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Qualitative assessment of imported frozen fish fillets in Sulaimani markets

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Abstract

This study aims to determine the quality of frozen fish fillets sold in Sulaimani city markets a total number of (64) sample of frozen fish fillets belonged to 4 foreign trademarks were collected from different parts of Sulaimani markets. The samples were subjected to physical and chemical tests to determine their quality and suitability for human consumption. The proximate chemical analysis referred to presence of significant differences in moisture, fat and protein content among the four trademarks except for ash content. While the physical indices showed that White fish fillets recorded the lowest thawing and cooking loss which in return recorded the highest WHC. Chemical indices showed that the pH mean values of Myanmar and Flander mark were significantly differed (P<0.05) than Hasson and White fish fillet, Although, the results of FFA recorded no significant differences among the trademarks, and Flander mark recorded the highest PV and TBA among the other which made it significantly differed than them and White fish fillet recorded the lowest, still, they were within the international standard limits. Where, the results of TVN values recorded no significant differences () among the inspected marks. All obtained results referred to the validity of these fish fillets for human consumption.

Keywords: Fish; Frozen fillets; Chemical Composition; Physical traits; Chemical indicators.
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التقييم النوعي لشرائح الأسماك المجمدة المستوردة في أسواق السليمانية

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الخلاصة

هدفت هذه الدراسة الى تقييم نوعية شرائح السمك المجمد والموجود في اسواق مدينة السليمانية لبيان صلاحيتها للاستهلاك البشري. تم جمع ٦٤ عينه لاخضاعها للفحوصات الفيزيائية والكيميائية. اظهرت نتائج الفحص الكيميائي التقريبي وجود اختلافات معنوية بين معايير الرطوبة، الدهن الخام والبروتين عدا الرماد. اظهرت نتائج شرائح السمك الابيض للدلائل الفيزيائية اقل نسبة فقد اثناء الاذابة ونسبة الفقد اثناء الطبخ مما ادى الى حصولها على اعلى نسبة قابلية حفظ للماء. اما الدلائل الكيميائية فاظهرت وجودالاختلافات المعنوية (P<0.05) لكل من علامتي مينمار و فلاندر عن علامتي حسون وشرائح السمك الابيض وبالرغم من عدم وجود اختلافات معنوية بين القيم الاحماض الدهنية المتطايره و حصول علامة فلاندر على اعلى (قيمة بيروكسيد وحامض البيربيوتريك) مما ادى ذلك الى اختلاف معنوي عن باقي الشرائح وحصول شرائح السمك الابيض على اقل نسبة فيها، اشارت النتائج المستحصلة كانت ضمن حدود المعايير الدولية المعتمدة. اما نتائج تحليل نسبة النتروجين الكلي المتطاير فقد تبين عدم وجود اختلافات معنوية (P>0.05) بين المفحوصة المفحوصة. كل النتائج اظهرت صلاحية هذه المنتجات للاستهلاك البشري.

Introduction

Fish freshness is fundamental to fish quality. The state of freshness can be described by a variety of definite properties of the fish which can be assessed by various indicators (1). Freezing and frozen storage have been largely used to retain fish sensory and nutritional properties (2,3). Fish muscle proteins can undergo denaturation during frozen storage due to formation and accretion of ice crystals resulting in dehydration (4). During frozen storage fish muscle may, however, lead to denaturation and aggregation of especially myofibrillar proteins. These changes result in altered functional properties, changed textural attributes and reduced water holding capacity and juiciness. The result is a hard, dry and fibrous fish product with a reduced eating quality. Moreover, liquid losses may also directly result in economic losses (5). Changes in lipid occur through hydrolysis and oxidation mechanism. The pH is considered as one of the important quality tests for evaluating the meat quality (6). As a result, the pH of fish muscle remains high after death (>6.0) favoring microbial growth and enzymatic activity (7). Thawing loss considered as one of an important tests because its determined the quality of frozen meat, the increase in leads to increase loosing of juice and the meat became dry and pale (8). The chemical spoilage associated with fish during storage is mainly due to fish lipid degradation (auto-oxidation). In general, fish have high degree of unsaturated lipids than other food commodities (9). According to Haard (10) fish lipids are subjected to two main changes, lipolysis and auto-oxidation. The main reactants in these processes involves atmospheric oxygen and fish unsaturated lipids, leading to the formation of hydroperoxides, associated with tasteless, flavor and accompanied by brown yellow discoloration of the fish tissue (11). Upon further degradation of hydroperoxides is the formation of strong rancid flavors e.g. aldehydes and ketones, usually associated with spoilt fatty fish species (12). With regard to evaluation of fish quality using chemical methods, the total volatile basic amines (TVB) constitute to the commonly measured chemical indicators. The concentration of these chemicals in fish tissues can be determined by steam distillation methods (13). Other methods such as Peroxide Value (PV) and Thiobarbituric Acid (TBA) also constitute to the chemical methods that are used to measure rancidity in fish and fish products generally. Free fatty acids (FFA) content has been used to establish the grade of deterioration (14). This study aimed to evaluate the physical and chemical quality parameter of some foreign trademarks of frozen fish fillets commercially available or sold in Sulaimani market.

Material and methods

The ultimate inspection included a total number of (64) samples of frozen fish fillets belonged to 4 foreign trademarks were collected from different parts of Sulaimani city markets. Physical and chemical tests were made in the laboratories of Animal Production Department, Faculty of Agriculture, University of Sulaimani, Kurdistan region, Iraq.

Chemical compositions

Chemical composition (moisture, protein, fat and ash) determined according to AOAC (15).

Physical indicators:

Water holding capacity (WHC) were measured according to (16). Cooking loss were measured according to (17). Thawing loss was done according to (18) method.

Chemical indicators:

The pH of the meat specimens were measured according to Naveena and Mendiratta (19). 10 grams were homogenized with 50ml of distillated water then filtered through whatman no.1 filter paper. pH of the filtrate was measured using digital pH meter. Total volatile nitrogen (T.V.N) was done according to (13), Thiobarbituric acid (TBA) value was analysis as described by (20) as adopted by (21), Free fatty acids (FFA) and peroxide value (PV) were analysis according to (22).

Statistical analysis

All data were subject to one-way analysis of variance (ANOVA) using SPSS 18.0 and XL Stat program for Windows. Differences Between the means were tested by Duncan's multiple range tests. The level of significance was chosen at $P<0.05$ and the results are presented as mean (23).

Results and discussion

Table (1) showed the chemical composition mean values for four trade of fish fillet. The moisture content mean values were 82.448; 81.742; 75.315; 73.340 % for Myanmar, Flander, Hasoon and White fish fillet respectively. Mayanmar and Flander mark were significantly different than the Hasson and White fish fillet which were not different in between. The protein content mean values were 13.727; 15.083; 20.375; 22.570 % for the four trademarks respectively. The first two marks were significantly different than the latter two marks. While the fat content means values were 1.665; 1.048; 2.008; 1.523% for the four marks respectively. Flander mark was significantly different than the other marks. The ash content mean values were 1.780; 1.657; 1.950; 2.100 % for the four trademarks respectively. There were no significant different among the marks.

Table 1: Chemical composition means of four trademarks of frozen fish fillets (Mean± SE).

Chemical composition	Trade marks			
	Myanmar	Flander	Hasoon	White fish fillet
Moisture%	82.448 ± 0.297a*	81.742 ± 1.103a	75.315 ± 2.663b	73.340±1.235b
Protein%	13.727 ± 0.393b	15.083 ± 0.821b	20.375 ± 1.841a	22.570±0.948a
Fat%	1.665 ± 0.227ab	1.048 ± 0.172b	2.008 ± 0.315a	1.523±0.441ab
Ash %	1.780 ± 0.069a	1.657 ±0.278a	1.950 ± 0.562a	2.100 ± 0.121a

*Means having different letters in the same raw are significantly different (P<0.05) for each parameter.

Physical indicators

The physical indices mean values for four trademark of frozen fish fillet are shown in table (2). The mean values of thawing loss were 22.208; 24.967; 21.375; 12.69 %, and for cooking loss were 28.083; 32.010; 38.575; 13.573 %, while water holding capacity were 29.815; 31.712; 42.857; 54.642 ml/ 10 gm meat for Myanmar, Flander, Hasson and White fish fillets marks respectively. Thawing loss recorded significant differences among the marks. While Hasson had the highest cooking loss and White fish fillet had the lowest, although the both mentioned marks were significantly different than the other two marks which were not differences in between. Water holding capacity showed that white fish fillet recorded highest value among the other marks and Myanmar recorded the lowest, which were significantly different than the rest trademarks.

Table 2: Physical traits means of four trademarks of frozen fish fillets (Mean± SE).

Physical traits	Trade marks			
	Myanmar	Flander	Hasoon	White fish fillet
Thawing loss	22.208 ±0.330b*	24.967 ±0.682a	21.375 ±0.476b	12.693 ±0.811c
Cooking loss	28.083 ± 0.850b	32.010 ±0.201b	38.575 ±3.899a	13.573 ± 1.593c
Water holding capacity	29.815 ± 1.090c	31.712 ±.379c	42.857 ± 0.420b	54.642 ±1.002a

*Means having different letters in the same raw are significantly different (P<0.05) for each parameter.

Chemical indices

Figure (1) showed the pH mean values of four trademarks of fish fillets. The results showed that Myanmar and Flander mark (7.908- 7.728) were significantly differed than Hasson and White fish fillet (6.885- 6.757).

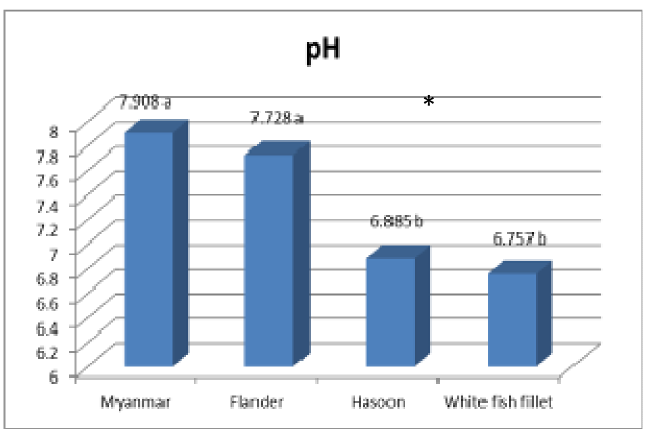

Figure 1: pH means for four trademarks of frozen fish fillets. *Means having different letters are significantly different (P<0.05).

Figure (2) showed the free fatty acid mean values for four trademarks of fish fillets. The results showed that there were no significant different among the samples trademarks.

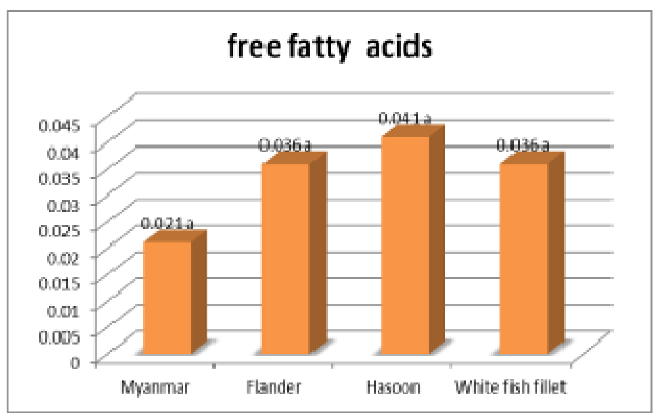

Figure 2: free fatty acid means for four trademarks of frozen fish fillets. Means having different letters are significantly different (P<0.05).

Figure (3) showed the peroxide value mean values for four trademarks of fish fillets. The results showed that

Flander mark recorded the highest value among the other which made it significantly differed than them. While, White fish fillet recorded the lowest.

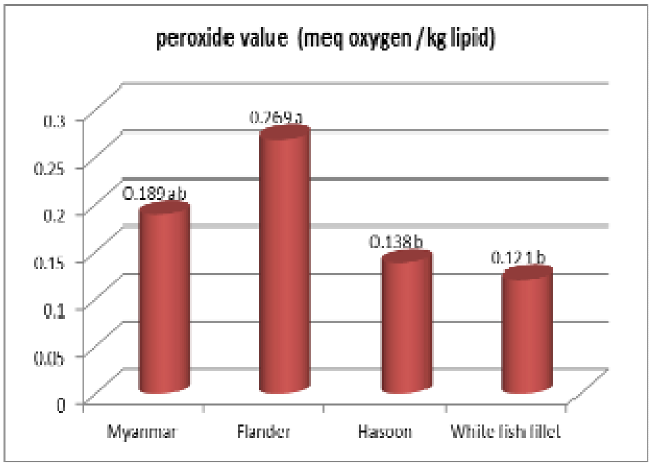

Figure 3: Peroxide value means for four trademarks of frozen fish fillets. Means having different letters are significantly different (P<0.05).

The mean values of Thiobarbituric acid for four trademarks of fish fillets are shown in figure (4). The values were 0.752; 0.879; 0.631; 0.470 mg Malonaldehyde/ kg meat for Myanmar, Flander, Hasson and white fish fillet respectively. Flander mark had the highest value while White fish fillet had the lowest.

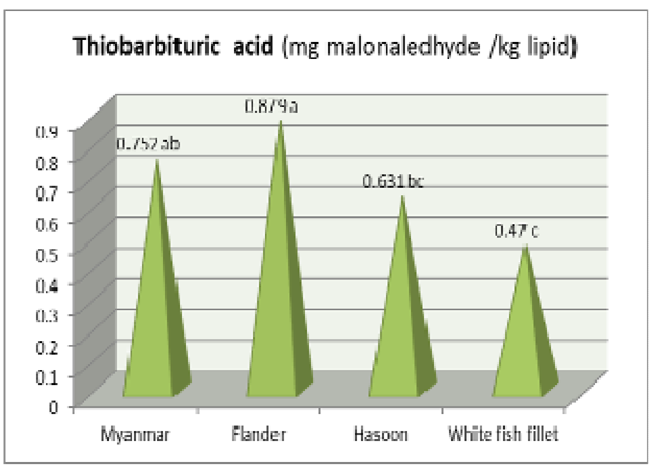

Figure 4: Thiobarbituric acid means for four trademarks of frozen fish fillets. Means having different letters are significantly different (P<0.05).

The Total Volatile Nitrogen (T.V.N.) of the frozen fish fillets of four trademarks are shown in figure (5). The mean values were 6, 11, 9, 13 mg N/100 g meat for the four trademarks respectively. There were no significant differences among the inspected marks.

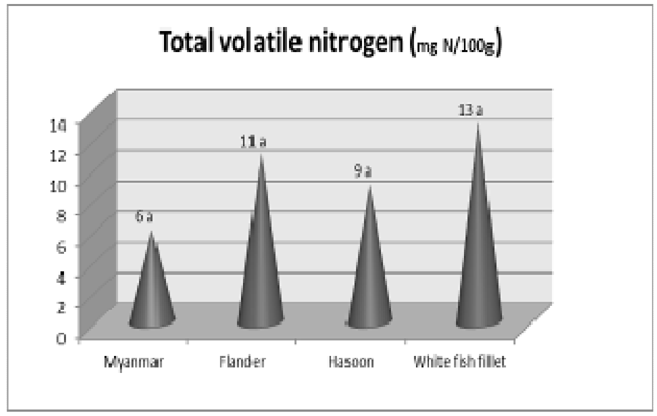

Figure 5: Total Volatile Nitrogen means for four trademarks of frozen fish fillets. Means having different letters are significantly different (P<0.05).

Discussion

It appeared that there was an inverse relationship between lipid and moisture contents in the four trade mark of fish fillet. This result is in agreement with previous investigation (24). Mayanmar and Flander recorded highest moisture content than Hasson and White fish fillet. The fat content showed that only Flander and Hasson mark were significantly differ from each other, this could be due to that lipid content of fish flesh, is directly related to the nutrition of the fish (25-27). Although high protein contents were shown in Hasson and white fish fillet mark, but the protein contents for all four marks occurred within the normal range values of protein in fish (15-25%) (9), and the variation in protein content could be due to the variation in species, feed availability, sexual maturity, spawning, season of catching and processing methods (28). The obtained results were within the range recorded by Burgaard (29), as the average lipid content of the 22 cod used in study was 0.7 % and the water content was 79.7 %. The average lipid content of the 22 trout was 8.2 % and the water content was 72.7 %. The average lipid content of the tuna used was 0.9 ± 0.2 % and the water content was 72.9. Data of ash contents showed no different among inspected marks, other studies have mentioned values of 1.05 - 1.29 % which are within the ranges found in the present study (30) and in Rainbow trout and Tilapia muscles (31). The proximate composition is species specific (32), so it is logic to see differences amongst all examined fish. However all values were within the normal ranges of proximate composition (water 66-84%, protein 15-25 % and fat 0.1 -24 %) (9).

Flander mark recorded the highest thawing loss (drip loss), while White fish fillet recorded the lowest, this variation could be due to, either type of freezing; at freezing fish muscles, the slow freezing will result in a considerable loss of fluid when the fish thawed. The smaller ice crystals formed, when fish is frozen quickly, were thought to do little damage to the cell walls and, as a result, little fluid was lost on thawing (11). Or due to the storage temperature; whenever the storage temperature was high (-30 to -40) whenever the lowest drip loss (30), or due to that the fish protein properties change during frozen storage and they are partially denaturized which can lead to water leakage (drip) when thawed and decreased water holding capacity (33, 34). Our results were higher than results mentioned by Magnea and Karlsdottir (35) who recorded the drip loss of fresh control cod fillets after (1) month of frozen storage was 10.7 while in control fresh skinless fillets after one month of frozen storage was 4.7.

The data of water holding capacity revealed that white fish fillet had the highest water holding capacity, while both of Flander and Mayanmar share the lowest. There are many factors that influence the water holding capacity of muscle tissue and can be categorised as internal or external factors. Internal factors are e.g. species, age, size, muscle type, amount of intra muscular fat and muscle tissue condition post mortem. External factors are e.g. feeding patterns, season and location of catching and handling post slaughter. Changes in chemical composition during processing are also important, especially in processes like salting (36).

In general, pH is commonly known to be one of the most important factors to affect the WHC of a product (37-39). The WHC is affected by the changes that take place in muscle tissue post mortem. Figure (1) showed that White fish fillet had the lowest pH value. Reduced WHC is primarily due to denaturation/aggregation of actin and in particular myosin. These are the main contractile proteins responsible for functional properties and their denaturation and aggregation is typically caused by ice crystal growth, increased ionic strength due to water crystallization and protein and lipid oxidation (33,34,39), the obtained results were lower than results obtained by Burgaard (29) who recorded the WHC in tuna samples at second month of frozen storage at (-10ºC) was 90.96 and at third month was 94.98.

The cooking loss results revealed that Hasson mark had the highest cooking loss while White fish fillet had the lowest. The low cooking loss may be due to increased moisture content, water holding capacity (table, 2) which leads to an increased ability of meat tissue to retain water and reducing loss during cooking and depended on protein percentage, lowering pH value (3), also affects cooking loss by changes in ionic balances of proteins on acidic pH. The determination of the WHC and cooking loss allows conclusions to be drawn about the degree of denaturation of the proteins and therefore the quality of the fish (40).

The glycogen levels of fish muscles are lower than those of mammalian muscles, mainly due to the stress of fishing. There were many studies involving the pH of fishes meat, such as Taşkaya et al. (41) who demonstrated the pH of fresh flesh as 6.83-7.03 but there was change in this value through storage period to reach 5.67-5.82. Kilinc and Cakli (42) noted in their study on fresh Sardine fishes that the pH was 6.72, Gandotra, et al. (43) studied the effect of chilling and freezing on fish muscles, and they used the muscles of *Mystus seenghala,* their results showed that at -12ºC (frozen) for 21 days the pH of the muscles were increases slightly from 6.8 to 7.1, although, Aubourg et al. (44) claimed that frozen storage did not have significant effect on pH changes during storage period.

Lipid (glycerol-fatty acids esters) present in the fish muscle undergoes hydrolysis, resulting in the release of fatty acids (45). Due to lipid hydrolysis, FFA accumulates in the tissue during frozen storage, especially at high temperatures around -10 to -20 °C (46, 47). Slow freezing rates or fluctuating storage temperatures may result in the lysis of lysosomes and thereby increased activity of some endogenous lipases resulting in increased rates of FFA accumulation (48). The obtained results were lower than the results recorded by Gandotra et al. (43), that at -12, the FFA in *Mustus seengala* muscles was 0.57 % on day zero and 5.61% on 21st day of storage. Rodriguez et al. (47) observed increasing FFA during frozen storage in farmed Coho salmon (*Oncorhynchus kisutch*). While Seifzadeh et al. (49) made a study to evaluate the fat quality in packaged common kilka fish (*Clupeonella cultriventris caspia*) soaked in whey protein compared with sodium alginate, they recorded the FFA at the first day was 4.10 and increases to 12.38 at the sixth month.

According to Connell (50), when the peroxide value exceeded 10 meq oxygen/ kg fat of fish meat, the fish meat is then considered unfit for human consumption or refused; all inspected marks were within the acceptable limits. Egan et al. (51) suggested that the rancidity flavor occur when peroxide values reach to 20-40 meq oxygen/ kg fat. So, the present investigation found that all four tested marks haven't showed rancidity flavor. The current result were lower than results of Rostamzad *et al.* (52) who recorded the PV level in control fillets of *Persian Sturgeon* during frozen storage increases from 0.2 in first day of storage to 10 at sixth month. While Seifzadeh et al. (49) recorded the PV at the first day was 0.2 and increases to 5.10 at the sixth month.

The good quality product should not be more than 5mg malonaldehyde/kg (53). According to this, all four inspected marks were with the limits. The increase of lipid content than the lipid oxidations resulting from action of lipolytic enzymes (Lipases and phospholipases) that fish phospholipids undergo degradation to produce hydroperoxides, Aldehydes and ketones which are responsible for the development of oxidative rancidity (54). The recorded results were less than the results of Rostamzad et al. (52) who revealed that the TBA values was 0.2 at first day of storage and increases to 2.7 at the sixth month. And with Seifzadeh et al. (49) who recorded the TBA at the first day was 0.03 and increases to 0.32 at the sixth month.

If the T.V.N. reaches 30mg N/100g most authorities would consider the fish to be stale, whilst at 40 mg N/100 g the fish is regarded as unfit for consumption. The level of TVN for white fish is generally considered to be fresh if the T.V.N. is less than 20mg N/100 g sample according to the Codex Alimentarius Committee proposed in 1968 the TVB assay by steam distillation (23). Although, Frozen storage have an effect on the lipid contents which might be related to fat oxidation (54-56), still, all inspected marks recorded a satisfied limits and they were not agree with the results of Seifzadeh et al. (49) who reported that TVN at the first day was 9.8 and increases to 21.7 at the sixth month.

Conclusion

Regarding the proximate chemical analysis with physical and chemical indices showed that all inspected marks were within limits specified by National regulations and with satisfied qualities, inspit for the frozen storage which have no significant effect on the quality of the samples.

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