Zagazig J.Agric. Res., Vol.30 No.(4) 2003 1667-1689

EFFECT OF CANNING PROCESS ON SOME CHEMICAL CHANGES OF CANNED COMMON CARP *(CYPRINUS CARPIO L.)* AND TUNA FISH*(TUNA SP.)*

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Received 14 / 4 / 2003 *Accepted 14 / 5 / 2003*

ABSTRACT: Fish is an excellent source of animal protein with high biological value, vitamins, minerals and polyunsaturated fatty acids. There are many methods available for processing and preserving including, cooling, freezing, pickling, fermenting, smoking, salting, drying and canning. Canning is one of the old methods for processing and preserving of the food and the canning process depending on using the high temperature which lead to destroy the most of microorganisms which found in the cans. This study was carried out in the Central Laboratory for Aquaculture Research (CLAR), Agriculture Research Center, Ministry of Agriculture Abbasa Abou-Hammad Sharkia governorate and cooperation with production united food products Ismaelia industrial zoon.

Proximate composition of canned common carp and tuna fish packed in salt, lemon juice and nisin solution in presence of olive, cotton seed oil and mixture of each oils (1:1 v/v) sterilized at 110 °C for 55 min and 121°C for 40 min after canning process immediately. While fatty acids and minerals levels, were studied in canned of common carp (*Cyprinus carpio l.*) and tuna fish samples *(Tuna sp)*,after stored for six months at room temperature. The obtained results indicated that, moisture and protein contents decreased after canning, while fat and ash content increased. Besides an increase in fatty acids content was observed in all canned samples after storage

for 6 months at room temperature. The essential fatty acid C18:1, C18:2 and C18:3 (oleic, lenolanic and lenolaic) indicated in samples canned in presence of olive oil, because the olive oil have a high concentration of essential fatty acid C18:1, C18:2 and C18:3 (Oleic, lenoleic and lenolenic) compared with cotton seed oil and mixture of each oils.

On the other hand, the obtained results revealed an increase in minerals content in all canned samples during storage period for 6 months at room temperature. The concentration of minerals was higher in canned samples packed in lemon juice solution due to its autolysis effect on tissues.

INTRODUCTION

Freezing and canning are the preferred methods for long term preservation of fish. It is axiomatic that the quality of the canned products depends primarily up the raw material, resulting from the natural characteristics of the fish, prestorage before canning and the handling prior to canning. Environmental factors and the life cycle often have an influence. Other seasonal variations affect the composition of the fish, mainly the fat, water contents, and influence the flavour of the final product. Storage conditions also greatly influence the quality of the final product.

Belitz and Grosch (1988) declared that salting, drying and canning are three conventional practices used by many cultures to preserve food. Nowadays these processes are not only used to preserve food but also to give them a special flavor.

Darweish *et al.* (1990) reported that canning process reduced the total nitrogen of the fish flesh which may be ascribed to the leaching of some nitrogeneous compounds with the escape fluid in the cans. Upon canning, the total nitrogen of customary smoked canned samples decreased by 2.02% and 0.95% when compared with the smoked mackerel and bolti fish samples respectively (before canning).

El-Samkary *et al.* (1997) reported that, canned silver carp processed from presorted fish showed lower protein and moisture contents while canning caused an increase in fat and ash.

Perez *et al.* (1997) investigated, the nutritional value of four kinds of canned sardines in olive oil, soybean oil, tomato sauce and a marinade. They found that, the content in protein and ash was similar in the four preparations, but not in the level of fat, which was higher in the preparations with oil. The composition of fatty acids had more to do with the kind of oil used in the covering of the food than with the commercial preparation of it.

On the other hand, Fish and fish oil fatty acids are currently under intense scientific investigation because of the numerous health benefits attributed to them. Researchers have shown that freshwater fish generally contain lower proportions of w-3 (n-3) polyunsaturated fatty acids (PUFA) than marine fish (Huah *et al.* (1995).

Baltasar *et al.* (1998) reported that, the effect of maturation on the palatability of sardines showed a significant loss of saturated fatty acid in fish during the canning process while, polyunsaturated fatty acid (PUFA) showed almost no variation. The palatability of sardines was significantly higher after 6 months of maturation than immediately after canning and this quality was maintained for at least 5 years of storage.

Basby *et al.* (1998) noticed that fresh and lightly salted roe had similar compositions of fatty acids and total amino acids. In contrast, lightly salted roe had increased levels of free fatty acids, peroxide values, thiobarbituric acid (TBA-values) and free amino acids.

Sinclair *et al.* (1998) reported that, highest levels of n-3 fatty acids were found in fresh and smoked sardines, mackerels, red salmon and atlantic salmon while the lowest levels were found in tuna.

Wirth *et al.* (2000) demonstrated that average of protein content varied between 26.2 and 31.1% (wet wt.) and fat content from 10.9 to 19.4% with lowest values for caviar from farmed sturgeon. The same authors reported that Cu and Zn concentration of caviar from sturgeon varied between 1.20 - 1.69 and 10.3 - 12.4 mg/kg, respectively. These values reflect the elevated requirement of sturgeons for these components. Also, Pb content varied between 0.06 and 0.15 mg/kg and Cd concentration were <5 µg/kg leading to conclusion that no

accumulation took place in the eggs.

MATERIALS AND METHODS

1. Sampling:

Common carp fish (*Cyprinus carpio*) was immediately obtained after catching from Abbasa farm in Sharkia government Egypt. Each samples weighted 50 Kg. While the mean of individual weight of common carp fish was about 2.5 Kg After that, the fish samples were washing using tap water, then the head, scales and all fins of common carp fish were removed using a sharp knife. After that, the internal viscera was removed by hand then washing the fish using tap water.

Tuna fish was obtained from the local market (El-obor) samples weighted 50 Kg, after that the fish was clean and washing using tap water, then the head and all fins were removed using a sharp knife. After that, the internal viscera was removed by hand and the fish was washing using tap water. Fish samples (common carp and tuna) were packed in ice boxes and transported to the factory in the second industrial zone of Ismailia (United food products company).

The samples were soaking in saturated salt solution with a littel acetic acid (6%). then, washing the fish samples using tap water to remove the over salt. The fish samples were cutting and packed in the cans. The common carp cans weighed were 340.0 gm. (310.0gm. Common carp fish, 10.0ml. oil and 20.0 ml. packing solution.) while the tuna samples cans weighed were 105 gm. (75.0gm. tuna, 10.0ml. oil and 20.0ml. packing solution.) The olive oil, cotton seed oil and mixture of each (olive oil and cotton seed oil 1:1 v/v) added for every can. On the other hand, packing solution consists of salt solution, lemon juice solution and nisin solution were individually added for every can.

2. Preparation of packing solutions:

2.1. Salt solution preparation :

Astock of salt solution was prepared from commercial salt containing sodium chlorid 2.0% (w/w), 3.5% vinegar (6% conc.) and 1.5% spices mixture consists of 22.5% coriander, 7.5% cubeb, 15.0% cummin, 32.0% black pepper, 9.0% red pepper, 10.0% cardamon and 40.0% cloves.

2.2. Lemon juice solution preparation :

A stock of lemon juice solution was prepared from lemon juice and salt solution which preparation (2-1). The pH was adjusted using pH-meter (Orion Research Digital Ion analyzer, Model 420A.) the pH of a stock Lemon solution was adjusted at pH 4.

2.3. Nisin solution preparation:

A stock of nisin was prepared from a commercial preparation containing (14 p.p.m) nisin. The commercial preparation was dissolved in salt solution preparation (2-1) using HCl 0.02 N to pH 2- 4 in which the nisin will be dissolved, Kelley *et al.* (1999). The pH of a nisin stock solution was adjusted to pH 4 using pH-meter (Orion Research Digital Ion analyzer, Model 420A.).

3. Pre-heating :

Samples of common carp and tuna fish were pre-heated by steaming at (100 °C for 30 min) and then sealed .

4. Sterilization of the cans:

Sterilization was performed at 110 °C and 121 °C for 55 and 40 min at pressure respectively. After sterilization the cans were cooling for 10 min using cooled water. After that, the cans were carefully dried and incubated for 21 days at 37°C. then, the samples were stored at room temperature for 6 months , where after. Samples were periodically with draun every month for analyses

5. Analytical procedures:

Moisture was determined by oven drying at 105 °C to constant weight as mentioned in the AOAC (1990). Crude protein was determined by Kjeldahl procedure using a 6.25 conversion factor according to the method described in the AOAC (1990). Total lipids were measured by extraction using chloroform: methanol method (2:1, v/v) as described by Bligh and Dyer (1959). Ash was determined by aching at 550°C using a muffle furnace according to the method described in the AOAC (1990). Minerals content were determined using Atomic Absorption Spectrometer (AAS). Model, Perkin-Elmer 2280, with an air-acetylene flame. ("P", "Ca", "Fe" ,"Cu" and "pb") according to the method described in the AOAC (1990). Fatty acids were analyzed as described by Jeong *et al.* (2000). Fatty acid methyl ester (FAME) were derived by methylation with 14% BF_3 in methanol. The FAME composition of total lipids (TL) was analyzed with a gas-liquid

chromatograph (Shimadzu GC14A; Shimadzu Seisakusho, Co. Ltd., Kyoto, Japan) equipped with an Omegawax 320 fused silica capillary column (30m x 0.32 mm, ID; Supelco, Bellefonte, PA, USA). Injection port and a flame-ionization detector were held at 250°C, and the column oven temperature was initially held at 180°C for 8 min and then programmed to a final temp. of 230°C at 3°C/min. Helium was used as a carrier gas at the constant column inlet pressure of 1.0 kg/cm^2 with a split ratio of 1:50. Peak assignments were carried out by comparison of retention times of authentic standards (Sigma Chemical Co., St Louis, MO, USA) as well as oyster fatty acids which had been analyzed. Methyl tricosanoate (99%; Aldrich Chem. Co., Milwaukee, WI, USA) was used as an internal standard. These procedure was carried at the Central Laboratory, Faculty of Agriculture, Ain Shams University.

6. Statistical analysis:

Three replicates of each trial were performed for analysis. Moisture, protein, total lipids and ash data were statistically analyzed using ANOVA and means were separated by Duncan' test at a probability level of $P<0.05$ (SAS, 2000).

RESULTS AND DISCUSSION

The moisture content were 76.2% and 72.93% for fresh common carp and tuna fish, respectively Tables (1-A and B). The moisture content of canned common carp and tuna fish in different packing solutions (salt, lemon juice and nisin solution) and different oils (olive, cotton seed oil and mixture of each 1:1 v/v) sterilized at 110 °C for 55 min and 121°C for 40 min are shown in Tables (1-A and B).

Results in Table (1-A) showed a treated decrease in the moisture content of canned common carp in all canned samples of different packing solution and different oils at zero time of storage period. It could be also observed that canned samples lemon juice treated with solution had low moisture content as compared with other samples treated with salt and nisin solution and there are significantly difference between packing solutions ($P<0.05$) in all canned samples. On the other hand, results in Table (1-B) showed similar trend in moisture content for all

Table (1-A): Gross composition of some chemical properties of canned common carp (*Cyprinus carpio L.*) packed in salt, lemon juice and nisin solution in presence of olive oil, cotton seed oil and mixture of each (1:1 v/v) and sterilized at 110 °C and 121 °C (on dry basis).

parameters	Raw fish	Olive oil					
		Salt		Lemon Juice		Nisin	
		110°C	121°C	110°C	121°C	110°C	121°C
Moisture content (%)	76.20	66.49±0.70 a	66.36±0.70 a	65.19±0.45 b	65.13±0.33 b	65.97±0.66 a	65.89±0.69 a
Protein content (%)	70.50	63.30±0.70 a	63.39±0.70 a	63.85±0.80 a	63.92±0.80 a	63.66±0.75 a	63.62±0.77 a
Fat content (%)	18.80	22.35±0.60 a	22.28±0.59 a	21.49±0.44 a b	21.41±0.44 ab	21.89±0.55 a	21.84±0.54 a
Ash content (%)	9.97	13.49±0.65 a	13.64±0.65 a	13.56±0.70 a	13.72±0.71 a	13.65±0.68 a	13.74±0.67 a
parameters	Raw fish	Cotton seed oil					
		Salt		Lemon Juice		Nisin	
		110°C	121°C	110°C	121°C	110°C	121°C
Moisture content (%)	76.20	66.40±0.59 a	66.30±0.69 a	66.15±0.45 b	65.09±0.33 b	65.91±0.66 a	65.81±0.67 a
Protein content (%)	70.50	63.29±0.69 a	63.35±0.70 a	63.80±0.80 a	63.90±0.80 a	63.60±0.73 a	63.58±0.71 a
Fat content (%)	18.80	22.29±0.60 a	22.21±0.60 a	21.40±0.43 ab	21.35±0.43 ab	21.79±0.58 a	2173±0.56 a
Ash content (%)	9.97	13.60±0.66 a	13.75±0.67 a	13.66±0.69 a	13.80±0.70 a	13.81±0.70 a	13.89±0.71 a
parameters	Raw fish	Mixture of oils (1:1 v/v)					
		Salt		Lemon Juice		Nisin	
		110°C	121°C	110°C	121°C	110°C	121°C
Moisture content (%)	76.20	66.43±0.70 a	66.31±0.68 a	65.17±0.35 b	65.11±0.36 b	65.94±0.70 a	65.84±0.65 a
Protein content (%)	70.50	63.30±0.70 a	63.36±0.71 a	63.82±0.80 a	63.91±0.80 a	63.62±0.74 a	63.59±0.76 a
Fat content (%)	18.80	22.31±0.60 a	22.23±0.60 a	21.43±0.42 ab	21.36±0.42 ab	21.82±0.58 a	21.79±0.55 a
Ash content (%)	9.97	13.56±0.70 a	13.72±0.65 a	13.63±0.68 a	13.77±0.67 a	13.76±0.66 a	13.82±0.65 a

a-bc Means within a raw with the same superscript are significantly different (P<0.05).

Table (1-B): Gross composition of some chemical properties of canned tuna fish *(Tuna sp.)* packed in salt, lemon juice and nisin solution in presence of olive oil, cotton seed oil and mixture of each (1:1 v/v) and sterilized at 110 °C and 121 °C (on dry basis).

parameters	Raw fish	Olive oil					
		Salt		Lemon Juice		Nisin	
		110°C	121°C	110°C	121°C	110°C	121°C
Moisture content (%)	72.93	63.69±0.80 a	63.65±0.74 a	62.37±0.40 b	62.34±0.63 b	63.23±0.75 a	63.17±0.70 a
Protein content (%)	83.02	71.38±0.70 ab	71.48±0.75 a	71.93±0.82 a	72.00±0.90 a	71.70±0.80 a	71.74±0.80 a
Fat content (%)	11.70	16.50±0.36 a	16.48±0.36 a	15.80±0.22 b	15.77±0.19 b	16.13±0.35 ab	16.09±0.34 ab
Ash content (%)	5.20	11.00±0.39 ab	11.10±0.42 ab	11.42±0.50 a	11.54±0.50 a	11.33±0.57 a	11.41±0.52 a
parameters	Raw fish	Cotton seed oil					
		Salt		Lemon Juice		Nisin	
		110°C	121°C	110°C	121°C	110°C	121°C
Moisture content (%)	72.93	63.60±0.80 a	63.52±0.75 a	62.31±0.36 b	62.25±0.40 b	63.15±0.70 a	63.14±0.70 a
Protein content (%)	83.02	71.33±0.59 ab	71.45±0.75 a	71.87±0.80 a	71.95±0.85 a	71.62±0.77 a	71.69±0.73 a
Fat content (%)	11.70	16.49±0.35 a	16.46±0.40 a	15.75±0.21 b	15.73±0.25 b	16.10±0.34 ab	16.05±0.32 ab
Ash content (%)	5.20	11.10±0.37 ab	11.20±0.43 ab	11.46±0.50 a	11.61±0.54 a	11.41±0.56 a	11.53±0.55 a
parameters	Raw fish	Mixture of oils (1:1 v/v)					
		Salt		Lemon Juice		Nisin	
		110°C	121°C	110°C	121°C	110°C	121°C
Moisture content (%)	72.93	63.65±0.77 a	63.58±0.75 a	62.33±0.40 b	62.29±0.35 b	63.19±0.70 a	63.15±0.70 a
Protein content (%)	83.02	71.34±0.66 ab	71.46±0.80 a	71.90±0.85 a	71.96±0.90 a	71.64±0.77 a	71.73±0.80 a
Fat content (%)	11.70	16.49±0.41 a	16.47±0.39 a	15.76±0.20 b	15.75±0.19 b	16.11±0.34 ab	16.06±0.33 ab
Ash content (%)	5.20	11.08±0.40 ab	11.15±0.45 ab	11.45±0.55 a	11.59±0.57 a	11.36±0.50 a	11.50±0.57 a

*,** Means within a raw with the same superscript are significantly different (P<0.05).

canned tuna samples at zero time of storage period.

Moreover, the decrement in moisture content in all canned samples (common carp and tuna fish) under the effect of canning was reported by Perez (1990), who found that moisture content of canned fish products was decreased after the preheating treatment while, the sterilization treatment did not affect the water content of the fish since preheating treatment is run as open process, where after the sterilization is already done in closed space, thereby limiting water was loss of the fish. These results are also in agreement with those obtained by El-Samkary *et al.* (1997) and Baltasar *et al.*, (1998).

On the other hand, the protein content of fresh fish were 70.5 and 83.02% for common carp and tuna fish, respectively Tables (1-A and B). Data also declared, the changes in crude protein of canned common carp and tuna fish packing in different solution salt, lemon juice and nisin solution in presence olive, cotton seed oil and mixture of each 1:1 v/v and sterilized at 110 °C for 55 min and 121°C for 40 min Tables (1-A and B).

At zero time of storage period, the crude protein of canned common carp Table (1-A) in salt, lemon juice and nisin solution in presence olive oil treatment, sterilized at 110°C for 55 min was 63.30, 63.85 and 63.62%, also was 63.39, 63.92 and 63.66% at 121°C for 40 min respectively, and there are no significant difference between packing solutions ($P<0.05$) in all canned samples.

While, in cotton seed oil treatment crude protein was 63.29, 63.80 and 63.58% at 110°C and 63.35, 63.90 and 63.60% at 121°C. In addition, crude protein in presence of mixture of each (1:1 v/v) was 63.30, 63.82 and 63.59% at 110°C and 63.36, 63.91 and 63.62% at 121°C for the same previously samples respectively Table (1-A).

On the other side, the crude protein of canned tuna fish Table (1-B) packed in salt, lemon juice and nisin solution in presence of olive oil and sterilized at 110°C was 71.38, 71.93 and 71.70%. While, at 121°C was 71.48, 72.00 and 71.74% respectively. While, in cotton seed oil treatment crud protein was 71.33, 71.87 and 71.62% at 110°C and 71.45, 71.95 and 71.69 % at 121°C respectively. On the other hand in presence of mixture of each 1:1 v/v was 71.34, 71.90 and 71.64% at 110°C and at

121°C was 71.46, 71.96 and 71.73% for the same previously samples respectively and there are no significant difference between packing solutions ($P<0.05$) in all canned samples Table (1- B).

From these results, it could be noticed that, reduction in the crude protein content may be mainly attributed to autolysis leading to formation of some soluble protein fraction, which leached out gradually to packing medium, these results are in a good agreement with those reported by El-Samkary *et al.* (1997) and Baltasar *et al.* (1998) they found that, crude protein in mackerel was deceased during storage of canned samples at room temperature.

According to fat content, results in Tables (1-A and B) indicated that, the fat content were 18.8 and 11.7% for fresh common carp and tuna fish, respectively. The changes in fat content of canned common carp and tuna fish packing in salt, lemon juice and nisin solution in presence of olive, cotton seed oil and mixture of each 1:1 v/v and sterilized at 110 °C for 55 min and 121°C for 40 min are given in Tables (1-A and B).

Data given in Tables (1-A and B) declared an increase in the fat content in all canned common carp and tuna fish as compared with the fresh samples and there are significant difference between packing solutions ($P<0.05$) in all canned samples.

They found that, canned fish in oil had less moisture and higher fat content than the canned fish in tomato sauce as reported by Samkary *et al.* (1997).

The increment in fat content of samples packed in oils could be due to absorption of some oil by fish flesh from surrounding medium. These results are in agreement with the findings previously reported by Darweish *et al.* (1990).

Ash content:

The ash content were 9.97 and 5.20% for fresh common carp and tuna fish, respectively Tables (1-A and B). The changes occurred in ash content of canned common carp and tuna fish samples packed in salt, lemon juice and nisin solution in presence of (olive, cotton seed oils and mixture of each 1:1 v/v) treatments, sterilized at 110°C for 55 min and 121°C for 40 min are presented in Tables (1-A and B).

It could be observed from results given in Table (1-A and B), that canned common carp samples showed a higher ash content than

canned tuna fish samples at zero time and after six months of storage period. It could be also observed that, there are significant difference between packing solutions ($P<0.05$) in all canned samples.

The higher ash content was found in lemon juice treatment in presence of different oils. Results indicated that, after sterilization at 121°C for 40 min., the ash content reached to 13.72, 13.80 and 13.77% for canned common carp and 11.54, 11.61 and 11.59% for canned tuna fish samples at zero time of storage period, respectively.

The increment in ash content could be mainly due to addition of salt before canning. These results are in agreement with those obtained by El-Tanahy (1990); Darweish *et al.* (1990); El-Samkary *et al.* (1997) and Baltasar *et al.* (1998).

Fatty acids content:

The results given in Tables (2-A and B) declared the changes in fatty acid content of canned common carp and tuna fish packed in salt, lemon juice and nisin solutions in presence of different olive, cotton seed oil and mixture of each 1:1 v/v and sterilized at 110 °C for 55 min and 121°C for 40 min. after six months of storage period at room temperature.

Data tabulated in Table (2-A) showed that, fatty acids content of raw common carp sample (saturated, mono unsaturated and poly unsaturated fatty acid) were 29.09, 41.58 and 27.58% respectively.

At the end of storage period for six months at room temperature, the saturated fatty acid content of common carp samples packed in salt solution in presence of different oils and sterilized at 110 °C for 55 min reached to 25.18, 30.00 and 30.26% and at 121°C for 40 min recorded 25.26, 29.29 and 28.20 %, respectively. While, mono unsaturated fatty acid content of the same samples reached to, 46.20, 48.85 and 48.51% at 110 °C and 45.97, 48.17 and 48.17% at 121°C respectively and poly unsaturated fatty acid of the same samples reached to 26.67, 19.37 and 20.31 % at 110 °C and 27.77, 19.89 and 22.37% at 121°C respectively Table (2-A).

On the other side, at the end of storage period, the saturated fatty acid content of common carp samples packed in lemon juice solution reached to 24.30, 28.22 and 26.23% at 110 °C and 26.11, 30.38 and 29.22 % at 121°C

Table (2-A): Changes in fatty acids content (%) of fresh and canned common carp (*Cyprinus carpio L.*) packed in salt, lemon juice and nisin solution in presence of olive oil, cotton seed oil and mixture of each (1:1 v/v) and sterilized at 110 °C and 121 °C after six months of storage at room temperature (on dry basis).

Fatty acids	Raw material			Olive oil						Cotton seed oil						Mixture of oils (1:1 v/v)					
	Oils		Fresh fish	Salt		Lemon Juice		Nisin		Salt		Lemon Juice		Nisin		Salt		Lemon Juice		Nisin	
	Olive	Cotton seed		110°C	121°C	110°C	121°C	110°C	121°C	110°C	121°C	110°C	121°C	110°C	121°C	110°C	121°C	110°C	121°C	110°C	121°C
C 14 : 0	0.00	1.00	0.94	0.80	0.75	0.82	0.91	0.97	0.62	1.53	1.61	1.34	1.69	1.43	0.49	1.16	1.18	1.08	1.30	1.20	1.01
C 16 : 0	11.0	25.70	24.50	20.70	20.40	19.47	21.23	22.00	21.70	25.10	24.29	25.39	25.48	24.65	24.93	25.00	23.35	20.43	24.39	23.31	24.29
C 18 : 0	2.80	2.80	1.09	1.47	1.89	1.70	1.63	1.32	1.46	2.17	2.30	0.41	2.19	2.30	2.25	1.82	2.09	3.06	1.90	1.80	1.82
C 20 : 0	0.70	0.41	1.46	1.31	1.46	1.42	1.40	1.50	1.64	0.59	0.68	0.49	0.35	0.70	0.51	0.96	1.07	0.96	0.87	1.10	1.00
C 22 : 0	-	-	0.59	0.48	0.39	0.50	0.39	0.40	0.35	0.31	0.19	0.27	0.29	0.20	0.15	0.42	0.20	0.36	0.31	0.30	0.25
C 23 : 0	0.34	0.50	0.14	0.27	0.20	0.21	0.34	0.19	0.10	0.10	0.01	0.13	0.20	0.22	0.29	0.19	0.15	0.18	0.26	0.20	0.17
C 24 : 0	0.19	0..25	0.37	0.15	0.17	0.18	0.21	0.22	0.31	0.20	0.15	0.19	0.18	0.22	0.26	0.18	0.16	0.20	0.19	0.19	0.35
Σ S F A	15.03	30.66	29.09	25.18	25.26	24.30	26.11	26.60	26.18	30.00	29.29	28.22	30.38	29.72	28.88	30.62	28.20	26.23	29.22	28.10	28.89
C 16 : 1	11.40	17.10	5.29	10.10	10.30	11.19	10.00	12.69	12.20	20.10	20.00	19.79	20.70	20.16	20.18	17.00	15.73	15.60	15.38	17.29	16.69
C 18 : 1	61.70	49.70	35.5	35.50	34.89	35.00	36.00	35.20	34.00	28.14	27.67	28.00	27.00	29.05	28.13	30.90	31.78	32.03	31.00	32.09	31.64
C 20 : 1	0.30	-	0.79	0.61	0.78	0.92	0.87	0.68	0.87	0.61	0.50	0.45	0.35	0.39	0.51	0.61	0.64	0.70	0.59	0.23	0.43
Σ MU F A	73.4	66.80	41.58	46.20	45.97	47.11	46.82	48.49	49.07	48.85	48.17	48.24	48.05	49.60	48.82	48.51	48.17	48.33	46.97	49.61	48.67
C 18 : 2	8.20	-	25.83	25.00	26.20	24.90	23.06	22.00	23.06	18.42	19.00	20.10	20.27	17.10	17.93	19.00	21.05	21.85	22.13	19.00	18.90
C 18 : 3	0.60	-	1.75	1.67	1.75	1.50	139	1.40	1.23	0.95	0.89	0.75	0.91	0.83	0.19	1.31	1.32	1.13	1.15	1.07	1.00
Σ PU F A	8.80	-	27.58	26.67	27.77	26.40	24.45	23.40	24.29	19.37	19.89	20.85	21.18	17.93	18.12	20.31	22.37	22.63	23.28	20.07	19.90

SFA=Saturated fatty acids MUFA=Mono unsaturated fatty acids PUFA=Poly unsaturated fatty acids

Table (2-B): Changes in Fatty acids content (%) of fresh and canned tuna fish *(Tuna sp.)* in salt, lemon juice and nisin solution with different olive oil, cotton seed oil and mixture of each (1:1 v/v), sterilized at 110 °C and 121 °C after six months of storage at room temperature (on dry basis).

Fatty acids	Raw material			Olive oil						Cotton seed oil						Mixture of oils (1:1 v/v)					
	Oils		Fresh fish	Salt		Lemon Juice		Nisin		Salt		Lemon Juice		Nisin		Salt		Lemon Juice		Nisin	
	Olive	Cotton seed		110°C	121°C	110°C	121°C	110°C	121°C	110°C	121°C	110°C	121°C	110°C	121°C	110°C	121°C	110°C	121°C	110°C	121°C
C 14 : 0	0.00	1.00	6.30	5.06	5.24	6.09	6.00	5.71	5.60	7.00	6.19	7.19	6.95	7.30	5.90	6.03	5.80	6.60	6.47	6.50	5.68
C 16 : 0	11.0	25.70	26.50	26.13	27.20	28.00	28.50	27.20	26.90	30.20	31.00	32.59	31.00	30.90	31.71	28.31	29.00	30.91	29.70	29.00	29.30
C 18 : 0	2.80	2.80	9.70	7.90	9.00	8.10	8.50	7.05	7.91	6.60	6.20	5.00	5.90	5.91	7.30	7.25	6.90	7.00	7.20	7.28	7.40
C 20 : 0	0.70	0.41	0.48	0.40	0.32	0.49	0.52	0.38	0.51	0.43	0.51	0.52	0.47	0.49	0.39	0.42	0.43	0.48	0.45	0.43	0.45
C 23 : 0	0.34	0.50	0.98	0.95	0.70	0.81	0.80	0.87	0.92	0.90	0.81	0.75	0.99	0.63	0.75	0.90	0.75	0.80	0.83	0.76	0.53
C 24 : 0	0.19	0.25	12.00	13.00	11.56	8.27	10.00	11.00	11.83	9.37	11.00	7.00	11.50	10.00	11.09	10.68	11.39	8.00	10.69	11.06	12.31
Σ S F A	15.03	30.66	55.96	53.44	52.02	51.76	54.32	52.21	53.67	54.50	55.71	53.05	56.72	56.23	57.14	53.59	54.37	52.99	55.34	55.03	55.97
C 16 : 1	11.40	17.10	6.10	5.10	6.40	6.10	5.20	3.00	4.91	14.36	15.00	17.00	14.20	15.10	16.09	9.73	9.70	10.00	9.20	8.91	9.89
C 18 : 1	61.70	49.70	19.70	28.60	27.20	29.40	27.30	29.40	26.10	19.43	19.10	17.00	18.10	19.00	16.50	24.00	23.00	23.70	22.70	24.00	21.20
C 20 : 1	0.30	-	4.30	4.60	4.70	4.80	4.20	4.90	4.50	4.10	4.00	4.50	4.20	3.00	4.20	4.10	4.60	4.00	4.36	4.56	4.39
Σ M U F A	73.4	66.80	30.10	38.30	38.30	40.00	36.70	37.30	35.51	37.89	38.10	38.50	36.50	37.10	36.79	37.83	37.30	37.70	36.26	37.47	35.48
C 18 : 2	8.20	-	4.90	6.00	5.81	5.42	6.29	6.00	6.30	4.00	4.10	4.40	4.70	4.00	4.00	4.50	4.97	5.00	4.89	4.49	4.67
C 18 : 3	0.60	-	1.60	1.90	1.80	1.73	1.92	1.80	1.97	1.50	1.12	1.43	1.04	1.20	1.23	1.70	1.70	1.56	1.81	1.50	1.52
Σ P U F A	8.80	-	6.50	7.90	7.61	7.15	8.21	7.80	8.00	5.50	5.22	5.83	5.74	5.20	5.23	6.20	6.67	6.56	6.70	5.99	6.19

SFA=Saturated fatty acids MUFA=Mono unsaturated fatty acids PUFA=Poly unsaturated fatty acids

respectively. While mono unsaturated fatty acid content of the same samples reached to 47.11, 48.24 and 48.33% at 110 °C and 46.82, 48.05 and 46.97% at 121°C respectively and polyunsaturated fatty acid of the same samples reached to 26.40, 20.85 and 22.63% at 110 °C and 24.45, 21.18 and 23.28% at 121°C respectively Table (2-A).

On the other hand, the saturated fatty acid content of common carp samples packed in nisin solution reached to 26.60,29.72 and 28.10% at 110 °C and 26.18, 28.88 and 28.89 % at 121°C respectively. While mono unsaturated fatty acid content of the same samples reached to, 48.49, 49.60 and 49.61% at 110 °C and 49.07,48.82 and 48.67% at 121°C respectively, and polyunsaturated fatty acid of the same samples reached to 23.40, 17.93 and 20.07% at 110 °C and 24.29, 18.12 and 19.90% at 121°C respectively Table(2-A).

Data tabulated in Table (2-B) showed that, fatty acids content of raw tuna fish sample (saturated fatty acid, mono unsaturated fatty acid and poly unsaturated fatty acid) were 55.96, 31.10 and 6.50% respectively.

At the end of storage period for six months at room temperature the saturated fatty acid content of tuna fish samples packed in salt solution in presence of different oils and sterilized at 110 °C for 55 min reached to 53.44, 54.50 and 53.59% and at 121°C for 40 min recorded 52.02, 55.71 and 54.27 %, respectively. While, mono unsaturated fatty acid content of the same samples reached to, 38.30, 37.89 and 37.83% at 110 °C and 38.30, 38.10 and 37.30% at 121°C respectively, and polyunsaturated fatty acid of the same samples reached to 7.90, 5.50 and 6.20% at 110 °C and 7.61, 5.22 and 6.67% at 121°C respectively Table (2-B).

On the other side, at the end of storage period the saturated fatty acid content of tuna fish samples packed in lemon juice solution reached to 51.76, 53.05 and 52.99 at 10°C and 54.32, 56.72 and 55.34 % at 121°C respectively. While, mono unsaturated fatty acid content of the same samples reached to, 40.30, 38.50 and 37.70% at 110 °C and 36.70, 36.50 and 36.26% at 121°C respectively and polyunsaturated fatty acid of the same samples reached to 7.15, 5.83 and 6.56% at 110 °C and 8.21, 5.74 and 6.70% at 121°C respectively Table (2-B).

On the other hand, the saturated fatty acid content of tuna fish samples packed in nisin solution reached to 52.21, 56.23 and 55.03% at 110 °C and 53.67, 57.14 and 55.97 % at 121°C respectively. While, mono unsaturated fatty acid content of the same samples reached to, 37.30, 37.10 and 37.47% at 110 °C and 35.51 36.79 and 35.48% at 121°C respectively and polyunsaturated fatty acid of the same samples reached to 7.80, 5.20 and 5.99% at 110 °C and 8.00, 5.23 and 6.19% at 121°C respectively Table (2-B). Finally the saturated fatty acid were increased in all canned samples (common carp and tuna fish samples) presence of cotton seed oil because the cotton seed oil have a high ratio from saturated fatty acids while, the mono unsaturated fatty acids were increased after canning process in all canned samples (olive, cotton seed and mixture of each oils 1:1 v/v) but the polyunsaturated fatty acids were decreased slightly in all canned common carp samples, while in tuna fish samples polyunsaturated fatty acids were increased in all canned samples in olive oil with different packing solution.

The essential fatty acid C18:1, C18:2 and C18:3 (oleic, lenoleic and lenolenic) were increased in samples canned in presence of olive oil because the olive oil have a high concentration of essential fatty acid C18:1, C18:2 and C18:3 (oleic, lenoleic and lenolenic) compared with cotton seed oil and mixture of each oils.

These findings are in agreement with those obtained by Chan (1987) who reported that, lipid damage is often focused on the significant number volatiles that can be produced by oxidation of polyunsaturated fatty acid (PUFA) during thermal treatments of food. Due to the high degree of unsaturated fatty acids present in marine lipids, rancidity as a consequence of lipid degradation is critical in the determination of the shelf life of fatty fish species during storage and processing. Lipid composition of the processed product can be influenced by raw material composition, process conditions and packing substrate.

Baltasar *et al.* (1998) reported that, the effect of maturation on the palatability of sardines showed a significant loss of saturated fatty acid in fish during the canning process and a rise in monounsaturated fatty acid was

observed; while polyunsaturated fatty acid showed almost no variation. The palatability of sardines was significantly higher after 6 months of maturation than immediately after canning and this quality was maintained for at least 5 years of storage.

Minerals contents:

Data in table (3-A) show the contents of Ca, P, Cu, Fe, and Pb (p.p.m) of fresh and canned common carp in different packing solutions (salt, lemon juice and nisin solution) and different oils (olive, cotton seed oil and mixture of each 1:1 v/v) sterilized at 110 °C for 55 min and 121°C for 40 min. After storage for six months at room temperature it could be observed that, all canned products were rich in minerals. Results in Tables (3-A and B) indicated that, fresh common carp contained 583.2 p.p.m. of "P" while canned common carp packed in salt, lemon juice and nisin solution in presence of olive oil and sterilized at 110°C contained 773.0, 801.3 and 700.2 p.p.m., and 607.1, 829.0 and 850.0 p.p.m. at 121°C"P" content (p.pm.) respectively. In cotton seed oil "P" content (p.pm.) treatment was 767.6, 702.1 and 722.8 p.pm. at 110°C and 654.9, 768.5 and 700.1 p.pm. at 121°C. In addition, "P" content (p.pm.) in mixture of each oils (1:1 v/v) recorded 605.1, 796.3 and 650.9 p.pm. at 110°C and 800.0, 700.1 and 692.1 p.pm. at 121°C respectively, for the same previously samples Table (3-A).

On the other side, the "Ca" content (p.pm.) of fresh common carp was 135.9 p.p.m, while in canned common carp packed in salt, lemon juice and nisin solution in presence olive oil and sterilized at 110°C was 197.4, 147.8 and 160.0 p.p.m., and 165.2, 192.3 and 179.2 p.p.m. at 121°C respectively. In cotton seed oil treatment " Ca" content (p.pm.) was 176.3, 166.9 and 147.2 p.pm. at 110°C and 144.0, 170.1 and 195.4 p.pm. at 121°C. In addition, "Ca" content (p.pm.) in mixture of each oils (1:1 v/v) recorded 186.8, 146.5 and 183.6 p.pm. at 110°C and 154.6, 181.2 and 183.0 p.pm. at 121°C respectively for the same previously samples Table (3-A).

On the other side, the "Fe" content (p.pm.) of fresh common carp recorded 0.21 p.p.m. while in canned common carp packed in salt, lemon juice and nisin solution in presence of olive oil sterilized at 110°C reached to 0.37, 0.25 and 0.19 p.p.m., and 0.41, 0.22 and 0.35 p.p.m. at 121°C respectively.

Table (3-A): Changes in minerals content (p.p.m.) of fresh and canned common carp (*Cyprinus carpio L.*) packed in salt, lemon juice and nisin solution in presence of olive oil, cotton seed oil and mixture of each (1:1 v/v) and sterilized at 110 °C and 121 °C after six months of storage at room temperature (on dry basis).

Minerals (p.p.m.)	Raw fish	Olive oil						Cotton seed oil						Mixture of oils (1:1 v/v)					
		Salt		Lemon Juice		Nisin		Salt		Lemon Juice		Nisin		Salt		Lemon Juice		Nisin	
		110°C	121°C	110°C	121°C	110°C	121°C	110°C	121°C	110°C	121°C	110°C	121°C	110°C	121°C	110°C	121°C	110°C	121°C
Phosphor (P)	583.2	733.0	607.1	801.3	829.0	700.2	850.0	767.6	654.9	702.1	768.5	722.8	700.1	605.1	800.0	796.3	700.1	650.9	692.1
Calcium (Ca)	135.9	197.4	165.2	147.8	192.3	160.0	179.2	176.3	144.0	166.9	170.1	147.2	195.4	186.8	154.6	146.5	181.2	183.6	183.0
Iron (Fe)	0.21	0.37	0.25	0.19	0.41	0.22	0.35	0.30	0.41	0.38	0.28	0.17	0.29	0.32	0.37	0.35	0.27	0.29	0.40
Caper Cu)	0.025	0.027	0.030	0.025	0.025	0.040	0.027	0.036	0.041	0.040	0.029	0.025	0.030	0.030	0.041	0.027	0.037	0.025	0.041
Lead(Pb)	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL

BDL = below the detection limit (0.094 p.p.m.)

Table (3-B): Changes in minerals content (p.p.m.) of fresh and canned tuna fish *(tuna sp.)* in salt, lemon juice and nisin solution with different oils treatments olive oil, cotton seed oil and mixture of each (1:1 v/v), sterilized at 110 °C and 121 °C after six months of storage at room temperature (on dry basis).

Minerals (p.p.m.)	Raw fish	Olive oil						Cotton seed oil						Mixture of oils (1:1 v/v)					
		Salt		Lemon Juice		Nisin		Salt		Lemon Juice		Nisin		Salt		Lemon Juice		Nisin	
		110°C	121°C	110°C	121°C	110°C	121°C	110°C	121°C	110°C	121°C	110°C	121°C	110°C	121°C	110°C	121°C	110°C	121°C
Phosphor (P)	479.1	563.0	630.2	434.2	536.8	600.7	564.1	481.9	508.8	531.1	487.7	532.4	550.3	461.2	506.4	587.1	543.5	521.9	500.3
Calcium (Ca)	116.2	156.0	124.1	146.8	151.7	127.9	173.2	166.0	132.9	125.8	160.0	173.5	140.0	187.2	146.5	115.9	180.4	157.0	169.7
Iron (Fe)	0.35	0.48	0.37	0.34	0.53	0.45	0.46	0.43	0.46	0.50	0.39	0.32	0.41	0.45	0.49	0.46	0.42	0.42	0.52
Caper (Cu)	0.037	0.041	0.052	0.049	0.040	0.055	0.050	0.053	0.047	0.040	0.058	0.050	0.043	0.042	0.040	0.053	0.049	0.052	0.050
Lead (Pb)	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL

BDL = below the detection limit (0.094 p.p.m.)

Besides, "Fe" content (p.pm.) in cotton seed oil treatment was found to be 0.30, 0.41 and 0.38 p.pm. at 110°C and 0.28, 0.17 and 0.29 p.pm. at 121°C respectively. In addition, "Fe" content (p.pm.) in mixture of each oils 1:1 v/v treatments recorded to 0.32, 0.35 and 0.29 p.pm. at 110°C and 0.37, 0.27 and 0.40 p.pm. at 121°C for the same previously samples respectively.

According to, results given in Table (3-A) indicated that, fresh common carp contained 0.025 p.p.m. of "Cu" while "Cu" content of canned common carp packed in salt, lemon juice and nisin solution in presence olive oil and sterilized at 110°C reached to 0.027, 0.025 and 0.040 p.p.m., and 0.030, 0.025 and 0.027 p.p.m. at 121°C respectively. Besides, "Cu" content (p.pm.) in cotton seed oil treatment recorded 0.036, 0.040 and 0.025 p.pm. at 110°C and 0.041, 0.029 and 0.030 p.pm. at 121°C respectively. In addition, "Cu" content (p.pm.) in mixture of each oils (1:1 v/v) treatments showed 0.030, 0.027 and 0.025 p.pm. at 110°C and 0.041, 0.037 and 0.041 p.pm. at 121°C for the same previously samples respectively Table (3-A), with the regarded to lead content, results given in Table (3-A) declared that, lead content "Pb" was below the detection limit (0.094 p.p.m.) in fresh common carp and in all canned common carp samples in different packing solutions (salt, lemon juice and nisin solution) and different oils (olive, cotton seed oil and mixture of each 1:1 v/v) sterilized at 110 °C for 55 min and 121°C for 40 min Table (3-A).

Data in Table (3-B) showed Ca, P, Cu, Fe, and Pb content (p.p.m.) of fresh and canned tuna fish samples in different packing solutions (salt, lemon juice and nisin solution) and different oils (olive, cotton seed oil and mixture of each 1:1 v/v) sterilized at 110 °C for 55 min and 121°C for 40 min after storage for six months at room temperature.

It could be observed that the "P" content (p.pm.) of fresh tuna fish samples was 479.1 p.p.m., while canned tuna fish sample packed in salt, lemon juice and nisin solution in presence of olive oil and sterilized at 110°C reached to 563.0, 434.2 and 600.0 p.p.m., and 630.0, 536.8 and 564.1 p.p.m. at 121°C respectively Table (3-B). In cotton seed oil treatment "P" content (p.pm.) was 481.9, 531.1 and 532.4 p.pm. at 110°C and 508.8, 487.7 and 550.3 p.pm. at

121°C respectively. In addition, "P" content (p.pm.) in mixture of each oils (1:1 v/v) treatments recorded 461.2, 587.1 and 521.9 p.pm. at 110°C and 506.4, 543.5 and 500.3 p.pm. at 121°C for the same previously samples respectively Table (3-B).

On the other side, the "Ca" content (p.pm.) of fresh tuna fish sample was 116.2 p.p.m. Canned tuna fish samples packed in salt, lemon juice and nisin solution in presence of olive oil and sterilized at 110°C contained 156.0, 146.8 and 127.9 p.p.m., and 124.1, 151.7 and 173.2 p.p.m. at 121°C respectively. Besides," Ca" content (p.pm.) in cotton seed oil treatment was 166.0, 125.8 and 173.5 p.pm. at 110°C and 132.9, 160.0 and 140.0 p.pm. at 121°C. In addition, "Ca" content (p.pm.) in mixture of each oils (1:1 v/v) treatments recorded 187.2, 115.9 and 157.0 p.pm. at 110°C and 146.5, 180.4 and 169.7 p.pm. at 121°C for the same previously samples respectively Table (3-B).

Results given in Table (3-B) showed that, the "Fe" content (p.pm.) of fresh tuna fish sample recorded 0.35 p.p.m., while canned tuna fish samples packed in salt, lemon juice and nisin solution in presence olive oil and sterilized at 110°C contained 0.48, 0.34 and 0.45 p.p.m., and 0.37, 0.53 and 0.46 p.p.m. at 121°C respectively. Besides, "Fe" content (p.pm.) in cotton seed oil treatment showed 0.43, 0.50 and 0.32 p.pm. at 110°C and 0.46, 0.39 and 0.41 p.pm. at 121°C respectively. In addition, "Fe" content (p.pm.) in mixture of each oils (1:1 v/v) treatments recorded 0.45, 0.46 and 0.42 p.pm. at 110°C and 0..49, 0.42 and 0.52 p.pm. at 121°C for the same previously samples respectively Table (3-B).

On the other hand, the "Cu" content (p.pm.) of fresh tuna fish sample was 0.037 p.p.m., while canned tuna fish samples packed in salt, lemon juice and nisin solution in presence olive oil and sterilized at 110°C contained 0.041, 0.049 and 0.055 p.p.m., and 0.052, 0.040 and 0.050 p.p.m. at 121°C respectively. On the other side, "Cu" content (p.pm.) in cotton seed oil treatment reached to 0.053, 0.040 and 0.050 p.pm. at 110°C and 0.047, 0.058 and 0.043 p.pm. at 121°C. In addition, "Cu" content (p.pm.) in mixture of each oils (1:1 v/v) treatments recorded 0.042, 0.053 and 0.052 p.pm. at 110°C and 0.040, 0.049 and 0.050 p.pm. at 121°C for the same previously samples respectively

Table (3-B), with the regarded to lead content, results given in Table (3-A) declared that, the Lead content "Pb" was below the detection limit (0.094 p.p.m.) in fresh tuna fish sample and in all canned tuna fish samples in different packing solutions (salt, lemon juice and nisin solution) and different oils (olive, cotton seed oil and mixture of each 1:1 v/v) sterilized at 110 °C for 55 min and 121°C for 40 min after storage for six months at room temperature.

Finally, it could be observed that, the minerals content (P, Ca, Fe and Cu) were increased in all canned common carp and tuna fish samples. The (P and Ca) were higher in common carp fish than in tuna fish samples. While the (Fe and Cu) were higher in tuna fish than in common carp samples packed in salt, lemon juice and nisin solutions and different oils (olive, cotton seed oil and mixture of each oils 1:1 v/v). The concentration of minerals was higher in canned samples packed in lemon juice solution due to the autolysis effect of the lemon juice for the tissues. These results may be due to that, fish contained high amounts of bone and skin. Also these results are in agreement with those obtained by Misharina *et al.* (1985).

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تأثير عملية التعليب على بعض التغيرات الكيماوية لأسماك المبروك العادى والتونه المعلبة

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**المعمل المركزى لبحوث الثروة السمكية بالعباسة – مركز البحوث الزراعية– وزارة الزراعة – الدقى – الجيزة.

تعتبر الأسماك مصدر ممتاز للبروتين عالي القيمة الحيوية والمعادن والفيتامينات والأحماض الدهنية الغير مشبعه. وهناك العديد من الطرق تستخدم في تصنيع وحفظ الأسماك وتشمل التبريد، التجميد، التخليل، التدخين، التمليح، التجفيف، التعليب. ويعتبر التعليب من أقدم طرق الحفظ في الأغذية ويعتمد على استخدام درجات حرارة مرتفعه والتى تؤدى إلى التخلص من معظم الكائنات الحية الدقيقة الموجودة في العبوات. واجريت هذه الدراسة فى المعمل المر كزى لبحوث الأسماك – مركز البحوث الزراعية وزارة الزراعة – العباسة أبوحماد محافظة الشرقية بالتعاون مع الشركة المتحدة للمنتجات الغذائية –المنطقة الصناعية الثانية بالإسماعيلية.

تم دراسة التركيب الكيماوى لأسماك المبروك والتونه المعلبة في أنواع مختلفة من محاليل التعبئة مثل "محلول نيسين، محلول عصير الليمون، المحلول الملحي المستخدم في المصنع فى وجود أنواع مختلفة من الزيوت" زيت الزيتون، زيت بذرة القطن، خليط مكون من (زيت الزيتون : زيت بذرة القطن ١ : ١ ح/ح) و التعقيم على درجات حرارة مختلفة ١١٠° م لمدة ٥٥ دقيقة و ١٢١ م لمدة ٤٠ دقيقة بعد عملية التعليب مباشرة. ثم خزنت العينات على درجة حرارة الغرفة لمدة ٦ شهور تم خلالها دراسة التغير فى الأحماض الدهنية والمعادن فى نفس العينات. ويمكن تلخيص أهم النتائج فى النقاط التالية:

- أوضحت النتائج المتحصل عليها انخفاض فى نسبة الرطوبة ونسبة البروتين الكلى و ارتفاع نسبة الدهن وارتفاع فى قيم الرماد لعينات اسماك المبروك العادي والتونه المعلبة بعد عملية التعليب مباشرة

- أوضحت النتائج المتحصل عليها ارتفاع فى عدد الأحماض الدهنية الناتجة من تحلل الدهن خلال فترة النضج فى عينات اسماك المبروك العادي والتونه المعلبة خلال تخزينها على درجة حرارة الغرفة لمدة ٦ شهور وكان الارتفاع واضحا فى العينات المعاملة بمحلول عصير الليمون. مع زيادة الأحماض الدهنية الأساسية (اوليك، ، اللينوليك، اللينولينك) فى العينات المعلبة فى زيت الزيتون ويرجع ذلك الى احتواء الزيت على هذه الأحماض الدهنية بنسبة عالية بالمقارنة مع زيت بذرة القطن والزيت الخليط المكون من زيت الزيتون : زيت بذرة القطن ١ : ١ ح/ح).

- أوضحت النتائج المتحصل عليها ارتفاع فى العناصر المعدنية خلال فترة النضج فى عينات اسماك المبروك العادي والتونه المعلبة عند تخزينها على درجة حرارة الغرفة لمدة ٦ شهور وكان الارتفاع واضحا فى العينات المعاملة بمحلول عصير الليمون. حيث ترجع الزيادة فى محتوى المعادن فى العينات المعلبة فى عصير الليمون الى احتواء عصير الليمون على بعض الأحماض والمؤثرة على تحليل الأنسجة وانفراد العناصر خلال فترة النضج.