Scientific Papers. Series D. Animal Science. Vol. LXV, No. 1, 2022
ISSN 2285-5750; ISSN CD-ROM 2285-5769; ISSN Online 2393-2260; ISSN-L 2285-5750

MEAT BIOCHEMICAL COMPOSITION OF SOME FISHES FROM DANUBE RIVER, ROMANIA

Mihaela MOCANU[1], Lucian OPREA[2], Mirela CREȚU[1,2], Anca-Nicoleta (SĂVESCU) CORDELI[1], Lorena DEDIU[1,2]

[1]"Dunărea de Jos" University, 47 Domnească Street, 800 008 Galați, Romania
[2]Romanian Center for Modelling Recirculating Aquaculture Systems, "Dunărea de Jos" University of Galați, 800008 Galați, Romania

Corresponding author email: mirela.cretu@ugal.ro

Abstract

Fish represent a good source of animal protein which contains all the essential amino acids. Also, fish meat is an important source of valuable lipids, micronutrients, vitamins, and minerals with several benefits for human health. In this context, the biochemical composition of common carp (Cyprinus carpio), white bream (Blicca bjoerkna), barbel (Barbus barbus), asp (Aspius aspius),common bream (Abramis brama), ide (Leuciscus idus), Prussian carp (Carassius gibelio), European perch (Perca fluviatilis), and Pontic shad (Alosa immaculata) from the Danube River was studied to evaluate their nutritional value. Fish were captured in the year 2020, during the spring season (march-may), between km 169 of the river (Brăila) and km 197 of the Danube River (Gropeni). Fish samples were analyzed for water, protein, fat, moisture and ash, at the Nutrition Laboratory of Faculty of Food Science, University Dunărea de Jos, from Galați. From the obtained results we can conclude that the analyzed fish meat of some species from the Danube River represents a valuable source the consumers healthy.

Key words*: freshwater fish,, lipids, proteins, proximate composition.*

INTRODUCTION

Fish is a major source of protein in humans' diet (Sarojnalini & Abdul, 2019; Wennberg et al., 2012; Oyase et al., 2016). With a higher protein content and lower fat, fish meat is an excellent source of omega-3 fatty acids. The high nutritional quality is determined by the high quality of proteins (which contain all the essential amino acids) and a wide variety of vitamins and minerals, which include vitamins A, D, and B vitamins, phosphorus, magnesium, selenium, cobalt, and iodine (Banu et al., 2010; Dhaneesh et al., 2012).

According to EUMOFA (2017), the average per capita consumption of fish in Romania is very low compared with other European countries. In 2017, Romanians consume around 7.9 kg of fish per capita. Among the most consumed fish are Cyprinids and trout (European Commission Report, 2021). Regarding the preferences of Romanian consumers about the provenience source of fish (wild or farmed) those express high percentages of preference for farmed products, (EUMOFA 2017), mainly because these products are more available on the market. The principal constituents of fish meat are divided into Protein, Lipid, Ash, and Water and traditionally are used as indicators of the nutritional value of fish. Generally, the variation of these constituents depends on species, feeding mode, migrations, age, size, sex, environment, or season (Bud et al., 2008; Herawati et al, 2018).

Previously the composition of aquaculture fish, provided from Romanian farms, has been investigated to analyze their nutritional quality (Paltenea et al., 2007; Mocanu et al., 2019). However, there is a lack of information about the nutritional values of fish species provided from the Danube River, Romania. In this context, the present study was carried out to analyze the proximate composition of some of the most preferred species of fish by consumers from Romania. Therefore, the data of this study provides information regarding the nutrient qualities of these species for the benefit of consumers and the scientific community as a whole, since for most of them there were not published any relevant data. The list of investigated species includes common carp (*Cyprinus carpio*), white bream (*Blicca*

bjoerkna), barbel (*Barbus barbus*), asp (*Aspius aspius*), common bream (*Abramis brama*), ide (*Leuciscus idus*), Prussian carp (*Carassius gibelio*), European perch (*Perca fluviatilis*), and Pontic shad (*Alosa immaculata*).

MATERIALS AND METHODS

Sample collection. All fish were captured between km 169 of the Danube River (Brăila) and km 197 (Chiscani-Gropeni). Fish were collected weekly during the spring season (March-May). After collection, fishes were immediately placed in an icebox and transported to the Nutrition laboratory of the Romanian Center for Modelling Recirculating Aquaculture Systems (MoRAS) of "Dunărea de Jos" University of Galați, România. All fishes were eviscerated and filleted in the laboratory. Only the muscle tissue was mixed with the blender and used for further analysis.

Proximate composition analysis. The moisture content (%) was determined by drying flesh in a convection oven (Jeiotech, Jeio Tech Co., Inc, Korea) at 105 °C until a constant weight was obtained (Chemists, 1990). It was removed and allowed to cool in a desiccator and weighed. The difference between the wet and dry weights gave the moisture content. After the determination of moisture content, dry samples were finely ground and used for the determination of protein, fats, and ash. Crude protein content (%) was calculated by converting the nitrogen content (using the common conversion factor of N×6.25), quantified by Dumas's method, by combustion of dry samples at 1100°C (Primacs SNC 100, Skalar Analytical B.V., The Netherlands). Lipid content (%) in fish tissue was analyzed using the Soxhlet extraction method using petroleum ether as the solvent (C. Gerhardt GmbH & Co. KG, Germany), AOAC, 1997. Ash content (%) of the sample was determined using a muffle furnace (Nabertherm, Applied Scientific Instruments Co., Ltd. Thailand) at 525±25 °C for 8 hours.

Statistical Analysis. The proximate composition of fish was statistically analyzed using SPSS for Windows, Version 21.0 (SPSS Inc., Chicago, United States). The results obtained after the analysis of ten fish of each species are presented as means±standard deviation (S.D). For common carp and carp bream, fish samples were divided into two class sizes, and the number of analyzed fish was seven for each size class. The differences between the mean values of proximate composition were calculated using a one-factor analysis of variance (ANOVA). Tukey HSD test was used to find out which specific groups' means (compared with each other) are different. Statistically significant differences were reported at $p<0.05$.

RESULTS AND DISCUSSIONS

The present study analyzed the muscle composition of fish. In this study, we analyze only fish that had reached the marketable size (Table 1).

Table 1 presents the summary of fish weights, while the biochemical composition of the studied fish species from the Danube River, km 169 of the Danube River (Brăila), and km 197 (Gropeni) is presented in Figures 1, 2, 3, and 4.

Table 1 Weight of investigated fish

Fish species	Fish weight (g) Mean ± SD	N*
Cyprinus carpio	3660±113.14	7
	538±22.12	7
Blica bjoerkna	112.4±12.25	10
Barbus barbus	259±21.12	10
Aspius aspius	260±18.69	10
Abramis brama	342±21.21	7
	1184±24.21	7
Leuciscus idus	930±28.22	10
Carassius gibelio	512.5±36.06	10
Perca fluviatilis	193.5±4.95	10
Alosa immaculata	265±21.22	10

*N= number of analyzed fish

The statistical analysis revealed significant differences ($p<0.05$) between all constituents from the analysed species.

Protein contents. From the analyzed fish species, the highest protein content was obtained for *Perca fluviatilis* (18.86±1.96 %), *Abramis brama* (18.3±2.16 % for fish with a mean weight of 342±21.21 g; respectively 18.31±2.23 % for fish with a mean weight of 1184±24.21 g) and *Leuciscus idus* (18.05±2.56 %), with no statistical differences ($p>0.05$) between these species. A significant ($p<0.05$) lower protein content (%) was obtained for *Cyprinus carpio* (with the mean weight of 3660±113.14 g;

protein content - 17.84±2.85 %), *Blica bjoerkna* (17.59±2.12%), *Barbus barbus* (17.04±3.10 %) and for *Aspius aspius* (17.61±1.90%). The lowest protein content was in the case of the *Pontic shad* (16.95±2.41%), *Cyprinus carpio* (with the mean weight of 538±22.12 g; protein content-16.50 %), respectively for *Carassius gibelio* (16.95±2.41 %) (Figure 1).

Lipids content. *Alosa immaculata* registered the highest lipid content of 19.18±1.01 %. *Cyprinus carpio,* with the mean weight of 3660±113.14 g, has a lipid content of 4.24±0.62 %, while the mean values of the lipid content of *Barbus barbus, Cyprinus carpio* (with the mean weight of 538±22.12 g), *Abramis brama* (both class sizes), and *Blica bjoerkna*, recorded no significant difference ($p>0.05$) and was 3.97±0.12%, 3.54±0.65% (for fish with a mean weight of 1184±24.21 g), 3.58±0.25% (for fish with a mean weight of 342±21.21 g), respectively 2.58±0.69%. *Carrasius gibelio, Perca fluviatilis,* and *Aspius aspius* registered similar content of lipids: 1.9±0.51%, 1.89±0.51%, 1.1±0.56% ($p>0.05$), and the lowest lipid content was obtained for *Leuciscus idus* (0.61±0.29%).

Ash content. According to the present results *Perca fluviatilis (1.82±0.16 %)* had the highest ash content. *Aspius aspius* (1.59±0.16%) and *Abramis brama* (1.39±0.12% and 1.45±0.11%) registered similar lipid content. *Barbus barbus*, *Cyprinus carpio* (with the mean weight of 3660±113.14 g), and *Alosa immaculata* have similar ash content: 1.32±0.04 %, 1.29±0.08% respectively 1.22±0.09 %. Mean values between *Cyprinus carpio* (with the mean weight of 538±22.12 g; 1.06±0.08%), *Leuciscus idus* (1.19±0.09%), *Blica bjoerkna* (1.15±0.06%), and *Carrasius gibelio* (1.14±0.04%) recorded no significant difference ($p>0.05$) in ash content.

Moisture content. Water is the main constituent of fish and accounts for between 70 and 80% of the weight of the fish (Ionescu et al. 2006). Moisture content was significantly different ($p < 0.05$) among species. In our study, *Leuciscus idus* (79.79±4.12%), *Aspius aspius* (79.12±4.11%), *Carrasius gibelio* (79.51±3.08%), *Cyprinus carpio* (with the mean weight of 538±22.12 g; 78.78±4.42%), and *Blica bjoerkna* (78.02±4.62 %) tissue contained a significantly higher amount of moisture in comparison with *Barbus barbus* (77.4±5.23%), *Perca fluviatilis* (76.62±4.09%), *Abramis brama* (76.09±3.56%, for fish with the mean weight of 342±21.21 g, respectively 75.83±4.49% for fish with the mean weight of 1184±24.21 g), and *Cyprinus carpio* (with the mean weight of 3660±113.14 g). The lowest moisture content was obtained for *Alosa immaculata,* 61.97±16.95%.

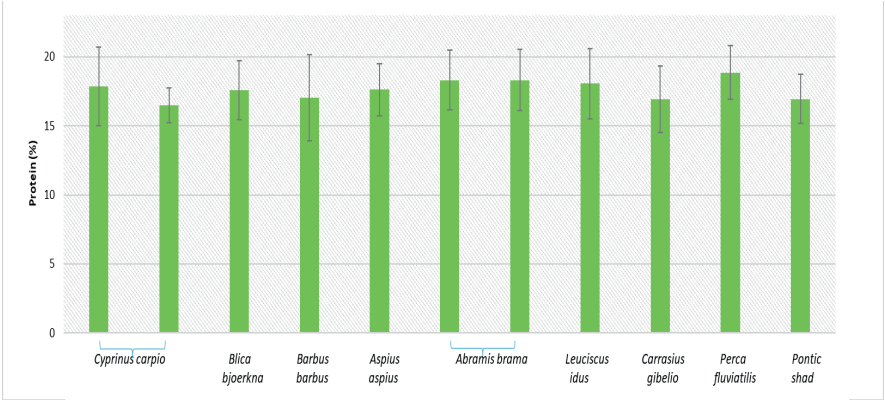

Figure 1. The protein content of fish meat

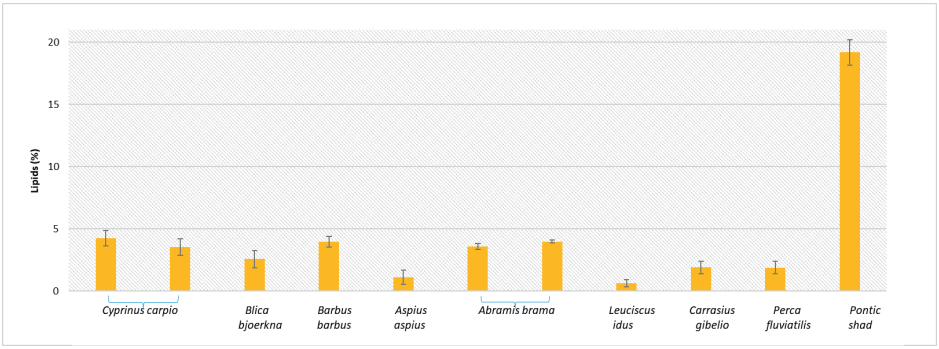

Figure 2. The lipids content of fish meat

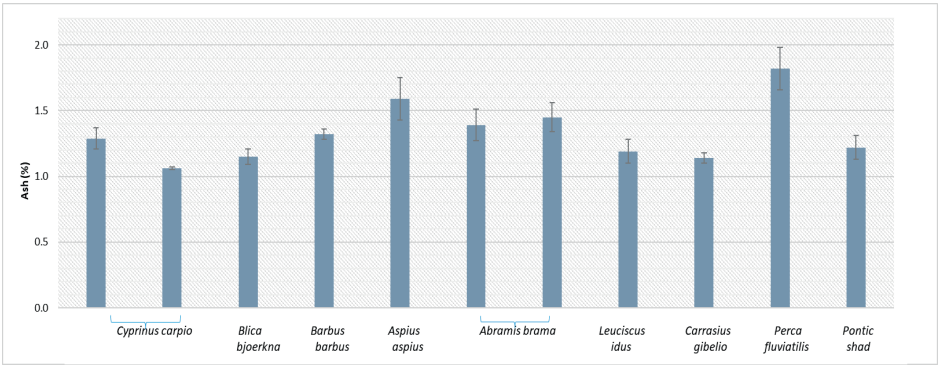

Figure 3. The ash content of fish meat

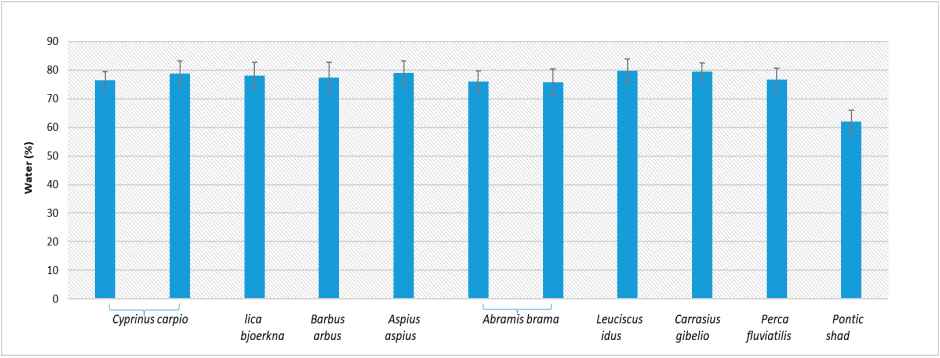

Figure 4. The water content of fish meat

The body composition of fish can be an indicator of their physiological condition and nutritional status (Zafar et al., 2004). Generally, the biochemical composition of fish varies from one species to another and within the same species (Mohamed, 2013; Nasef, 2021). The biochemical composition of fish is made up of 70-84 % water, 15-24% protein, 0.1-22% fat and 1-2 % minerals, and 0.1-1% carbohydrates (Ogunlade et al., 2005; FAO/WHO, 2011; Suganthi & Venkatraman, 2015; Kundam et al., 2018; Khawli et al., 2019). The results obtained in our study are in line with the range quoted above by these authors for fishes.

The higher content of water from all studied species supports the fact that water is the main constituent, ranging in our study from 61 to 79 %. Also, it can be observed that there is an inverse correlation between the fat and protein content of fish meat and the percentage of water.

Mainly the relationship between these indicators depends on the ambient conditions of the water ecosystem.

According to the fat content, Ackman (1989) classified fish into lean fish (fat content of less than 2%), fish with small fat content (2-4%), moderate fatty fish (4-8%), and fatty fish (more than 8% fat). In our study, *Leuciscus idus, Aspius aspius, Carrasius gibelio* and *Perca fluviatilis* are classified as lean fish, registered a lipid content between 0.6-1.9%, while *Blica bjoerkna, Cyprinus carpio* (weight of 538±22.12 g), *Abramis brama* and *Barbus barbus* are fish with small fat content. Although some authors (Aggelouis & Lazos, 1991) state that *Abramis brama* is a lean fish, with a lipid content under 1%, in our study the lipid content was 3.58 % (for fish with the mean weight of 342 g) and 3.97 % (for fish with the mean weight of 1184 g). Similar results such in our study or even higher (3.63- 5.51%) were reported in the case of *Abramis brama* by Zmijewski et al. (2006) and Zivkovic et al. (2013). Also, Mielcarek et al. (2020) reported for bream fished in the lakes of Warmia and Mazury Region, Poland, a mean fat content of 3.14±0.78%, and mean protein content of 19.33±0.6 %.

Cyprinus carpio with the weight of 3660±113.14 g is moderate fatty fish, while *Alosa immaculata* is classified as a fatty fish, with lipid content of 19.18 %. The lipid content of *Alosa immaculata* in the present study is in correlation with the findings of Savin et al. (2020), in the same fishing area (19.05 %). Analyzing the chemical composition of open water carp from Romania, Bud et al. (2008) obtained higher values of protein content (16.6%), fat (8.97%), while the water content (73.22%) and ash (1.20%) was lower in comparison with our study. Also, in research regarding the biochemical composition of carp from waters in Bulgaria, Hadjinikolova (2008) registered a protein content of 16.21%, fat 8.30%, water 74.55%, and 0.94% ash. Ljuboević et al. (2013) studying the chemical composition of common carp with an average weight of 1420 g from open water (Danube River) in Serbia obtained a protein content of 16.69%, fat 7.13%, ash 0.88%, and 73.73% water. Also, in the same study Ljubojevic et al. (2013) reported for *Barbus barbus* and *Aspius aspius* a higher protein, fat, and water content in comparison with our results (*Barbus barbus* 18.61±0.37%; 7.78±0.15%, 72.39±0.29%, respectively 18.07±0.09%; 2.78±0.11%; 78.51±0.2% for *Aspius aspius*). These differences provides from the location of the fish samples, the season, the nutritional condition of the fish, the conditions in the aquatic environment, the fish size and age, etc.

CONCLUSIONS

Fish is the most preferable food for human consumption because of its relatively high value of protein content. In perspective of nutritional value of the fish meat, the results of our study revealed that all studied species are rich in protein content being an important source of animal protein. Also, the obtained results by us are valuable information to food scientist and nutritionists, since there were no data on meat quality of freshwater fish species from the Danube River in Romania region.

ACKNOWLEDGEMENTS

The principal author of the article thanks to the "Dunărea de Jos" University of Galați, which through the University Degree Program, the doctoral studies contract has supported the achievement. Also, the authors are grateful for the technical support offered by MoRAS through the Grant POSCCE ID 1815, cod SMIS 48745 (www.moras.ugal.ro).

REFERENCES

Ackman, R.G. (1989). Nutritional composition in sea foods. *Progress in Food and Nutrition Science,* 13, 161-240.

Aggelousis, G., & Lazos, E.S. (1991). Fatty acid composition of the lipids from eight freshwater fish species from Greece. *Journal of Food Composition and Analysis* 4(1), 68–76.

AOAC Official method 991.36; March (1997). Fat (Crude) In Meat & Meat products *Solvent Extraction (Submersion) Method First Action 1991 Final Action 1996.*

Banu, C., Bărăscu, E., Stoica, A., & Dorin, S. (2010). *Fish-Functional Food*. Bucharest, RO: Agir Publishing House.

Bud, I., Ladosi, D., Reka, S. T., & Negrea, O. (2008). Study concerning chemical composition of fish meat depending on the considered fish species. *Lucrări ştiinţifice Zootehnie şi Biotehnologii,* 41, 201–206.

Chemists, A.O.O.A. (1990). Official Methods of Analysis: Changes in Official Methods of Analysis

Made at the Annual Meeting. Supplement. *Association of Official Analytical Chemists*.

Dhaneesh, K.V., Noushad, K.M., & Ajith Kumar, T.T., (2012). Nutritional Evaluation of Commercially Important Fish Species of Lakshadweep Archipelago, India. *PLoS ONE,* 7(9), e45439.

EUMOFA (2017). Eu consumer habits regarding fishery and aquaculture products. https://www.eumofa.eu/documents/20178/84590/Annex+1+-+Mapping+of+studies.pdf, accessed at 20.01.2022.

European Commission. (2021). Scientific, Technical and Economic Committee for Fisheries (STECF) - *The EU Aquaculture Sector – Economic report 2020 (STECF-20-12).* https://literatur.thuenen.de/digbib_extern/dn063559.pdf, accessed at 20.01.2022.

FAO/WHO, Expert Committee on Food Additives, & World Health Organization. (2011). Report of the Joint FAO/WHO Expert Consultation on the Risks and Benefits of Fish Consumption. *Rome, Food and Agriculture Organization of the United Nations; Geneva, World Health Organization,* 50.

Khawli, A. F., Pateiro, M., Domínguez, R., Lorenzo, J. M., Gullón, P., Kousoulaki, K., Ferrer, E., Berrada, H., & Barba, F.J. (2019). Innovative green technologies of intensification for valorization of seafood and their byproducts. *Marine Drugs,* 17, 689.

Hadjinikolova, L. (2008). Investigations on the chemical composition of carp (*Cyprinus carpio* L.), bighead carp (*Aristichthys nobilis* Rich.) and pike (*Esox lusius* L.) during different stages of individual growth. *Bulgarian Journal of Agriculture Sciences,* 14, 121-126.

Herawati, T., Yustiati, A., Nurhayati, A., & Mustikawati, R. (2018). Proximate composition of several fish from Jatigede Reservoir in Sumedang district, West Java. *IOP Conf. Series: Earth and Environmental Science* 137 012055.

Ionescu, A., Zara, M., Gurau, G., Aprodu, I., Vasile, A., & Paltenea, E. (2006). *Industrial processing of fish*. Galaţi, RO: University „Dunarea de Jos" Foundation Publishing House.

Kundam, D.N., Acham, I.O., & Girgih, A.T. (2018). Bioactive compounds in fish and their health benefits. *Asian Food Science Journal*, 1-14.

Ljuboević, D., Trbović, D., Lujić, J., BjelićCabrilo, O., Kostić, D., Novakov, N., & Cirković, M. (2013). Fatty acid compositionof fishes from inland waters. *Bulgarian Journal of Agricultural Science, 19* (1), 62-71.

Mielcarek, K., Puscion-Jakubik, A., Gromkowska-Kepka, K. J., Soroczynska, J., Naliwajko, S. K., Markiewicz-Żukowska, R., Moskwa, J., Nowakowski, P., Borawska, M. H., & Socha, K. (2020). Proximal Composition and Nutritive Value of Raw, Smoked and Pickled Freshwater Fish. *Foods,* 1-21.

Mocanu, E., Tenciu, M., Patriche, N., Jecu, E., Savin, V., & Popa, M. D. (2019). The comparative study of fish meat quality from two fish farms according to the technological water quality. *International Scientific Symposium Bioengineering of Animal Resources, The Second International Conference on Life Sciences, Section Bioengineering Of Animal Resources*, Timisoara.

Mohamed, E.H.A. (2013). Proximate and Mineral Composition in Muscle and Head Tissue of Seven Commercial Species of the Nile Fish from Sudan. *Asian Journal of Science and Technology*, 4, 62–65.

Nasef, M.A. (2021). Effect of Variation in Aquatic Environment Type on Biochemical Composition and Protein Quality in Some Fishes*. Egypt. Acad. J. Biolog. Sci.,* 13(2), 207-223.

Ogunlade, I., Olaofe, O., & Fadare, T. (2005). Chemical composition, amino acids and functional properties of selected seafoods. *Journal of Food, Agriculture and Environment*, 3(2), 130-133.

Oyase, A., Jemerigbe, R., & Elakhame, L. (2016). Biochemical composition of five fish species (*C. laticeps; D. rostratus; S. schall; S. mystus* and *H. bebe*) from river Niger in Edo State, Nigeria. *International Journal of Fisheries and Aquatic Studies*; 4(3), 507-512.

Paltenea, E., Talpeş, M., Ionescu, A., Zara, M., Vasile, A., & Mocanu, E. (2007). Quality assessment of fresh and refrigerated culture sturgeon meat. *Lucrări ştiinţifice Zootehnie şi Biotehnologii,* 40(2), Timişoara.

Sarojnalini, C., & Abdul, H. (2019). Fish as an Important Functional Food for Quality Life. *In: Vasiliki Lagouri (Eds.), Functional Foods*.

Savin, V., Mocanu, E., Patriche, N., Tenciu, M., Savin, C., Stroe, D., Popa, D., & Năstase, G. (2020). Study on the maintenance status and biochemistry of pontic shad alosa immaculata (Bennet, 1835) during migration. *Scientific Papers-Animal Science Series: Lucrări Ştiinţifice - Seria Zootehnie,* 74, 146-150.

Suganthi, A., & Venkatraman, C. (2015). Proximate composition of different fish species collected from Muthupet mangroves. *International Journal of Fisheries and Aquatic Studies,* 2(6), 420–423.

Wennberg, M., Tornevi, A., & Johansson, I. (2012). Diet and lifestyle factors associated with fish consumption in men and women: a study of whether gender differences can result in gender-specific confounding. *Nutr. J.,* 11, 101.

Zafar, M., Siddiqui, M.Z.H., & Hoque, M.A. (2004). Biochemical Composition in *Scylla serrata* (Forskal) Of Chakaria Sundardan area, *Bangladesh. Pak. J. Biol. Sci.,* 7, 2182–2186.

Zivkovic, D., Sobajic, S., Perunovic, M., & Stajic, S. (2013). Seasonal variations in the chemical composition and fatty acid composition of selected fish species from the Danube river. *Acta Alimentaria,* 42(4), 473-480.

Zmijewski, T., Kujawa, R., Jankowska, B., Kwiatkowska, A., & Mamcarz, A. (2006). Slaughter yield, proximate and fatty acid composition and sensory properties of rapfen (*Aspius aspius* L) with tissue of bream (*Abramis brama* L) and pike (*Esox lucius* L). *Journal of Food Composition and Analysis,* 19(2–3), 176-181.