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Full Length Research Paper

Flesh quality differentiation of wild and cultured Nile tilapia (*Oreochromis niloticus*) populations

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Variation in chemical composition and carcass traits among different wild and cultured Nile tilapia, *Oreochromis niloticus* populations were analyzed to study and compare the differences among different wild (Manzalah lake, Nile river and Edku lake) and cultured Nile tilapia populations. Data of body composition of different Nile tilapia (*O. niloticus*) populations showed that, the highest mean value of moisture content (80.32 ± 0.39%) was shown by cultured population and differ significantly (P≤0.05) from those of other populations studied. The highest mean value of protein content (58.14 ± 0.51%) was shown by cultured population but did not differ significantly (P≤0.05) from that of River Nile population. Lipids content showed lower mean (21.74 ± 0.06%) by River Nile population but did not differ significantly (P≤0.05) from that of cultured population. The results of carcass traits show insignificant differences (P≤0.05) in all parameters among different Nile tilapia populations studied. The evaluation of flesh quality of different wild and cultured populations of Nile tilapia studied can result in a genotype suitable for aquaculture.

Key words: Flesh quality, wild, cultured, Nile tilapia, population.

INTRODUCTION

Tilapias are very important in world fisheries, and are the second most important group of food fishes in the world. Nile tilapia, *Oreochromis niloticus* accounted for a harvest of nearly 2.54 million tones in 2009 (FAO, 2011), second only to carp as a warm water food fish and exceeding the harvest of Atlantic salmon, *Salmo salar*, although, the value of the Atlantic salmon catch is more than twice that of the tilapia catch (Maclean et al., 2002). Although, native to Africa, tilapias are cultured in Asia and the Far East, and occupy two rather separate market niches, being a poor man's food fish in countries such as Israel and the Southern United States (Maclean et al., 2002).

Flesh quality has gained importance among consumers and in the aquaculture industry because it is directly related to human health and nutrition. Flesh quality comprises several different characteristics. Due to the large number of traits involved and the ensuing complexity, genetic improvement for flesh quality has been almost neglected in breeding programs for aquaculture species. Quality traits can usually be recorded only on dead fish, and therefore family selection must be practiced in a breeding program (Gjedrem, 1997).

In order to meet the increase in human fish demand, aquaculture is increasing along the necessity of supplying fish products of high quality and also diversified product (Queméner et al., 2002). Generally, an important success

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Table 1. Minimum and maximum weight and total length of Nile tilapia population samples collected from Manzalah Lake, Nile river, Edku Lake and cultured.

Trait	Manzalah Lake	Nile river	Edku Lake	Cultured
Average weight	124.69±46.98	184.54±41.62	179.82± 90.11	139.86±60.20
Minimum	46.60	111.90	65.00	30.00
Maximum	208.00	225.00	295.00	209.40
Average total length	18.92±2.02	21.30±1.79	20.43±3.14	19.26±3.31
Minimum	13.30	18.40	15.10	12.30
Maximum	21.70	25.00	24.50	23.20

factor is that consumers accept farmed fish to be equivalent or superior to the wild fish (Olsson et al., 2003). Quality terms and how they are perceived differ for the fish farmer, processing industry and consumer. While growth and feed conversion are of great importance to the aquaculturist, these parameters are unlikely to be of indirect interest to the latter. However, producing fish that are positively received by processors and consumers alike is naturally of major concern to the fish farming industry (Rasmussen, 2001). The quality of farmed fish has occasionally been reported as being lower than that of wild fish (Sylvia et al., 1995). Although, contradictory result have also been obtained (Jahncke et al., 1988). Hernandez et al. (2001) reported that wild fish acceptability is greater than that of farmed fish. The term fish quality is all encompassing and its study is difficult owing to the fact that specific parameters that are recognized as being vital in one part of the world are judged to be less important elsewhere. Salmonid aquaculture has focused for many years on enhancing the quantity of fish produced. However, optimization of the quality of salmonids may lead to improvement of consumer acceptance and higher price for the farmed product (Rasmussen, 2001). In these connections, Sahu et al. (2000) reported that among the commercial characteristics of fish, flesh quality is becoming more important to the aquaculture industry. The consumer dictates the flesh quality and it is a very complex characteristic. An attempt has to be made to define and analyze flesh quality and its relation to carcass characteristics. Carcass quality traits must be defined precisely and should be able to be measured with a high repeatability. Some of the quality traits vary within the carcass. Therefore, a very precise carcass evaluation is necessary to arrive at any useful conclusion. To have an efficient program for improving growth and flesh quality traits of fish, it is necessary to test 10 to 15 fishes from each family for carcass evaluation each year and to compile a database. The genetic gain will increase when more families are tested in each generation.

The evaluation of flesh quality of different populations can result in a genotype suitable for aquaculture. Therefore, the present work aimed to evaluate and compare the flesh quality (chemical composition and carcass traits) of wild and cultured Nile tilapia, *O. niloticus* populations collected from Manzalah lake, Nile river, Edku lake and cultured.

MATERIALS AND METHODS

The present study was carried out at Animal and Fish Production Department, Faculty of Agriculture (Saba-Bacha), Alexandria University, Alexandria, Egypt.

Specimen collection

Fifty mature individuals (both sex) of each of wild and cultured Nile tilapia, (*O. niloticus*) populations were randomly collected from Manzalah Lake, Nile river, Edku Lake and cultured, by professional fishermen (Table 1).

Chemical composition

Three samples from each population with equal number of fish were chosen randomly for body chemical analysis. Fish body moisture, crude protein and crude fat contents were determined according to A.O.A.C. (1984) methods.

Flesh quality

Dressings were conducted on the same samples of fish collected from different geographical areas. The following body traits were recorded individually on each fish within each population:

Inedible parts traits

The following parameters were estimated as percentage values of whole body weight (BW):

Head weight (%) = head weight / total body weight × 100.

Viscera (%) = weight of viscera / total body weight × 100.

Fins weight (%) = fins weight / total body weight × 100.

Scales weight (%) = scales weight / total body weight × 100.

Backbone weight (%) = backbone weight / total body weight × 100.

Inedible parts weight (%) = inedible parts weight/total body weight × 100.

Table 2. Chemical composition of different Nile tilapia (*O. niloticus*) populations.

Population	Moisture	On dry matter basis (%)	
		Protein	Lipid
Manzalah	74.28±0.07^{b}	54.82±0.9d4^{b}	23.32±0.32^{a}
Nile	72.94±0.76^{b}	55.88±1.56^{ab}	21.74±0.06^{b}
Edku	70.80±0.57^{c}	53.59±0.28 ^{b}	23.52±0.40^{a}
Cultured	80.32±0.39^{a}	58.14±0.51^{a}	21.95±0.64^{b}

Means within each comparison in the same column with the different superscripts differ significantly (P ≤ 0.05).

Edible parts traits

Meat yield (%) = Skin with fillet weight / total body weight ×100 (Huang et al., 1994).

Dress-out (D%) = (body weight – head – scales – viscera – gonads – fins) / body weight x 100.

Headed–gutted body weight (HGBW%) = (gutted body weight – head) / total body weight (g) × 100.

Head-on dress-out (HD dress%) = (body weight – scales – viscera – gonad - fins) / body weight × 100.

Gutted body weight (GBW%) = (body weight – viscera - gonads) / body weight × 100 (Rye and Refstie, 1995).

Statistical analysis

Data were statistically analyzed using the following model (CoStat, 1986):

$Y_{ij=} \mu_{+} T_{i+} e_{ij}$

Where, Y_{ij} is observation of the ijth parameter measured; μ, overall mean; T_i, effect of ith population; e_{ij}, random error.

Significant differences (P≤0.05) among means were tested by the method of Duncan (1955).

RESULTS AND DISCUSSION

The results of chemical composition of different Nile tilapia, *O. niloticus* populations on dry matter basis are presented in Table 2. The highest mean value of moisture content (80.32 ± 0.39%) was shown by cultured population and differ significantly (P≤0.05) from those of the other populations studied. Moreover, the highest mean value of protein (58.14±0.51%) was achieved by cultured population, but did not differ significantly (P≤0.05) from that of Nile River population. Lipids content showed higher mean (23.52 ± 0.40%) by Edku Lake population, but did not differ significantly (P≤0.05) from that of Manzalah Lake population. In these connections, Abdel-Aziz (2006) found that Nile tilapia (*O. niloticus*) from River Nile contains about 80.08% moisture. The same results were obtained by Abo-Raya (1975) and El-Akel (1983). Galhom (2002) reported that, moisture content of fish from Egyptian waters ranged between 70.00 and 79.00%. On the other hand, Abd-Alla (1994) found a range between 80.50 and 84.00% for moisture content of fish muscles from various fish cultures. There is a general trend towards increasing the percentage of moisture in cultured as compared to wild fish. The results of the present work are consistent with the ranges reported by several other investigators that worked on tilapia *O. niloticus* obtained from various water sources and different fishing seasons (Saleh, 1986; Salama, 1990; El-Ebzary and El-Dashlouty, 1992; Keshk, 2004). Distribution of fat in the carcass is an important economic trait. It is very difficult to ascertain the optimum level of fat in a carcass. Generally, it is felt that fat percentage of 16 to 18% in a fillet is too high. Excessive fat deposits reduce the quality of the fish. Increase in fat depots increases waste in processing. Dissection in and around the intestine is a standard method for checking the fat deposit of a fish. There are several other methods available to measure fat content in a fish carcass (Wold and Isaksson, 1997; Sahu et al., 2000). Moreover, Sahu et al. (2000) reported that protein content and composition are stable during development. The wide variability in the characteristics of muscle and connective tissues in commercial fish is related to their mode of development. Chemical composition differences among Nile tilapia, *O. niloticus* populations may be due to some environmental factors. In these connections, Svàsand et al. (1998), Favalora et al. (2002) and Flos et al. (2002), reported that the quality of fish is affected by parameters such as feed type, level of dietary intake and growth. Feed composition has a major influence on the proximate composition of salmonids. In particular, whole body lipids as well as the lipid content in the edible fillet are directly related to dietary fat content, while the fatty acid composition of the fish flesh is also strongly influenced by the dietary fatty acid profile. Fish body composition appears to be largely influenced by feed composition. An increase in other parameters such as feeding rate and fish size also result in enhanced adipose deposition and decrease water content in the fish body. The protein content, however, remains more or less stable. An increase in body fat content is generally accompanied by reduction in slaughter yield, owning to an increase in the weight of viscera in relation to body weight. The levels of

Table 3. Carcass traits (% of body weight) of different Nile tilapia (*O. niloticus*) populations.

Trait	Population			
	Manzalah	Nile	Edku	Cultured
Head	23.05±1.62	22.05±1.87	25.01±2.73	23.49±2.21
Viscera	12.48±1.42	12.78±1.58	9.78±2.95	12.25±1.40
Fins	2.73±0.17	2.68±0.17	2.58±0.50	2.95±0.73
Scales	3.65±0.51	3.78±0.45	3.90±0.54	3.80±0.54
Back bone	8.73±0.51	9.05±4.12	9.15±0.47	8.65±0.37
Inedible parts	50.58±2.00	49.70±2.36	50.43±3.35	51.69±2.20
Meat yield	47.27±2.11	47.25±3.41	46.30±2.97	46.33±1.40
Dress out	58.15±2.12	56.08±2.70	55.93±5.60	55.30±3.98
HGBW	63.38±2.97	64.30±2.94	64.30±3.37	63.35±2.66
HD Dress	80.08±1.20	80.38±1.09	82.83±3.90	80.06±0.99
GBW	86.43±1.73	86.75±1.54	90.28±4.36	86.80±1.75

Dress-out (D %) = (body weight – head – scales – viscera – gonads – fins) / body weight × 100; headed – gutted body weight: (HGBW %) = (gutted body weight– head)/ body weight × 100; head-on dress-out: (HD dress %) = (body weight with skin-scales-viscera-gonad-fins)/body weight × 100; gutted body weight: (GBW %) = (body weight–viscera–gonads) / body weight × 100.

proximate constituents in the whole body as well as the fillet are readily manipulated by feed composition and feeding strategies, whereas the sensory parameters are less affected by these variables. Different rearing systems generate products having variable quality level which differ from wild fish in color.

Carcass traits of different Nile tilapia, *O. niloticus* populations are presented in Table 3. The results show that insignificant differences (P≤0.05) were detected in all carcass traits studied among different Nile tilapia populations tested. Head weight as percentage of body weight ranged from 22.05 ± 1.87 to 25.01 ± 2.73. Viscera percentage ranged from 9.78 ± 2.95 to 12.78 ± 1.58. Fins percentage varied between 2.58 ± 0.50 and 2.95±0.73. Scales percentage ranged from 3.65 ± 0.51 to 3.90 ± 0.54. Back bone percentage ranged from 8.65 ± 0.37 to 9.15 ± 0.47. Meat yield percentage ranged from 46.30 ± 2.97 to 47.27 ± 2.11. Dress out percentage varied between 55.30 ± 3.98 and 58.15±2.12. HGBW percentage ranged from 63.35 ± 2.66 to 64.30 ± 3.37. HD dress percentage ranged from 80.06 ± 0.99 to 82.83 ± 3.90. GBW percentage varied between 86.43 ± 1.73 and 90.28 ± 4.36. Non-edible parts percentage varied between 49.70 ± 2.36 to 51.69±2.20. The results of carcass traits of the present work are consistent with the ranges reported by several other investigators who worked on tilapia *O. niloticus* obtained from various water sources and different fishing seasons (El-Sagheer, 2001; Khalifa, 2003; Keshk, 2004; Johnston et al., 2006; Abdel-Aziz, 2006). The evaluation of flesh quality of different wild and cultured populations of Nile tilapia studied can result in a genotype suitable for aquaculture.

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