EFFECT OF STORAGE ON THE CHEMICAL COMPOSITION AND BACTERIOLOGICAL STATUS OF CANNED COMMON CARP (*CIPRINUS CARPIO L.*)

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Abstract

Canning is one of the old methods for processing and preserving of the food. The canning process depending on using the high temperature which leads to destroy the most microorganisms found in the cans. Therefore, this research was designed to investigate the effect of canning in different oils such as: olive oil, cotton seed oil and mixture of oils (1:1 v/v) with different packing solutions, such as nisin, lemon juice and salt solution and sterilized at 110°C for 55 min and 121°C for 40 min then, stored at room temp for 6 months. Different treatments were subjected to chemical and microbiological examination during subsequent storage. Collected data were statistically analyzed throughout whole investigation period.

The obtained results revealed that, moisture, protein, fat contents were decreased, while, the results indicated a remarkable increase in ash content in all canned samples during storage period for 6 months at room temperature. The obtained results indicated an increase in total bacterial count of canned common carp fish samples. Based on the forgoing results, it could be concluded that: common carp fish can be canned by using lemon juice solution at pH 4 as a natural material and as a packing solution in canned fish in order to reduce time of heat processing without consequent spoilage during storage.

INTRODUCTION

Fish is a highly perishable commodity. It undergoes autolytic, microbiological, as well as, chemical decomposition quite easily. In Egypt, there is shortage in the source of proteins, consequently development of fisheries and canning of fishery products are the most important solutions today.

Fish constitute one of the most important sources of protein in the world today particularly in the third world. However, there are many methods available for processing and preserving fish and fish products including, cooling, freezing, pickling, fermenting, smoking, salting, drying and canning (Sorinmade *et al.* 1986).

Perez *et al.* (1997) examined the nutritional value of four kinds of canned sardines in olive oil, soybean oil, tomato sauce and a marinade. In the results it was shown 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.

From the other side, microbiological control has a very important role in maintaining the high quality of the finished product in the fish canning industry. Swelling (bulging) of cans, as well as the spoilage of raw material and semifinished products are due to microbiological infection.

Frazier and Westhoff (1978) concluded that the processing for local canned fish was sufficient to destroy aerobic and anaerobic bacteria which cause spoilage of the canned fish. Therefore, neither *Bacillus cereus* nor *Clostridium perfringens* were observed in the canned sardines and mackerel stored for 24 months at room temperature.

Bibek (1992) reported that, nisin possesses antimicrobial activity against the Gram positive organisms including many of spore-forming bacteria. Nisin inhibits the out growth or spores and causes lysis of vegetative cells. Nisin is also active against certain non-spore forming bacteria as staphylococcus, micrococcus, lactic acid bacteria. Furthermore, nisin resists the growth of the pathogenic organism *Listeria monocytogenes*. Nisin does not inhibit Gram negative organisms, yeast or fungi.

Nykanen *et al.* (2000) declared the effectiveness of nisin (4000-6000 IU/ ml), sodium lactate (60%) and a combination of nisin + sodium lactate (1:1) in inhibiting the growth of *Listeria monocytogenes* in cold smoked rainbow trout. They also added that, vacuum packaged samples were then opened inoculated with *L. monocytogenes* (10^3-10^4 log cfu/g) vacuum packaged again and stored at 8 and 3°C for 17-29 days. Results showed that, the combination of nisin + sodium lactate was more effective inhibitor than either compound used individually. Nisin and sodium lactate injected into smoked fish reduced *L. monocytogenes* from 3.2-1.8 log cfu/g during 16 days storage at 8°C.

This work was carried out to study the effect of different temperatures and time of sterilization, the use of different oils (olive, cotton seed oil and mixture of each 1:1 v/v), the different packing solutions (nisin, lemon juice and salt solution) and the storage at room temperature for six months on the chemical composition and microbiological status of canned common carp fish.

MATERIALS AND METHODS

This study was carried out in the Central Laboratory for Aquaculture Research (CLAR), Agricultural Research Center, Ministry of Agriculture, Abbasa, Abou-Hammad Sharkia governorate in cooperation with production united food products, Ismaelia industrial zone.

Sampling

Common carp fish (*Cyprinus carpio L.*) was immediately obtained after catching from Abbasa farm in Sharkia governorate, Egypt. Each sample weighed 50 Kg. The mean of individual weight of common carp fish was 2.5 Kg. The fish samples were washed using tap water, then, the head, scales and all fins of common carp fish were removed using a sharp knife. The internal viscera were removed by hand, after which the eviscerated fish was washed in tap water. Fish samples (common carp) were packed in ice boxes and transported to the factory in the second industrial zone of Ismailia (United food products company).

The samples were soaked in saturated salt solution with a little acetic acid (6%), followed by washing using tap water to remove the over salt. The fish samples were cut and packed in the cans. The common carp cans weighed 340.0 g (310.0 g Common carp fish, 10.0ml. oil and 20.0 ml packing solution). The olive oil, cotton seed oil and mixture of both (olive oil and cotton seed oil 1:1 v/v) were added to every can. On the other hand, packing solution consists of salt solution prepared from commercial salt containing sodium chloride 2.0% (w/w), 3.5% vinegar (6% conc.) and 1.5% spices mixture consisted 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, lemon juice solution prepared from lemon juice and salt solution . 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 and nisin solution prepared from a commercial preparation containing 14 p.p.m nisin. The commercial preparation was dissolved in salt solution preparaed using HCl 0.02 N to pH 2- 4 in which the nisin was dissolved (Kelley *et al.,* 1999). The nisin stock solution was adjusted to pH 4 using pH-meter (Orion Research Digital Ion analyzer, Model 420A.) and was individually added to every can.

Pre-heating: Samples of common carp fish were pre-heated by steaming at 100°C for 30 min and then sealed.

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 cooled for 10 min using cooled water. The cans were carefully dried and incubated for 21 days at 37°C then, the samples were stored at room temperature for 6 months. Samples were periodically withdrawn every month for analysis.

Analytical procedures

Moisture content 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 from a 2-g portion of dried samples for each treatment by AOAC (1990). Ash was determined by aching at 550°C using a muffle furnace according to the method described in the AOAC (1990). Total bacterial count, the plate count method described by Frazier and Foster (1959) was adopted using nutrient agar medium which contained 3.0g beef extract, 5.0g peptone and 15.0g. agar in liter of distilled water pH 7.0. One ml from each dilution was plated in the above medium in replicates and incubated at 37°C for 48hours. The bacterial count was then calculated per 1.0g sample. *Clostridium botulinum*, anaerobic thermophilic colony count of *clostridium botulinum* were carried out according to the method reported by Anderson (1951). The composition medium used was as follows: yeast extract 3.0g, beef extract 10.0g, peptone 10.0g., dextrose 5.0g., soluble starch 1.0g, sodium chloride 5.0g, cystein hydrochloride 0.5, agar 15.0 and distilled water 1000 ml, the pH of the final medium was 6.8.

Statistical analysis

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

RESULTS AND DISCUSSION

I- Effect of storage period at room temperature on the changes of some physicochemical and chemical properties of canned common carp

Moisture content

The moisture content of canned common carp 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 Table 1.

Results showed a decrease in the moisture content of canned common carp treated in all canned samples of different packing solutions and different oils at zero time of storage period. It could be also observed that canned samples treated with lemon juice solution had low moisture content as compared with other samples treated with salt and nisin solution, and there are significant differences between packing solutions ($P<0.05$) in all canned samples. Additionally, the moisture content in all canned samples was decreased with prolonged storage for 6 months at room temperature with percentages of 60.39, 60.23 and 60.30 at 110°C for canned samples in treatments of lemon juice solution in presence of olive, cotton seed oils and mixture of both 1:1 v/v, respectively, and 60.25, 60.11 and 60.19 at 121°C for the same previous samples, respectively. These results are in agreement with those obtained by El-Samkary *et al.* (1997) and Baltasar *et al.* (1998) who found that, different samples of canned silver carp fish were subjected to chemical analysis as well as organoleptic evaluation. The moisture content and protein of fresh silver carp were 77.09% and 82.9%, respectively. Fat, ash and the moisture was decreased as the time of storage increased.

Crude protein

Data in Table 2 illustrated the changes in crude protein of canned common carp fish packed in different solution salt, lemon juice and nisin solutions in presence of olive, cotton seed oil and mixture of both 1:1 v/v and sterilized at 110°C for 55 min and 121°C for 40 min.

At zero time of storage period, the crude protein of canned common carp (Table 2) in salt, lemon juice and nisin solutions, in presence of olive oil treatment, sterilized at 110°C for 55 min was 63.30, 63.85 and 63.66%, also, was 63.39, 63.92 and 63.62% at 121°C for 40 min, respectively, and there are non-significant difference between packing solutions ($P<0.05$) in all canned samples. In cotton seed oil treatment, crude protein was 63.29, 63.80 and 63.60 % at 110°C and 63.35, 63.90 and 63.58% at 121°C. In addition, crude protein in the presence of mixture of each (1:1 v/v) treatments was 63.30, 63.82 and 63.62% at 110°C and 63.36, 63.91 and

63.59 % at 121°C for the same previous samples, respectively. Storage period at room temperature for 6 months, showed a decrease in the crude protein content in all canned common carp samples. This occurred in canned samples packed in salt solution in presence of different oils treatment when compared with lemon juice and nisin solutions treatments. At the end of storage period, the crude protein of canned common carp packed in salt solution in presence of different oils was 60.39, 60.27 and 60.33% at 110°C and 60.50, 60.40 and 60.47% at 121°C for the same previous samples, respectively.

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

Fat content

The effect of storage period at room temperature for 6 months on the changes in fat content of canned common carp 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 was given in Table 3.

Data given in Table 3 recorded an increase in the fat content in all canned common carp fish as compared with the fresh samples, and there were significant differences between packing solutions ($P<0.05$) in all canned samples. 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) who found that, canned fish in oil had less moisture and higher fat content than the canned fish in tomato sauce.

It could be also observed that, the fat content of canned common carp fish packed in different oils (olive, cotton seed oil and mixture of both 1:1 v/v), sterilized at 110 °C for 55 min and 121°C for 40 min was decreased during storage period at room temperature for 6 months. Data in Table 3 showed that, the fat content of canned common carp samples packed in salt solution in presence of different oils was 22.35, 22.29 and 22.31% at 110°C, while, at 121°C was 22.28, 22.21 and 22.23% at the beginning of storage period, respectively. On the other side, the fat content of canned common carp samples packed in salt solution in presence of different oils was 20.97, 20.85 and 20.90% at 110°C and at 121°C was 20.89, 20.74 and 20.81% at the end of

storage period for the same previous samples, respectively. The fat content of common carp samples packed in lemon juice in presence of different oils was 21.49, 21.40 and 21.43% at 110°C and at 121°C was 21.41, 21.35 and 21.36% at the beginning of storage period, while, at the end of storage period was 20.34, 20.23 and 20.29% at 110°C, also, 20.23, 20.11 and 20.15% at 121°C for the same previous samples, respectively.

Table 3 showed that, the fat content of common carp samples packed in nisin solution in presence of different oils was, 21.89, 21.79 and 21.82% at 110°C and at 121°C was 21.84, 21.73 and 21.79% at zero time of storage period, while, at the end of storage period was, 20.67, 20.56 and 20.60% at 110°C, also, 20.58, 20.50 and 20.52% at 121°C for the same previous samples, respectively.

These data are in agreement with those found by Seet *et al.* (1983) and El-Samkary *et al.* (1997). They noticed that, different samples of canned silver carp fish were subjected to chemical analysis as well as organoleptic evaluation. The obtained results revealed that fresh silver carp fish had 77.09% moisture, 82.9% protein, fat, ash and the moisture decreased as the time of storage increased.

Ash content

The effect of storage period at room temperature for 6 months on the changes in ash content of canned common carp fish samples packed in salt, lemon juice and nisin solution in presence of olive, cotton seed oils and mixture of both 1:1 v/v treatments, sterilized at 110°C for 55 min and 121°C for 40 min is presented in Table 4. It could be observed that canned common carp samples showed an increase in ash content at zero time and after 6 months of storage period, but, there were significant differences between packing solutions ($P<0.05$) in all canned samples. The increase in ash content was also noticed in lemon juice treatment in presence of different oils. Results indicated that at 121°C of sterilization for 40 min, the ash content reached to 13.72, 13.80 and 13.77% for canned common carp at zero time of storage period. After at the end of storage period the ash content in the same previous samples was 18.02, 18.29 and 18.16% for canned common carp fish packed in lemon juice solution and different oils then sterilized at 121°C for 40 min. These results are in agreement with those obtained by Darweish *et al.* (1990) El-Samkary *et al.* (1997) and Baltasar *et al.* (1998). They found that, the increment in ash content could be mainly due to addition of salt before canning.

II. Effect of storage period at room temperature on the microbiological status of canned common carp fish

Total bacterial counts

Changes in the total bacterial count of canned common carp fish samples packed in salt, lemon juice and nisin solutions and olive, cotton seed oil and mixture of both 1:1 v/v sterilized at 110°C for 55 min and 121°C for 40 min and stored at room temperature for 6 months are shown in Table 5 with significant difference between packing solutions ($P<0.05$) in all canned samples.

The obtained results given in Table 5 showed that, the total bacterial counts of canned common carp in contained salt, lemon juice and nisin solutions and olive oil, satirized at 110°C was 0.68, 0.61 and 0.64 colony forming unit (CFU/g.x10^2), while, for the same samples at 121°C was, 0.67, 0.59 and 0.62 (CFU/g.x10^2) respectively at zero time of storage. It could be noticed that there was a slight increase in the total bacterial count as the storage period increased. On the other hand, after storage at room temperature for 6 months, the total bacterial counts 1.02, 0.85 and 0.96 (CFU/g.x10^2) at 110°C and at 121°C was, 0.94, 0.80 and 0.93 (CFU/g.x10^2), respectively, for the same samples.

The data given in Table 5 declared that, the total bacterial counts of canned common carp in contained salt, lemon juice and nisin solutions and cotton seed oil, sterilized at 110°C, were 0.71, 0.63 and 0.67 (CFU/g.x10^2), while for the same samples at 121°C, was 0.69, 0.62 and 0.66 (CFU/g.x10^2), respectively, at zero time of storage. It could be noticed that there was a slight increase in the total bacterial count as the storage period increased, especially in canned samples containing salt solution. On the other hand, after storage at room temperature for 6 months, the total bacterial counts were 1.08, 0.90 and 1.01 (CFU/g.x10^2) at 110°C, and at 121°C were 0.98, 0.88 and 0.98 (CFU/g.x10^2), respectively, for the same samples. On the other side, the total bacterial counts of canned common carp fish packed in salt, lemon juice and nisin solutions with mixture of both oils 1:1 v/v and sterilized at 110°C were 0.70, 0.61 and 0.65 (CFU/g.x10^2), while, for the same samples sterilized at 121°C were 0.68, 0.60 and 0.63 (CFU/g.x10^2) at zero time of storage. Also, a slight continuous increase in the total bacterial counts was noticed as the storage period was prolonged, especially, in canned samples packed in salt solution with different oils. At the end of the 6 months, storage period at room temperature, the total bacterial counts recorded were 1.05,

0.87 and 0.99 (CFU/g.x10^2) at 110°C, and the total bacterial counts for the same samples were 0.96, 0.84 and 0.94 (CFU/g.x10^2) at 121°C, respectively.

These results are in accordance with the maximum permitted levels given by Awad (1985) who reported that, the bacteriological examination revealed that, the average total colonies count was 2x10^2 and 2.9x10^2 per gram of canned sardines and mackerel, respectively. However, according to the Egyptian Standard (1990), the total count/gram should not exceed 300 CFU/g.

Clostridium botulinum

Changes in *Clostridium botulinum* count of canned common carp fish samples packed in salt, lemon juice and nisin solutions and olive, cotton seed oil and mixture of both 1:1 v/v sterilized at 110 °C for 55 min and 121°C for 40 min and stored at room temperature for 6 months are shown in Table 6.

From the results shown in Table 6, it could be seen that all investigated samples of canned common carp fish samples were found to be free from *Clostridium botulinum* at any time during storage period, even after 6 months of storage period at room temperature. These results are in agreement with the Egyptian Standard (1990).

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Table 1. Effect of storage period at room temperature for six months in moisture content (%) 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 both (1:1 v/v) and sterilized at 110 °C and 121 °C (on dry weight basis).

Oils		Olive oil						Cotton seed oil						Mixture of oils (1:1 v/v)					
Solution		Salt		Lemon Juice		Nisin		Salt		Lemon Juice		Nisin		Salt		Lemon Juice		Nisin	
Sterilization		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
Storage period (Months)	0	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	66.40 ±0.59 a	66.30 ±0.69 a	65.15 ±0.45 b	65.09 ±0.33 b	65.91 ±0.66 a	65.81 ±0.67 a	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
	1	65.91 ±0.60 a	65.60 ±0.70 a	64.41 ±0.45 b	64.29 ±0.39 b	65.32 ±0.62 a	65.13 ±0.46 ab	65.67 ±0.70 a	65.56 ±0.70 a	64.31 ±0.40 b	64.22 ±0.37 b	65.20 ±0.70 a	65.00 ±0.58 ab	65.75 ±0.68 a	65.58 ±0.70 a	64.37 ±0.37 b	64.23 ±0.40 b	65.23 ±0.62 a	65.02 ±0.68 ab
	2	65.57 ±0.64 a	64.81 ±0.66 a	63.85 ±0.40 b	63.50 ±0.45 bc	64.58 ±0.47 ab	64.32 ±0.46 ab	64.87 ±0.70 a	64.70 ±0.68 a	63.61 ±0.45 b	63.47 ±0.25 bc	64.39 ±0.46 ab	64.28 ±0.43 ab	64.90 ±0.70 a	64.73 ±0.65 a	63.79 ±0.45 b	63.49 ±0.25 bc	64.46 ±0.49 ab	64.28 ±0.35 b
	3	64.30 ±0.70 a	64.19 ±0.69 a	62.70 ±0.35 b	62.61 ±0.35 b	63.73 ±0.59 a	63.62 ±0.66 a	64.21 ±0.70 a	64.12 ±0.66 a	62.63 ±0.37 b	62.55 ±0.20 bc	63.57 ±0.55 ab	63.45 ±0.50 ab	64.25 ±0.66 a	64.15 ±0.68 a	62.65 ±0.39 b	62.57 ±0.30 bc	63.60 ±0.70 a	63.50 ±0.58 ab
	4	63.61 ±0.60 a	63.59 ±0.60 a	61.95 ±0.33 b	61.85 ±0.40 b	62.99 ±0.69 a	63.00 ±0.70 a	63.57 ±0.66 a	63.42 ±0.68 a	61.85 ±0.39 b	61.65 ±0.30 bc	62.84 ±0.58 ab	62.89 ±0.58 ab	63.58 ±0.63 a	63.50 ±0.70 a	61.87 ±0.40 b	61.70 ±0.35 bc	62.87 ±0.55 ab	62.95 ±0.70 a
	5	62.95 ±.59 a	63.04 ±0.70 a	61.30 ±0.39 b	61.06 ±0.35 bc	62.39 ±0.60 a	62.15 ±0.58 ab	62.78 ±0.70 a	62.82 ±0.69 a	61.00 ±0.30 bc	60.86 ±0.32 bc	62.00 ±0.49 ab	62.00 ±0.53 ab	62.84 ±0.60 a	62.96 ±0.65 a	61.10 ±0.29 bc	60.89 ±0.20 bc	62.18 ±0.55 ab	62.09 ±0.55 ab
	6	62.29 ±0.69 a	62.19 ±0.61 a	60.39 ±0.42 b	60.25 ±0.37 bc	61.48 ±0.59 ab	61.39 ±0.70 ab	62.10 ±0.70 a	62.02 ±0.70 a	60.23 ±0.29 bc	60.11 ±0.20 bc	61.30 ±0.46 ab	61.21 ±0.46 ab	62.20 ±0.59 a	62.10 ±0.62 a	60.30 ±0.35 b	60.19 ±0.30 bc	61.40 ±0.46 ab	61.30 ±0.48 ab

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

Table 2. Effect of storage period at room temperature for six months in protein content (%) 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 both (1:1 v/v) and sterilized at 110 °C and 121 °C (on dry weight basis).

Oils		Olive oil						Cotton seed oil						Mixture of oils (1:1 v/v)					
Solution		Salt		Lemon Juice		Nisin		Salt		Lemon Juice		Nisin		Salt		Lemon Juice		Nisin	
Sterilization		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
Storage period (Months)	0	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	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	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
	1	62.79 ±0.58 ab	62.90 ±0.55 ab	63.32 ±0.79 a	63.55 ±0.78 a	63.21 ±0.74 a	63.12 ±0.72 a	62.75 ±0.55 ab	62.80 ±0.53 ab	63.28 ±0.75 a	63.50 ±0.78 a	63.06 ±0.74 a	63.07 ±0.70 a	62.76 ±0.56 ab	62.83 ±0.59 ab	63.29 ±0.79 a	63.51 ±0.74 a	63.11 ±0.72 a	63.10 ±0.74 a
	2	62.26 ±0.39 b	62.55 ±0.50 ab	62.90 ±0.60 a	63.09 ±0.69 a	62.74 ±0.67 a	62.70 ±0.62 a	62.09 ±0.20 b	62.50 ±0.40 ab	62.80 ±0.72 a	63.03 ±0.76 a	62.61 ±0.59 ab	62.58 ±0.65 a	62.17 ±0.21 b	62.52 ±0.49 ab	62.84 ±0.68 a	62.95 ±0.72 a	62.73 ±0.67 a	62.64 ±0.79 a
	3	61.81 ±0.59 ab	61.92 ±0.42 ab	62.54 ±0.60 a	62.65 ±0.69 a	62.33 ±0.69 a	62.26 ±0.67 a	61.74 ±0.40 ab	61.85 ±0.50 ab	62.45 ±0.72 a	62.59 ±0.69 a	62.23 ±0.78 a	62.18 ±0.73 a	61.78 ±0.48 ab	61.89 ±0.57 ab	62.49 ±0.60 a	62.61 ±0.79 a	62.18 ±0.80 a	62.25 ±0.80 a
	4	61.42 ±0.47 ab	61.50 ±0.49 ab	62.04 ±0.66 a	62.29 ±0.61 a	62.00 ±0.80 a	61.89 ±0.70 a	61.33 ±0.42 ab	61.45 ±0.47 ab	61.95 ±0.71 a	62.21 ±0.66 a	61.95 ±0.80 a	61.77 ±0.75 a	61.35 ±0.52 ab	61.49 ±0.57 ab	61.99 ±0.80 a	62.24 ±0.80 a	61.96 ±0.75 a	61.83 ±0.71 a
	5	60.79 ±0.21 b	61.01 ±0.40 ab	61.70 ±0.60 a	61.90 ±0.62 a	61.60 ±0.71 a	61.40 ±0.75 a	60.60 ±0.37 b	60.89 ±0.40 b	61.59 ±0.70 a	61.84 ±0.80 a	61.47 ±0.78 a	61.35 ±0.72 a	60.65 ±0.20 b	60.95 ±0.28 b	61.65 ±0.96 a	61.87 ±0.80 a	61.57 ±0.72 a	61.37 ±0.67 a
	6	60.39 ±0.30 b	60.50 ±0.57 ab	61.30 ±0.69 a	61.44 ±0.67 a	61.06 ±0.66 a	60.98 ±0.69 a	60.27 ±0.30 b	60.40 ±0.36 b	61.19 ±0.65 a	61.33 ±0.62 a	60.92 ±0.69 a	60.85 ±0.73 a	60.33 ±0.40 b	60.47 ±0.39 b	61.24 ±0.74 a	61.37 ±0.76 a	60.96 ±0.81 a	60.91 ±0.80 a

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

Table 3. Effect of storage period at room temperature for six months in fat content (%) 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 both (1:1 v/v) and sterilized at 110 °C and 121 °C (on dry weight basis).

Oils		Olive oil						Cotton seed oil						Mixture of oils (1:1 v/v)					
Solution		Salt		Lemon Juice		Nisin		Salt		Lemon Juice		Nisin		Salt		Lemon Juice		Nisin	
Sterilization		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
Storage period (Months)	0	22.35 ±0.60 a	22.28 ±0.59 a	21.49 ±0.44 a b	21.41 ±0.44 ab	21.89 ±0.5 5 a	21.84 ±0.5 4 a	22.29 ±0.6 0 a	22.21 ±0.6 0 a	21.40 ±0.4 3 ab	21.35 ±0.4 3 ab	21.79 ±0.5 8 a	2173 ±0.5 6 a	22.31 ±0.6 0 a	22.23 ±0.6 0 a	21.43 ±0.4 2 ab	21.36 ±0.4 2 ab	21.82 ±0.5 8 a	21.79 ±0.5 5 a
	1	22.12 ±0.59 a	22.00 ±0.57 a	21.30 ±0.40 ab	21.25 ±0.40 ab	21.69 ±0.6 1 a	21.64 ±0.6 0 a	22.04 ±0.6 0 a	22.00 ±0.5 9 a	21.21 ±0.2 7 b	21.14 ±0.2 0 b	21.59 ±0.6 1 a	21.53 ±0.6 1 a	22.09 ±0.5 7 a	22.05 ±0.5 9 a	21.24 ±0.1 7 b	21.19 ±0.1 5 b	21.63 ±0.5 7 a	21.60 ±0.5 0 a
	2	21.90 ±0.59 a	21.76 ±0.56 a	21.15 ±0.37 ab	21.00 ±0.30 ab	21.45 ±0.5 9 a	21.39 ±0.5 9 a	21.75 ±0.6 0 a	21.73 ±0.5 2 a	20.98 ±0.3 3 ab	20.90 ±0.4 0 ab	21.37 ±0.4 0 ab	21.30 ±0.4 4 ab	21.83 ±0.5 0 a	21.75 ±0.5 0 a	21.05 ±0.3 0 ab	20.97 ±0.2 8 ab	21.40 ±0.5 7 a	21.34 ±0.4 7 a
	3	21.64 ±0.57 a	21.56 ±0.58 a	20.90 ±0.27 b	20.80 ±0.26 b	21.26 ±0.5 8 ab	21.18 ±0.5 7 ab	21.55 ±0.6 1 a	21.46 ±0.5 4 a	20.80 ±0.2 5 b	20.71 ±0.1 7 b	21.18 ±0.3 8 ab	21.10 ±0.4 0 ab	21.59 ±0.5 0 a	21.49 ±0.4 9 a	20.94 ±0.1 9 b	20.74 ±0.1 5 b	21.18 ±0.4 4 ab	21.13 ±0.4 0 ab
	4	21.44 ±0.49 a	21.39 ±0.45 a	20.70 ±0.39 ab	20.61 ±0.40 ab	21.07 ±0.6 0 a	21.00 ±0.6 0 a	21.32 ±0.45 a	21.22 ±0.53 a	20.61 ±0.32 ab	20.50 ±0.19 b	21.00 ±0.5 5 a	20.93 ±0.5 0 a	21.40 ±0.47 a	21.27 ±0.49 a	20.66 ±0.43 ab	20.56 ±0.10 b	21.03 ±0.5 3 a	21.00 ±0.5 6 a
	5	21.20 ±0.45 a	21.12 ±0.46 a	20.53 ±0.35 ab	20.40 ±0.33 ab	20.83 ±0.5 7 a	20.77 ±0.6 1 a	21.00 ±0.5 5 a	20.96 ±0.5 0 a	20.40 ±0.34 ab	20.32 ±0.30 ab	20.78 ±0.5 0 a	20.71 ±0.4 5 a	21.10 ±0.47 a	21.00 ±0.43 a	20.47 ±0.45 ab	20.39 ±0.40 ab	20.81 ±0.5 0 a	20.75 ±0.4 7 a
	6	20.97 ±0.45 a	20.89 ±0.45 a	20.34 ±0.32 ab	20.23 ±0.30 ab	20.67 ±0.6 1 a	20.58 ±0.5 9 a	20.85 ±0.5 3 a	20.74 ±0.4 5 a	20.23 ±0.29 ab	20.11 ±0.28 ab	20.56 ±0.4 7 a	20.50 ±0.4 5 a	20.90 ±0.45 a	20.81 ±0.44 a	20.29 ±0.39 ab	20.15 ±0.42 ab	20.60 ±0.4 4 a	20.52 ±0.4 0 a

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

Table 4. Effect of storage period at room temperature for six months in ash content (%) 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 both (1:1 v/v) and sterilized at 110 °C and 121 °C (on dry weight basis).

Oils		Olive oil						Cotton seed oil						Mixture of oils (1:1 v/v)					
Solution		Salt		Lemon Juice		Nisin		Salt		Lemon Juice		Nisin		Salt		Lemon Juice		Nisin	
Sterilization		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
Storage period (Months)	0	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	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	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
	1	13.95 ±0.55 ab	14.09 ±0.65 a	14.20 ±0.65 a	14.10 ±0.68 a	14.16 ±0.68 a	14.43 ±0.70 a	14.15 ±0.68 a	14.39 ±0.70 a	14.33 ±0.69 a	14.50 ±0.70 a	14.64 ±0.71 a	14.65 ±0.66 a	14.05 ±0.67 ab	14.25 ±0.68 a	14.30 ±0.66 a	14.35 ±0.66 a	14.23 ±0.64 a	14.60 ±0.68 a
	2	14.31 ±0.45 b	14.72 ±0.58 ab	15.07 ±0.70 a	15.29 ±0.70 a	14.90 ±0.67 a	15.00 ±0.69 a	14.90 ±0.68 a	15.12 ±0.70 a	15.16 ±0.70 a	15.45 ±0.71 a	15.26 ±0.68 a	15.17 ±0.67 a	14.57 ±0.66 ab	15.00 ±0.68 a	15.08 ±0.69 a	15.33 ±0.70 a	15.19 ±0.69 a	15.02 ±0.67 a
	3	14.86 ±0.45 b	15.49 ±0.59 ab	15.69 ±0.70 a	15.87 ±0.70 a	15.56 ±0.71 a	15.69 ±0.71 a	15.47 ±0.59 ab	15.68 ±0.67 a	15.86 ±0.69 a	16.05 ±0.71 a	15.76 ±0.67 a	15.87 ±0.68 a	15.40 ±0.58 ab	15.62 ±0.69 a	15.77 ±0.70 a	15.95 ±0.72 a	15.71 ±0.71 a	15.79 ±0.71 a
	4	15.29 ±0.31 bc	16.06 ±0.49 ab	16.49 ±0.70 a	16.69 ±0.70 a	16.11 ±0.60 ab	16.18 ±0.60 ab	16.07 ±0.59 ab	16.25 ±0.61 ab	16.54 ±0.70 a	17.00 ±0.71 a	16.55 ±0.68 a	16.31 ±0.55 ab	15.89 ±0.53 b	16.15 ±0.64 ab	16.49 ±0.70 a	16.80 ±0.68 a	16.40 ±0.60 ab	16.25 ±0.59 ab
	5	15.79 ±0.20 c	16.98 ±0.59 ab	17.25 ±0.66 a	17.45 ±0.69 a	16.90 ±0.63 ab	17.08 ±0.64 ab	16.80 ±0.50 b	17.10 ±0.56 ab	17.39 ±0.71 a	17.70 ±71 a	17.00 ±0.70 ab	17.19 ±0.71 a	16.48 ±0.43 b	17.02 ±0.55 ab	17.38 ±0.69 a	17.52 ±0.70 a	16.99 ±0.59 ab	17.10 ±0.60 ab
	6	16.12 ±0.21 c	17.37 ±0.53 b	17.83 ±0.67 a	18.02 ±0.68 a	17.47 ±0.59 ab	17.64 ±0.64 ab	17.34 ±0.52 b	17.60 ±0.57 ab	18.05 ±0.71 a	18.29 ±0.72 a	17.72 ±0.72 a	17.85 ±0.72 a	17.24 ±0.45 b	17.51 ±0.59 ab	17.93 ±0.71 a	18.16 ±0.71 a	17.64 ±0.60 ab	17.77 ±0.70 a

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

Table 5. Effect of storage period at room temperature for six months in Total bacterial count (CFU/g.x10^2) 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 both (1:1 v/v) and sterilized at 110 °C and 121 °C.

Oils		Olive oil						Cotton seed oil						Mixture of oils (1:1 v/v)					
Solution		Salt		Lemon Juice		Nisin		Salt		Lemon Juice		Nisin		Salt		Lemon Juice		Nisin	
Sterilization		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
Storage period (Months)	0	0.68 ±0.03 a	0.67 ±0.05 a	0 . 6 1 ± 0 . 0 3 b	0.59 ±0.02b	0.64 ±0.04 ab	0.62 ±0.03 b	0.71 ±0.05a	0.69 ±0.04 a	0.63 ±0.03 ab	0.62 ±0.03 b	0.67 ±0.05 a	0.66 ±0.03 a	0.70 ±0.05 a	0.68 ±0.04 a	0.61 ±0.03 b	0.60 ±0.03 b	0.65 ±0.04 ab	0.63 ±0.04 ab
	1	0.74 ±0.05 a	0.72 ±0.04 a	0.65 ±0.02 b	0.62 ±0.02 b	0.68 ±0.04 ab	0.66 ±0.03 b	0.76 ±0.05 a	0.74 ±0.03a	0.65 ±0.03 b	0.65 ±0.03 b	0.72 ±0.05 a	0.69 ±0.04 ab	0.74 ±0.04 a	0.73 ±0.05 a	0.65 ±0.02 b	0.63 ±0.03 b	0.70 ±0.03 ab	0.68 ±0.04 ab
	2	0.77 ±0.04 a	0.74 ±0.05 a	0.66 ±0.03 b	0.63 ±0.02 bc	0.71 ±0.04 ab	0.68 ±0.03b	0.80 ±0.05 a	0.76 ±0.05 a	0.68 ±0.03 b	0.67 ±0.03 b	0.76 ±0.05 a	0.75 ±0.05 a	0.79 ±0.05 a	0.75 ±0.05 a	0.67 ±0.03 b	0.65 ±0.02 bc	0.74 ±0.05 a	0.72 ±0.04 ab
	3	0.80 ±0.05 a	0.76 ±0.04 ab	0.68 ±0.02 bc	0.64 ±0.01 c	0.75 ±0.03 b	0.72 ±0.02 b	0.85 ±0.05 a	0.78 ±0.04 ab	0.71 ±0.03 b	0.69 ±0.02 bc	0.79 ±0.04 ab	0.77 ±0.04a b	0.83 ±0.05 a	0.77 ±0.04 ab	0.70 ±0.02 bc	0.67 ±0.02 bc	0.77 ±0.04 ab	0.74 ±0.03 b
	4	0.87 ±0.05 a	0.83 ±0.04 ab	0.74 ±0.01 c	0.70 ±0.01 c	0.84 ±0.04 ab	0.79 ±0.03 b	0.93 ±0.05 a	0.84 ±0.04 ab	0.79 ±0.03 b	0.75 ±0.01 c	0.87 ±0.04 ab	0.84 ±0.04 ab	0.90 ±0.05 a	0.83 ±0.04 ab	0.76 ±0.01 c	0.72 ±0.01 c	0.86 ±0.04 ab	0.82 ±0.03 b
	5	0.93 ±0.04 ab	0.89 ±0.03 b	0.79 ±0.02 bc	0.76 ±0.01 c	0.90 ±0.04 ab	0.85 ±0.03 b	1.00 ±0.05 a	0.91 ±0.05 a	0.85 ±0.03 b	0.82 ±0.02 bc	0.95 ±0.05 a	0.93 ±0.04 ab	0.96 ±0.05 a	0.90 ±0.04 ab	0.82 ±0.02 bc	0.79 ±0.02 bc	0.92 ±0.03 b	0.89 ±0.03 b
	6	1.02 ±0.05 a	0.94 ±0.04 ab	0.85 ±0.03 b	0.80 ±0.02 bc	0.96 ±0.05 a	0.93 ±0.04 ab	1.08 ±0.05a	0.98 ±0.05 a	0.90 ±0.04 ab	0.88 ±0.03b	1.01 ±0.05 a	0.98 ±0.04 a	1.05 ±0.05 a	0.96 ±0.05 a	0.87 ±0.03 b	0.84 ±0.02 bc	0.99 ±0.05 a	0.94 ±0.04 ab

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

Table 6. Effect of storage period at room temperature for six months in growth of *clostridium botulinum* 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 both (1:1 v/v) and sterilized at 110 °C and 121 °C.

Oils		Olive oil						Cotton seed oil						Mixture of oils (1:1 v/v)					
Solution		Salt		Lemon Juice		Nisin		Salt		Lemon Juice		Nisin		Salt		Lemon Juice		Nisin	
Sterilization		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
Storage period (Months)	0	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	3	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	4	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	5	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	6	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

تأثير التخزين على التركيب الكيميائي والحالة البكتيرية خلال التخزين لسمك المبروك العادي المعلب

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يعتبر التعليب من أقدم طرق الحفظ في الأغذية ويعتمد على استخدام درجات حرارة مرتفعه والتي تؤدى إلى التخلص من معظم الكائنات الحية الدقيقة الموجودة في العبوات. أجريت هذه الدراسة فى المعمل المركزي لبحوث الأسماك – مركز البحوث الزراعية – وزارة الزراعة – العباسة أبوحماد محافظة الشرقية بالتعاون مع الشركة المتحدة للمنتجات الغذائية –المنطقة الصناعية الثانية بالإسماعيلية.

تم دراسة إمكانية تعليب سمك المبروك العادى 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 ، ١٢١°م لمدة ٤٠ دقيقة بعد عملية التعليب مباشرة. ثم خزنت العينات على درجة حرارة الغرفة لمدة ستة اشهر تم خلالها دراسة التغيرات فى التركيب الكيميائي والمحتوى الميكروبيولوجى للعينات.

أوضحت النتائج المتحصل عليها انخفاضاً فى نسبة الرطوبة ، نسبة البروتين الكلى ، نسبة الدهن وارتفاعاً فى قيم الرماد ، كما أوضحت النتائج زيادة العدد الكلى للبكتريا ولم يظهر نمواً للبكتريا المسببة للتسمم الغذائي وذلك فى العينات خلال تخزينها على درجة حرارة الغرفة لمدة ستة اشهر. وبناء على نتائج هذا البحث يمكن التوصية بإمكانية تعليب سمك المبروك العادي باستخدام عصير الليمون فى محاليل التعبئة كمادة طبيعية (عند رقم الأس الهيدروجينى ٤) لكي يتم اختزال مدة التعقيم دون حدوث فساد خلال التخزين.