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Nutritional Composition and Some Biological Characteristics of the Tub Gurnard (*Chelidonichthys lucerna*) Captured in the Western Black Sea Coasts of Türkiye

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Abstract

The study was carried out between 01 September 2021 and 15 April 2022 in the Western Black Sea coasts. Tub gurnard (*Chelidonichthys lucerna* L., 1758) were examined in the commercial fishery. A total of 28.885 kg tub gurnard was caught during the study period. Total length and weight of 54 tub gurnard individuals were measured. Minimum, maximum and average total lengths were calculated as 15.2 cm, 55.5 cm and 25.6±0.95 cm, respectively. Length-weight relationship (LWR) of tub gurnard were determined as $W=0.0123L^{2.9757}$ for all individuals in the study. The value of the parameter 'b' was found negative allometric growth for tub gurnard. The food components of male and female tub gurnard were determined to 75.540±0.303, 75.801±0.69 for moisture 20.130±0.024, 19.151±0.023 for protein, 2.764±0.042, 3.704±0.059 for lipid, 1.550±0.042, 1.530±0.059 for ash, 0.434±0.121, 0.281±0.041 for carbohydrate and 141.677±0.062, 144.432±0.057 energy (kcal), respectively. In the study, it was determined that the biological fetures and nutrition composition values of tub gurnard vary as gender.

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INTRODUCTION

Pelagic species are mostly caught in Türkiye seas. While most of the production is supplied from the Black Sea region, it attracts attention especially in anchovy and other small pelagic fishes such as horse mackerel, bluefish, shad and sprat (TurkStat, 2021). However, although the production amount of demersal fish is low, their economic value is high.

Besides pelagic species, demersal fish such as whiting, red mullet and turbot are caught in the Black Sea. These species are captured by demersal trawls, gillnets and trammel nets. With these fishing gears, some non-target species can be captured except for target species. One of these species is the tub gurnard (*Chelidonichthys lucerna*), which has economic value (ICES, 2010; Kasapoğlu and Düzgüneş, 2017; Özdemir et al., 2019; Rodriuges et al., 2019). Tub gurnard is one of the three species of Triglidae family living in the Black Sea. (Bilecenoğlu et al., 2014; Yankova et al., 2014).

There are many studies on some population and biological features of tub gurnard in the Marmara Sea, Aegean Sea, Mediterranean and Atlantic coasts, (Papaconstantinou, 1984; Colloca et al., 1994; Abdallah, 2002; Santos et al., 2002; Borges et al., 2003; Mendes et al., 2004; İşmen et al., 2004; Eryılmaz and Meriç, 2005; İlhan and Toğulga, 2007; Deval et al., 2007; Boudaya et al., 2008; Çiçek et al., 2008; Vallisneri et al., 2011; Stagioni et al., 2012; Demirel and Dalkara, 2012; Akyol, 2013) but studies in the southern Black Sea coats are very few (Haşimoğlu et al., 2016; Özdemir et al., 2019).

There are many studies on the processing technologies and quality of economical fish used for both the aquaculture industry and human consumption in the Black Sea region (Duyar et al., 2012; Duyar et al., 2013; Çağlak et al., 2016; Tokur & Aksun, 2018; Bayraklı & Duyar, 2019a; Bayraklı & Duyar, 2019b). However, in recent years, studies on fish that have passed from discarded and by-catch to target species and are likely to pass are at a very low level. Notable among these species are scorpionfish, sole fishes and goby fishes (Duyar et al., 2020).

In this study, it was aimed to determine some biological characteristics in terms of fishing technology and the nutrient composition of human consumption and processing technology of tub gurnard captured as by-catch by the demersal trawl in the Black Sea coats.

MATERIAL AND METHOD

The study was carried out in the Southern Black Sea coasts of Türkiye at monthly by using a commercial demersal trawl (01 September 2021 – 15 April 2022). The sampling areas were western Black Sea (Sinop-İnceburun coasts), this area is an important transit and aggregation location pelagic and demersal fish shoals in the Black Sea coasts of Türkiye (Figure 1). Samples were collected with demersal trawl at depths ranging from 60 m to 105 m.

Figure 1. Map of the area where the fish samples were caught.

Fishes were captured by using a typical otter demersal trawl with 40 mm codend mesh size; tow duration was to 45-90 minutes.

A total of 36 hauls were conducted during the study period. Fish were measured to the nearest 1 mm (total length) and weighted to the nearest 0.01 g (Figure 2). The gender and maturity stages were determined by the macroscopic and microscopic examination of the gonads (Follesa and Carbonara, 2019).

Figure 2. Length measurement of tub gurnard captured by demersal trawl

Length-weight relationships were estimated by fitting an exponential curve ($W=aL^b$) to the data (Ricker, 1975; Pauly, 1984).

Parameters a and b of the exponential curve were estimated by linear regression analysis over log-transformed data: logW=loga+blogL

Where

L is the total length (cm),

W is the total weight (g),

a is the intercept and b is the slope, using the least-squares method.

The association-degree between variables of W and L was calculated by the determination coefficient (R). Additionally, 95% confidence limits of the parameter b were estimated. The Student's t test was used for comparison of the slopes (Zar, 1996).

From nutrient composition analysis, total crude protein was performed using Kjeldahl (AOAC, 1990), crude oil analysis (Bling & Dyer, 1959), crude ash analysis (AOAC, 1984), and moisture analysis (Ludorf & Meyer, 1973). Carbohydrate and energy amounts were calculated according to Merril & Watt (1973).

Carbohydrate (g/100g) = 100 – (W + F + P + A),

Energy (Kcal/100g) = (Fat * 9.50) + (Protein * 5.65) + (Carbohydrate * 3.90)

Analysis of the nutrient composition of fresh tub gurnard was carried out in two replications and in three parallels.

RESULTS

A total of 28.885 kg tub gurnard were caught with demersal trawl during the study. Female fish were captured more and larger size than male fish. The captured fishes occurs of 65% (35) female fishes and 35% (19) male fishes. A total of 54 specimens ranging sizes were between 15.2 and 55.5 cm. The average total length and weight of the fishes was determined as 25.6±0.95 cm and 312.50±78.55 g (Table 1).

Table 1. Length and weight parameters of the tub gurnard (*Chelidonichthys lucerna*)

Parameters		**Female**	**Male**	**Combined**
Length (cm)	Maximum	55.5	41.4	55.5
	Minimum	15.2	16.3	15.2
	Average	30.43±1.44	22.15±1.57	25.62±0.95
Weight (g)	Maximum	1541.5	622.4	1541.5
	Minimum	55.2	56.6	55.2
	Average	362.17±85.86	227.75±88.32	312.50±78.55

The length-weight relationships (LWRs) of tub gurnard were calculated as $W=0.0123L^{2.9757}$ (R=0.98, N=54), negative allometric growth (Pauly's t-test, $P < 0.05$) were obtained for all individuals. Descriptive statistics on the length and sample size (n), regression parameters a and b of the length-weight relationship (LWR), 95% confidence intervals of a and b, the coefficient of determination (R) of analyzed species are shown in Table 2.

Table 2. Length-weight relationship (LWR) parameters for tub gurnard

Parameters of LWR	
N	54
a	0.01232
95 % Confident of a	0.00987-0.01398
b	2.9757
b (SE)	0.0471
95 % Confident of b	2.9286-3.0228
R	0.9811
Growth	− Allometric
P (t-test)	0.05<

N is number of specimens; a is intercept of the relationship; b is slope of the relationship; R is coefficient of determination; b (SE) is the standard error of b.

Nutrient composition analyses were made in the meat of fresh tub gurnard (*Chelidonichthys lucerna*) in males and females, energy amounts were calculated and the results are given in Table 3.

Table 3. Nutrient composition energy value of fresh tub gurnard (*Chelidonichthys lucerna*)

	Male (♂)	Female (♀)
Moisture (%)	75.540±0,303	75.801±0.69
Crude protein (%)	20.130±0,024	19.151±0.023
Crude oil (%)	2.764±0,042	3.704±0.059
Crude ash (%)	1.550±0,042	1.530±0.059
Carbohydrate (%)	0.434±0,121	0.281±0.041
Energy (kcal7100g)	141.677±0,062	144.432±0.057

DISCUSSION

The tub gurnard has an important economic value in the Türkiye fish market. Many scientists have stated that tub gurnard are caught by trammel nets, gillnets, and demersal trawl nets (Özdemir et al., 2003; Çiçek et al., 2006; Ceylan et al., 2014; Kasapoğlu and Düzgüneş, 2017; McCartey and Marriott, 2018; Özdemir et al., 2019).

The present study were founded as 25.6±0.95 cm average length of fishes. The maximum, minimum total length measured for fishes were 55.5 cm, 15.2 cm respectively. Minimum and maximum total lengths were reported as 2.2 cm (Eastern Mediterranean Sea) and 88.2 cm (Eastern Black Sea) in Türkiye seas (Çiçek et al., 2006; Haşimoğlu et al., 2016).

Length-weight relationship was determined as $W=0.01124L^{2.943}$ (R=0.989) for tub gurnard (negative allometric growth, b<3) in the study. b values, which indicated positive allometric growth (Papacostantinou, 1984; İlhan and Toğulga, 2007; İlkyaz et al., 2008; Bilge et al., 2014; El-Serafy et al., 2015; McCarty and Marriott, 2018) and isometric growth (Borges et al., 2003; İşmen et al., 2004; Eryılmaz & Meriç, 2005; Keskin & Gaygusuz, 2010; Bök et al., 2011; Vallisneri et al., 2011; Demirel & Dalkıran, 2012; Özdemir et al., 2019) for tub gurnard.

The present study showed that the b-values have generally been in agreement similar with results (negative allometric growth) in the previously most studies (Papacostantinou et al. 1994; Serene et al. 1998; Abdallah, 2002; Santos et al. 2002; Çiçek et al. 2006; Olim & Borges, 2006; İşmen et al. 2007; Sangun et al. 2007; Boudaya et al. 2008; Çiçek et al. 2008; İşmen et al. 2018).

The variations in b-values may be attributed to one or more factors: the seasons and effects of different region, differences in salinity, temperature and pollution of aquatic environment, sex, food quality and availability, differences in the number of fish examined, as well as in the observed size ranges of the sampled species (Gonçalves et al., 1997; Froese et al., 2011; Özdemir et al., 2018).

First reproduction size of male and female are 17-18 cm and 19-20 cm for tub gurnard in the Türkiye seas (İşmen et al., 2004; Eryılmaz & Meriç, 2005; Ilhan & Toğulga, 2007). The lengths are range 25 cm and 40 cm in some studies of other Mediterranean countries (Papacostantinou, 1984; Baron, 1985; McCarty & Marriott, 2018). The minimum landing size (MLS) is 18 cm for tub gurnard in Türkiye seas (Anonymous 2020). But it is not sufficient for once breeding of fish. The size is absolutely raised for the sustainable and continuity of tub gurnard fish stocks in Türkiye seas.

As a result of the nutrient composition analyses made in the meat of male tub gurnard caught in Sinop, crude protein, crude oil, crude ash, moisture, and carbohydrate ratios were respectively; It was determined as 23.12%, 2.64%, 1.55%, 75.54%, 0.43%. As a result of the nutrient composition analyses made in the meat of female individuals of the same fish, crude protein, crude oil, raw ash, moisture, and carbohydrate ratios were respectively; 19.15%, 3.70%, 1.53%, 75.80%, 2.28%. While the energy value of male tub gurnard was calculated as 141.68kcal/100g, the energy value of female individuals was calculated as 144.43 kcal/100g.

As a result of the study, the protein value (20.13%) of the male tub gurnard was found to be higher than the protein value of the female (19.15%). The lipid value (2,76%) of male tub gurnard was found to be lower than that of female fish (3,70%), and the difference between the sexes was significant ($p<0.05$).

The spawning period of tub gurnard is between June and September. While female fish store their lipid in their muscles before the breeding period, the amount of lipid in the muscles decreases during the breeding period, the lipid rate in the ovaries increases and they spend their fat for egg development. Çaklı (2007) grouped fish samples into three categories according to their lipid content. Fish samples with lipid content of 0-5% are classified as lean fish, those containing 5-10% lipids as oily fish, and those containing more than 10% lipid as very fatty. The tub gurnards are evaluated in the lean fish group.

The raw ash value of male tub gurnard was found to be 1.55%, while it was 1.53% in female fish. It was determined that the difference in raw ash value between the gender was insignificant ($p>0.05$).

There was no significant difference between the moisture values of male and female tub gurnard ($p>0.05$) and the results were generally consistent with the moisture content of the fish (75,54-75.80). Close analysis results on tub gurnard fillets are generally similar to other studies on tub gurnard (Ersoy, 2006; Küçükgülmez et al. 2010; Roncarati et al. 2014; Dağtekin, 2021).

The energy value of male tub gurnard was lower than that of female tub gurnard. Since female tub gurnard have a higher amount of lipid than males, the energy amount of females is calculated to be higher.

CONCLUSION

Consequently, changes in the Black Sea ecosystem in recent years also affect fish stocks and population characteristics (Bat et al., 2007). For this reason, studies on stock, biology and population characteristics of all fish living in the Black Sea should be kept up to date and continued.

Although tub gurnard is captured as by-catch in the demersal trawl fisheries, the fish is a valuable fish for the fishermen, in Türkiye (Özdemir, et al., 2019). Tub gurnard have to not capture by the fishermen before reaching the first reproductive length (20 cm) and minimum landing size for tub gurnard should be reviewed by the fisheries management. The minimum landing size should not be less than 25 cm in order to renew itself and ensure the sustainability of the tub gurnard stocks.

People need an average of 50-55g of animal protein per day for a healthy diet (Bayraklı, 2021; Duyar, 2016). The tub gurnard has a high nutritional value and is a type of fish that is loved and consumed by the people of the region.

Fish species caught by bottom trawl and discarded have a very little probability of survival if released to the sea again. Consequently, it will be useful to bring discarded species into the economy. It is understood that the studies intended at reducing the discard rate have not reached a sufficient level universal.

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