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RESEARCH PAPER

Comparison of Nutrition Values of Discarded Fish By Bottom Trawl Fishing in the Mersin Bay

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Abstract

In the present study, proximate composition and meat yield of discarded fish Tub gurnard (*Chelidonichthys lucerna* Linnaeus, 1758), brown comber(*Serranus hepatus* Linnaeus, 1758) and Scaldfish (*Arnoglosus laterna* Walbaum, 1792) caught in Mersin Bay (Northeastern Mediterranean) by bottom trawlers were investigated. The highest protein values and the lowest total lipid and ash values were recorded during spring in three species ($P<0.05$). Meat yield was found to be different significantly among spring and autumn samples ($P<0.05$). Mean meat yield of tub gurnard, brown comber and scaldfish were 50.94%, 53.85% and 64.56%, respectively. Results of study show that although these species are considered to be discarded, they can be considered as food or additive for various living groups due to their high nutritional quality, thus they can contribute significantly to the food requirement and economy of the country. Thus, both the ecological balance in the marine environment will be protected and economic losses will be prevented.

Introduction

Discard, which is a big problem in world fisheries (Catchpole et al., 2005; Mukhopadhyay et al., 2020; Johnsen and Eliasen, 2011), is defined as the release of sea creatures into the sea after being caught. Evaluations made on discard indicate that it is around 8% worldwide and the estimated amount of discard is 7.3 million tons per year (Kelleher, 2005). On the other than, it is known that mortality rates are high in discarded species (Benoît et al., 2012).

Discarded seafood is non-marketable or can be usable different forms (as food or additive for various groups of organisms)are aquatic products which caught during commercial fishing activities but released back into the sea (dead or alive) whatever reason (such as they are not legal or market size, deformed or have visible parasites etc.) (Laevastu and Favorite, 1988; FAO, 1997, Catchpole and Gray, 2010; Catchpole et al., 2013; Tsagarakis et al., 2017). They not only cause ecological and environmental pollution but also leads to the loss of valuable components such as proteins, lipids, and minerals. This waste containing a substantial amount of nutrients, and are widely used for the production of low-value by-products such as fertilisers, animal feed ingredients, and fish meal or oil (Renuka et al., 2016; Özyurt et al., 2019).

Even though high discard rates can be acceptable for fishing grounds having low biodiversity in regions such as the Northeastern Mediterranean, it induces

problems related to fishery and resource management in some regions where high biodiversity and rich species habitat exist (Kınacıgil et al., 1999). In this respect, examining the effects of untargeted species is crucial for the sustainable development of the ecologic environment.

Globally, the highest by-catch and discard rates have been obtained through shrimp trawling. It is known that shrimp trawlers, especially those in the Northeastern Coast of the Mediterranean (Turkey). Some of the studies have found that tub gurnard (*Chelidonichthys lucerna* Linnaeus, 1758), brown comber (*Serranus hepatus* Linnaeus, 1758) and scaldfish (*Arnoglosus laterna* Walbaum, 1792) are discarded species of this region (Kınacıgil et al., 1999; Dalyan, 2020).

In the present study, proximate composition and meat yield of discarded fish tub gurnard (*Chelidonichthys lucerna* Linnaeus, 1758), brown comber (*Serranus hepatus* Linnaeus, 1758) and scaldfish (*Arnoglosus laterna* Walbaum, 1792) caught in Mersin Bay (Northeastern Mediterranean) by trawlers were investigated.

Material and Method

Material

Tub gurnard (*Chelidonichthys lucerna* Linnaeus, 1758) is a demersal fish species that lives in sandy, gravelly and muddy regions, in 20-318 m deep, of the sea (Figure 1). This family species spawns so far away from the coast in June-July. The maximum length and weight of this species are known as 75 cm (30 cm which is common) and 6 kg (Akşıray, 1954; FAO, 2021).

Brown comber (*Serranus hepatus* Linnaeus, 1758) is a demersal fish species that lives in sea grass, sand, stones and mud regions, 5-100 m deep, of the sea (Figure 2). This family species which is living in our country are coming for spawning, from June to the end of August or even September, from the deeps of the sea to coast. The maximum length of this species grows until 25 cm (Akşıray, 1954; FishBase, 2021)

Scaldfish *(Arnoglosus laterna* Walbaum, 1792) is a demersal fish species that lives in sand and mud regions, 10-200 m deep, of the sea (Figure 3). This family species spawns during the period from February to the end of

Figure 1. Tub gurnard (*Chelidonichthys lucerna* Linnaeus,1758)

Figure 2. Brown comber (*Serranus hepatus* Linnaeus, 1758)

Figure 3. Scaldfish *(Arnoglosus laterna* Walbaum, 1792)

September at a time convenient to them. The length of individuals of this species extends up to 25 cm (Akşıray, 1954; FishBase, 2021).

Method

In the study, tub gurnard, brown comber and scaldfish which were obtained from the local fishermen on the coast of Mersin Bay (Northeastern Mediterranean, Figure 4) in spring and in autumn were used.

Fish samples taken from the bottom trawl fishermen were brought by maintaining with ice to the laboratory of Mersin University Faculty of Fisheries for doing somatic measurements and analysis. Two samplings, one in spring and the other in autumn, were done for the analysis. After measuring the total lengths and individual weight of fish, they were washed with tap water and gutted immediately and filleted. Meat yield, moisture, crude ash, crude protein and total lipid analysis of all three species of fish were measured in Mersin University Faculty of Fisheries.

The meat yield of samples was calculated from the part of edible detached samples (Erkoyuncu et al., 2004). Moisture contents of samples were determined by drying homogenized samples at 70 ˚C for 14 hours (Ludorf and Meyer, 1973). The ash content was analyzed by burning the samples at 550 ^{o}C for 6 hours (Mattissek et al., 1988). Lipid content of samples was analyzed according to Bligh and Dyer (Bligh and Dyer, 1959), protein content by Kjeldahl methods (AOAC, 1995). Three replicate samples were analyzed for each parameter, and the results of all parameters were calculated on dry-weight basis. Statistical analysis was performed in SPSS 11.5.1 software package.

Results and Discussion

According to statistical analysis, the relationship between the protein, total lipid, ash and moisture values of the samples in autumn was found to be significant at the $P<0.05$ level (Figure 5). While there was a significant relationship at the level of $P<0.05$ between the ash and moisture values of the samples in spring, there is no significant difference was found between the protein and total lipid values ($P>0.05$) (Figure 6).

As a result of the study, the highest protein value was detected in tub gurnard with 16.47%. It was determined that this group was followed by brown comber (16.42%) and scaldfish (14.78%) in autumn. In spring, the highest protein value was measured in brown comber (19.49%), it was followed by tub gurnard (18.35%) and scaldfish (18.02%), respectively. Protein values detected in spring in all three fish species were higher than the protein values in autumn. Protein content of fish species migrating for spawning is reduced together with lipid content after spawning due to the reduction in lipid and protein cavings Gülyavuz and Ünlüsayın (1999), The results of the study were consistent with this finding as well.

In autumn, the highest value of lipid was found in scaldfish (5.90%), and tub gurnard (5.14%) and brown comber (4.84%) was followed to this group respectively. When compared in terms of total lipid contents in spring, the highest value was found to be 3.73% in scaldfish. This species was followed by brown comber (3.72%) and tub gurnard (3.30%), respectively. Lipid values of species were compared according to months, this value was found to be higher in autumn in all three fish species. Depending on the lipid content, Gülyavuz and Ünlüsayın, (1999) and Çaklı (2007) grouped fish samples into three categories. Fish samples having 0-5 % lipid content are classified as lean fish, those having 5-10 % lipid as fatty fish and those having more than 10 % lipid as very fatty (Gülyavuz and Ünlüsayın, 1999; Çaklı, 2007). These findings dictate that these three species can be put into the lean fish group before and even after the spawning period.

Ash values of fish species were examined, it was determined that while the total mineral content of tub gurnard was the highest with 2.13%, it was followed by brown comber and with 1.85% and scaldfish 1.69%,

Figure 4. Sample collection area in the Mersin Bay

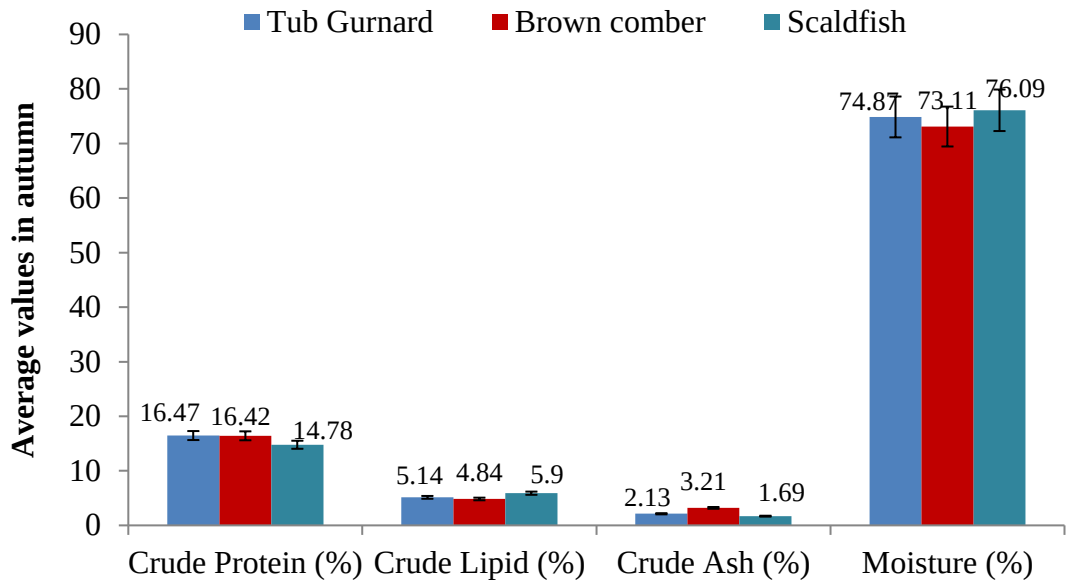

Figure 5. Chemical composition of three species in autumn

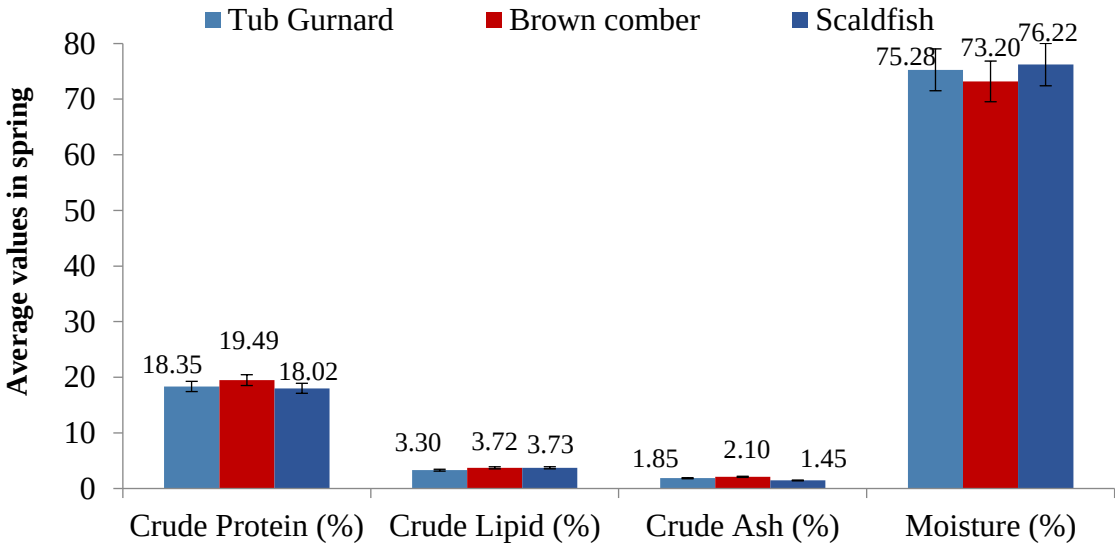

Figure 6. Chemical composition of three species in spring

respectively in autumn. When the moisture values of the same species are examined in autumn, although there is no big difference, the highest moisture rate with 76.09% was found in scaldfish, followed by tub gurnard with 74.87% and brown comber with 73.11%. When the ash values of spring samples were compared, they were found, in orderly, as brown comber (2.10%), tub gurnard (1.85%) and scaldfish (1.45%). Moisture values of three species in spring were determined as 76.22% scaldfish, 75.28% tub gurnard and 73.20% brown comber, and it was determined that the moisture content of the small flounder was higher than the other two species.

The spawning season of tub gurnard and brown comber is taken place between June and September, this time for scald fish is between February and September. Compared to the post-breeding samples (autumn), spring samples for all species taken in the pre-breeding period had higher protein content but lower oil and ash contents. These results show that although the protein content is high before migration, the protein ratio decreases due to the breakdown of protein along with fat in the body after migration. Moreover, the protein content of fish species migrating for spawning is reduced together with lipid content after spawning due to the reduction in lipid and protein cavings (Gülyavuz and Ünlüsayın, 1999). The results of the study were consistent with this finding as well.

According to the results obtained, it was determined that while the moisture rate was high in spring, the total lipid rate was low in all species, and the lipid rate was high in autumn when the humidity rate was low. These results are stated by and Gülyavuz and Ünlüsayın (1999), Meriç (2003), and Çaklı (2007), that the water ratio and lipid ratio are inversely proportional in fisheries products, and as the lipid ratio increases, the water ratio decreases; therefore, it agrees with the conclusion that the water content is high in animals with low fat content.

In the study, it was determined that there was a significant difference (P=0.00) between species in terms of meat yield in autumn (P<0.05).In terms of meat yield, the highest yield was obtained from scaldfish (65.27%), followed by brown comber (56.32%) and tub gurnard (52.05%), respectively (Figure 7).

In Spring, it was determined that there was a significant difference (P=0.00) between species in terms of meat yield (P<0.05). Meat yield was highest in scaldfish (63.96%), followed by brown comber (52.25%) and tub gurnard (50.10%) (Figure 8). Meat yield in fish varies according to species, sex, age, breeding season, feeding status, and stomach content of the fish. Especially in female fish, at the time of spawning, the eggs constitute 30-40% of the body weight and they should not be catching because the meat yield is very low. In male fish, testicles do not affect the yield as much as in females, but it is not recommended to catch these fish during natural breeding (Gülyavuz and Ünlüsayın, 1999).

Conclusion

Fish species caught by bottom trawl and discarded have a very low probability of survival if released to the sea again. Therefore, it will be beneficial to bring discarded species into the economy. The species were thrown into the sea as discard either have no economic value or are below the minimum legal size. In this study, among the species considered, while Tub gurnard and Brown comber are discarded because of below the minimum legal size, scaldfish has no economic value. It is understood that the studies aimed at reducing the discard rate have not reached a sufficient level worldwide (Lucombe, 2021).

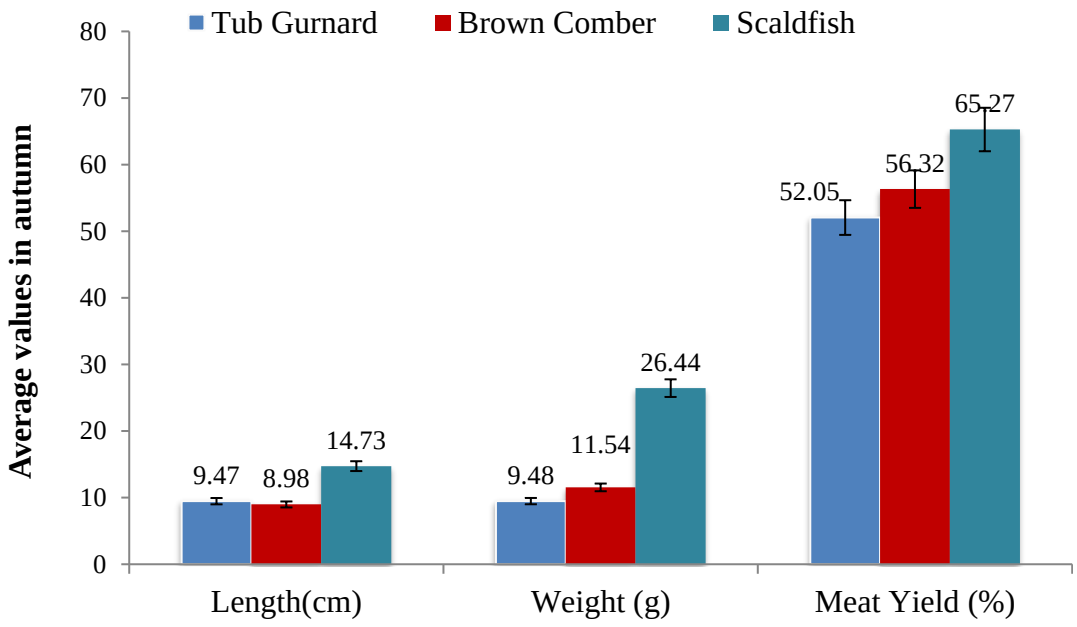

Figure 7. Average values of the length, weight and meat yield of three species in autumn

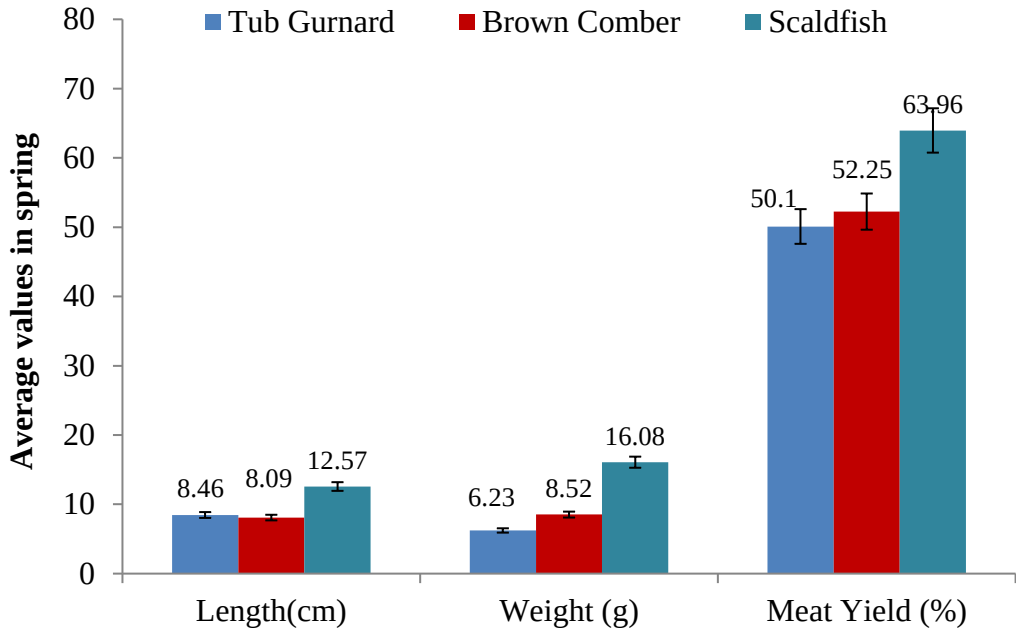

Figure 8. Average values of the length, weight and meat yield of three species in spring

In conclusion, the findings of the present research imply that although these species are regarded as a discarded fish, it has high nutritional quality. Therefore, this fish species can be used as a food component or as supplementary food for various cultured species. This will, in turn, provide an additional income for the local fishermen, and indirectly will help the ecological state of the region, since it will prevent back discard of the species to the marine ecosystem. Thus, economic losses in the marine environment will be prevented.

Ethical Statement

Ethical approval was not required for this study.

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This study was performed as a master thesis project [BAP-FBE SÜ (BBG) 2006-1 YL] granted by the Mersin University Scientific Research Project Unit (Mersin University, Turkey).

Author Contribution

Büket Buşra (GÖZÜ) DAĞTEKİN: Conceptualization, writing original draft, editing.

Conflict of Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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