EFFECTS OF CHITOSAN ON QUALITY OF COMMON CARP FILLETS DURING COLD STORAGE

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Abstract

The effects of chitosan on quality and shelf life of common carp fillets during storage at 4±1°C for 15 days were investigated.

Fish samples were treated with of 0, 1, 2 and 3% chitosan solution and stored at 4±1°C for 15 days. The control and treated fish samples were analyzed periodically for chemical deterioration (protein, fat, total volatile bases nitrogen (TVBN) trimethylamine nitrogen (TMAN), Thiobarbituric acid (TBA) Peroxide value (PV), microbiological load (total bacterial count, psychrophilic bacteria PsBC), and sensory characteristics (color, flavour, texture and overall acceptability).

Results indicated that the effect of chitosan on fish samples was to retain their good quality characteristics and extend the shelf life during storage, which was supported by the results of microbiological, chemical, and sensory evaluation analyses.

INTRODUCTION

Refrigerated storage of fish and fishery products results an increase in a shelf life of 5 to 10 days depending on species, harvest location, and season (Pedrosa and Regenstein, 1990). Refrigeration is of particular importance as regards fish. So, cold storage of fish for limited periods is usually used to extend shelf life for direct consumption and/or processing (Nabih, 1997).

Because of consumer demand for fresh refrigerated foods with extended shelf life, considerable research has been directed toward using

various preservation strategies to preserve or prolong the shelf life, while ensuring the safety of fresh foods including fishery products. (Sallam and Samejima, 2004). The shelf life and better quality can be made possible by using different processing techniques such as refrigeration and appropriate combinations of these techniques. Several studies showed that edible coatings made of protein, polysaccharide, and oil-containing materials help to prolong the shelf life and preserve the attributes of edible quality. Generally, meat and other foods are covered with dry particles (breaded) or dipped in liquid solutions of these particles (battering) (Osman *et al.,* 2009).

Chitosan [b-(1, 4)-2-amino-2-deoxy-D-glucopyranose], which is mainly made from crustacean shells, is the second most abundant natural polymer in nature after cellulose (Shahidi *et al.,* 1999). Due to its non-toxic nature, antibacterial and anti-oxidative activity, film-forming property, biocompatibility and biodegradability, chitosan attracted much attention as a natural food additive (Majeti and Kumar, 2000). Several authors reported that chitosan has been used in foods, as a clarifying agent in apple juice (Boguslawski *et al*., 1990), and antimicrobial and antioxidant in muscle foods. Furthermore, chitosan also has potential for food packaging, especially as edible films and coatings (Kim and Thomas, 2007). However, research on the retention of the good quality characteristics for long periods and the extension of shell life during frozen storage of fish by chitosan coating is still lacking.

Therefore, the objective of this study was to evaluate the effect of soaking in different percentages of chitosan solutions on the quality and shelf life of common carp fillets during refrigeration storage at ($4\pm1^{o}C$) for 15 days.

MATERIAL AND METHODS

Samples preparation and treatments.

Fresh common carp (*Cyprinus carpio L.*) was immediately obtained after catching from Abbasa farm in Sharkia Governorate, Egypt. Samples weighted 10 Kg (the mean of individual weight of common carp fish was 1- 1.5 Kg). The fish samples were washed using tap water, processed to fillets and divided to four groups then soaked in 0, 1, 2 and 3% w/w chitosan solutions for 120 min at room temperature and drained. Chitosan (Sigma Company, Saint Louis, MO, USA) have molecular weight 1.6 x 10^5 and 85% degree of deacetylation). To prepare 1, 2 and 3% w/w chitosan solutions (10, 20 and 30 g chitosan mixed with 900 ml of distilled water and stirred for 10 min, 10 ml of glacial acetic acid 100% added to the mixture which was then stirred for 2 h., the solution was made up to 1000 ml with distilled water) (Duun and Rustad, 2008 and Gallart *et al.* 2007). Samples were individually packed in plastic trays and airproofed with polyvinyl dichloride (PVDC). All the packs were kept in a refrigerator maintained at 4±1^{o}C for 15 days. Fish samples were taken randomly every 3 days for microbiological, chemical and sensory evaluation.

Analytical procedures.

Total protein and fat contents were determined according to the methods described in AOAC (2000). Total volatile bases nitrogen (TVBN) and trimethylamine nitrogen (TMAN) were determined according to AMC (1979). Thiobarbituric acid (TBA) value was acheired colorimetrically by the method of Porkony and dieffenbancher as described by Kirk and Sawyer (1991). Peroxide value (PV). was determined according to the method described by Pearson (1986). Microbiologically, total bacterial count (TBC) and psychrophilic bacterial count (PsBC): were detected according to the method described by Swanson *et al.* (1992). Sensory characteristics of samples were

organoleptically evaluated for appearance and texture of uncooked fillets during storage at 4±1°C as described by Teeny and Miyauchi (1972).

Statistical analysis.

Three replications of each trial were performed. Sensory data were analyzed using ANOVA and means were separated by Duncan,s method (1955) at a probability level < 0.05 **(SAS, 2000).**

RESULTS AND DISCUSSION

Protein and fat content:

The protein and fat contents of common carp fillets soaked in different concentrates of chitosan solutions during storage at 4±1ºC are presented in Table 1. Protein and fat content at zero time were 71.85 and 21.75 %, respectively. Results indicated that a slight decrease in crude protein and crude fat with prolonging of cold storage period. The least levels of protein and fat content were recorded for samples after 15 days of storage period which reached to 68.70, 69.23, 70.36 and 71.03% for protein and 19.20, 20.05, 20.38 and 20.80% for fat in untreated samples (control), 1, 2 and 3% of chitosan, respectively. The previous changes may be due to uptake of the chitosan into the fish fillets during cold storage period which led to denaturation of proteins and oxidation of fat. These results are in agreement with those reported by Santerre *et al.* (2000) and Arannilewa *et al.* (2005).

TABLE 1: Changes in total protein (%) and total lipids (%) of common carp fillets treated with different percentages of chitosan solutions during storage at 4±1ºC.

Treatments		Total protein (%)				Total lipids (%)			
		Control	Chitosan solutions treatments			Control	Chitosan solutions treatments		
		0 %	1%	2%	3%	0 %	1%	2%	3%
Storage Period (Days)	0	71.85± 0.03^{a}	71.85± 0.04^{a}	71.85± 0.04^{a}	71.85± 0.03^{a}	21.57± 0.02^{a}	21.57± 0.03^{a}	21.57± 0.02^{a}	21.57± 0.03^{a}
	3	71.32± 0.05^{ab}	71.42± 0.05^{a}	71.60± 0.04^{a}	71.73± 0.05^{a}	21.13± 0.04^{ab}	21.36± 0.04^{a}	21.43± 0.03^{a}	21.46± 0.05^{a}
	6	70.70± 0.06^{b}	70.90± 0.05^{ab}	71.30± 0.05^{a}	71.61± 0.06^{a}	20.75± 0.05^{ab}	21.06± 0.03^{a}	21.29± 0.03^{a}	21.33± 0.05^{a}
	9	70.10± 0.04^{bc}	70.40± 0.05^{b}	70.94± 0.04^{ab}	71.46± 0.04^{a}	20.38± 0.04^{b}	20.70± 0.03^{ab}	21.14± 0.04^{a}	21.19± 0.05^{a}
	12	69.50± 0.03^{bc}	69.89± 0.04^{b}	70.61± 0.04^{ab}	71.28± 0.03^{a}	19.85± 0.03^{b}	20.48± 0.03^{ab}	20.97± 0.02^{a}	21.04± 0.02^{a}
	15	68.70± 0.04^{d}	69.23 ± 0.05^{c}	70.36 ± 0.04^{b}	71.03 ± 0.03^{a}	19.20± 0.02^{c}	20.05 ± 0.04^{b}	20.38 ± 0.03^{ab}	20.80 ± 0.02^{a}

$^{a-c}$ Means within a row with the different superscript are significantly different ($P<0.05$). Values are expressed as Mean ± SE.

Total volatile bases nitrogen and trimethylamine nitrogen:

Total volatile basic nitrogen (TVBN), which is mainly composed of ammonia and primary, secondary and tertiary amines, is widely used as an indicator of meat deterioration. Its increase is related to the activity of bacterial spoilage and endogenous enzymes (Kyrana *et al*., 1997).

Results presented in Table 2 indicated that, the formation of total volatile bases nitrogen TVBN and trimethylamine nitrogen TMAN (mg./100g) were affected by all treatments. Throughout storage, a gradual increase in TVBN and TMAN was occurred and valued 6.95 and 1.17 (mg/100g), respectively, at zero time, while reached to 53.78, 42.16, 38.90 and 29.32 mg/100g for TVBN, and 30.50, 23.00, 19.00 and 12.17 mg/100g for TMAN in samples treated with 0, 1, 2 and 3% chitosan, respectively. The lowest values of TVBN and TMAN was mentioned in samples treated with 3% chitosan. Connel (1990) reported that, the

content of TVBN is a useful indicator of freshness of lean fish and suggested 30-40 mg N/100g (on fresh weight basis) as the upper limit for fresh – water fish and marine fish, respectively. Also, Maga (1978) reported that perfectly fresh fish had 3.37 mg/100g of TMAN, good grade fish showed 3.79-5.90 mg/100g, fair fish had 12.65-16.02 mg/100g while spoiled fish contained as high as 59.01mg/100g.

TABLE 2: Changes in total volatile bases nitrogen (mg/100g) and trimethylamine nitrogen (mg/100g) of common carp fillets treated with different percentages of chitosan solutions during storage at 4±1ºC.

Treatments		Total volatile bases nitrogen (mg/100g)				Trimethylamine nitrogen (mg/100g)			
		Control	Chitosan solutions treatments			Control	Chitosan solutions treatments		
		0 %	1%	2%	3%	0 %	1%	2%	3%
Storage Period (Days)	0	6.95± 0.07^{a}	6.95± 0.06^{a}	6.95± 0.06^{a}	6.95± 0.07^{a}	1.17± 0.03^{a}	1.17± 0.04^{a}	1.17± 0.03^{a}	1.17± 0.03^{a}
	3	16.00± 0.2^{a}	15.40 ± 0.1^{ab}	13.14 ± 0.2^{b}	11.50 ± 0.1^{c}	6.690± 0.05^{a}	5.19± 0.04^{b}	3.18± 0.04^{c}	1.93± 0.03^{d}
	6	29.40± 0.3^{a}	23.45 ± 0.5^{b}	19.20 ± 0.3^{c}	15.91 ± 0.4^{d}	15.82± 0.04^{a}	13.11 ± 0.05^{b}	7.50± 0.05^{c}	3.89± 0.04^{d}
	9	40.08± 0.3^{a}	32.00 ± 0.4^{b}	25.80 ± 0.4^{c}	20.00 ± 0.5^{d}	19.20± 0.07^{a}	16.17 ± 0.05^{b}	12.37 ± 0.05^{c}	6.78± 0.05^{d}
	12	47.52± 0.5^{a}	37.12 ± 0.5^{b}	31.25 ± 0.6^{c}	24.89 ± 0.5^{d}	22.96± 0.1^{a}	20.00 ± 0.8^{b}	15.77 ± 0.06^{c}	9.77± 0.05^{d}
	15	53.78± 0.6^{a}	42.16 ± 0.7^{b}	38.90 ± 0.6^{c}	29.32 ± 0.5^{d}	30.50± 0.2^{a}	23.00 ± 0.1^{b}	19.00 ± 0.08^{c}	12.17 ± 0.07^{d}

$^{a-d}$ Means within a row with the different superscript are significantly different (P<0.05). Values are expressed as Mean ± SE.

However, the increment in TVBN and TMAN during cold storage may be resulted of decomposition and degradation of nitrogen substances which may be due to the activity of microorganisms. These results are in

line with those obtained by Woyewoda and Bligh (1986) and Khuntia *et al.* (1993).

Thiobarbituric acid (TBA) and Peroxide value (PV):

Thiobarbituric acid (TBA) is an index of lipid oxidation. Fish samples havling TBA-values more than 2 will probably smell and taste rancid (Bonnell, 1994). This observation was indicative of the fact that chitosan clearly retarted lipid oxidation in fish flesh. According to Connell (1990), TBA values of 1–2 mg. malonaldhyde /kg of fish flesh are usually regarded as the limit beyond which fish will normally develope an objectionable odour. Results presented in Table 3 indicated a gradual increase in TBA-values up to 15 days of cold storage. Minimum TBA-values were found in fish fillets soaked in 3% chitosan after 15 days of cold storage period. On the other hand, untreated samples recorded 7.00 mg. malonldehyde /Kg at the end of cold storage period.

TABLE 3. Changes in thiobarbituric acid (mg. malonldehyde / Kg.) and peroxide value (PV) levels (milliequivalents peroxide / Kg of lipid) of common carp fillets treated with different percentages of chitosan solutions during storage at 4±1ºC.

Treatments		Thiobarbituric acid (mg. Malonldehyde / Kg.)				Peroxide value (PV) levels (milliequivalents peroxide / Kg of lipid)			
		Control	Chitosan solutions treatments			Control	Chitosan solutions treatments		
		0 %	1%	2%	3%	0 %	1%	2%	3%
Storage Period (Days)	0	0.19± 0.003^{a}	0.19± 0.004^{a}	0.19± 0.003^{a}	0.19± 0.003^{a}	16.1± 0.1^{a}	16.1± 0.2^{a}	16.1± 0.1^{a}	16.1± 0.1^{a}
	3	1.36± 0.01^{a}	0.93± 0.02^{ab}	0.70± 0.01^{b}	0.52± 0.007^{b}	20.50± 0.3^{a}	8.6± 0.3^{b}	7.03± 0.2^{bc}	16.5± 0.2^{c}
	6	2.50± 0.02^{a}	1.78± 0.02^{ab}	1.32± 0.01^{b}	0.97± 0.01^{b}	26.00± 0.5^{a}	20.3± 0.4^{b}	9.8± 0.4^{bc}	17.1± 0.3^{c}
	9	4.01± 0.03^{a}	2.68± 0.02^{b}	1.90± 0.02^{b}	1.61± 0.01^{c}	29.03± 0.7^{a}	23.2± 0.7^{b}	21.5± 0.6^{c}	19.7± 0.6^{d}
	12	5.87±	3.27±	2.36±	1.92±	33.12±	26.7±	23.5±	21.8±

		0.05[a]	0.04[b]	0.03[bc]	0.02[c]	0.7[a]	0.6[b]	0.6[c]	0.5[d]
	15	7.00± 0.08[a]	4.89± 0.06[b]	3.68± 0.04[c]	2.20± 0.02[d]	36.70± 0.8[a]	29.6± 0.8[b]	26.0± 0.7[c]	24.9± 0.6[d]

[a-d] Means within a row with the different superscript are significantly different (P<0.05). Values are expressed as Mean ± SE.

The increment in TBA presumably resulted from the concentration of pigments in fish fillets which can act as peroxidant.

Regarding peroxide value (PV), Table 3 indicated a significantly increase (P < 0.05) in PV contents in all samples up to 15 days of cold storage.

However, the increment rate was higher in fish fillets treated with 0, 1 and 2% chitosan compared with 3% chitosan, respectively. PV started with 16.1 (meq. peroxide/ Kg fat) at zero time of storage at 4±1°C and reached to 36.7, 29.6, 26.0 and 24.9 (meq. peroxide/ Kg fat) for samples soaked with 0, 1, 2 and 3% chitosan solution, respectively. The lowest values of PV occurred in samples treated with 3% chitosan.

Additionally, from the foregoing results, the increment in TBA and PV during storage could be resulted from lipid oxidation. These results are in agreement with those reported by Khuntia *et al.* (1993).

Microbial changes:

Results presented in Table 4 indicated that, gradually increase in total bacterial count (Log CFU/g) and significantly differed (P<0.05) between the different treatments of common carp fillets treated in studied percentages of chitosan during storage at 4±1ºC for 15 days. The initial total bacterial count of fish sample was 3.18 CFU/g, and the low initial TBC indicated very good fish quality. The highest number of TBC was observed in control samples followed by the fish fillets soaked in 1, 2 and 3% chitosan solutions, respectively. It did not exceed the maximal permissible limit of 7.0 log10 CFU/g for the bacterial count in fish, soaked in 3% chitosan solutions, while the level of TBC in control and

samples soaked in 1 and 2% chitosan solutions reached to about 7.1 log10 CFU/g after 6, 9 and 12 day during storage at 4±1ºC.

On the o[illegible] Mohamed I. Salama and Atef E.E. Ibrahim [illegible] (PsBC) shc [illegible] significant increase (P<0.05) with the progress of storage time. Samples recorded 1.50 (Log10 CFU/g) at the beginning of storage period. Although, the count of psychrophilic bacteria was significantly increase (P<0.05) during storage. The count for different treatments of common carp fillets soaked in different percentages of chitosan solutions during storage at 4±1ºC for 15 days were 3.89, 3.39, 3.05 and 2.61 (Log10 CFU/g), respectively, after the end of storage period at 4±1ºC.

TABLE 4: Changes in total bacterial count and psychrophilic bacterial count (Log CFU/g.) of common carp fillets treated with different percentages of chitosan solutions during storage at 4±1ºC.

Treatments		Total bacterial count				Psychrophilic bacterial count			
		Control	Chitosan solutions treatments			Control	Chitosan solutions treatments		
		0 %	1%	2%	3%	0 %	1%	2%	3%
Storage Period (Days)	0	3.18± 0.03^{a}	3.18± 0.05^{a}	3.18± 0.02^{a}	3.18± 0.03^{a}	1.50± 0.02^{a}	1.50± 0.02^{a}	1.50± 0.01^{a}	1.50± 0.01^{a}
	3	4.92± 0.04^{a}	4.53± 0.04^{a}b	4.32± 0.03^{ab}	4.15± 0.03^{b}	2.41± 0.03^{a}	1.95± 0.03^{b}	1.82± 0.02^{b}	1.71± 0.02^{b}
	6	6.52± 0.05^{a}	5.00± 0.05^{b}	4.82± 0.04^{bc}	4.50± 0.03^{c}	2.85± 0.03^{a}	2.31± 0.03^{b}	2.00± 0.02^{bc}	1.92± 0.01^{c}
	9	7.84± 0.06^{a}	6.09± 0.05^{b}	5.41± 0.05^{bc}	5.04± 0.04^{c}	3.12± 0.04^{a}	2.70± 0.03^{b}	2.32± 0.03^{bc}	2.12± 0.02^{c}
	12	8.58± 0.07^{a}	7.77± 0.06^{b}	6.30± 0.06^{bc}	5.85± 0.05^{d}	3.42± 0.04^{a}	3.00± 0.03^{b}	2.69± 0.02^{bc}	2.40± 0.02^{c}
	15	9.67± 0.08^{a}	8.96± 0.08^{b}	7.70± 0.07^{c}	6.57± 0.06^{d}	3.89± 0.03^{a}	3.39± 0.03^{b}	3.05± 0.03^{c}	2.61± 0.02^{d}

$^{a-d}$ Means within a row with the different superscript are significantly different (P<0.05).
Values are expressed as Mean ± SE.

The result indicated that 3% chitosan solution was equally effective for extending during storage at 4±1ºC life of the fish sample to 15 days compared with 0, 1 and 2% chitosan. The significant reduction

in TBC was observed in the control, 1 and 2% chitosan solutions can be attributed to the inhibitory effect of chitosan on spoilage bacteria. These numbers were the highest after 15 days of storage at 4±1°C. Our results are in accordance with those reported by Kyung *et al.* (2002) and Eldaly and Eleiwa (2006).

Sensory Evaluation:

Table 5 showed the changes of color and flavour of common carp fillets treated with different percentages of chitosan during storage for 15 days at 4±1ºC. Color and flavour reflected a significantly differences ($P<0.05$) between the treatments. Samples treated with 3% chitosan recorded the highest grade at the end of storage period as compared with the other treatments and control sample. However, control and treated samples showed the highest scores at zero time.

TABLE 5: Changes in color and flavour of common carp fillets treated with different percentages of chitosan solutions during storage at 4±1ºC.

Treatments		Color				Flavour			
		Control	Chitosan solutions treatments			Control	Chitosan solutions treatments		
		0 %	1%	2%	3%	0 %	1%	2%	3%
Storage Period (Days)	0	9.10± 0.09^{a}	9.10± 0.08^{a}	9.10± 0.08^{a}	9.10± 0.09^{a}	9.10± 0.08^{a}	9.10± 0.09^{a}	9.10± 0.09^{a}	9.10± 0.08^{a}
	3	7.00± 0.07^{b}	8.50± 0.08^{b}	8.70± 0.08^{b}	8.80± 0.08^{b}	6.90± 0.06^{b}	8.55± 0.07^{b}	8.72± 0.07^{b}	8.80± 0.08^{a}
	6	5.70± 0.05^{d}	7.00± 0.06^{c}	7.40± 0.07^{b}	8.10± 0.08^{a}	5.40± 0.04^{c}	6.70± 0.05^{b}	7.80± 0.06^{ab}	7.97± 0.06^{a}
	9	4.510± 0.04^{d}	5.30± 0.04^{c}	6.21± 0.05^{b}	7.20± 0.06^{a}	4.00± 0.03^{c}	5.30± 0.04^{b}	6.90± 0.05^{ab}	7.20± 0.06^{a}
	12	3.80± 0.03^{d}	4.20± 0.04^{c}	5.40± 0.04^{b}	6.60± 0.05^{a}	3.00± 0.02^{d}	4.00± 0.03^{c}	5.70± 0.04^{b}	6.30± 0.05^{a}
	15	2.60± 0.02^{d}	3.30± 0.02^{c}	4.70± 0.03^{b}	5.00± 0.04^{a}	2.50± 0.02^{d}	3.50± 0.02^{c}	4.25± 0.03^{b}	5.40± 0.05^{a}

$^{a-d}$ Means within a row with the different superscript are significantly different ($P<0.05$).
Values are expressed as Mean ± SE.

TABLE 6: Changes in texture and overall acceptability of common carp fillets treated with different percentages of chitosan solutions during storage at 4±1ºC.

Treatments		Texture				overall acceptability			
		Control	Chitosan solutions treatments			Control	Chitosan solutions treatments		
		0 %	1%	2%	3%	0 %	1%	2%	3%
Storage Period (Days)	0	9.00± 0.05^{a}	9.00± 0.06^{a}	9.00± 0.05^{a}	9.00± 0.05^{a}	90.7± 0.7^{a}	90.7± 0.7^{a}	90.7± 0.6^{a}	90.7± 0.6^{a}
	3	7.00± 0.07^{b}	8.26± 0.04^{ab}	8.57± 0.04^{a}	8.80± 0.05^{a}	69.6± 0.5^{c}	84.4± 0.6^{b}	86.6± 0.7^{ab}	88.0± 0.7^{a}
	6	5.70± 0.06^{b}	7.50± 0.05^{ab}	7.89± 0.04^{a}	7.90± 0.04^{a}	56.0± 0.5^{d}	70.6± 0.5^{c}	76.9± 0.6^{b}	79.9± 0.5^{a}
	9	4.20± 0.05^{b}	6.50± 0.05^{ab}	6.70± 0.06^{a}	7.00± 0.07^{a}	41.0± 0.6^{d}	57.0± 0.5^{c}	66.0± 0.7^{b}	71.3± 0.7^{a}
	12	3.50± 0.06^{c}	4.90± 0.06^{b}	5.80± 0.05^{ab}	6.20± 0.06^{a}	34.3± 0.6^{d}	43.6± 0.7^{c}	55.3± 0.7^{b}	63.7± 0.6^{a}
	15	2.70± 0.05^{d}	3.52± 0.05^{c}	4.68± 0.07^{b}	5.30± 0.07^{a}	26.0± 0.4^{d}	34.4± 0.5^{c}	45.0± 0.6^{b}	52.3± 0.5^{a}

$^{a-d}$ Means within a row with the different superscript are significantly different (P<0.05). Values are expressed as Mean ± SE.

Results in Table 6 showed, the effect of cold storage period at 4±1ºC for 15 days on texture and overall acceptability of common carp fillets treated with different percentages of chitosan. The data analysis of texture and overall acceptability grades, indicated that the scores were significantly higher ($p<0.05$) in samples treated with 3% chitosan at the end of storage period as compared with the other treatments and control sample.

The gradual decrease in color, flavour texture and overall acceptability during the cold storage could be attributed to the protein hydrolysis and its degradative products, total volatile basis nitrogen

(TVBN), and fat oxidation which are considered as major factors of changes in organoleptic properties. (Kyung *et al.,* 2002) results.

Thus, common carp fillets soaked in 3% of chitosan was acceptable up to 15 days during storage at 4±1ºC, while fillets soaked in 0, 1, 2% of chitosan were in good and acceptable up to 6, 9 and 12 days, respectively, during storage at 4±1ºC. This may be attributed to chitosan's functional properties, antioxidant, antimicrobial and oxygen barrier, and this conclusion is supported by the results of chemical quality analyses. Finally the results indicated that common carp fillets soaked in 3% of chitosan lead to retention of the good quality characteristics and extension of the shelf life during storage at 4±1ºC compared with fillets treated in 0, 1, and 2% chitosan.

REFERENCES

AMC. 1979. Recommended method for the examination of fish and fish products. Analyst., 104, 433.

AOAC. 2000. Official methods of Analysis, K. Helrich (Ed.). Vol. I and II. Association of Official Anlytical Chemists, Arlington, VA.

Arannilewa, S.T.; S.O. Salawu; A.A. Sorungbe and B.B. Salawu. 2005. Efffect of frozen period on the chemical, micobological and sensory quality of frozen tilapia fish (*Sarotherodun galiaenus*). African J. of Biotechnology, 4 (8): 852–855.

Boguslawski, S.; M. Bunzeit and D. Knorr. 1990. Effects of chitosan treatment on clarity and microbial counts of apple juice. Z. Lebensm Technol., 41: 42–44.

Bonnell, A.D. 1994. Quality assurance in seafood processing. Chapter 5. Quality assessment, P. 72. Academic press, New Yourk, USA.

Connel, J.J. 1990. Methods of assessing and selecting for quality. In control of fish quality (3rd ed.)., Berlin, Springer.

Duncan, D.B. 1955. Multiple range and F test. Biometrics, 11:1-42.

Duun, A.S. and T. Rustad. 2008. Quality of super-chilled vacuum packed Atlantic s Mohamed I. Salama and Atef E.E. Ibrahim 1.4 and -3. ٩.
Food Chemistry, 106 (1): 122–131.

Eldaly, E.A. and N.Z. Eleiwa. 2006. Effect of storage temperature and antimicrobial treatment on shelf life of fresh fish. 8th Sci. Vet. Med. Zag., Conference (31 Aug.- 3 Sept. 2006), Hurghada.

Gallart-Jornet, L.; T. Rustad; J.M. Barat; P. Fito and I. Escriche. 2007. Effect of super chilled storage on the freshness and salting behaviour of Atlantic salmon (*Salmo salar*) fillets. Food Chemistry, 103(4): 1268–1281.

Khuntia, B.K.; L.N. Srikar; L.N. Reddy and B.R. Srinivasa. 1993. Effect of food additives on quality of salted pink perch (*Nemipterus japonicus*). J. Food Sci. Technol., 30 (4): 261.

Kim, K.W. and R.L. Thomas. 2007. Antioxidative activity of chitosans with varying molecular weights. Food Chemistry, 101(1): 308–313.

Kirk, R.S. and R. Sawyer. 1991. Pearson's composition and analysis of foods (9 th ed.). London: Longman Scientific and Technical.

Kyrana, V. R.; V.P. Lougovois and D.S. Valsamis. 1997. Assessment of shelf life of maricultured gilthead sea bream (*Sparus aurata*) stored in ice. International Journal of Food Science and Technology, 32: 339–347.

Kyung, K.H.; M.H. Kim; M.S.Park and Y.S. Kim. 2002. Alliinase-independent inhibition of *Staphylococcus aureus* B33 by heated garlic. J. Food Sci., 67: 780-785

Maga, J.A. 1978. Amines in foods. CRC Critical Reviews in food and Nutrition

Majeti, N.V. and R. Kumar. 2000. A review of chitin and chitosan applications. Reactive and Functional Polymers, 46: 1–27.

Nabih, N.M. 1997. Studies on the expiration period and quality attributes of some fish products, M. Sc. thesis Faculty of Agric., Ain Shams Univ.

Osman K.; S.D. Ismail and K. Erdogan 2009. Effect of edible coatings on the quality of frozen fish fillets. Food Science and Technology, 42: 868–873.

Pearson, D. 1986. Indices de acites y enranciamiento. In Tecnicas de laboratorio para el analisis de alimentos, P. 132-143. Acribia, Zaragoza, Spain.

Pedrosa, M.A. and J.M. Regenstein. 1990. Shell–life extension of fresh fish : A review. Part II. Preservation of fish. J. Food Quality, 13: 129-146.

Sallam, K.h.I. and K. Samejima. 2004. Microbiological and chemical quality of ground beef treated with sodium lactate and sodium chloride during refrigerated storage. Lebensmittel-Wissenschaft and-Technologie/ LWT-Food Science and Technology, 37: 865–871.

Santerre, C.R.; R. Ingram; D.H. Xu; G.W. Lewis and L.G. Lane. 2000. Chlorolane and toxaphene residues following cooking of treated channel catfish fillets. J. Food Protection, 63 (6): 763–767.

SAS. 2000. SAS User's Guide: statistics, SAS Institute INC., Cary, NC. Oplp.

Shahidi, F.; J.K.V. Arachchi and Y.J. Jeon. 1999. Food applications of chitin and chitosan. Trends in Food Science and Technology, 10: 37–51.

Swanson, K.M.; F.F. Busta; E.H. Peterson and M.G. Johnson. 1992. Colony Mohamed I. Salama and Atef E.E. Ibrahim ٢anderzant ٩٢ D.F.Splittoesser (Eds.). Compendium of methods for tne microbiological examination of foods, 3rd ed. American Public Health Association, Washington, D.C.

Teeny, F.M. and D. Miyauchi. 1972. Preparation and utilization of frozen block of mince block fish muscle. J. Milk Food Technology, 35 (7): 414, 417.

Woyewoda, A.D. and E.G. Bligh. 1986. Effect of phosphate blends on stability of cod fillets in frozen storage. J. Food Sci., 51(4): 932.

تأثيـر الكـيتوزان على جـودة شـرائح سـمك المبـروك العادى خـلال التـخزين بالتبـريد

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الملخص العربى

تم دراسة تأثير الكيتوزان على جودة وفترة صلاحية شرائح سمك المبروك العادى خلال التخزين على درجة ١±٤ م لمدة ١٥ يوم حيث تم معاملة عينات السمك بمحلول الكيتوزان صفر، ١، ٢ ،٣% والتخزين على درجة ١±٤ م لمدة ١٥ يوم. تم تحليل الكنترول والعينات المعاملة كيميائيا (بروتين، دهن، المواد النتروجينية الكلية الطيارة، ثلاثى ميثيل الامين نيتروجين، حمض الثيوباربيتوريك، رقم البيروكسيد) وميكروبيولوجيا (البكتريا الكلية والمحبة للبرودة) وحسيا (اللون، النكهة، القوام، القابلية العامة) لفترات منتظمة خلال التخزين.

اوضحت النتائج ان الكيتوزان لـه تـاثير معنـوى علـى حفظ شـرائح الاسـمك بخـواص جودتهـا وزيـادة فتـرة الصـلاحية اثنـاء التخـزين والتـى تـدعم بالنتـائج الكيميائيـة والميكروبيولوجيـة والحسية التى تمت خلال هذه الدراسة.