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FULL LENGTH ARTICLE

Chemical compositions and heavy metal contents of *Oreochromis niloticus* from the main irrigated canals (rayahs) of Nile Delta

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KEYWORDS

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Oreochromis niloticus;
Proximate composition;
TBA;
TMA;
TVB-N

Abstract The present study aimed to assess the seasonal variations of the proximate chemical composition, physicochemical, microbiological aspects and heavy metal concentrations of *Oreochromis niloticus* muscles collected from The Nile rayahs from spring 2014 to winter 2015. Rayahs are the main irrigated canals of Nile Delta, Egypt and represent El Tawfiki, El Menoufy, El Behery, and El Nasery rayahs. Results showed a spatial and temporal significant difference ($p < 0.01$) in the proximate composition and Physicochemical aspects of *O. niloticus* muscles. The moisture, protein, fat, ash, carbohydrates and calorific values varied between (78.55–80.77%), (16.10–17.88%), (1.10–1.95%), (0.55–1.50%), (0.10–0.94%) and (78.37–89.73%), respectively. Heavy metal accumulation in the *O. niloticus* muscles showed irregular distributions with descending order of: Fe > Zn > Mn > Cu > Pb > Cd. Generally, heavy metals, TVB-N, TMA, TBA and TVC did not exceed the maximum permissible limits in the tissues of *O. niloticus*. The values of Hazard Index (HI) and Hazard Quotient (HQ) are lower than the acceptable limits, which indicate that the metals in *O. niloticus* in the Nile rayahs, Egypt, do not pose any particular human health risk concern. Therefore, *O. niloticus* muscles collected from four rayahs are safe for human consumption and could be used as a source of healthy diet for humans.

Introduction

Egypt is the 8th global aquaculture producer and is the largest in Africa. In 2011 the aquaculture production was about 986,820 tons (FAO, 2013). According to the General Authority for Fisheries Resource Development (GAFRD), a significant contribution to income, food security and employment is created by the aquaculture sector. It is also a rapidly growing sector: fish consumption in Egypt rose from 8.5 kg/person/year during 1996 to 15.4 kg during 2008 and 20.8 kg during 2013 (Macfadyen et al., 2012; FAO, 2014 and Eltholth et al., 2015).

Tilapia is the most important aquatic species produced and consumed in Egypt. Tilapia production has grown over the

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years; in 2010 it reached 687,400 Mt valued at US$991 million (L.E. 5478.4 million) representing 38% of the total fish value and 53% of total fish production (GAFR, 2011). Body composition of the same fish species may vary depending on changes in the environmental conditions. Water pollution is the most important factor affecting the quality of fish production in its natural habitats (Younis et al., 2014).

Chemical composition varies according to season, environment, sexual cycle, maturity stage, feed, age, organs and also muscle location. In addition, mineral concentrations of fish muscle zones may be influenced by different biological factors. Consequently, it is very important to determine the seasonal biochemical composition of fish in order to ensure its quality (Khitouni et al., 2010; Kozlova, 1997; Gockse et al., 2004; Zlatanos and Laskaridis, 2007; Noël et al., 2011; Roy and Lall, 2006). Evaluation of proximate composition is necessary to indicate that, fish tissues have healthy safe qualities and meet the national and international standard specifications (WHO/FAO, 2011).

Tilapia is an important food resource for human consumption in Egypt. Thus, this study aims to assess the effects of seasonal variations on the proximate chemical composition, physicochemical aspects and heavy metal concentrations in the muscles of *Oreochromis niloticus* that were collected from El Tawfiki, El Menoufy, El Behery and El Nasery rayah, River Nile Egypt (Fig. 1) from spring 2014 to winter 2015.

Materials and methods

Fish samples collection and preparation

Nile tilapia (*O. niloticus*) fish samples were collected seasonally from the four rayahs from spring 2014 to winter 2015 (10 fish were taken randomly from each one). This species was selected on the basis of its dominance and importance to local human fish consumption. Fish samples were thoroughly washed with tap water to remove any adhering contaminants and then transported using an icebox to the pollution laboratory, National Institute of Oceanography and Fisheries. Mean weights and lengths of investigated fish samples were (350 ± 57.73 g) and (25.5 ± 1.32 cm), respectively. Upon arrival fish samples were re-washed thoroughly with potable water then beheaded, skinned and dissected (using plastic tools) to obtain muscles, gills and bones. Chemical composition, physicochemical characteristics and heavy metals concentrations were determined in the fish muscles only.

Analytical methods

Proximate compositions (moisture, protein, fat and ash contents) and trimethylamine nitrogen (TMA-N) were determined according to (A.O.A.C, 2002). Total volatile basic nitrogen (TVB-N), thiobarbituric acid (TBA) and pH value were estimated as described by (Pearson, 1991). Ten grams of fish samples was diluted in 90 ml of peptone water and homogenized mechanically for 1 min. Sequential dilutions in peptone water (0.1% w/v) were made, 0.1 ml inoculums were plated out using plate count agar (SPCA, Oxoid) to determine the (TBC) expressed as (cfu g^{-1}) fish muscle and the plates were incubated for 48 h at 37 °C (FAO, 1992).

For heavy metal analysis 0.5 g of dried fish muscles was placed into PYREX Erlenmeyer flasks (and then 10 ml 2:1 v/v concentrated nitric acid and perchloric acid mix was add). The digestion was done on a hotplate (200–250 °C) until the solutions were clear. The solutions were then filtered through an acid resistant 0.45 mm filter paper and made up to 50 ml each with distilled water (Kotze et al., 2006). The samples were stored in clean plastic bottles prior to the determination of Fe, Zn, Cu, Mn, Pb and Cd concentration using an atomic absorption reader (SavantAAS with GF 5000 Graphite Furnace) and the results were given as mg/kg of dry weight and then converted to ppm wet weight basis.

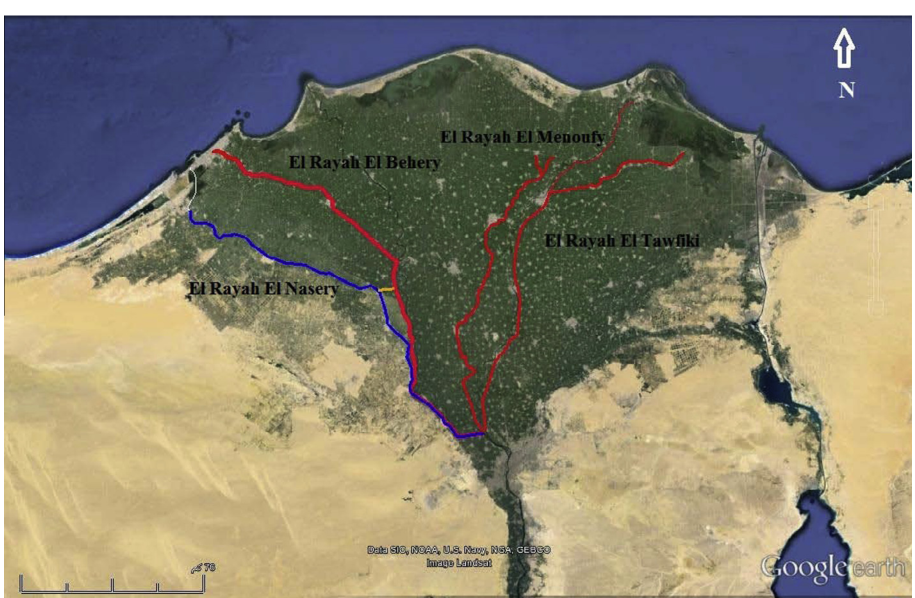

Figure 1 Map of the study area (cited from Goher, 2015).