FISH CAKE FROM TUNA-LIKE FISH (*Scombromorous spp.*) FLESH TO IMPROVE ITS CONSUMPTION ACCEPTABILITY

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ABSTRACT

The study was aimed to greater the eating quality and acceptability of Tuna – like fish (*Scombromorous spp.*) which had undesired bloody dark flesh by using the minced flesh for producing a fish cake. The prepared cake were tested chemically, microbiologically and sensory evaluation. The results reveal that, filling material carbohydrate increased, lipids and protein in produced fish cake increased. On the other hand, after deep fried moisture content decreased while, protein and lipids were increased as affected by firing. As well as, microbial contamination were in permissible range. Fish cake was accepted organolepticly and consider as a good source of energy. Protein fractionation by SDS-polyacrylamide gel shows differences between the minced flesh and the fish cake after heat process in bands which were ranged between 30 to 66 kDa and blow 20 kDa. Therefore, the suitable supplementation level of wheat flour was 15 w\w.

Key word: Tuna – Like Fish; *Scombromorous spp.*; fish cake; consumer acceptability.

INTRODUCTION

Fish has long been regarded as a highly desirable food due to its richness in protein with high biological value, polyunsaturated fatty acids and many minerals elements such as calcium and phosphorus, as well as some vitamins (**Yaser, 1994**).

Fish intake is associated with improved cardiovascular health, including a lower risk of arrhythmic death, arterial fibrillation, and heart failure (**Mozaffarian, *et al.*, 2005**).

Tuna-like fish (*Scombromorous sp.*) is belonged to so call dark-flesh fish types. It is constituent about 8 – 10% of the total marine fishes landing each year of our country was used for the production of hot smoked fillets and fish finger with high quality attributes (**Abu-Tor, 2002a**). This fish genus is characterized by dark bloody flesh and presences of many blood vessels therefore, it is susceptible to rapid spoilage. Also for the same reason it have a negative effect on consumer acceptance, consequently large amounts of raw materials is wasted every year (**Abu-Tor, 2002a**). The present study was proposed to improve the flesh quality and acceptability of bloody dark flesh from Tuna-like fish (*Scombromorous sp.*) by converting

the fish flesh to producing an acceptable product such as fish cake. The prepared cakes were subjected to sensory; chemically and microbiologically evaluation.

MATERIALS AND METHOD

Material :

Tuna – like fish (*Scombromorous sp.*) was purchased from the fish local market of Alexandria City, during the summer season of 2007. Fishes were transported in ice box to the laboratory. Fish weight ranged from 0.980 to 1.250 Kg. Wheat flour of 72% extraction with 14% moisture content supplied from North Delta Mills Company, Kafr El-Sheikh. Salt (sodium chloride) and spices (black peper & sodium glutamate) were bought from market at Kafr El-Sheikh.

Methods:

Length and weight of fish different parts were determined according to **Zaitsev *et al.*, (1969).**

Flesh recovery and cake making:

Fishes were washed with tap water to remove any impurities then beheaded, eviscerated and skinned, and then the flesh was isolated from the bones. The obtained flesh was washed and minced by passing twice through an electric meat-mincer type Moulinex, France made. The minced flesh was manufacture to cakes according to the method described by **Atta *et al.* (1993)** and mentioned in Fig (1). Part of minced flesh and fresh cake were stored in sealed plastic pouches at -18°C until required for analysis.

Fish cakes frying:

Fish cakes were fried in corn oil at 180°C for 5 min. according to the conditions mentioned by **Abd El-Aal *et al.* (2000),** and served hot to the panelists.

Determine of cooking yield:

The cooking loss and cooking yield of fish cakes were calculated as described previously by **Abd El-Aal *et al.* (2000).**

Chemical analysis:

Fresh flesh and fried cakes were subjected to chemical analysis, Moisture, ash, crude lipid and nitrogen contents were determined according to the standard methods of the Association of Official Analytical Chemists **(AOAC, 2000)**. Nitrogen content was converted to crude protein by multiplying by 6.25 while the crude carbohydrate was determined by the difference.

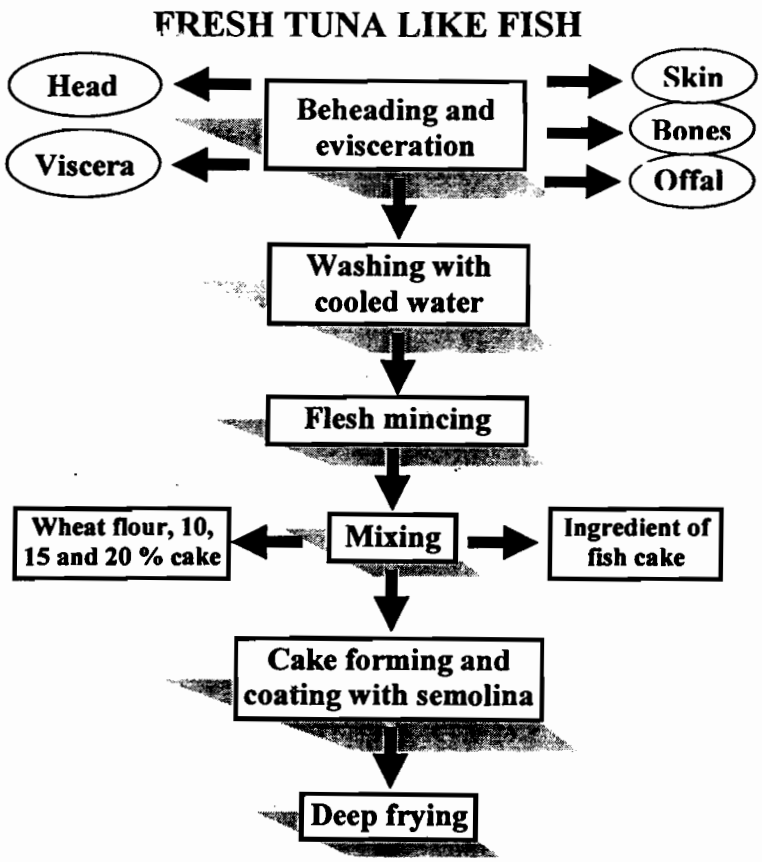


Fig (1): Flow chart for Tuna-like fish cakes manufacture.

Sodium and potassium were determined by using flame emission spectrometry (flame photometer) according to the method described by **Pearson (1991)**. Total phosphorus was measured calorimetrically according to the **(A.O.A.C. 2000)** using (Spectrophotometer Jenway, 6100). Determinations were done in triplicates and results were expressed as averages on dry weight basis.

Sensory evaluation of fried fish cake:

To evaluate the manufactured fried fish cake, sensory test was carried out by a group of 10 panelists from staff members of the Food Technology, Faculty of Agriculture, Kafrelshiekh University. The sensory test was conducted at six items, color, odor, texture, taste, appearance and overall acceptability as described by **Rangana (1977)**, using a 9-point scale for grading the quality of samples. Data obtained were statistically analyzed according to **Steel and Torrie (1980)**.

Microbiological methods:

Samples were prepared using the recommended method for the microbiological examination of food by American Public Health association **APHA (1996).** Total viable bacteria, molds, yeasts, Staphylococci, Coliform bacterial, Salmonella, Shigella and Psycrophilic bacteria counts were carried out according to the methods given by (**Kiss, 1984**).

Polyacrylamide gel electrophoresis (SDS-PAGE):

Electrophoresis was carried out according to the method of **Laemmli (1970)** with some modifications as follows: The TEMED was reduced from 30 µl to 25µl and also APS was reduced from 1.5 ml to 1.3 ml. Approximately 1g freeze dry growth from each tested fish sample, ground in a mortar and pestle in liquid nitrogen. Crushing continued until the sample completely homogenized. The crushed samples were transferred to 1 ml Eppendorf tube brought to 200 µl with extraction buffer (50 mM tris-HCl buffer, pH 6.8, glycerol 10 % w/v, ascorbic acid 0.1 %, cycteine hydrochloride 0.1 w/v).Centrifugation,18,000 rpm for about 30 min, was carried out to remove debris. Standard markers were wide range molecular weight from Sigma and contain low, high molecular weight protein.

RESULTS AND DISCUSSION

Fish body measurements and flesh recovery ratio

From the body measurements of used fishes it could be observed that fishes had the same body weight, they had about equal bodies length measurements, this character is very important from industrial point of view as reported by **Atta *et al.* (1993)**, who reported that, the body measurements of fish such as length, size, shape and weight are very important, which clarifies the suitable handling methods and the required equipments that should be used in fish processing.

Also, from the table (1) it could be noticed that the flesh recovery ratio of used fish (average weight 1.28kg) was 59.80% w/w of whole weight. This ratio was more than that reported by **Abu-Tor (2002a)**. This ratio increasing may be due to the season of fish coughing then the fish at mature state. Fig. (2) show the appearance of fresh fish yield.

Chemical composition:

Table (2) show the chemical composition of fresh flesh and fried fish cakes. The results indicated that the frying loss had a great effect on moisture lost in control fish cakes and that supplemented with wheat flour.

The holding of moisture increased as the flour ratio increase in fish cakes. The same phenomenon was previously observed by **Ghazi *et al.* (1993)**. This is important from the point of view of organoleptic properties

of prepared cake since it enhanced its tenderness. The results also revealed that the decrease in moisture content of samples meeting by increasing in fat content. This due to the water loss from fish samples as a function of deep frying. Ash as salting contents of fish cakes were slightly increased upon subjecting to deep frying, then decreased with flour ratio increasing. Carbohydrate content was also increased after frying treatment and with flour adding. These results were in agreement with those reported by **Abd El Aal *et al.* (2000) and Abu-Tor (2002a).**

Table (1): Body measurements of used Tuna – like fish.

Characteristics	Value	Ratio (%)
Weight measurements (g) :		
Weight of whole fish	1000.28	100.00
Weight of fish head	191.23	19.12
Weight of fish flesh	598.15	59.80
Weight of fish viscera	70.80	7.08
Weight of other wastes	140.10	14.00
Length measurements (cm) :		
Length of whole fish	40.27	100.00
Length of fish body (Trunk)	14.82	36.80
Length of fish head	13.07	18.82
Length of fish tail	4.80	32.45
Length of caudal/tail fin	5.75	11.92
Maximum thickness (cm)	5.75	–

* Mean value of ten fishes.

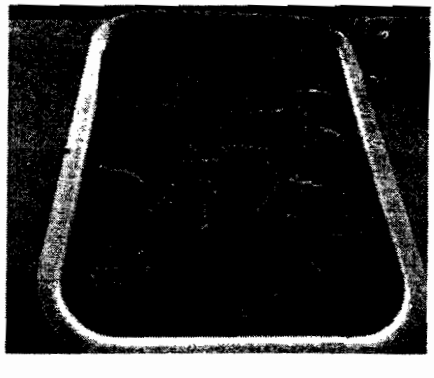


Fig. (2): Show the appearance of fresh flesh *Scombromorous spp.* (Tuna-like fish).

Table (2): Chemical composition of fresh fish and fried cakes prepared from Tuna – like fish (*Scombromorous sp.*)

Parameter	Fresh fish flesh (%)	Deep fat fried cakes			
		Control without flour	Cakes mixed with wheat flour		
			10 %	15 %	20 %
Moisture%	69.72	54.05	55.57	55.74	56.12
Crude protein%	23.15	33.35	31.73	31.45	31.10
Ether extract%	4.65	8.52	8.72	8.70	8.70
Ash content%	1.18	1.95	1.93	1.93	1.92
Carbohydrates*	1.3	1.83	2.05	2.18	2.16
Sodium (mg/100g)	112.40	156.80	150.50	148.80	146.50
Potassium (mg/100g)	1400.9	1456.6	1438.2	1430.1	1425.5
Phosphorus (mg/ 100g)	965.50	985.4	980.0	977.0	975.5

* Carbohydrates were determined by differences =100–(protein + ether extract + ash).

Frying yield, Cooking loss, and caloric value

The highest cooking yield of fried cakes was found with 20%w/w wheat flour supplementation and the lowest value was found in the control as shown in Table (3). With respect to cooking loss it could be noticed that cooking loss of control cakes was higher than those of other treatments. The cooking loss increased as the filling materials ratio increased. This observation may be explained by the water absorption power of wheat flour during fraying process. These results were in agreement with those reported by **Gall *et al.* (1983) and Abd El-Aal *et al.*, (2000)** for fried fish. As shown in table (3) the prepared fish cake can be consider as a good source of energy in addition to its high content of animal protein.

Table (3): Frying yield; cooking loss, and caloric value of Tuna-like fish cakes.

Wheat flour ratio (%)	Deep fried yield (%)	Cooking loss (%)	Caloric value (K cal/100g)
Control (0)	74.90	25.15	220.10
10	79.71	20.29	213.60
15	79.95	20.05	212.82
20	80.50	19.50	211.34

Effect of frying on microbiological characteristics in Tuna-like fish

Table (4) tabulated the microbiological counts of fried Tuna – like fish cakes. The total viable count (TVC) of raw flesh was 2.5 $\times 10^2$ cfu/g. The TVC of prepared fish cake were within the range of 1.8 $\times 10^2$ cfu/g to 3.1 $\times 10^2$ cfu/g with different supplementation ratio of wheat flour. There were a decreasing in TVC with increasing wheat flour ratio which may be attributed to lower water activity/ moisture content and its bacterial effect (**FAO, 1981**). Also, it should be noted that Staphylococci, Coliform

bacterial counts, Salmonella and Shigella were not detected in all tested samples. Molds and yeasts of raw flesh was 0.62 $\times 10^2$ cfu/g. The TVC of prepared fish cake were within the range of 0.42 $\times 10^2$ cfu/g to 0.68 $\times 10^2$ cfu/g reversed with different supplementation ratio of wheat flour. Similar results were mentioned by **Ghazi *et al.*, (1993)** and **Abu-Tor (2002b)**. It can be also noticed that the microbial count of fried cake were within the permissible range **(APHA, 1996).**

Table (4): Microbial count in fresh fish and fried cakes prepared from Tuna – like fish (*Scombromorous sp.*)

Microbial tests Count × 10^2 cfu	Fresh fish flesh	Deep fat fried cakes			
		Control without flouer	Cakes mixed with wheat flour		
			10 %	15 %	20 %
Total viable count	2.5	3.1	2.2	2.0	1.8
Molds and yeast	0.62	0.68	0.55	0.42	0.30
Coliform group	Nil	Nil	Nil	Nil	Nil
Salmonella and Shigilla	Nil	Nil	Nil	Nil	Nil
Psycrophilic bacteria	1.5	1.4	1.2	1.0	0.9
Staphylococci	Nil	Nil	Nil	Nil	Nil

* Mean value of three replicates.

Organoleptic properties of frying Tuna – like fish cakes:

The organoleptic properties of deep fat fried Tuna–like fish cakes are shown in Table (5). The data revealed that, the organoleptic properties were affected by wheat flour levels in fish cakes. The highest score of overall acceptability was recorded in case of cake supplemented with 15% w/w wheat flour and Fig. (3) declare the produced cakes after frying, cakes prepared with 15% wheat flour was the good appearance. For instance, the mean of the control score was not significantly differ from that of cakes supplemented with wheat flour at 15% w/w level. Whilst 10% w/w levels were significantly lower compared with the control. These results were in agreement with those found by **Atta *et al.*, (1993)** who indicated that, the suitable supplementation level of wheat flour was 15% w/w.

Table (5): Organoleptic properties of deep fat fried Tuna – like fish cakes prepared with various levels of wheat flour.

Supplementation ratio (%w/w)	Organoleptic score*					
	Appearance	Color	Odor	Texture	Taste	Overall acceptability
0 (Control)	7.8	7.5	7.9	7.6	7.8	7.72
10	7.3	7.7	7.8	7.3	8.0	7.62
15	8.2	7.8	8.3	7.8	8.2	8.06
20	7.3	7.5	8.0	7.4	7.6	7.56

* Mean value obtained from 10 panelists.

Overall acceptability = Appearance + Texture + Color + Odor + Taste divided by 5.

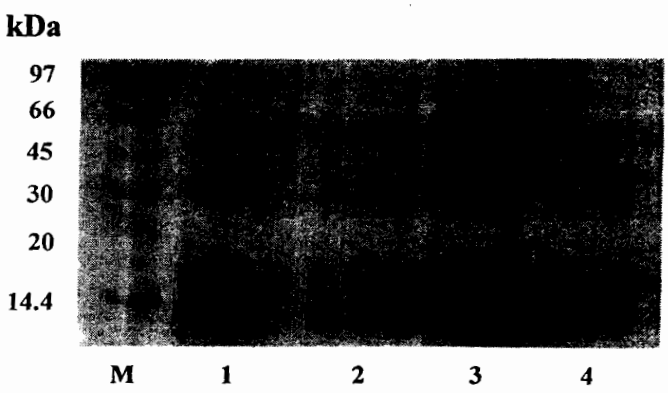
▼ Score sheet: Dislike extremely =1; dislike very much = 2; dislike moderately =3; dislike slightly =4; neither like nor dislike =5; like slightly = 6;like moderately=7; like very much =8 and like extremely =9.

Control (Without wheat flour) | With 10% wheat flour | With 15% wheat flour | With 20% wheat flour

Fig. (3): Fish cake after deep frying process.

Protein fractionation by SDS–polyacrylamide gel electrophoresis technique

Soluble protein of minced fish flesh and fish cake supplemented with different ratios of wheat flour were extracted and separated by SDS–PAGE technique as shown in fig 4. The results reveal that, the main difference between the patterns of minced fish flesh and fish cake were the presence of additional prominent bands and smears in the fish cake of Mw between 30 and 66 kDa and below 20 kDa. From these results its clear that water soluble protein in fish cake supplemented with wheat flour was higher than in fish flesh this, may be attributed to differences in the relative amount of protein loaded or wheat protein or the differences in the processing conditions. Similar results were reported by **Martinez *et al* (2007)**.



Where: M : Marker protein.
1 : Minced fish flesh.
2 : Fish cake with 10% wheat flour
3 : Fish cake with 15% wheat flour
4 : Fish cake with 20% wheat flour

Fig. (4): Typical chromatogram of fried fish flesh and fish cake soluble protein bands fractionated by SDS–polyacrylamide gel electrophoresis technique.

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الملخص العربي

تحسين القابلية لاستهلاك لحم سمك سكومبروموروس (الشبيه بالتونة) بتصنيعه إلي أقراص سمكية

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تهدف الدراسة إلي تحسين القابلية لاستهلاك لحم سمك سكومبروموروس (الشبيه بالتونة) حيث أنة ذو مظهر دموي داكن غير مرغوب لدي المستهلك مما يؤدي إلي بطء في تسويقه وفساد كميات منه؛ تم تصنيع أقراص سمكية من مفروم لحم السمكة بإضافة دقيق القمح إليه كمادة مالئة بالإضافة إلي بعض ملح الطعام والتوابل بغرض تحسين الطعم وإخفاء اللون الدموي الداكن وقد أدى ذلك لرفع محتوى الكربوهيدرات وخفض نسب البروتين والليبيدات في النتائج.

وأظهرت النتائج المتحصل عليها أن أقراص السمك المصنعة من لحم سمك سكومبروموروس (الشبيه بالتونة) قد حظي بقابلية عالية للاستهلاك وأوضحت التحاليل الكيماوية للمنتج أنه يحتوي علي نسبة جيدة من البروتين و الدهون المرغوبة غذائيا ، كما أنه يعتبر مصدر جيد للسعرات الحرارية ، وأدت عملية التحمير إلى خفض نسبة الرطوبة وزيادة نسب البروتين والليبيدات كما أن الاختبارات الميكروبية التي أجريت علي المنتج أظهرت عدم احتوائه علي أي من الميكروبات الممرضة وكان الحمل الميكروبي في الحدود المسموح بها غذائيا ؛ وباستخدام تكنيك SDS-PAGE لأنماط الهجرة الكهربية للبروتينات الذائبة في الماء أوضحت أن الببتيدات الموجودة في هذه النوعية من الأسماك قد انحصرت ما بين ٣٠ و ٦٦ (كيلو دالتون) وما تحت ٢٠ (كيلو دالتون).

بناء على النتائج السابقة يمكن القول بأن تصنيع سمك سكومبروموروس وتقديمه إلى المستهلك في صورة أقراص أدى إلى تحسين القابلية لاستهلاكه ، كما أن محتواه البروتيني عالي وذو قيمة غذائية مرتفعة تساهم في حل مشكلة نقص البروتين وارتفاع أسعار البروتين الحيواني في الدول النامية .