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# Effect of pre-frozen storage and canning on quality aspects of silver carp (*Hypophthalmichthys molitrix*) fillets

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## Abstract

Effect of pre-frozen storage (at-18ºC/6 months) and canning conditions on quality aspects of silver carp fish (*Hypophthalmichthys molitrix*) fillets was investigated. Frozen fillets were canned in different filling media and stored at ambient temperature for one year. Results showed that raw carp fillets were composed (wet weight) 78.53% moisture, 17.13% protein, 2.75% lipid and 1.22% ash. Frozen storage caused a decline slightly in chemical composition. Besides, values of pH, thiobarbituric acid (TBA), total volatile bases (TVB), and trimethylamine (TMA) contents were increased with prolonging storage period. Concerning canning process, all previous values were reduced directly after canning and based on used filling media. Sensory tests showed that canned fillets with oil filling medium had got highest scores than others. However, a significant difference ($p \leq 0.05$) was found between different products. Also, storage periods had significantly ($P \leq 0.05$) affect taste and overall acceptability scores especially in canned with oil. Therefore, amino acids (AAs)

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and nutritional value were determined and showed that total AAs of canned fillets with oil was 99.97g/16 g N at zero time of storage then slightly decreased to be 99.46g/16 g N after one year storage. In conclusion, the quality parameters of silver carp fillets were largely affected by storage and canning conditions. Canned carp fillets with oil were considered as the best treatment; due to its high acceptance comparing with others. Also, canning process could be completely reduced of histidine which was found in frozen samples; however, extending storage period led to reformation of it.

**Keywords:** *Silver carp, freezing, canning, nutritional value.*

## 1-Introduction

Fish is widely consumed in many parts of the world because of its high protein content, low saturated fat that contains omega fatty acids known to support good health (Ikem and Egiebor, 2005). Carp fish is considered one of the main types of fish widely used in fish farms in the world. Their advantage is due to lively to faster of their growth, easily their breeding (Arthur et al., 2010). It is well known that frozen storage and canning treatments can prolong shelf-life of fish and their products. However, the thermal treatment leads to the formation of volatile amines, free fatty acids and secondary lipid oxidation compounds (anisidine and thiobarbituric acid values) as well as interaction compounds in canned fish (Rodríguez et al., 2009). It is possible to improve the quality of the product being canned; giving sardines with an added value in terms of quality and safety to the consumer that may increase the use of sardines as food for direct

human consumption (Uriarte-Montoya et al., 2010). Therefore, this study was done to study the effect of pre-frozen storage at -18˚C for 6 months and canning on quality parameters of silver carp fillets in different filling media (oil, vegetable and spices mixture) throughout 12 months storage at ambient temperature.

## 2-Materials and methods

**2-1-** Fish samples: silver carp fish (*Hypophthalmichthys molitrix*) samples were obtained from Manzala farm, Dakahlia Governorate, Egypt. The average weight (mean ± SD) was 2±0.5 kg. Fish samples were carefully washed with tap water and transported by using ice box within three hours to Fish Processing Technology Laboratory, El-Qanater El-Khairia-Fish Research Station, National Institute of Oceanography and Fisheries.

**2-2-** Vegetables and other additives: commercial frozen beans and peas, carrot, onion, spices mixture, sodium chloride, tomato sauce (ketchup) and sunflower oil were obtained from local market. Spices mixture consists of 32% black pepper, 22.50% coriander, 15% cumin, 10% cardamom, 9% red pepper, 7.5% cubeb and 4% cloves.

**2-3-** Freezing: silver carp samples were eviscerated, beheaded, filleted, glazed with chilled water (4ºC), packed in polyethylene bags and frozen stored at -18 °C for 6 months.

**2-4-** Canning process: frozen fillets were manufactured in tin cans enameled C (8.8cm highest, 5.5cm diameter and 170g capacity) as follows: (A) canned fillets with oil (70% fish fillets,10% brine and 10% heated oil); (B) canned carp mince (resultant trimming) with

spices (70% fish mince, 3% spices mixture,10% brine and 10% heated oil) and (C) canned fillets with vegetables [70% (60% fillets and 40% vegetables mixture), 10% tomato sauce,10% brine and 10% heated oil]. 40% vegetables mixture consists of 60% pastured peas and beans, 25% fried carrot, 12% fried onion and 3% spices mixture (as mentioned in type B). After that, all batches (A, B and C) were exhausted at 60°C for 15 min. double seamed, commercial sterilized at 116°C for 60 min and 1.2 bar by horizontal retort and suddenly cooled (El-Sherif, 2001 and Abd-El-Ghafour, 2004).

Canning process was carried out by the Edfina Co. for preserved Foods, Damietta Governorate. All canned carp products were stored at room conditions for 12 months and periodically analyzed every four months.

**2-5- Analytical Methods**

Moisture, protein, fat and ash contents were determined (AOAC, 2000). pH value was measured by checker pocket-sized pH meter with replaceable electrode (HANNA Instruments, USA), thiobarbituric acid (TBA) value and total volatile basic nitrogen (TVB-N) were determined (Pearson, 1976). Trimethylamine nitrogen (TMAN) was determined (AOAC, 2000). Individual amino acids were determined using reverse phase HPLC; hydrolysis, derivatization and analysis were performed according to the Pico-Tag method (Millipore Co-operative, 1987). Tryptophan was not determined. Indispensable amino acids were calculated in relation to FAO/WHO (1985) reference protein. Essential amino acid index (EAAI) and biological

value (BV) were calculated (Oser, 1959). Protein efficiency ratio was calculated (Alsmeyer et al., 1974).

Microbial analysis: total viable count (TVC) was determined (FAO, 1992). The results were expressed as log10 cfu/g sample.

Sensory characteristics; appearance, texture, odour, taste and overall acceptability were evaluated by ten staff members of El-Qanater El-Khairia Station for fish Research, NIOF. A ten point scale was used where 10 = excellent and 1 = extremely poor (El-Sherif, 2001). Data of sensory tests was statisticaly analyzed using one way analysis of variance (ANOVA) and Least Significant Differences test (LSD) was conducted to calculate significance ($P \leq 0.05$) among the treatments mean (SPSS, Ver.10). The results obtained were expressed as mean values (n=3).

## 3- Results and discussion

### 3-1- Chemical composition

Table (1) shows chemical composition of fresh fish, fillets pre-frozen stored at -18°C for 6 months and their canned products. Raw carp fillets were composed 78.53% moisture, 17.13% protein, 2.75% lipid and 1.22% ash content (wet weight). Frozen storage caused a little change in all values of chemical composition. These changes are due to the evaporation of water, separated drip and lipid hydrolysis, oxidation of lipids during thawing process. Similar findings are in agreement with those mentioned by Abo- Zeid (1995); Hanafy (2002) and Sarhan (2003); Ibrahim and El-Sherif (2008) and Ibrahim and Dosuky (2009).

On the other hand, canning and filling media are main factors affected chemical composition. Canned product type C had a high content of lipid resulting fried carrot and onion used. These changes in composition of canned fish may be due to denaturation protein, oxidation and hydrolysis of lipids as affected by thermal process. These observations are in agreement with those mentioned by Arafa, (1994); Abo-Taleb (1997); Ibrahim (1999); Abd-El-Ghafour (1999 & 2004); El-Sherif (2001).

**3-2- Quality parameters**

Table (2) exhibits the effect of pre-frozen storage and canning on quality parameters of carp fillets. pH value was increased to 6.77 in frozen sample comparing with initial value (6.34). This is due to changes in proteinous compounds and formation volatile basic nitrogen components as affected by biochemical changes under low temperature. TVB content was increased from 13.93 of fresh sample to 23.10 mg/100 g sample after 6 months of frozen storage. Also, values of TMA were sharply increased from 0.35 to 2.68 mg/ 100 g sample at the end of frozen storage (180 days). This increment in TVB may be due to microbial activity under low temperature. The same trend was observed in TBARS value where it was 0.06 in raw fish increased to 1.30 mg malonaldhyde/kg flesh; due to lipid hydrolysis and secondary products formation under low temperature. These phenomena were reported by Abo-Zeid (1995); Hanafy (2002) and Sarhan (2003); Ibrahim and El-Sherif (2008) and Ibrahim and Dosuky (2009).

With regard to the effect of canning, pH values were slightly decreased in canned products especially in case of canned C; due to tomato sauce used with vegetables mixture. TVB content was decreased in all products. Its content was higher in product B than others. This is because of product type B contained fish mince. TMA value was taken the same trend in TVB content. Also, its content in canned type A was slightly higher than ones. An increase in TVB and TMA content is due to derivatives resulting protein content was more than that other products. Furthermore, value of TBA was decreased in all products after directly canning and it was increased with extend storage period. TBA was more value than other products. Also, Table (2) shows total viable count (TVC) of canned fish products as affect by pre-frozen storage and canning. TVC was increased to 5.65 in frozen fillets comparing its initial count (3.45 log10 cfu/g) in raw flesh. After canning, TVC decreased in all canned fillets products and increased at the end of storage period. Also, TVC was lower in product type B than products A and C; may be due to type B contained spices mixture as antimicrobial agent. In general, filling media used are played an important role in quality parameters in carp products. Similar results were found by Arafa, (1994); Abo-Taleb (1997); Ibrahim (1999); El-Sherif (2001); Abd- El-Ghafour (1999 & 2004).

**3-3-Sensory evaluation**

Table (3) shows the effect of storage period on sensory evaluation of canned carp products. Biochemical changes in canned fish products are reflect on sensory evaluation by panelists. Appearance scores of

canned fish in oil were the best product compared with others. Spices used in canned fish mince could be improved odour, taste and canned fillet with vegetables mixture had been given high scores by increase of storage periods. There were significant different ($P \leq 0.05$) between different fish products. Also, storage periods had significant ($P \leq 0.05$) effect on taste and overall acceptability scores especially in product A. Therefore, nutritive value was done in canned product type A compared with frozen fish fillets.

**3-4- Nutritive value**

Effect of pre-frozen storage and canning on amino acids (AAs) composition of carp fillets is shown in Table (4). AAs were 99.98% of 17 amino acids, while tryptophan was not determined. High value of serine was 34.39 g/16g N while glycine, alanine, phenylalanine and arginine were not detectable. The restricting AA was valine. After canning, total AAs of canned fish with oil at zero time of storage was 99.97g/16 g N and decreased slightly to 99.46g/16 g N after 12 months storage. In addition, total essential AAs were 40.47 and 34.76g/16gN in oil-canned product after canning and at the end of storage, respectively. Moreover, the restricting AA was therionine at zero time of storage while at the end storage period was (phenylalanine and tyrosine). Alanine, phenylalanine and histidine were not detectable at the beginning of storage. Also, leucine, thrionine and phenylalanine were not found but histidine was 0.35 g/16gN at the end of storage.

Data in Table (5) shows effect of storage period on grams

consumed to cover the daily requirements of adult man (GDR) and the percentage satisfaction of the daily requirements of adult man (PS/150%) of canned fillets with oil. Results showed that 150g was enough for GDR and PS/150% in relation to USRDA (1989). The restricting EAA was threonine (5670g GDR and 3g PS) at zero time of storage, while phenylalanine + tyrosine (2993g GDR and 5g PS) was a RAA at the end of storage. However, some EAA were covered at a high proportion such as leucine (47g GDR and 319g PS), and methionine + cystine (54g GDR and 278g PS) at zero time of storage, while isoleucine (32g GDR and 469g PS) and valine (64g GDR and 234g PS) were found at the end of storage. These changes in protein quality of canned carp in oil filling medium were affected by extending storage period. Similar findings were reported by El-Sherif (2001) and Abd- El-Ghafour (2004).

**4- Conclusion**

In conclusion, the quality parameters of carp fillets were largely affected by pre-storage and canning conditions. Canned carp fillets in oil are considered the best treatment; due to its sensory scores comparing with others. Also, canning process could be completely reduced of histidine which was found in frozen samples however, extending storage period led to reformation of it.

**Table (1) : Chemical composition of fresh silver carp, fillets pre-stored at -18˚C/ 6 months and stored at room temperature /12 months.**

| Canned carp products | Fresh carp flesh | Frozen carp flesh for 6 months | Storage period of canned carp fish products (months) | | | |
|---|---|---|---|---|---|---|
| | | | Zero | 4 | 8 | 12 |
| | **Moisture%** | | | | | |
| A | 78.53 | 77.74 | 77.48 | 76.71 | 74.50 | 72.86 |
| B | -- | -- | 75.64 | 74.12 | 74.24 | 70.32 |
| C | -- | -- | 75.06 | 74.15 | 74.78 | 70.89 |
| | **Crude protein%** | | | | | |
| A | 17.13 | 18.27 | 19.06 | 18.60 | 20.76 | 23.76 |
| B | -- | -- | 19.65 | 20.01 | 21.03 | 23.66 |
| C | -- | -- | 18.40 | 20.38 | 20.98 | 22.37 |
| | **Lipid%** | | | | | |
| A | 2.75 | 2.16 | 1.45 | 1.26 | 1.89 | 1.68 |
| B | -- | -- | 1.62 | 1.98 | 2.05 | 2.30 |
| C | -- | -- | 1.96 | 1.68 | 2.72 | 3.10 |
| | **Ash %** | | | | | |
| A | 1.22 | 1.09 | 1.95 | 1.95 | 1.73 | 1.97 |
| B | -- | -- | 2.02 | 2.27 | 2.11 | 2.18 |
| C | -- | -- | 2.57 | 2.89 | 2.30 | 2.87 |

**A :** Canned carp fillets with oil; B: Canned carp mince with spices mixture; C: Canned carp fillets with vegetables mixture.

**Table (2): Quality parameters of fresh silver carp, fillets pre-stored at -18˚C/ 6 months and canned products stored at room temperature /12 months.**

| Canned carp products | Fresh carp flesh | Frozen carp fillets for 6 months | Storage period of canned carp fish products (months) | | | |
|---|---|---|---|---|---|---|
| | | | Zero | 4 | 8 | 12 |
| | pH value | | | | | |
| A | 6.34 | 6.77 | 6.06 | 5.83 | 5.89 | 5.67 |
| B | -- | -- | 5.96 | 5.80 | 5.86 | 5. 75 |
| C | -- | -- | 4.94 | 4.74 | 5.07 | 4.94 |
| | **Total Volatile Basic Nitrogen (TVB-N) mg/ 100 g flesh** | | | | | |
| A | 13.93 | 23.10 | 18.20 | 9.80 | 22.40 | 16.80 |
| B | -- | -- | 20.05 | 16.80 | 25.20 | 23.80 |
| C | -- | -- | 16.00 | 8.40 | 12.60 | 11.20 |
| | **Trimethylamine Nitrogen (TMA-N) mg/ 100 g flesh** | | | | | |
| A | 0.35 | 2.68 | 1.27 | 1.17 | 1.45 | 1.84 |
| B | -- | -- | 1.39 | 1.22 | 0.62 | 1.45 |
| C | -- | -- | 0.91 | 0.66 | 1.35 | 1.27 |
| | **Thiobarbituric acid (TBA) mg Malonaldhyde/ kg flesh** | | | | | |
| A | 0.06 | 1.30 | 0.41 | 1.72 | 2.07 | 2.81 |
| B | -- | -- | 0.30 | 1.21 | 2.10 | 1.21 |
| C | -- | -- | 0.99 | 0.94 | 1.09 | 1.06 |
| | **Total viable count(TVC) log 01 cfu/g flesh** | | | | | |
| A | 3.45 | 5.65 | 5.59 | 4.70 | 4.80 | 5.14 |
| B | -- | -- | 5.68 | 4.63 | 4.81 | 4.98 |
| C | -- | -- | 5.59 | 4.76 | 4.92 | 5.24 |

**A :** Canned carp fillets with oil; B: Canned carp mince with spices mixture; C: Canned carp fillets with vegetables mixture.

**Table (3): Mean scores of sensory attributes of canned carp products.**

| Canned carp products | Storage period of canned carp fish products (months) | | | | LSD (P≤0.05) |
|---|---|---|---|---|---|
| | 0 | 4 | 8 | 12 | |
| **Appearance** | | | | | |
| A | 8.5 | 8.4 | 8.2 | 8.0 | 0.559 |
| B | 8.0 | 8.0 | 7.8 | 7.9 | 0.475 |
| C | 7.8 | 7.8 | 7.5 | 7.2 | 0.430 |
| LSD (P≤0.05) | 0.598 | 0.896 | 0.549 | 0.602 | |
| **Odour** | | | | | |
| A | 8.7 | 8.4 | 8.0 | 6.5 | 0.345 |
| B | 8.0 | 8.0 | 7.6 | 7.5 | 0.839 |
| C | 7.5 | 7.5 | 7.3 | 7.2 | 0.560 |
| LSD (P≤0.05) | 0.230 | 0.704 | 0.421 | 0.896 | |
| **Taste** | | | | | |
| A | 8.8 | 7.9 | 6.5 | 5.5 | 0.430 |
| B | 7.8 | 7.6 | 7.4 | 7.3 | 0.670 |
| C | 7.2 | 7.1 | 7.1 | 7.0 | 0.409 |
| LSD (P≤0.05) | 0.280 | 0.030 | 0.430 | 0.395 | |
| **Overall acceptability** | | | | | |
| A | 8.8 | 8.2 | 7.8 | 6.5 | 0.430 |
| B | 8.1 | 8.0 | 7.6 | 7.6 | 0.723 |
| C | 7.6 | 7.5 | 7.5 | 7.2 | 0.476 |
| LSD (P≤0.05) | 0.195 | 0.222 | 1.342 | 0.280 | |

**A :** Canned carp fillets with oil; B: Canned carp mince with spices mixture; C: Canned carp fillets with vegetables mixture.

**Table (4): Amino acids composition of carp fish pre- stored at -18 °C/ 6 months and canned with oil after 12 months storage at room temperature.**

| Amino acids | FAO/ WHO/ UNU (1985) g/16 g N | Frozen silver carp fish at -18 ◦c for 6 months | | Canned carp product at zero time of storage | | Canned carp product after 12 months storage | |
|---|---|---|---|---|---|---|---|
| | | g/ 16 g N | Amino acid score (AAS) | g/ 16 g N | Amino acid score (AAS) | g/ 16 g N | Amino acid score (AAS) |
| Aliphatic: | | | | | | | |
| Isolucine | 1.3 | 5.22 | 402 | 4.39 | 338 | 18.20 | 1400 |
| Leucine | 1.9 | 11.80 | 621 | 16.94 | 892 | ud | - |
| Thrionine | 0.9 | 0.11 | 12 | 0.06 | 7* | ud | - |
| Valine | 1.3 | 0.11 | 8* | 2.59 | 199 | 9.03 | 695 |
| Serine | | 34.39 | | 29.83 | | 37.05 | |
| Glycine | | ud | | 8.43 | | ud | |
| Alanine | | ud | | ud | | 6.70 | |
| Aromatic: | | | | | | | |
| Phenylalanine | | ud | | ud | | ud | |
| Tyrosine | | 1.53 | | 1.66 | | 0.28 | |
| Phenyl.+Tyr. | 1.9 | 1.53 | 81 | 1.66 | 87 | 0.28 | 15* |
| Sulpher: | | | | | | | |
| Methionine | | 2.21 | | 10.70 | | 2.18 | |
| Cystine | | 7.83 | | 2.46 | | 2.18 | |
| Meth. + Cyst. | 1.7 | 10.04 | 591 | 13.16 | 774 | 4.36 | 256 |
| Heterocyclic: | | | | | | | |
| Tryptophan | 0.5 | nd | | nd | | nd | nd |
| Proline | | 1.76 | | 1.86 | | 0.35 | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Acidic: | | | | | | | |
| Aspartic | | 24.40 | | 10.63 | | 8.53 | |
| Glutamic | | 9.31 | | 7.37 | | 12.06 | |
| Basic: | | | | | | | |
| Histidine | 1.6 | 0.91 | 25 | 0.00 | | 0.35 | |
| Lysine | 1.6 | 0.40 | | 1.66 | 104 | 2.54 | 159 |
| Arginine | | ud | | 1.39 | | 0.01 | |
| TAA | | 99.98 | | 99.97 | | 99.46 | |
| TEAA | | 30.12 | | 40.47 | | 34.76 | |
| EAAI | | | | 20.63 | | | |
| BV% | | | | 10.76 | | | |
| PER | | | | 6.95 | | | |

**Nd :** not determined; TAA: total amino acids; UD:Untetectable; TEAA: total essential amino acids; TEAAI: total essential amino acid index; BV: biological value; PER: protein efficiency ratio; *:Restricting A.A.

**Table ( 5 ): GDR (g) & PS (150g %) of canned carp product with oil at zero time and after 12 months storage at room temperature.**

| Amino acids (AA) | USRDA (1989) | Canned carp product at zero time of storage | | | Canned carp product after 12 months storage | | |
|---|---|---|---|---|---|---|---|
| | | g\100g | GDR(g) | PS/150g% | g\100g | GDR (g) | PS/150g% |
| Aliphatic: | | | | | | | |
| Isolucine | 0.819 | 0.66 | 124 | 121 | 2.58 | 32 | 469 |
| Leucine | 1.197 | 2.55 | 47 | 319 | ud | - | - |
| Thrionine | 0.567 | 0.01 | *5670 | 3 | ud | - | - |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Valine | 0.819 | 0.39 | 210 | 71 | 1.28 | 64 | 234 |
| Serine | | 4.49 | | | ud | | |
| Glycine | | 1.27 | | | 5.25 | | |
| Alanine | | ud | | | 0.95 | | |
| Aromatic: | | | | | | | |
| Phenylalanie | | ud | | | ud | | |
| Tyrosine | | 0.25 | | | 0.04 | | |
| Phenyl.+ Tyr. | 1.197 | 0.25 | 479 | 31 | 0.04 | *2993 | 5 |
| Sulpher: | | | | | | | |
| Methionine | | 1.61 | | | 0.31 | | |
| Cystine | | 0.37 | | | 0.31 | | |
| Meth.+ Cyst. | 1.071 | 1.98 | 54 | 278 | 0.62 | 173 | 87 |
| Heterocyclic: | | | | | | | |
| Tryptophan | 0.315 | nd | | | nd | | |
| Proline | | 0.28 | | | 0.05 | | |
| Acidic: | | | | | | | |
| Aspartic | | 1.60 | | | 1.21 | | |
| Glutamic | | 1.11 | | | 1.71 | | |
| Basic: | | | | | | | |
| Histidine | 1.008 | 0.00 | | | 0.05 | 2016 | 7 |
| Lysine | | 0.25 | | | 0.36 | | |
| Arginine | | 0.21 | | | 0.002 | | |

**Nd :** not determined; UD:Untetectable; G.D.R.: The grams consumed to cover the daily requirements of adult man; P.S. / 150%: The percentage satisfaction of the daily requirements of adult man.; *R.A.: Restricted essential amino acid.

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# تاثير التخزين بالتجميد والتعليب على جودة شرائح أسماك المبروك الفضى

**محمد أبو طالب - سيد مكاوي ابراهيم - شعبان عبد الحليم الشريف**
معمل تكنولوجيا تصنيع الأسماك - المعهد القومى لعلوم البحار والمصايد - مصر

**المستخلص :**

يهدف هذا البحث إلى دراسة تاثير ظروف التخزين بالتجميد (-١٨°م / ٦ شهور) والتعليب على جودة شرائح أسماك المبروك الفضى . تم الحصول على عينات اسماك المبروك الفضى من مزرعة المنزلة – محافظة الدقهلية ، وقد أجريت عمليات التنظيف والتشفية وتجهيزها يدويا ثم تعبئة الشرائح السمكية فى اطباق فوم ومغلفة بالبولى اثيلين وحفظت بالتجميد (- ١٨ °م / ٦ شهور). أجريت عملية التعليب على تلك الشرائح فى اوساط تعبئة مختلفة (بالزيت ، والمفروم الناتج من عملية التشفية بالتوابل، وخليط من الخضروات) ثم خزنت على درجة حرارة الغرفة لمدة عام. وبإجراء تطبيق بعض معايير الجودة على المنتجات محل الدراسة أوضحت النتائج الآتى :

احتوت شرائح سمك المبروك الفضى الخام على ٧٨,٥٣٪ رطوبة، ١٧,١٣٪ بروتين، ٢,٧٥٪ دهون، ١,٢٢٪ رماد، و(على أساس الوزن الرطب). أدت ظروف التجميد الى حدوث تغيرات طفيفة فى هذه القيم وكذلك فى قيم معايير الجودة. أيضا أحدثت عملية التعليب تغيرات في معايير جودة شرائح المبروك لكنها كانت فى الحدود المسموح بها من قبل المواصفات القياسية المصرية، وحسيا فقد حصلت شرائح المبروك المعلبة بالزيت على قيم أعلى مقارنة بالمنتجات الأخرى ، وبناءا على ذلك فقد تم تقدير القيمة الغذائية لهذا المنتج حيث بلغت الأحماض الأمينية ٩٧,٩٩ جم / ١٦ جم نيتروجين بعد التعليب مباشرة بينما حدث انخفاض طفيف ( ٤٦,٩٩ جم / ١٦ جم نيتروجين) فى نهاية فترة التخزين (١٢ شهرا على درجة حرارة الغرفة).

وبناءا على النتائج المتحصل عليها فان كلا من ظروف التجميد والتعليب قد أثرت على معايير الجودة لشرائح سمك المبروك الفضى فضلا على أن المنتجات المعلبة في الزيت كانت أكثر قبولا مقارنة بالمنتجات الأخرى. هذا بالاضافة الى أن عملية التعليب قد أدت الى اختفاء حمض الهستدين بصورة كاملة بينما أدت ظروف التخزين الى تكوينه مرة أخرى.