QUALITY EVALUATION OF SOME FISHES IN EGYPTIAN MARKETS

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Abstract

Wild, cultured Nile tilapia *Oreochromis niloticus* and imported mackerel *Scombridae spp.* are the cheapest commercial consumed fishes in Egypt. Their fillet yield, chemical composition, was subjected to evaluation according to the following items: (minerals, fatty acids, cholesterol levels), microbiological and organoleptic properties. Fillets weigh, length and yield showed the highest values for imported mackerel fillets when compared with the wild and cultured Nile tilapia. Significant ($P<0.05$) differences in moisture, crude protein, total lipids, ash, carbohydrate % and energy calories were observed between Nile tilapia and imported mackerel, whereas non-significant ($P<0.05$) differences in chemical composition between wild and cultured Nile tilapia were detected. Fish that were examined in this study had more than 50% of the daily requirements of adult man from P and Mg. Cultured Nile tilapia had elevated contents of mineral (Ca, Mg, P, Fe and K), mono unsaturated fatty acids (MUFA), poly unsaturated fatty acids (PUFA) as compared with the other fishes. While, the imported mackerel had the highest level of cholesterol. Non-significant ($P<0.05$) differences were exhibited in total bacterial count (TBC) and coliform count (CC) between the three types of fish. Staphylococcus count (SC) was not detected in all samples. Appearance, color, odour, texture and overall acceptability showed higher significant scores ($P<0.05$) for wild followed by cultured Nile tilapia and imported mackerel, respectively.

INTRODUCTION

Fish are considered an ideal healthy, low-caloric food source. They are low in fat and high in protein content. They are also rich sources of minerals and vitamins (Silva and White, 1994). GAFRD (2006) declared that, as in other Mediterranean countries, fish and fish products are common items in the Egyptian diet especially in the coastal provinces, where the average annual consumption figure in 2004 being approximately 15.63 kg per person. In Egypt the fish supply from aquaculture, wild populations and imported fish were representing by 43.4, 36.23 and 20.37% of the total available for consumption respectively. As a result of the rapid depletion of stocks, aquaculture is a rapidly expanding industry in Egypt. Currently, the cultured fish species, primarily Nile tilapia, account for more than 39.26% of the total Egyptian fishery products. Gonzalez *et al.* (1999) showed that, the initial microbial load of freshwater fish is depending on water conditions and temperature. Wild and cultured specimens taken from cold and relatively unpolluted waters generally yield aerobic counts (mesophil and psychrophile)

of 10^2 to 10^5 CFU/cm^2 of skin surface and of 10^3 to 10^6 CFU/g of gills, while numbers in the intestinal contents may be as high as $>10^8$ CFU/g.

The permissible levels of total bacterial count (TBC), coliform count (CC) and staphylococcus count (SC) in frozen fish is 10^6, 10^2 and 10^3 CFU/g., respectively (Egyptian standard, 1991).

The wild fish muscles were rich in fatty acids C16: 1, C18: 3 and C20: 5, whereas the fatty acid proportions showed almost no differences between fish from different habitats. The cultured fish muscles were rich in fatty acids C18: 1, C18: 2 and C22: 6, in which the fatty acid proportions showed significant difference between fishes from different farms due to different used diets (Jeong *et al.,* 2000). Also, Hunter *et al.* (2001) found that, fillets of cultured and wild silver perch had fat contents of 7.9 and 5.4% and total *n*-3 fatty acid contents of 0.8 and 1.4 g. respectively.

A total of 60 compounds in cultured and 78 compounds in wild sea bream were tentatively identified (in addition to this, there were 23 unknown in cultured and 29 unknown in wild sea bream volatiles). These included aldehydes, ketones, alcohols, aromatics, terpenes, furans, sulfur-containing compounds, an acid, and miscellaneous compounds. Although selection of best fish is a subjective matter, more aldehydes, ketones, aromatics, and terpenes were found in wild sea bream as compared to its cultured counterpart (Alasalvar *et al.,* 2005).

The objective of this study was to compare some physicochemical properties, minerals, the fatty acids composition, bacteriological contents and organoleptic evaluation of the wild, cultured Nile tilapia *O. niloticus* and imported mackerel *Scombridae spp.* Collected from Egyptian markets.

MATERIALS AND METHODS

Sampling. Between January and April 2005, 30 specimens of wild Nile tilapia *Oreochromis niloticus* were collected from three localities at Ismailia canal (branch of Nile river), 30 specimens of cultured Nile tilapia *Oreochromis niloticus* were taken from El-Abbassa fish farm (earthen ponds). And 30 specimens of imported fish mackerel *Scombridae spp.* were obtained from the provincial market (El-obor) Cairo province. Frozen fish (in plastic boxes) were transported to the laboratory, then immediately washed with tap water. The head, scales and all fins were removed using a sharp knife. Thereafter, the fish were washed again and soaked in tap water, then they were filleted, fish fillets were obtained from dorsal muscles on both sides of the fish, along the spine and ribs [each one was weighed using precision scale (0.1 g) and its measurements (length and height) were recorded in mm]. Then chemical,

microbiological count and sensory evaluations were carried out. Each test was run in triplicate.

Analytical methods. Moisture content, total protein, lipids, ash and minerals "Ca, Mg, P, Fe, and K" were determined according to methods described in AOAC (1990). Energy calories were calculated according to the method described by Abd-Ellatef (1990). Fatty acids contents of fish fillets were estimated by gas-liquid chromatography after being liberated and esterified as recommended by AOAC (1990). Modification Cholesterol was determined as described by Wu and Lillard (1998). Total bacterial count (TBC) and the Coliform count (CC) were detected according to the methods described by Kato *et al.* (1985) and Hitchins *et al.* (1995), respectively. *Staphylococcus aureus* count (SC) was detected according to the Iso (1990). The bacterial counts were expressed as mean log 10 CFU/g sample. Samples were organoleptically evaluated for appearance, color, odour and overall acceptability every month during storage as described by Teeny and Miyauchi (1972) according to the following scheme:

Score	Description	Score	Description
10	Ideal	4	Fair
9	Excellent	3	Poorly fair
8	Very good	2	Poor
7	Good	1	Very poor
6	Fairly good	0	Repulsive
5	Acceptable		

Statistical Analysis. Three replications of each trial were analyzed using Analysis of Variance (ANOVA) and means were separated by Duncan at a probability level of < 0.05 (SAS, 2000).

RESULT AND DISCUSSION

Fillets yield

Table 1 showing the mean and range of weight (g), length, height (cm) and yield (%) of freshly caught wild and cultured Nile tilapia *O. niloticus* and imported mackerel *Scombridae spp.* The results indicated that, the fillets yield for each species were expressed as the total weight of both boneless, skinless fillets divided by the total weight of the whole fish in the round. As for fillets weight, length, height and yield, imported mackerel fillets had the highest values when compared with the wild and cultured Nile tilapia which were 144.2 g., 21.7 cm, 9.0 cm and 41.2%, respectively. On the other hand, non edible weight percentages were 67.5, 64.6 and

58.8 of wild, cultured Nile tilapia and imported mackerel, respectively. These results coincide with those given by Sage and Kenneth (2003).

Table 1. Average total weight (g), length, height (cm), and yield (%) of whole filleting of edible freshly caught wild and cultured Nile tilapia *O. niloticus* and imported mackerel *Scombridae spp.*

Variable	Nile tilapia (wild)	Nile tilapia (cultured)	Mackerel (imported)
Whole body wt.(g)	170-250 (205)	180-265 (230)	250-420 (350)
" " length (cm)	12.0-18.3 (16)	12.0-19.0 (16)	25.0-33.0 (30)
" " height (cm)	5.3-7.5 (6.4)	5.5-7.7 (6.5)	7.0-11.5 (10.3)
Fillets weight (g)	51.2-87.5 (66.6)	59.4-101.5 (81.4)	88.5-190.0 (144.2)
" length (cm)	7.3-11.1 (9.7)	7.5-11.5 (9.9)	19.1-23.4 (21.7)
" height (cm)	4.6-6.5 (5.7)	4.8-6.7 (5.6)	6.2-10.3 (9.0)
" Yield (%)	30.1-35.0 (32.5)	33.0-38.3 (35.4)	35.4-45.2 (41.2)
Non edible wt. (g)	118.8-162.5 (138.4)	120.6-163.5 (148.6)	161.5-230.0 (205.8)

Chemical composition:

The chemical composition (moisture, crude protein, total lipids, ash and carbohydrate %) and energy calories of edible freshly caught wild, cultured Nile tilapia *O. niloticus* and imported mackerel *Scombridae spp.* were presented in Table 2. Results showed significant differences ($P<0.05$) between Nile tilapia and the imported mackerel, while, non-significant differences ($P< 0.05$) between wild and cultured Nile tilapia. The highest percentages of moisture, protein and ash for wild Nile tilapia were 78.51, 85.16 and 6.79 %, respectively. While, the lowest levels were found for fat (6.55%) and energy calories (405.59) in wild Nile tilapia, while carbohydrate were (1.46%) in imported mackerel. These results coincide with those reported by Silva and White (1994) and Sage and Kenneth (2003).

Table 2. Percentages of moisture, protein, fat, ash, carbohydrate, and energy (calories) of edible freshly caught wild, cultured Nile tilapia *O. niloticus* and imported mackerel *Scombridae spp.*

Parameter	Moisture (%)	Protein (%)*	Fat (%)*	Ash (%)*	Carbohydrate (%)*	Energy (calories)*
Nile tilapia (wild)	78.51 ± 0.2 ^{a}	85.16 ± 0.05 ^{b}	6.55 ± 0.05 ^{b}	6.79 ± 0.02 ^{a}	1.50 ± 0.07 a	405.59 ± 3.7 b
Nile tilapia (cultured)	77.45 ± 0.1 ^{a}	83.81 ± 0.2 ^{a}	8.51 ± 0.03 ^{b}	6.12 ± 0.04 ^{a}	1.56 ± 0.03 ^{a}	418.07 ± 2.9 ^{b}
Mackerel (imported)	73.0 ± 0.3 ^{b}	74.40 ± 0.2 ^{b}	19.7 ± 0.04 ^{a}	4.44 ± 0.03 ^{b}	1.46 ± 0.04 ^{a}	480.74 ± 5.1 ^{a}

$^{a-b}$ Means within a column with the different superscript are significantly different ($p<0.05$).
*(On dry weight).Values are expressed as Mean ± SE.

Minerals contents:

Data in Table 3 showed that minerals content (mg/100g) of edible freshly caught wild, cultured Nile tilapia *O. niloticus* and imported mackerel *Scombridae spp.*,

with reference to the daily requirements of adult man are quite enough. Human consumption of 100gm of cultured Nile tilapia fulfill the daily requirements of adult man for Ca, Mg, P, Fe and K by 18.2, 40.4, 67.8, 5.3 and 27.3%, respectively, followed by imported mackerel and wild Nile tilapia, respectively. On the other hand, all types of fish had more than 50% of the daily requirements of adult man for P, while, Fe was at a lower level in the same type. These results are in agreement with Alam *et al.* (2002) who found that, the difference in mineral concentration between cultured and wild carp are negligible and should pose no health problems for consumers of either fish species.

Table 3. Minerals composition (Mg/100g) of edible freshly caught wild and cultured Nile tilapia *O. niloticus* and imported mackerel *Scombridae spp.* with reference to the daily requirements of adult man (On dry weight).

Variable	D.R.A.M.*	Nile tilapia (wild)		Nile tilapia (cultured)		mackerel (imported)	
Minerals	(mg)	Mg/100g	%**	Mg/100g	%**	Mg/100g	%**
Ca	800.00	101.6	12.7	145.4	18.2	112.1	14.0
Mg	350.00	102.7	29.3	141.3	40.4	111.5	31.9
P	800.00	450.1	56.3	542.2	67.8	465.2	58.2
Fe	10.000	0.51	5.1	0.53	5.3	0.73	7.3
K	1875.0	403.5	21.5	512.5	27.3	428.3	22.8

* Daily requirements of adult man (mg).

** % of daily requirements of adult man.

Fatty acids composition

Results in Table 4 indicated that, cultured Nile tilapia had the lowest level of saturated fatty acids (36.5%) as compared with both imported mackerel *Scombridae spp.* and wild Nile tilapia *O. niloticus* (54.3 and 50.10%, respectively). Results showed that cultured Nile tilapia had elevated levels of mono unsaturated fatty acids (MUFA), poly unsaturated fatty acids (PUFA) and unsaturated/saturated (U/S) ratio followed by wild Nile tilapia and imported mackerel, respectively.

On the other hand, the predominant fatty acids were C16:0 (23.3%), C20:0 (9.0%), C18:1 (15.9%), C16:1 (14.6%) and C18:2 (7.4% for wild Nile tilapia, while for cultured Nile tilapia were C11:0 (24.2%), C18:1 (30.7%) and C18:2 (20.3%). Also, the dominant fatty acids were C16:0 (24.37%, C20:0 (10.02%), C18:0 (7.92%), C18:1 (16.4%), C16:1 (13.38%) and C18:2 (6.98%) for imported mackerel. From the previous results, it could be concluded that, the difference in fatty acids composition for different fish types were greatly affected by the lipid composition of their diets as reported by Jeong *et al.* (2000).

Table 4. Fatty acids composition (%) and Cholesterol (mg/g oil) of edible freshly caught wild, cultured Nile tilapia *O. niloticus* and imported mackerel *Scombridae spp.*

Variable	Nile tilapia (wild)	Nile tilapia (cultured)	Mackerel (imported)
C6:0	0.300	0.100	0.260
C8:0	0.600	2.900	0.470
C10:0	---	---	0.110
C12:0	0.200	0.500	0.220
C14:0	5.300	3.100	5.810
C15:0	0.800	0.400	0.760
C16:0	23.30	24.20	24.37
C18:0	7.200	5.000	7.920
C20:0	9.000	---	10.02
C22:0	3.400	0.400	4.360
Σ SFA*	50.10	36.50	54.30
C10:1	0.300	2.200	1.010
C12:1	3.900	0.400	2.500
C14:1	0.100	---	---
C16:1	14.60	5.600	13.38
C18:1	15.90	30.70	16.40
C20:1	1.200	0.200	0.720
Σ MUFA**	36.00	39.10	34.10
C18:2	7.400	20.30	6.980
C18:3	6.500	4.100	4.620
Σ PUFA***	13.90	24.40	11.60
U/S Ratio	0.996	1.740	0.842
Cholesterol (mg/g oil)	11.57	14.02	21.80

*SFA: Saturated fatty acids. **MUFA: Mono unsaturated fatty acids. ***PUFA: Poly unsaturated fatty acids.

Cholesterol content in wild Nile tilapia showed the lowest level followed by cultured Nile tilapia and imported mackerel 11.57, 14.02 and 21.8 mg/g oil, respectively. Jeong *et al.* (2000) and Hunter *et al.* (2001) achieved similar results.

Microbiological evaluation:

Results in Table 5 indicated that maximum TBC and CC were observed in cultured Nile tilapia *O. niloticus* samples followed by wild Nile tilapia and imported mackerel *Scombridae spp.*, respectively. On the other hand, SC was not detected in all samples of the different types. Also, the CC was not detected in imported mackerel samples, while in wild and cultured Nile tilapia reached to 0.75 and 1.53 (Log 10 CFU/g.), respectively. The gained results may be attributed to the initial microbial load of water conditions and temperature. These results coincide with those given by Egyptian standard (1991) and Gonzalez *et al.* (1999).

Table 5. Total bacterial count (TBC), Coliform bacterial count (CC) and *Staphylococcus aureus* bacterial count (SC) in edible freshly caught wild, cultured Nile tilapia *O. niloticus* and imported mackerel *Scombridae spp.*

Parameter	TBC (Log 10 CFU/g.)	CC (Log 10 CFU/g.)	SC (Log 10 CFU/g.)
Nile tilapia (wild)	4.35 ± 0.03 ^{ab}	0.75 ± 0.02 ^{ab}	---- ----
Nile tilapia (cultured)	4.67 ± 0.04 ^{a}	1.53 ± 0.02 ^{a}	---- ----
Mackerel (imported)	4.15 ± 0.02 ^{ab}	---- ----	---- ----

$^{a-b}$ Means within a column with the different superscript are significantly different ($p<0.05$).
Values are expressed as Mean ± SE.

Organoleptic evaluation

Table 6 represents the changes in appearance, color, odour, texture and overall acceptability scores in edible freshly caught wild, cultured Nile tilapia *O. niloticus* and imported mackerel *Scombridae spp.* It is proved that, wild Nile tilapia has the highest scores of sensory properties followed by cultured Nile tilapia and imported mackerel, respectively. The results ranged from good to very good quality depending on the source of the fish type and their diets. The obtained results are in agreement with those given by Sage and Kenneth (2003) and Delwiche and Liggett (2004) who reported that, the primary influence of prepared diets on fish flavor seem to be a suppression rather than enhancement of flavor. Commonly used feed-stuffs have very little adverse effect on flavor. High levels of fat or fats containing certain fatty acids in the diet can cause soft texture, "fishy" flavor, or reduce frozen storage quality of the flesh of the fed fish.

Generally, from the results obtained in the present study, it may be concluded that, the best recommended fish fillets for consumption were wild Nile tilapia followed by cultured Nile tilapia compared with the imported mackerel. So, become necessary to pay more intention to development the fish products from natural water and aquaculture to decreased imported fishes.

Table 6. Organoleptic parameters of freshly caught wild, cultured Nile tilapia *O. niloticus* and imported mackerel *Scombridae spp.*

Variable	Appearance	Color	Odour	Texture	Overall acceptability
Nile tilapia (wild)	8.2 ± 0.3 ^{a} (V.G.)	9.1 ± 0.1^{a} (E.)	8.7 ± 0.2 ^{a} (V.G.)	8.5 ± 0.3 ^{a} (V.G.)	86.3 ± 0.3 ^{a} (V.G.)
Nile tilapia (cultured)	7.8 ± 0.1^{ab} (G.)	8.3 ± 0.2 ^{b} (V.G.)	8.0 ± 0.2 ^{ab} (V.G.)	7.7 ± 0.1 ^{ab} (G.)	79.5 ± 0.2 ^{ab} (G.)
Mackerel (imported)	7.0 ± 0.2 ^{b} (G.)	8.0 ± 0.1^{b} (V.G.)	8.0 ± 0.3 ^{ab} (V.G.)	8.5 ± 0.1 ^{a} (V.G.)	78.8 ± 0.2 ^{ab} (G.)

$^{a-b}$ Means within a column with the different superscript are significantly different ($p<0.05$).
Values are expressed as Mean ± SE., G. = Good., V.G. = Very good., E = Excellent

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تقييـــم جـــودة بـــعض الأســـماك فـــى الأسواق المصريـــة

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نظرا لان أسماك البلطى النيلى البرى والمستزرع وكذلك اسماك الماكريل المستوردة تمثل الغالبية العظمى من الأسماك المستهلكة فى مصر، فقد تم عمل دراسة مقارنة بين تلك الأنواع الثلاثة (حيث استخدمت ٣٠ سمكة من كل نوع) من حيث تصافى الشرائح، التركيب الكيميائى، مستوى كل من العناصر، الأحماض الدهنية والكوليسترول وكذلك التقييم الميكروبيولوجى والحسى. وقد أظهرت النتائج، ان وزن الشرائح وأطوالها وعرضها وكذلك تصافيها قد سجلت أعلى قيم لها فى أسماك الماكريل المستورد مقارنة بالأنواع الأخرى المدروسة. كما لوحظ وجود إختلافات معنوية ما بين أسماك البلطى والماكريل المستورد فى نسب الرطوبة، البروتين الخام، الدهن الكلى، الرماد، الكربوهيدرات والطاقة. بينما لا توجد إختلافات معنوية بين أسماك البلطى البرى مقارنة بالمستزرع. كذلك أوضحت النتائج أن الأنواع الثلاثة من الأسماك والمستخدمة فى هذه الدراسة قد أحتوت على أكثر من نصف الإحتياجات اليومية للبالغين من عناصر الفوسفور والماغنسيوم، كما احتوت أسماك البلطى المستزرع على أعلى مستوى من العناصر (الكالسيوم، الماغنسيوم، الحديد والبوتاسيوم) والأحماض الدهنية أحادية عدم التشبع والأحماض الدهنية عديدة عدم التشبع مقارنة بالأنواع الأخرى. بينما احتوت اسماك الماكريل على أعلى مستوى من الكوليسترول مقارنة بالأنواع الأخرى. كما أوضحت النتائج عدم وجود اختلافات معنوية بين الأنواع الثلاثة المدروسة فى المحتوى الميكروبى من حيث العدد الكلى للبكتريا والبكتريا القولونية، بينما لم يلاحظ وجود بكتريا المكور العنقودى فى لحوم الأنواع الثلاثة المدروسة. وقد سجلت الخواص الحسية (المظهر، اللون، الرائحة، القوام والقابلية العامة) أعلى درجات معنوية ($P<0.05$) لشرائح البلطى النيلى البرى متبوعة بشرائح أسماك البلطى المستزرع ثم الماكريل المستورد على التوالى.

من هذه الدراسة لوحظ أن اكثر شرائح الأسماك قبولا (من حيث الجودة والقيمة الغذائية والصحية للمستهلك) هى من الأسماك البرية ثم المستزرعة وذلك مقارنة بالأسماك المستوردة، وعلى ذلك يمكن التوصية بزيادة الاهتمام بتنمية الثروة السمكية فى القنوات المائية وفى الاستزراع السمكى لخفض كميات الأسماك المستوردة.