Proximate Composition, Mineral Content, Amino Acid Profile and Technological Uses of Underutilized Sea Water Ferakh (*Trigla Corax)* Fish Mince

Samia A. K. Keshk[1]

ABSTRACT

This study was concerned to evaluate the chemical properties (proximate composition, mineral content and amino acid profile) of deep sea water ferakh *(Trigla corax*) fish mince and its suitability for preparing new edible products (fish finger, fish sausage and spiced salted fish paste). The results showed that the fish mince prepared from beheaded and gutted fish was rich in protein (16.95%), ash (2.43%),mineral (mg/100g) such as Ca (165.08), P (631.46), Na (968.80), K (193.76) and Zn (0.62). The mince fish protein has good amounts of essential amino acids comparing to FAO/WHO pattern and contained very low amount of lipid (0.95 %). The different edible products prepared from the fish mince, contained balanced levels of protein, lipid, and carbohydrates were accepted by the panelists.

Key words: fish, fish bone, fish fingers, fish sausage and spiced salted fish.

INTRODUCTION

An adequate supply of low cost high protein food is needed to break the vicious cycle of poverty, malnutrition and diseases. Utilization of underutilized fish including small pelagic fish and deep sea water fish species can offer a partial solution to this problem. Number of an economical and technological factors including handling processing difficulties, seasonal nature and lack of proper technological methods have combined to reduce the use of these resources for human food (Wood and Poulter,1983 and El- Sahn *et al*.,1990).Ferakh or tub gurnard (*Trigla corax.)* is one of the underutilized fish in Egypt. It is caught from the Mediterranean coast. The annual catch of this fish is around 1200 ton according to the General Authority of Fish Resources Development (GAFRD, 2000-2009). Like many species of deep sea water fish, it contains much water, low fat and nearly white flesh which are free from toxic substances. Such specifications are required for preparing fish mince (Toppe *et al*., 2007 and Bochi *et al*., 2008).Such product, can be used to prepare several comminuted meat like products such as fish burger, fish fingers, fish patties, fish croquettes, hot dogs and other cooked sausage products (Tokur *et al.*,2006 and Rahman *et al.*,2007). Therefore, the main objective of this study is to maximize the utilization of ferakh fish as a human food by using its mince in producing high quality new food products such as fish finger, sausages and spiced salted paste.

MATERIALS AND METHODS

Materials:-

Ferakh *(Trigla corax*.) deep sea water fish was obtained from Alexandria fish market, Egypt, during summer season, 2010. The overall length and number of fish per kilogram were ranged from 14 to 16 cm, and 21-32, respectively.

Corn flour, corn starch, common salt, sugar, fresh onion and garlic, vinegar, refined sun flower oil ,tomato paste, sesame butter, milk powder, wheat flour (72 % extraction),breading crumbs and two types of spice mixtures (the first consisting of 8%carry,8% cumin,8% white pepper and 76% coriander, while the other one composing of 30% black pepper,30% coriander, 20% cumin, 5% nutmeg, 5% chili powder,5% cinnamon and 5% paprika).They were bought from the local market in Alexandria, Egypt.

Methods

I- Technological methods:-

Preparation of fish mince:- After washing and cleaning from impurities, the scales, heads, internal organs and fins of fish were removed. The beheaded and gutted fish was first washed with running water to remove any blood residues then soaked in water containing 2% acetic acid and 4% common salt at 1:3 (w/w) fish: solution ratio at room temp. (25^{o}C) for 30 min. to remove the fishy odour, the samples were rewashed with running water and drained. The resulted deodorized beheaded and gutted fish was packed in polyethylene bags, frozen at -18^{o}C for 3 weeks to soften its bony cartilaginous tissues, thawed at 4^{o}C and minced 4 times through a 5mm plate of meat chopper to small lumps. The ferakh mince was then used to prepare the following products:

1-*fish finger*:-It was prepared by mixing 60% of fish mince with 20% corn flour, 1.5% common salt, 1% sugar, 6.5 % first spice mixture, 6% tomato paste (16% concen.), 4% fresh shredded onions and 1% fresh shredded garlic. The mixture was well blended in kitchen blender (Moulinex) before forming into finger

[1]Meat & Fish Technology Res. Dept.Food Technology Res. Ints. A.R.C., El-Sabahia, Alex., Egypt.
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shape with 6.5 cm length, 1.0 cm thickness and≈ 25g weight. The fingers were first coated with a batter, this batter was prepared by blending cold water with wheat flour at 2.2:1 (w/w) ratio for 2 min. in a blender (Tokur *et al.,* 2006). The battered fingers were recoated with conventional breading crumbs and pre-fried at 180^{o}C for 30second. The pre-fried fish fingers were packed in a foam plate, wrapped with polyethylene film and kept at -18^{O}C until used.

2-*fish sausage*:-It was formulated by blending 70% of fish mince with 8% corn starch, 1% common salt, 1.0% sugar, 10%crushed ice, 5%sunflower oil, 2% milk powder, 0.5% fresh shredded garlic, 0.5% fresh shredded onion and 2%second spice mixture in a kitchen blender (Moulinex) then inserted into collagen casings using a hand sausage filling machine and then linked into 40-45g portions to form sausages that were packed and kept as mentioned in case of fish fingers.

Cooking yield and shrinkage% of both fish fingers and sausages were calculated as mentioned by Naveena *et al.,* (2006).

3-*Spiced salted fish paste*:-The beheaded and gutted fish was subjected to dry salting in large brown glass jar at ratio of 4:1 (w/w) fish: salt at room temp. for 15 days. The salted product was desalted in running water until it's salt content was 7-8%, then minced 3 times in a meat chopper to small lumps with 3-5mm diameter. The spiced salted fish paste was formulated by blending 46% salted minced fish with 20% sesame butter (Tahina), 2%first spice mixture, 30% water and 2% vinegar in a blender at low speed until a uniform texture was obtained then packed in 100g glass jars with a tin plate covers. After sealing, the jars were immersed in water bath at 85-90^{O}C for one hour, cooled, and kept after drying at room temp. (25^{o}C) until used.

II-Chemical methods:-Moisture, crude protein, crude ether extract and ash contents of fish mince and its products were determined in triplicates according to AOAC (1995) methods .Also Ca, K, Zn and Na were determined in ash solution by flame atomic absorption spectrophotometer, using Perkin Elmer Atomic absorption Spectrophotometer model 2380 while P was estimated calorimetrically using ammonium molybdate method as mentioned in the previous refrence. Carbohydrates were calculated by differences. Amino acids composition was analyzed as describes by Pellet and Young (1980). Using Beckman amino acid analyzer Model 119 CL. After hydrolyzing the protein with 6N HCL containing 0.1% mercaptoethanol at 110^{O}C for 24 hrs. Amino acid composition was compared with reference protein of FAO/WHO (1991). The pH value was measured after blending 0.5g fish mince or it's product with 50ml deionized water for 2 min. using Digital Eutch Cybernetics' Scan pH meter 500.

III-*Sensory methods*:- Ferakh fingers were fried in sunflower oil at 180^{O}C for 3 min. while ferakh sausages were cooked for 20 min in a pre heated hot air oven at 140±1^{o}C. before subjecting for sensory evaluation. These products in addition to spiced salted fish paste were tested for colour, taste, odour, texture and overall acceptability using 10 trained panelists of Food Technology Res. Inst. (A.R.C.), El- Sabahia Station, Alex., Egypt, and hedonic scoring scale (Kramer and Twigg, 1970).

IV- *Statistical methods*:- Standard deviation of the obtained data was calculated as described by Steel and Torrie (1980).

RESULTS AND DISCUSSION

1-*Weight composition, proximate analysis, mineral content and amino acid* profile *of beheaded and gutted ferakh fish mince;-* the results indicated that percentages of flesh, head, internal organs,skin+backbone, and fins of ferakh fish ranged from 52.5 to 56.25, 17.5 to 18.5, 6.6 to 7.74, 17.5 to18.7,and 1.9to 1.27%,respectively, . The beheaded and gutted fish mince represented 70 to79% from the total fish weight. It has been reported that the backbone can be considered as a good source of minerals specially calcium and phosphorus. Presence of skins may lower the whiteness of the colour and the acceptability of the raw fish mince but increase its nutritional value and yield (Zaitsev *et al.,* 1969).Wood and Poulter (1983) reported that the yield of fillet varied from 30 to50 % according to the fish species.

Results in Table (1) indicated that crude protein was the main component of the beheaded and gutted ferakh fish mince. This mince contained low level of crude ether extract. Therefore, it can be considered as a low oil-high protein source. Included ferakh backbone in this mince caused an increase in it's content of total ash (Table 1).Such increase raised its content of Na,P,K,Ca and Zn,respectively. According to Causeret (1962) the average values of Ca and P were 30 and 220 g/100g respectively in marine fish. This means that the presence of backbone in fish minces multiple the content of Ca by 5.5 and P by 2.8 times than that found in flesh. The Ca to P ratio was 0.26 in this mince which is higher than that mentioned by Causeret (1962), 0.2 for marine fishes. Martinez-Valverde *et al.,* (2000) showed that addition of backbone to fish flesh increased its content of Ca and P. Martinez–Valverde *et al.,* (1998) stated that Ca/ P ratio was increased to nearly 0.3 or more when backbone was added to fish flesh. Such ratio is required for weaning food. Although Ca and P are important in bone metabolism and development, other

minerals such as Zn, Na and K are considered essential for normal growth and for avoiding several pathologies (Sherman, 1992).Results of Martinez-Valverde *et al.*, (2000) showed that many variations in the content of Zn, Na.K, Fe and Ca were observed when backbone was added to fish flesh. The levels of such elements were quite low in flesh and flesh including bones. According to Toppe *et al.*,(2007) bone tissue is an important depot for storage of Ca and P. It is mainly built up of an organic extra cellular matrix covered with hydroxy apatite (Ca_5 (Po_4)$_3$ OH_2) .The contents of Na, K, Cu, Mg and P are up to 1mg/100g whereas these of Fe, Zn, and I are less than 1mg/100g in fish flesh.Na, K and Zn contents were found to be 77.3 and 28.9,459.7 and 393.8 ,0.28 and 0.11mg/100g in flesh of sea bass and sea bream fish ((Erkan and Ozden, 2007).

Table (2) showed the amino acid profile of ferakh beheaded and gutted fish mince comparing with the standard protein recommended by the world health Organization (FAO/WHO, 1991). The results showed high levels of proline, valine, leucine, isoleucine, glycine and tyrosine. These high levels may be due to the presence of skin and backbone rich in collagen protein in fish mince (Toppe *et al.*,2007).

Table 1. Proximate composition and mineral content of beheaded and gutted ferakh fish mince

Component (%)	On wet weight basis	On dry weight basis
Moisture	78.91±0.33	---
Crude protein	16.95 ± 0.05	80.37 ± 0.11
Crude ether extract	0.95± 0.03	4.51 ±0.04
Ash	2.43±0.03	11.52±0.44
Carbohydrates*	0.76±0.02	3.60±0.01
Minerals(mg/100g)		
Ca	165.08±0.11	758.99±0.25
P	631.46±0.11	2903.26±0.07
Na	968.80±0.61	4454.25±0.09
K	193.76±0.05	890.86±0.05
Zn	0.62±0.02	2.85±0.10

*By differences

Table 2. Amino acid content of beheaded and gutted ferakh fish minces

Amino acid (g/100g)	Beheaded and gutted ferakh fish mince	FHO/WHO (1991)
Essential amino acids (EAA)		
Lysine	5.25	5.8
Histidine	2.23	
Arginine	8.13	
Threonine	4.27	3.4
Met+cys.	5.38	2.5
Valine	4.71	3.5
Phenylalanine	5.09	6.3 phe.+tyr.
Isoleucine	5.78	2.8
Leucine	8.04	6.6
Tryptophane	ND*	1.1
Non essential amino acids (NEAA)		
Aspartic acid	11.52	
Glutamic acid	17.12	
Proline+Hydroxy proline	5.97	
Serine	3.02	
Glycine	3.32	
Alanine	5.28	
Tyrosine	3.48	

*ND= Not determined

The essential amino acids(EAA) can be arranged according to their concentrations in the following decreasing order,arginine,leucine,isoleucine, lysine, sulfur containing amino acids(methionine+cysteine), phenylalanine, valine, threonine, and histidine, respectively. .Meanwhile, glutamic acid represented the major non EAA followed by aspartic acid, proline+hydroxyl proline, alanine, tyrosine, glycine and serine respectively. Results of Adeyeye (2009) showed that the most abundant EAA in flesh of 3 species of Nigerian fish was leucine.Toppe *et al.*,(2007) observed small differences in the level of amino acids in bones from varied fish species.

2-*Chemical composition and sensory evaluation of ferakh fish mince products*;-

A-*Fish Fingers*:- Moisture, crude protein, crude ether extract and total ash of this product were 68.76%,12.32%,2.89%, and 4.16%, respectively (Table 3). The remaining percentages of total proximate analysis are thought to be carbohydrates. In general, fish are known to have low amount of carbohydrates in their muscle. However, the high level of carbohydrates (11.87%) is derived mainly from corn flour, sugar, and coating materials (batter+bread crumbs) used to formulate this product. Tokur *et al.* (2006) found that fish finger made from unwashed mirror carp mince composed of 68.5% moisture, 15.5% protein, 6% lipids, and 2.51% ash. After cooking, moisture content of fish fingers was reduced to 57.53% (Table 3). This reduction (16.33%) caused an apparent increase in the other components of this product. pH value of this product was slightly changed from 5.93 to 5.97 after cooking. Cooking of fish fingers decreased both the weight and shrinkage%, respectively. Generally, the cooking loss (35.15%) was relatively lower than shrinkage, 37.67%. The sensory score of the appearance, colour, texture, odour, taste and overall acceptability of the cooked fish fingers were more than 8 (Table 4). This means that the degree of acceptability of this product was very good.

Table 3. Proximate composition, pH and some cooking properties of products prepared from beheaded and gutted ferakh fish mince

Component* %	Fish product				
	Fish fingers		Fish sausage		Spiced salted fish paste
	Fresh	Cooked	Fresh	Cooked	
Moiture	68.76±0.39	57.53±0.49	68.45±0.20	64.47±0.36	61.84±0.13
Crude Protein	12.32±0.31	13.78±0.29	14.09±0.0	16.85±0.23	15.11±0.31
Crude ether extract	2.89±0.02	8.60±0.11	5.67±0.04	5.85±0.13	11.55±0.05
Ash	4.16±0.01	4.33±0.13	3.42±0.03	3.45±0.0	8.95±0.20
Carbohydrates**	11.87±0.08	15.76±0.06	8.37±0.12	9.38±0.07	2.65±0.05
pH	5.93±0.04	5.97±0.02	6.18±0.03	6.31±0.02	5.43±0.02
Cooking yield%	---	64.85±0.5	---	54.29±0.54	----
Shrinkage%	---	37.67±0.30	---	33.65±0.55	---

*On wet weight basis.
**By differences

Table 4. Sensorial properties of products prepared from beheaded and gutted ferakh fish mince

Property	Fish product					
	Cooked fish fingers		Cooked fish sausage		Spiced salted fish paste	
	Score*	Acceptability	Score*	Acceptability	Score*	Acceptability
Appearance	8.60±0.55	Very good	7.40±0.55	Good	7.60±0.55	Good
Colour	8.0±0.0	Very good	7.0±0.0	Good	6.60±0.89	Like slightly
Texture	8.90±0.22	Very good	7.40±0.55	Good	6.40±0.55	Like slightly
Odour	8.40±0.84	Very good	7.20±0.84	Good	6.60±1.34	Like slightly
Taste	8.40±0.55	Very good	7.60±1.34	Good	6.40±0.89	Like slightly
Overall acceptability	8.60±0.55	Very good	7.40±0.55	Good	7.30±1.0	Good

*Mean ±standard deviation

B-*Fish sausage*:- Moisture, crude protein, crude ether extract, and total ash of this product were 68.45%, 14.09%, 5.67% and 3.42 %, respectively (Table 3). Comparing with fingers, this product contained higher amount of protein, crude ether extract and lower amount of total ash. This was mainly due to the higher level of fish mince and oil used during formulating this product. Rahman *et al.*,(2007) formulated fish sausage from underutilized fish caught in Sultanate of Oman. Proximate composition of this product was 62.26% moisture, 15.27% protein, 9.86% lipid and 2.61%ash. Carbohydrates present in fish sausage prepared in this study was attributed to corn starch, sugar, milk powder, and others ingredient used to formulate this product. As in fish fingers, cooking process caused reduction in moisture content and an apparent increase in other components .Such changes were less in fish sausage than fish fingers due to the difference in formulating process, ingredients, and cooking method. This was also behinds the lower values of cooking yield and shrinkage% of fish sausage in comparing with fish fingers. Generally pHvalue of this product did not much affect by cooking. It was changed from 6.18 in fresh to 6.31 in cooked fish sausage (Table 3). The sensory score of the appearance, colour, texture, odour, taste and overall acceptability of fish sausage was ranged from 7.0% to 7.6 %,(Table 4).This means that the acceptability of such product was good. The lower acceptance of this product comparing to fish fingers could be attributed to an undesirable taste and colour change due to the incorporation of high amount of fish mince. Bochi *et al.,* (2008) showed that the acceptability of fish burger made of silver catfish was reduced with increasing the proportion of fish fillets in recipe of this product.

C-*Spiced salted fish paste*:-As mentioned in materials and method section this product was prepared from salted beheaded and gutted fish. Therefore this product contained high level of total ash, 8.95, which was mainly attributed to sodium chloride which was absorbed during salting period. Also this product contained high crude ether extract and low carbohydrates mainly from sesame butter addition and relatively high moisture content from water incorporation, (Table 3). pH value of this product was also relatively acidic due to the addition of acetic acid, (Table3). The protein content of this product was nearly 15% .Therefore this product was rich in protein, crude ether extracts, salt and low in carbohydrates. The sensory data (Table 4), showed that the panelists slightly like this product. The sensory score of both appearance and overall acceptability of this product was more than 7, (good). Meanwhile the others evaluated sensory properties were more than 6, (acceptable fair).

In conclusion, acceptable nutritive and edible products can be prepared from small beheaded and gutted underutilized fish such as ferakh fish. These products can offer protein food to overcome the poverty and malnutrition problem.

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الملخص العربي

التركيب التقريبى ومحتوى المعادن والاحماض الامينية والاستخدامات التكنولوجية لمفروم سمك الفراخ

سامية عبدالله خليل كشك

تناولت الدراسة التقييم الكيماوى (التركيب التقريبى ومحتوى المعادن وتركيب الاحماض الامينية)لمفروم سمك الفراخ(*Trigla corax*) وملائمتة لتجهيز منتجات جديدة صالحة للأكل (أصابع السمك- سجق السمك ومعجون السمك ا لمملح والمتبل). وأوضحت النتائج بأن المفروم المعد من السمك الخالى من الاحشاء والراس كان غنيا فى البروتين(16.95%)والرماد (2.43%) والمعادن (ملجم/100جم) مثل الكالسيوم(165.08) والفوسفور (631.46) والصـــوديوم(968.80) والبوتاســـيوم (193.76) والزنك (62,). كما احتوىبروتين السمك المفروم على كميات معتدلة مـن الاحمـاض الامينيـة الاساسـية مقارنـة FAO/WHO pattern بالاضافة الى المستوى المنخفض من الدهون (95,%). كما وجد ان جميع المنتجات المختلفة والمجهزة من هذا المفروم تحتوى على مستويات متوازنة من البروتين والدهن والكربوهيدرات كا نت مقبولة حسيا من قبل المحكمين.