Spain. Serdar et al. (2009) found lipid content in *R. decussatus* to range from 6.56% to 11.16% in Çakalburnu Lagoon. However, this study showed lipid content to range from 12.79% in February to 18.75% (dry meat) in March, which was lower in value than other studies.

The most significant energy source for bivalve is carbohydrate (Castro and de Mattio, 1987). Mohammad and Yusuf (2016) found in their study that carbohydrate is the second basic organic constituent in all species. A similar result has been reported by Salaskar and Nayak (2011) in *Perna viridis* and Rapana. The present study indicated that carbohydrates varied from 10.95±5.37% in September to 21.30±0.56% in January with a negative correlation between carbohydrate, protein, and meat yield. Likewise, Machado et al. (2018) determined in their study the negative correlation between proteins, glycogen, and CI stating that the use of the reserve relied on situations of psychological stress such as lack of nutrition and energy imbalance.

Bivalve species are rich in essential amino acids, playing roles in growth, reproduction, and vitamin synthesis (Inyang and Effong, 2017). There are 8 amino acids necessary for humans, which are lysine, methionine, threonine, tryptophane isoleucine leucine, phenylalanine, and valine (Erkan et al., 2010). This study determined all essential amino acids but tryptophane in the meat of a *P. rhomboides* all year round. There is an influence of the species, environmental conditions (temperature, salinity nutrition, etc.), and cycle of reproduction on the variation of amino acid amount (Chen et al., 2011; Baptista et al., 2014; Inyang and Effong, 2017).

Sidwell et al. (1977) observed that lycine amino acid in *C. virginica* is among the dominant amino acids. Özden and Erkan (2011) reported that phenylalanine is one of the major amino acids in *F. glaber*. However, Fatima (1996) found in his study that the main amino acids of *P. viridis* are arginine, leucine, and lycine. This study showed arginine to be dominant followed by glutamic acid, serine, methionine, and alanine.

Baptista et al. (2014) attributed a relatively increased amount of glutamic acid in as in leucine essential amino acid during spawning to the possibility of its re-participation in gonadal development after spawning. The present study found the amount of glutamic acid in *P. rhomboides* to be high value in all three seasons but spring.

The amount of lycine needed by humans is 1-1.5 g a day and a lack of lycine leads to Vitamin B deficiency (Özden and Erkan, 2011). Histidine is a semi-essential amino acid synthesized from methionine and fenilalanine amino acids (Belitz et al., 2001). It is recommended that pregnant women should ingest histidine of 33mg/kg a day (HMDB 2019). Threonine amino acid is suggested to be used for 1 g a day in the treatment of genetic spasticity disorder (HMDB 2019). Vural and Acarlı (2021) reported in their study that 555 g *F. glaber* could meet the daily requirement for threonine. This study reported that amounts of histidine, threonine, and lycine in *P. rhomboides* present in Çardak Lagoon were observed to be lower than those in other studies (Baptista et al., 2014; Inyang and Effong, 2017; Vural and Acarlı 2021). The amount of histidine, threonine and lycine in *P. rhomboides* was small in this study. However, the fact that this species contains these amino acids is important for a healthy diet of people.

CONCLUSION

In Turkey, no studies have been reported on the biometric components, length-weight relationship, and biochemical composition of *P. rhomboides*. Therefore, ıt is thought that tis study will form the basis for further studies.

The study indicated a negative allometric relationship between length/weight and length/width. In other words, length growth occurs more rapidly than those of weight and width. This study revealed that the nutritional values of *P. rhomboides* are similar to those of other bivalves with with high economic value. *P. rhomboides* is a potential source of good protein and high-quality fat. *P. rhomboides* meat could well be a source of alternative to high-fat meat such as chicken, beef, or other red meat. It could be said that the study in Çardak Lagoon showed reproduction to have an effect on meat yield and its maturity period was in winter and spring months. The present study showed protein content to be higher than in the species *R. decussatus* inhabiting Turkish seas to see the variation in the year to be more limited, which could be caused by protein storage and strategy for consumption as well as other components. The amount of histidine, threonine and lycine in *P. rhomboides* was small in the present study. However, the fact that this species contains these amino acids is important for a healthy diet of people.

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Author contributions

The author confirms sole responsibility for the following: study conception and design, data collection, analysis and interpretation of results, and manuscript preparation.

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