Effect of different cooking methods on sensory quality of pre-frozen tilapia and big eyed snapper fish

Shimaa S. Abd-Allah [1,*] and S. M. Ibrahim [2]

[1] *Student nutrition Department, AL-Azhar.*
[2] *Fish Processing Technology Lab, National Institute of Oceanography and Fisheries, Cairo, Egypt.*

*Corresponding author E-mail: shymasbhy456@gmail.com (SH. Abd-Allah)

ABSTRACT:

This study was designed to investigate the effect of different cooking methods on sensory quality of pre-frozen tilapia and big eyed snapper fish samples. Two fish species; Tilapia (*Oreochromis niloticus*) as freshwater fish and big eyed snapper (*Latjenus spp.)* called Morgan as marine fish were collected from Benha fish market. Both Tilapia and big eyed snapper were frozen at -18°C, and then cooked by different cooking methods; frying, grilling, microwave cooking and boiling. The results showed that all fried fish samples processed from Tilapia and Morgan had got high scores for all sensory quality parameters compared to other ones. With regard to the overall acceptability property, fried and both (grilled and microwaved) Tilapia samples at zero time and also microwaved and boiled Tilapia samples after 90 days were highly significant differences ($P \leq 0.05$). Concerning other fish products, there was only significant differences between fried and microwaved Morgan samples at 45 days. finally, it could be concluded that fried Tilapia and Morgan products were more accepted products than other ones,nd the significant differences ($P \leq 0.05$) between cooked fishery products investigated were dependent mainly on frozen storage periods, fish individuals, processing method (temperature and time used)

Key words: Fish; cooking methods;sensory quality.

INTRODUCTION

OECD/FAO (2011) showed that about 81% of global fish productions are destined for human consumption due to beneficial healthy and nutritional effects of fish and its products. Despite fish preservation by freezing their tissue is still in undesirable state by some physical, chemical and enzymatic changes occurred (Magnussen *et al*., 2008). the extent of quality loss in frozen foods is related with deterioration occurred in texture, flavor and color properties as well. The quality and shelf life of fish differs using different methods and has different acceptability by consumers (Boonsumrej *et al.,* 2007; Pourshamsian *et al*., 2012 and Mojisola, 2014). On the other side, cooking (boiling, baking, roasting, frying and grilling) improve hygienic quality of the fish by inactivation of pathogenic microorganisms and enhances digestibility of nutrients. However, minerals, thermo-labile compounds; fat-soluble vitamins and polyunsaturated fatty acids are often reduced, heating can cause loss of nutritional value through amino acids destruction, protein denaturation and Millard reaction as well as protein digestibility is reduced as a result of complex chemical (cross-linking) reactions, such as protein interactions or protein-fat interactions (Bognár, 1998; Sriket *et al.,*2007; Akinneye, *et al* 2010; EL SN and Kavas, 2012; and Abraha *et al*., 2018). Oduro *et al.,* (2011) showed that fish cooking fish by grilling, microwave, steaming and frying contributed in reducing of moisture and increasing protein content and caused a decrease in fat content by steaming, grilling and microwave. Smida *et al*., (2014) reported that heating affects the liquid holding capacity of frozen fish, which resulted in protein deterioration and dehydration of the muscles through disruption of cell structures and become very tough texture and difficult to eat. Therefore, this work was designed to investigate the effect of different cooking methods; frying, grilling, steaming and microwaving on sensory quality of the Nile Tilapia (*Oreochromis niloticus*) and big eyed snapper (*Latjenus spp.*) throughout different frozen storage periods.

MATERIAL AND METHODS

Fish samples

Two fish species of Nile Tilapia (*Oreochromis niloticus*) and big-eyed snapper (*Latjenus spp.*) were purchased from Benha fish market, Qalyubia Governorate, during June, 2019. They were transported immediately using ice box to Fish Processing Technology Laboratory, Elqanater ELkhiria Fish Research Station, National Institute of Oceanography and Fisheries, Egypt. Average weight recorded 325±2.47g and 350±2.82g for tilapia and big eyed snapper (Morgan) fishes, respectively.

Ingredients

Sunflower oil, wheat flower, spices mixture (black pepper, cumin, and fresh garlic) and sodium chloride were purchased from the local market.

Technological processes of fish samples

Nile tilapia and big eyed snapper samples were glazed and frozen at - 18ºC for 6 months. At each interval (45days), frozen samples were thawed under tap water, gutted, rewashed and then immersed in 10% NaCl solution for 10 minutes, rinsed, drained for a few minutes and treated with 10g of mixture of spices (25% black pepper powder, 25% cumin powder and 50% garlic paste). Scales, fins, tail, and viscera were removed. Spiced gutted samples were divided into four batches for processing. According to Shimaa Abd-Allah (2013).

Cooking methods

First batch of spiced gutted raw and frozen samples was thinly coated with wheat flour (72% extraction), left for 3-4min and deep-oil fried using stainless steel pan at 170˚C. Second batch was boiled using Braun-electrical steaming pan for 6 min for tilapia and 6-10 min for big eyed snapper. Third batch was microwaved at 600 watt for 10 min for tilapia and 12-15min for snapper using a microwave oven (Samsung model M 1932) and the final batch was coated with wheat bran and grilled using hot surface at 160ºC for 20 min for tilapia and 30-35 min for snapper. All cooked fish products were left under room temperature till cooled and analyzed. Shimaa Abd-Allah (2013)

Sensory quality

All cooked fish products for both fish *ssp*. were labeled alphabetically. Sensory quality of different cooked fish products was performed by 10 untrained panelists. Sensory quality tests (appearance, texture, odor, taste, and overall acceptability) were carried out according to Resurreccion (2007) using the 10-point unipolar hedonic scale (10= excellent 8= very good, 6= good and 4= accepted). The results obtained were statistically analyzed by using L.S.D. (at $P \leq 0.05$) and expressed as Mean ±SD using SPSS (Ver.16).

RESULTS

Sensory quality parameters (appearance, texture, odor, taste and overall acceptability) were applied on all different cooked tilapia and Morgan products throughout different frozen storage periods.

Appearance

Table (1) shows the appearance scores given by panelists of different cooked tilapia and snapper products. The highest score (8.28) was given for the appearance property of fried tilapia sample compared to other ones at zero time and 180 days storage.

High significant differences ($P \leq 0.05$) were found between fried and both (grilled and microwaved) Tilapia samples and also between grilled and boiled samples at zero time of frozen storage. After 45 days, differences between fried and both (microwaved and boiled) Tilapia samples, and grilled and boiled Tilapia samples were highly significant. However, no observed differences between all cooked tilapia samples pre-frozen for 90, 135 and 180 days storage.

Also, data show the mean scores of appearance for cooked big eyed snapper (Morgan). The highest scores (9.0) were given for the appearance of fried and boiled Morgan samples compared to others at zero time and 135 days storage. High significant differences ($P \leq 0.05$) were found between fried and grilled samples and also between grilled and microwaved samples at zero time. After 45 and 90 days, high significant differences between fried and both (grilled and boiled) Morgan samples were observed.

Texture

The effect of different cooking methods throughout frozen storage on texture of tilapia fish and big eyed snapper is exhibited in Table (2). Data showed that there was significant difference between fried and (microwaved and boiled) tilapia samples at zero time while it was found between boiled and both (fried and grilled) tilapia samples at 90 days storage.

Concerning the big-eyed snapper samples, we noticed that no significant differences between all cooked fish samples at zero time. Significant differences ($P \leq 0.05$) were observed between all cooked Morgan samples except fried and grilled samples at 45 days and also grilled and boiled samples at 90 days.

Odor

Mean scores of texture for cooked tilapia and big eyed snapper (Morgan) products are tabulated in Table (4). At zero time, significant differences between fried and microwave tilapia samples and also between grilled and boiled tilapia samples at 90 days were observed. However, no significances were found between different cooked samples stored 45, 135 and 180 days.

Concerning cooked big eyed snapper (Morgan), at zero time and 90 days, there were no significant difference between all cooked samples while there was highly significant difference between fried and both (microwaved and boiled) Morgan samples.

Taste

The mean scores of taste get by panelists for tilapia and big eyed snapper (Morgan) are presented in Table (4). A significant difference (*P≤0.05*) between fried and both (grilled and microwaved) tilapia samples at zero time and also grilled and boiled tilapia samples at 90 and 135 days storage were found. However, no significant difference were found between different cooked samples after 45 and 180 days.

On the other side, Morgan cooked products showed no significant differences between all cooked products at zero time. However, significant differences between fried and both (microwaved and boiled samples) after 45 days and between fried and microwaved sample after 90 days storage were observed.

Overall acceptability

Mean scores of overall acceptability for cooked Tilapia and big eyed snapper products are shown in Table (5). It could be found that differences between fried and both (grilled and microwaved) Tilapia samples at zero time and also between microwaved and boiled Tilapia samples after 90 days were highly significant (*P≤0.05*).

However, there was no significant difference between different cooked tilapia samples at 45-, 135- and 180-days storage. With regard to big eyed snapper products, there was only significant difference (*P≤0.05*) between fried and microwaved Morgan samples at 45 days.

DISCUSSION

It is well known that changes in digestibility, chemical, physical, nutritional compositions of fish are affected by different processing methods (frying, grilling, boiling, baking, and roasting). These changes cause reactive groups as a result of deformation in protein features and loss of solubility of temperature-sensitive proteins may be taken as an indicator of the time and temperature of processing. However, effects of cooking can improve or impair the fish nutritional value and content of thermo labile compounds, fat-soluble vitamins or polyunsaturated fatty acids is often reduced as reported by several researchers (Bognár, 1998, Boonsumrej *et al.*, 2007, Sriket *et al*., 2007, Akinneye, *et al* 2010, Alipour, *et al*., 2010 Pourshamsian *et al*., 2012 and Mojisola, 2014). In this work, appearance, texture, odor, taste and overall acceptability parameters (Tables 1-5) recorded high scores for both fried Tilapia and Morgan samples compared to other ones. This may be due to the fact that deep frying process improves the sensory quality of food by formation of aroma compounds, attractive color and texture (Bognár, 1998). These results agree with the results reported by Eriksson (1987), García-Arias *et al*., (2003), Alipour, *et al*., (2010) and Abraha *et al*., (2018; they showed that texture and general appearance of fish have significant contribution in product acceptability by the consumers. Also, cooking improved the color, taste and flavor and led to loss in water holding capacity and consequently change texture of fish to became hard or firm. However, time and temperature of processing affected protein quality, vitamins, minerals, some other essential amino acids, fatty acids and other nutrient contents.

CONCLUSION

Based on the results obtained in this study, it could be concluded that fried tilapia and Morgan products were more accepted products than other ones. And the significant differences (*P≤0.05*) between cooked fishery products investigated were dependent mainly on frozen storage periods, fish individuals, processing method (temperature and time used) as well as panelist features.

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Table 1: Mean scores of appearance for cooked tilapia and big eyed snapper Morgan products.

Storage period (day)	Cooked fish products				L.S.D. ($P \leq 0.05$)
	Fried	Grilled	Microwave	Boiled	
	Tilapia products				
0	8.28	4.57	5.7	6.7	1.60
45	9.5	8.8	6.0	6.5	2.49
90	6.8	6.4	6.0	5.8	1.73
135	8.0	7.6	7.5	7.0	1.70
180	9.0	8.5	9.0	8.8	1.69
	Big eyed snapper products				
0	9.0	6.8	8.3	9.0	1.06
45	9.0	7.0	7.5	7.17	1.73
90	8.0	6.0	7.0	6.5	1.4

*L.S.D least significant differences., * panelist were untrained., Scales from 1 to 10

Table 2: Mean score of texture for cooked tilapia and big eyed snapper Morgan products.

Storage period (day)	Cooked fish products				L.S.D. (*P≤0.05*)
	Fried	Grilled	Microwave	Boiled	
	Tilapia products				
0	8.28	8	6.28	6.14	1.87
45	9.5	8.25	8	5	3.21
90	6.8	6	6.8	7.5	2.28
135	8.0	7.5	8	8.2	1.40
180	9.0	9	9	8.8	0.45
	Big eyed snapper (Morgan) products				
0	9.0	8.8	7.3	8.5	2.28
45	9.0	9	8.5	7	0.31
90	8.0	8.5	7.5	7	1.19

L.S.D least significant differences, * panelist were untrained, Scales from 1 to 10

Table 3: Mean score of odor for cooked tilapia and big eyed snapper Morgan products.

Storage period (day)	Cooked fish products				L.S.D. (*P≤0.05*)
	Fried	Grilled	Microwave	Boiled	
	Tilapia products				
0	8.14	6.7	6	6.9	1.63
45	8.5	6	7	7	3.84
90	6.6	7.3	6.9	5.1	1.79
135	7.7	8	7.8	6.9	1.30
180	8.8	8.8	8.8	8.8	0.75
	Big eyed snapper (Morgan) products				
0	8.3	8	7.6	8	2.28
45	8.8	8.17	7	7.17	1.17
90	8.5	8	7	7	1.6

L.S.D least significant differences, * panelist were untrained, Scales from 1 to 10

Table 4: Mean scores of taste for cooked tilapia and big eyed snapper (Morgan) products.

Storage period (day)	Cooked fish products				L.S.D. (*P≤0.05*)
	Fried	Grilled	Microwave	Boiled	
	Tilapia products				
0	8.3	6.6	6.6	7.43	1.6
45	9	6.5	7	7.5	4.87
90	5.9	7.3	6.6	4.9	2.03
135	7	8.2	7.3	6	1.90
180	8.3	9	8	7.3	1.79
	Big eyed snapper (Morgan) products				
0	8.8	7.8	7.8	7.8	1.8
45	9	8	7.3	7.3	1.2
90	8.5	7.5	7	7.5	1.19

L.S.D least significant differences, * panelist were untrained, Scales from 1 to 10

Table 5: Mean scores of overall acceptability for cooked tilapia and big eyed snapper products.

Storage period (day)	Cooked fish products				L.S.D. (*P≤0.05*)
	Fried	Grilled	Microwave	Boiled	
	Cooked tilapia products				
0	8.29	5.7	6.14	7.4	1.79
45	10	6.5	7	7	4.65
90	6.2	6.9	7	5	1.92
135	7.5	7.7	7.7	6.7	1.41
180	8.8	8.5	8.5	8.3	0.89
	Cooked big eyed snapper products				
0	8.8	7.8	8.5	8.3	2.04
45	9	8.17	7.3	8	1.3
90	8	7.5	7	7.9	1.67

L.S.D least significant differences, * panelist were untrained, Scales from 1 to 10

تأثير طرق الطهي المختلفة على الجودة الحسية لأسماك البلطي والمرجان المحفوظة بالتجميد

شيماء صبحي عبدالله [1,*], سيد مكاوي ابراهيم [2]

[1] *إدارة تغذية الطلاب بالأزهر الشريف.*

[2] *قسم تكنولوجيا تصنيع الأسماك, معمل تصنيع الأسماك, المعهد القومي لعلوم البحار والمصايد, القاهرة, مصر.*

* البريد الإليكتروني للباحث الرئيسي: shymasbhy456@gmail.com

الملخص العربي

يهدف البحث الى دراسة تأثير كل من التخزين بالتجميد على درجة حرارة -18° لمدة ستة أشهر وكذلك عمليات الطبخ المختلفة (التحمير – الشي- الطهو بالميكروويف- والسلق) على مقاييس الجودة الحسية (التقييم الحسي) من حيث (المظهر- القوام- النكهة- الطعم- القبول العام) لكل من أسماك البلطي النيلي والمرجان. وقد أظهرت النتائج أن جميع عينات الأسماك المطهوة بالتحمير حصلت على درجات عالية لجميع مقاييس الحسية لكلا النوعين سواء البلطي النيلي أو المرجان مقارنة بطرق الطهو الأخرى. وفيما يتعلق بالقبول العام كان هناك فروق معنوية ($P \leq 0.05$) بين عينات البلطى المطهو بالتحمير وكل من العينات (المشوية والمطهوة بالميكروويف) في بداية فترة التخزين. وكذلك ما بين العينات المطهوة بالميكروييف والمسلوقة بعد 90 يوماً من التخزين في عينات أسماك البلطى النيلي. وتعتمد الفروق المعنوية بين المنتجات المطهوة التي تم فحصها اعتماداً رئيسيا على فترات التجميد وكذلك علي نوع الأسماك والطريقة المستخدمة من حيث درجة الحرارة ووقت الطهو.

الكلمات الاسترشادية: السمك، طرق الطهي، الجودة الحسية.