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ORIGINAL ARTICLE

Chemical composition and nutritive value of wild and cultured Tilapia, Southern Iraq

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Abstract
The study was designed to compare the chemical composition of cultured and wild Redbelly tilapia (*Coptodon zillii*), and Nile tilapia (*Oreochromis niloticus*) collected from the Shatt Al-Arab River (Southern Iraq) and fish farms (earthen ponds of Marine Science Center, University of Basrah). Twenty fish from each species weighing (77.17-141.56g) were collected. Chemical analysis was conducted for the two groups to determine moisture, protein, fat, ash, and nutritive value. The results showed that the two groups' protein, fat, and nutritional values differ significantly (P<0.05) between wild and cultured tilapia species. Wild fish have the highest percentage of fat, protein, and nutritional value. Information about the chemical composition of freshwater fishes is useful to nutritionists looking for low-fat, high-protein food sources.

Keywords: *Oreochromis niloticus, Coptodon zillii*, Chemical composition, Nutritive value.

INTRODUCTION

The quality and safety of fish products have gotten much attention (Dumas et al. 2010), and in this regard, recent nutritional, genetic, and health studies have focused on the chemical composition of fish species (Tobin et al. 2006). Chemical composition is an important nutritional quality factor influencing fish's nutrient and consumable quality (Azam et al. 2004; Breck 2014). Fish meats are preferred over other white or red meats due to their lower lipid content and higher protein content (Tobin et al. 2006). The moisture, protein, lipids, vitamins, and minerals in fish meat contribute to its nutritional value. Nutritionists interested in widely available high-protein, low-fat diets, such as most freshwater fish, can benefit from learning more about the overall chemical composition of freshwater fish (Job et al. 2015).

Tilapias are the world's second most important warm-water food fish, after carp. Tilapias play significant role in global fisheries (Maclean et al., 2002). To meet the growing human population, aquaculture is increasing the demand for high-quality fish products of various types (Queméner et al. 2002). Consumer acceptance of farmed fish as equal to or better than wild fish is a significant factor (Olsson et al. 2003). Sometimes reports have suggested that farmed fish quality is lower than wild fish (Sylvia et al. 1995). However, contradictory findings have also been reported (Jahncke et al., 1988). Hernandez et al. (2001) reported that farmed fish is less acceptable than wild fish. Sahu et al. (2000) noted that the aquaculture sector focuses more on fish meat quality as one of its commercial aspects. The study of fish chemical components is important because they influence the fish's industrial traits and quality (Adeniyi et al. 2012). Measuring proximate chemical composition, including protein, lipids, and moisture content, is frequently required to ensure compliance with food legislation and commercial requirements (Zenebe & Boberg 1998). The differences in the chemical components of fish are entirely dependent on feed intake and closely related to the environment of rearing in ponds or nature. Most studies comparing the quality of wild and farmed fish concentrate on the fish's chemical components, nutritional value, and other physical-chemical characteristics (Alasalvar et al. 2002; Grigorakis et al. 2003; Grigorakis 2007).

As consumer knowledge has grown, acquiring fish of the highest quality, enhanced safety, and nutritional value following international standards is necessary. Therefore, this study was done to examine the chemical composition of the meat from

Table 1. Average total length (cm) and Average total weight (g) of Redbelly tilapia and Nile tilapia samples collected from Shatt Al-Arab River, and Marine Science Center earthen fishpond, Southern Iraq.

Parameters	Nile tilapia (*Oreochromis niloticus*)		Redbelly tilapia (*Coptodon zillii*)	
	(Mean±SD) Wild	(Mean±SD) Cultured	(Mean±SD) Wild	(Mean±SD) Cultured
Length	21.43±4.31	20.56±2.45	14.55±1.01	13.69±0.75
Weight	141.56±24.56	126.75±39.33	77.71±13.61	77.17±11.22

Table 2. Chemical Composition of Redbelly tilapia and Nile tilapia collected from Shatt Al-Arab River, and Marine Science Center earthen fishpond, Southern Iraq.

Chemical components (%)	Nile tilapia (*Oreochromis niloticus*)		Redbelly tilapia (*Coptodon zillii*)	
	Wild	Cultured	Wild	Cultured
Moisture	73.262±0.668^{c}	75.221±1.1467^{b}	71.488±0.618^{d}	78.348±1.009^{a}
Protein	16.878±0.128^{a}	15.262±1010^{b}	17.821±0.347^{a}	15.121±0.116^{b}
Fat	7.668±0.446^{ab}	6.973±0.765^{b}	8.453±0.595^{a}	4.284±0.66^{c}
Ash	1.57±0.232^{b}	1.855±0.136a^{b}	2.234±0.372^{a}	2.149±0.160^{a}
Nutritive Value Kcal/100g	167.823±4.937^{ab}	152.125±12.935^{b}	180.569±7.583^{a}	125.9175±6.892^{c}

farmed and wild Nile tilapia, *Oreochromis niloticus*, and Redbelly tilapia, *Coptodon zillii*, collected from Shatt Al-Arab River, and Marine Science Center earthen fishpond, to offer the knowledge required for farming fish with high quality in various farming systems in Southern Iraq.

MATERIALS AND METHODS

Twenty mature individuals (both sex) of wild and cultured Nile tilapia and Redbelly tilapia were randomly collected from the Shatt Al-Arab River and Marine Science Center earthen fishpond, Southern Iraq (Table 1). Twenty samples of both species from the wild (Shatt Al-Arab River) and cultured (Marine Science Center earthen fish pond) were chosen randomly for body chemical analysis. The fish's moisture, crude protein, crude fat, and ash contents were determined based on A.O.A.C. (2000). The nutritive value content was calculated from the chemical composition using values of 5.65 and 9.45 kcal g^{-1} for protein and fat, respectively (Henken et al. 1986).

Statistical analysis: SPPS (ver. 22, USA) was used to analyze the data. Data were subjected to one-way ANOVA and Duncan's multiple range tests to determine the significant differences between the means.

RESULTS

The results of the chemical composition of C. *zillii* and *O. niloticus* are presented in Table 2. The highest mean value of moisture content (78.348±1.009%) was shown in the cultured Redbelly tilapia and differed significantly (P<0.05) from those of the other tilapia fishes. Moreover, the highest mean value of protein (17.821±0.347%) was measured in the wild Redbelly tilapia but did not differ significantly (P>0.05) from that of wild Nile tilapia (16.878±0.128%). Fat showed higher mean contents (8.453± 0.595%) in wild Redbelly tilapia but did not differ significantly (P>0.05) from that of wild Nile tilapia.

Ash content showed a higher mean value (2.234±0.372%) by wild Redbelly tilapia but did not differ significantly (P>0.05) from that of cultured Redbelly tilapia. Higher nutritive value is in wild Redbelly tilapia (180.569 ± 7.583 Kcal/100g), which does not differ significantly (P>0.05) from that of wild Nile tilapia (167.823± 4.937 Kcal/100g).

The cultured redbelly and Nile tilapia have high moisture content (Fig. 1). The differences in fat and protein are presented in Figures 2 and 3, showing that wild fish contain the highest fat and protein. The highest ash content was recorded in the wild and cultured redbelly tilapia fish (2.234± 0.372 and 2.149±0.160%, respectively (Fig. 4). The results revealed that wild fish had the highest nutritional value (Fig. 5).

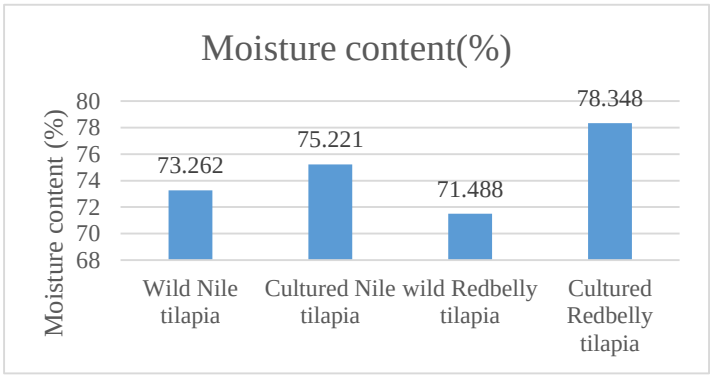

Fig.1. Moisture content of Nile tilapia and Redbelly tilapia collected from Shatt Al-Arab River, and Marine Science Center earthen fishpond, Southern Iraq.

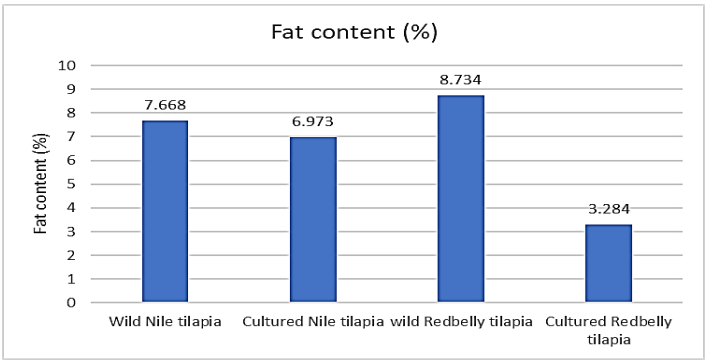

Fig.2. Fat content of Nile tilapia and Redbelly tilapia collected from Shatt Al-Arab River, and Marine Science Center earthen fishpond, Southern Iraq.

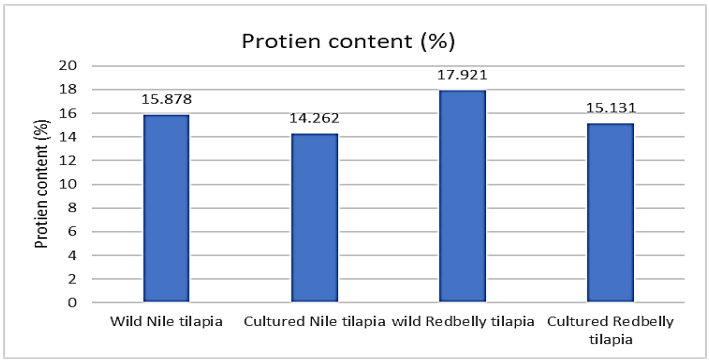

Fig.3. Protein content of Nile tilapia and Redbelly tilapia collected from Shatt Al-Arab River, and Marine Science Center earthen fishpond, Southern Iraq.

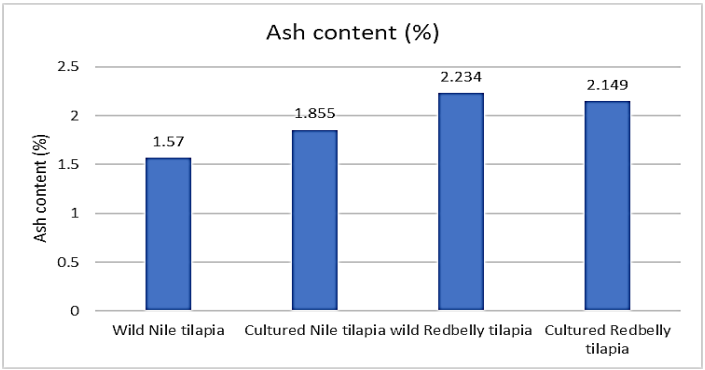

Fig.4. Ash content of Nile tilapia and Redbelly tilapia collected from Shatt Al-Arab River, and Marine Science Center earthen fishpond, Southern Iraq.

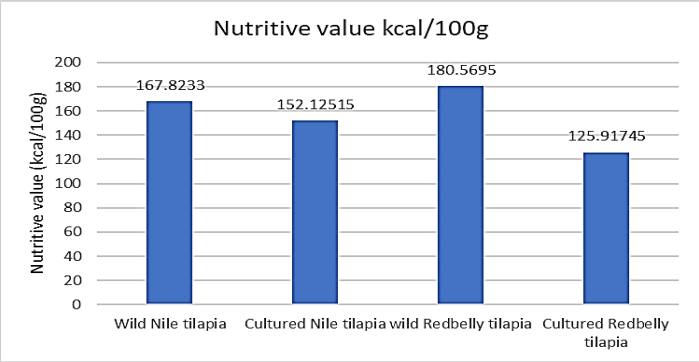

Fig.5. Nutritive value of Nile tilapia and Redbelly tilapia collected from Shatt Al-Arab River, and Marine Science Center earthen fishpond, Southern Iraq.

DISCUSSION

The current study aimed to evaluate and compare the chemical composition of wild and cultured *C. zillii* and *O. niloticus* collected from the Shatt Al-Arab River and the Marine Science Center's earthen ponds. Based on the results, there was a general trend towards increasing the percentage of moisture in culture as compared to wild fish, i.e. moisture content in the cultured redbelly tilapia fish (78.348±1.009%) and Nile tilapia (75.221±1.1467%) were higher compared to (71.488± 0.618% and 73.262±0.668%) in the wild redbelly tilapia and Nile tilapia, respectively. The current findings are consistent with the ranges reported by other researchers (Saleh 1986; El-Ebzary & El-Dashlouty 1992). The fat content in fish meat is an important economic characteristic. Our results showed that wild fish have the highest fat content. The fish are commonly categorized as fatty (having fat more than 10% weight) or medium-fat fish (fat 5-10%) (Ahmed et al. 2010; FAO 2011). Therefore, redbelly and Nile tilapia are medium-fat fish based on this criteria. Excessive fat deposits degrade the fish quality, and fat depots increase manufacturing waste. The significant variation in total fat contents of fish muscles among species is due to the importance of fish muscle as a storage site and its ability to deposit fat, but also to the feed of these species in their natural environment, season, age, or even the maturity of species (Bhavan et al. 2010; Adewumi et al. 2014).

Fish are generally an important source of high-quality animal protein and are used to supplement diets in developing countries (Tadesse 2010). The results showed that the total protein content was higher in wild tilapia than in cultured ones. Differences in chemical composition between wild and cultured tilapia populations could be attributed to environmental factors. Fish body composition is influenced by both exogenous and endogenous factors (Huss 1995). Exogenous factors influencing fish body composition include fish diet composition and environmental factors such as salinity and temperature (Oliveira et al. 2003; Ibrahim et al. 2008; Saeed 2013; Younis et al. 2014). The most important exogenous factor influencing proximate composition is diet. Several studies have investigated the effects of temperature, light, salinity, pH, and oxygen concentration on proximate composition, but these variables appear to have very limited effects (Iqbal et al. 2005; Anthony et al. 2016; Hasbullah et al. 2018). In this regard, Svāsand et al. (1998), Favaloro et al. (2002), and Flos et al. (2002) reported that parameters such as feed type, dietary intake level, and growth affect fish meat quality. Endogenous factors, on the other hand, are genetic and are associated with the life stage, age, size, gender, and anatomical position of the fish (Huss 1995).

These endogenous factors govern most of the principles that determine the composition of fish. The consumption of *O. niloticus* and *C. zillii* has increased steadily due to low prices and high nutritional value. Nutritionists looking for low-fat, high-protein food sources can benefit from knowing the chemical composition of freshwater fish. The

evaluation of meat quality in various wild and cultured populations of tilapia studied can lead to the identification of a wild species suitable for aquaculture.

In conclusion, wild and cultured redbelly and Nile tilapia are good sources of fat and protein. Chemical composition studies offer the knowledge required for farming fish with high quality in various farming systems in Southern Iraq.

REFERENCES

Adeniyi, S.A.; Orjiekwe, C.L.; Ehiagbonare, J.E. & Josiah, S.J. 2012. Nutritional composition of three different fishes (*Clarias gariepinus*, *Malapterurus electricus* and *Tilapia guineensis*). Pakistan Journal of Nutrition 11(9): 793-796.

Adewumi, A.A.; Adewole, H.A. & Olaleye, V.F. 2014. Proximate and elemental composition of the fillets of some fish species in Osinmo Reservoir, Nigeria. *A*griculture and Biology Journal of North America 5(3): 109-117.

Ahmed, E.O.; Ali, M.E.; Kalid, R.A.; Taha, H.M. & Mahammed, A.A. 2010. Investigating the quality changes of raw and hot smoked *Oreochromis niloticus* and *Clarias lazera*. Pakistan Journal of Nutrition 9(5), 481-484.

Alasalvar, C.; Taylor, K.D.A.; Zubcov, E.; Shahidi, F. & Alexis, M. 2002. Differentiation of cultured and wild sea bass (*Dicentrarchus labrax*): total lipid content, fatty acid and trace mineral composition. Food Chemistry 79(2): 145-150.

Anthony, O.; Richard, J. & Lucky, E. 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.

Association of Official Analytical Chemists (A.O.A.C) 2000. Official Methods of Analysis (17th ed), pp: 153-162.

Azam, K.; Ali, M.Y.; Asaduzzaman, M.; Basher, M.Z. & Hossain, M.M. 2004. Biochemical assessment of selected fresh fish. Journal of Biological Sciences 4(1): 9-10.

Bhavan, P.S.; Radhakrishnan, S.; Seenivasan, C.; Shanthi, R.; Poongodi, R. & Kannan, S. 2010. Proximate composition and profiles of amino acids and fatty acids in the muscle of adult males and females of commercially viable prawn species *Macrobrachium rosenbergii* collected from natural culture environments. International Journal of Biology 2(2): 107-119.

Breck, J.E. 2014. Body composition in fishes: body size matters. Aquaculture 433: 40-49.

Dumas, A.; France, J. & Bureau, D. 2010. Modelling growth and body composition in fish nutrition: where have we been and where are we going? Aquaculture Research 41(2): 161-181.

El-Ebzary M.M. & El-Dashlouty A.A. 1992. Influence of size on the storage stability of Bolti Fish. Research Bulletin Home Economy Menoufia University 2: 97-109.

FAO. 2011. The State of World Fisheries and Aquaculture, Food and Agriculture Organization, Rome, Italy.

Favaloro, E.; Lopiano, L. & Mazzola, A. 2002. Rearing of sharpsnout seabream (*Diplodus puntazzo* Cetti, 1777) in a Mediterranean fish farm: monoculture versus polyculture. Aquaculture Research 33(2): 137-140.

Flos, R.; Reig, L.; Oca, J. & Ginovart, M. 2002. Influence of marketing and different land-based systems on gilthead sea bream (*Sparus aurata*) quality. Aquaculture International 10(3): 189-206.

Grigorakis, K. 2007. Compositional and organoleptic quality of farmed and wild gilthead sea bream (*Sparus aurata*) and sea bass (*Dicentrarchus labrax*) and factors affecting it: A review. Aquaculture 272(1-4): 55-75.

Grigorakis, K.; Taylor, K.D.A. & Alexis, M.N. 2003. Organoleptic and volatile aroma compounds comparison of wild and cultured gilthead sea bream (*Sparus aurata*): sensory differences and possible chemical basis. Aquaculture 225(1-4): 109-119.

Hasbullah, D.; Karim, M.; Zainuddin, Z. & Trijuno, D. 2018. The effect of salinity on the body chemical composition and RNA/DNA ratio of the hybrid brackishwater Nile tilapia *Oreochromis niloticus*. *A*ACL Bioflux 11(3): 943-947.

Henken, A.M.; Lucas, H.; Tijssen, P.A.T. & Machiels, M.A.M. 1986. A comparison between methods used to determine the energy content of feed, fish and faeces samples. Aquaculture 58(3-4): 195-201.

Hernandez, M.D.; Martinez, F.J. & Garcia-Garcia, B. 2001. Sensory evaluation of farmed sharp snout seabream (*Dilpdis putazzo*). Aquaculture

International 9: 519-529.

Huss, H.H. 1995. Quality and Quality Changes in Fresh Fish. FAO. Rome. 348 p.

Ibrahim, S.M.; Shalloof, K.A. & Salama, H.M. 2008. Effect of environmental conditions of Abu-Zabal Lake on some biological, histological and quality aspects of fish. Global Veterinaria 2(5): 257-270.

Jahncke, M.; Hale, M.B.; Gooch, J.A. & Hopkins, J.S. 1988. Comparison of Pond-Raised and Wild Red Drum (*Sciaenops ocellatus*) with Respect to Proximate Composition, Fatty Acid Profiles, and Sensory Evaluations. Journal of Food Science 53(1): 286-287.

Job, B.E.; Antai, E.E.; Inyang-Etoh, A.P.; Otogo, G.A. & Ezekiel, H.S. 2015. Proximate Composition and Mineral Contents of Cultured and Wild Tilapia (*Oreochromis niloticus*) (Pisces: Cichlidae) (Linnaeus, 1758). Pakistan Journal of Nutrition 14: 195-200.

Maclean, N.; Rahman, M.A.; Sohm, F.; Hwang, G.; Iyengar, A.; Ayad, H.; Smith, A. & Farahmand, H. 2002. Transgenic tilapia and the tilapia genome. Gene 295(2): 265-277. mykiss). Aquaculture 261: 510-521.

Oliveira, E.R.N.D.; Agostinho, A.A. & Matsushita, M. 2003. Effect of biological variables and capture period on the proximate composition and fatty acid composition of the dorsal muscle tissue of *Hypophthalmus edentatus* (Spix, 1829). Brazilian Archives of Biology and Technology 46: 105-114.

Olsson, G.B.; Olsen, R.L.; Carlehög, M. & Ofstad, R. 2003. Seasonal variations in chemical and sensory characteristics of farmed and wild Atlantic halibut (*Hippoglossus hippoglossus*). Aquaculture 217(1-4): 191-205.

Queméner, L.; Suquet, M.; Mero, D. & Gaignon, J.L. 2002. Selection method of new candidates for finfish aquaculture: the case of the French Atlantic, the channel and the North Sea coasts. Aquatic Living Resources 15: 293-302.

Saeed, S.M. 2013. Impact of environmental parameters on fish condition and quality in Lake Edku, Egypt. Egyptian Journal of Aquatic Biology and Fisheries 17(1): 101-112.

Sahu, B.B.; Meher, P.K.; Mohanty, S.; Reddy, P.V.G.K. & Ayyappan, S. 2000. Evaluation of the Carcass and Commercial Characteristics of Carps. Naga, the ICLARM Quarterly 23(2): 10-14.

Saleh, S.M. 1986. Chemical composition and technology studies on fish. M.Sc. Thesis, Faculty of Agriculture, Tanta University, Tanta, Egypt.

Svåsand, T.; Skilbrei, O.T.; Van der Meeren, G.I. & Holm, M. 1998. Review of morphological and behavioural differences between reared and wild individuals: Implications for sea-ranching of Atlantic salmon, *Salmo salar* L., Atlantic cod, *Gadus morhua* L., and European lobster, *Homarus gammarus* L. Fisheries Management and Ecology 5(6): 473-490.

Sylvia, G.; Morrissey, M.T.; Graham, T. & Garica, S. 1995. Organoleptc qualities of farmed and wild salmon. J. Aquat. Food Prod. Technol. 4: 51-64.

Tobin D.; Kause, A.; Mäntysaari, E.A.; Martin, S.A.; Houlihan, D.F.; Dobly, A. & Ruohonen, K. 2006. Fat or lean? The quantitative genetic basis for selection strategies of muscle and body composition traits in breeding schemes of rainbow trout (Oncorhynchus mykiss). Aquaculture 261(2): 510-521.

Tadesse, Z. 2010. Diet composition impacts the fatty acid contents of Nile tilapia, *Oreochromis niloticus* L., in Ethiopian highland lakes. Internationale Vereinigung für theoretische und angewandte Limnologie: Verhandlungen 30(9): 1363-1368.

Younis, E.M.; Al-Asgah, N.A.; Abdel-Warith, A.W.A. & Al-Mutairi, A.A. 2015. Seasonal variations in the body composition and bioaccumulation of heavy metals in Nile tilapia collected from drainage canals in Al-Ahsa, Saudi Arabia. Saudi Journal of Biological Sciences 22(4): 443-447.

Zenebe, T.; Ahlgren, G. & Boberg, M. 1998. Fatty acid content of some freshwater fish of commercial importance from tropical lakes in the Ethiopian Rift Valley. Journal of Fish Biology 53(5): 987-1005.

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مقاله کامل

ترکیب شیمیایی و ارزش غذایی ماهیان تیلاپیا وحشی و پرورشی در جنوب عراق

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چکیده: این مطالعه به‌منظور مقایسه ترکیب شیمیایی ماهی تیلاپیا پرورشی و وحشی شکم‌سرخ (*Coptodon zillii*) و تیلاپیا نیل (*Oreochromis niloticus*) جمع‌آوری شده از رودخانه شط العرب (جنوب عراق) و مزارع پرورش ماهی (استخرهای خاکی مرکز علوم دریایی، دانشگاه بصره) به‌اجرا درآمد. ۲۰ قطعه ماهی از هر گونه با وزن (۱۴۱/۵۶-۷۷/۱۷ گرم) جمع‌آوری شد. آنالیز شیمیایی برای دو گروه جهت تعیین رطوبت، پروتئین، چربی، خاکستر و ارزش غذایی انجام شد. نتایج نشان داد که ارزش پروتئین، چربی و غذای دو گروه بین گونه‌های وحشی و پرورشی ماهی تیلاپیا تفاوت معنی‌داری دارد ($P<۰/۰۵$). ماهی‌های وحشی بیشترین درصد چربی، پروتئین و ارزش غذایی را دارند. اطلاعات در مورد ترکیب شیمیایی ماهی‌های آب شیرین برای متخصصان تغذیه که به‌دنبال منابع غذایی کم چرب با پروتئین بالا هستند، مفید می‌باشد.

کلمات‌کلیدی: تیلاپیا نیل، تیلاپیا شکم‌سرخ، ترکیب شیمیایی، ارزش غذایی.