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EFFECT OF GREEN TEA EXTRACT AND SODIUM CITRATE ON THE QUALITY OF FROZEN SILVER CARP FILLETS

Samya I. A. Hassanin and Ahmed Z. Hssab-Alla

Processing and Quality Control Department, Central Laboratory for Aquaculture Research, Agriculture Research Center, Egypt.

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Abstract

The objective of this study was to determine the changes in some chemical, microbiological and sensory properties of silver carp (*Hypophthalmichthys molitrix*) fillets treated by dipping in 200 ppm green tea extract (GTE), 2% sodium citrate (NaC) individually and in combined form 200 ppm GTE with 2% NaC (1:1, v/v) for 20 min and subjected to frozen storage at - 20±1ºC for 6 months.

In all samples the results revealed gradual decrease in total protein, fat and sensory properties. The highest scores in total protein, fat and sensorial criteria were measured in samples treated with mixture of GTE and NaC followed by samples treated with NaC then GTE as compared with control. The total volatile bases nitrogen values (TVBN), trimethylamine nitrogen (TMAN), peroxide values (PV), thiobarbituric acid values (TBA) and psychrophilic bacterial counts (PsBC) increased during frozen storage in all samples. As well as total bacterial counts significantly ($p<0.05$) decreased with increasing storage time. Meanwhile the lowest values of the previously mentioned parameters were observed in samples treated with mixture of GTE and NaC.

Results indicated that, the pre-soaking of fish fillets in the mixture of 200 ppm GTE and 2% NaC (1:1- v/v) then storage at - 20±1ºC kept its freshness better than individual treatment with either GTE or NaC. It can be concluded that, GTE and NaC in combined form safe as natural preservatives owing to their antimicrobials and antioxidants properties to extend the shelf-life and maintain fish fillets qualities and nutritional value during frozen storage.

Keywords: Silver carp; Freezing; Green tea extract; Sodium citrate.

INTRODUCTION

Fresh fish is a highly perishable product due to its biological composition. It is rich in polyunsaturated fatty acids [ώ-3 fatty acids, eicosapentaenoic (EPA) and docosahexaenoic (DHA) acids] and an excellent source of high quality protein that contains sufficient amounts of most essential amino acids which play an important role in human health and nutrition. From other hand the spoilage of fish is a complex process in which physical, chemical and microbiological mechanisms are implicated. Freezing is a common preservation method used to control or decrease biochemical changes in seafood products. Freezing does not improve the quality of the product but can help to retain the quality. The final quality depends on the initial quality of the fish at the time of freezing as well as other factors during freezing and distribution (Gonclaves *et al.* 2009).

However, some compounds occur as a result of lipid oxidation and protein deterioration during frozen storage. These compounds cause undesirable flavor and odor changes, which affect the sensory quality, chemical properties and nutritional value of sea food (Siddaiah *et al.*, 2001). In order to increase shelf life and maintaining qualities of fresh fish and its products, low levels of salt and/or natural preservatives (antimicrobials and antioxidants) have been also used (Del Nobile *et al.*, 2009).Tea catechins (TC), a predominant group of polyphenols present in green tea leaves have antimicrobial and antioxidant effect. The antioxidant extracted is apparently related to their phenolic content, from green tea which can be used as alternatives to the synthetic antioxidant because of their equivalent or greater effect on inhibition of lipids oxidation (Fan *et al.*, 2008). From other side sodium salts of the low molecular weight organic acids, such as acetic, lactic and citric, have been used to control microbial growth, improve sensory attributes and extend the shelf life of various food systems (Sallam, 2007a).

Furthermore, these salts are widely available, economical, and generally "recognized-as-safe". The decontamination of meat and fish with undesirable microorganisms was highly dependent on the concentration, type and exposure times of organic acid salts used (Theron and Lues, 2007). Carp, as a freshwater fish species, has been one of the most widely cultured species all over the world due to its fast growth rate, easy cultivation and high feed efficiency ratio (Tokur *et al.*, 2006). In Egypt, silver carp (*Hypophthalmichthys molitrix),* common carp (*Cyprinus carpio)* and grass carp (*Ctenopharyngodon idella)* species are extensively cultured. So, demand has come, from the fish producer to develop alternative commercial products such as fish fillets to increase the silver carp consumption (Asgharzadeh *et al.,* 2010).

The main objective of this study was to investigate the effects of green tea extract (GTE) and sodium citrate (NaC) treatments on some chemical, microbiological and sensory characteristics of silver carp (*Hypophthalmichthys molitrix*) fillets during freezing storage at - 20±1ºC for 6 months.

MATERIALS AND METHODS

Preparation of green tea extract (GTE) and sodium citrate (NaC) solution: Commercially available (Their origins were Kenya) dried green tea leaves (*Camelia sinensis*) were purchased from a local market. Green tea were ground using a Moulinex grinder then (10g) was homogenized with 100 ml distilled water at 40˚C left for 10 min using a Sanyo homogenizer (Japan). The homogenate was then filtered through a Whatman No 1 filter paper. 2 ml of filtrates (green tea extract) were separately added to distilled water (1 liter) to give 200 ppm solutions (Ojagh *et al*., 2011). Where as 2% NaC (powder from El-Gomhoria Company for Chemicals, Egypt) was used in the current study.

Fish preparation and treatments: Silver carp (*Hypophthalmichthys molitrix*) was obtained after catching from Abbasa farm in Sharkia

Governorate, Egypt. The mean of individual weight of fish was about 2.5-3 Kg for each. Fish samples transferred directly to the laboratory within an hour. Silver carp washed by clean cold water and the head and all fins of were handily removed using a sharp knife. The whole fish was eviscerated, then skinned off and filleted. Fillets were divided into four equal batches. The first batch acts as control was dipped in 2 liters distilled water. The second, third, and fourth batches were dipped for 20 min in 200 ppm green tea extracts (GTE) and 2% sodium citrate (NaC) separately and in combined form 200 ppm GTE with 2% NaC (1:1, v/v). Fish to dipping solution ratio was (1: 2.5). After dipping, fillet samples were allowed to drain on a sterile stainless wire mesh screen for 5 min at 18°C. Five fillets from each treatment were packaged individually in polyethylene bags. All packed fillets were freezing at - 40°C for 4 hr., and then storied at - 20±1ºC for 6 months. The fillets per batches were random periodically analyzed every month.

Chemical analyses: Total protein and crude fat content were determined as mentioned in AOAC (2000). Total volatile bases nitrogen (TVBN, mg/100g.) and trimethylamine nitrogen (TMAN, mg/100g.) values were determined according to AMC (1979). Thiobarbituric acid values (TBA) were estimated spectrophotometrically and calculated as milligrams malonaldehyde/kilogram sample according to the procedure described by Kirk and Sawyer (1991). Peroxide values (PV) were expressed as milliequivalents of oxygen/kilogram of lipid, PV was determined according to the methods described in AOAC (2000). All the analyses were made in three replicates.

Microbiological analyses: Total bacterial counts (TBC) were detected according to the method described by Harrigan and Margaret (1976). Psychrophilic bacterial count (PsBC) was detected according to Swanson *et al.* (1992).

Sensory evaluation: Fillet samples were evaluated for odor, color, texture and over all- acceptability. A group of 10 judges were always called upon for scoring beginning grads ranging from zero to 10 as described by Teeny and Miyauchi (1972) as estimated by the following scheme:

Score	Description	Score	Description
10	Ideal	4	Fair
9	Excellent	3	Poorly fair
8	Very good	2	Poor
7	Good	1	Very poor
6	Fairly good	0	Repulsive
5	Acceptable		

Statistical Analysis: Three replications of each trial were performed for, the chemical composition, TVBN, TMAN, TBA, PV, bacterial counts and sensory data were analyzed using analysis of variance (ANOVA), the means were separated by Duncan (1955) at a probability level of $P<0.05$ (SAS, 2000).

RESULTS AND DISCUSSION

Chemical evaluation: The chemical composition of fish fillets treated by 200 ppm green tea extracts (GTE), 2% sodium citrate (NaC) and their mixture (1:1, v/v) is presented in Tables (1). From the results, it could be noticed that the total protein was 71.83% for all fish fillets at zero time of storage period, while at the end of storage period total protein% was 67.15, 69.02, 69.89 and 70.75 % for control, GTE, NaC and their mixture (GTE with NaC), respectively. From other side, initial fat % was 17.52% for all fillet samples and at the end of storage fat % was 14.24, 15.33, 15.71 and 16.54% for control, GTE, NaC and their mixture, respectively.

Total protein and fat were decreased for all samples. The highest level in total protein and fat were detected in fillets treated with mixture (GTE with NaC) at the end of freezing storage. The decrease in total

protein may be due to denaturation and hydrolysis of protein which resulted from direct effect of freezing and/or bacterial activity and the decrease in fat during storage may be attributed to enzymatic hydrolysis in addition to auto-oxidation of lipids. These results are in agreement with those reported by Singh and Balange (2005) and Asgharzadeh *et al*. (2010). Moreover, the results observed in fillets treated with mixture solutions could be due to the green tea and NaC have been recognized efficient antioxidants by scavenging free radicals during oxidation and acting as cheltators for metal ions. Also inhibit enzymes like lipoxygenase in fish fillets which may be responsible for initiate auto-oxidation (Banerjee, 2006).

Table (1): Effect of green tea extracts, sodium citrate and their mixture on protein and fat % content of silver carp fillets during storage at - 20±1ºC for 6 months (on dry weight bases).

Fish fillets		**Protein %**				**Fat %**			
Treatments		**Control**	**GTE[1]**	**NaC[2]**	**Mixture[3]**	**Control**	**GTE[1]**	**NaC[2]**	**Mixture[3]**
Storage period/ months	**0**	71.83± 0.04[a]	71.83± 0.04[a]	71.83± 0.03[a]	71.83± 0.02[a]	17.52± 0.02[a]	17.52± 0.03[a]	17.52± 0.02[a]	17.52± 0.03[a]
	1	71.23± 0.04[b]	71.41± 0.05[a]	71.52± 0.06[a]	71.72± 0.03[a]	17.10± 0.06[b]	17.22± 0.03[ab]	17.35± 0.03[ab]	17.45± 0.05[a]
	2	70.63± 0.06[b]	70.96± 0.06[ab]	71.21± 0.03[ab]	71.62± 0.04[a]	16.66± 0.03[d]	16.90± 0.04[c]	17.08± 0.03[b]	17.29± 0.02[a]
	3	70.03± 0.04[c]	70.49± 0.03[b]	70.91± 0.04[b]	71.50± 0.05[a]	16.21± 0.03[c]	16.57± 0.04[bc]	16.80± 0.02[b]	17.13± 0.04[a]
	4	69.41± 0.04[d]	70.02± 0.04[c]	70.58± 0.03[b]	71.30± 0.04[a]	15.73± 0.04[d]	16.23± 0.03[c]	16.57± 0.04[bc]	16.96± 0.03[a]
	5	69.81± 0.03[d]	69.55± 0.04[c]	70.24± 0.04[b]	71.08± 0.06[a]	15.04± 0.02[d]	15.81± 0.02[c]	16.12± 0.03[b]	16.78± 0.04[a]
	6	67.15± 0.03[d]	69.02± 0.04[c]	69.89± 0.02[b]	70.75± 0.03[a]	14.24± 0.02[d]	15.33± 0.03[c]	15.71± 0.04[b]	16.54± 0.03[a]

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

Values are expressed as mean ± SE.

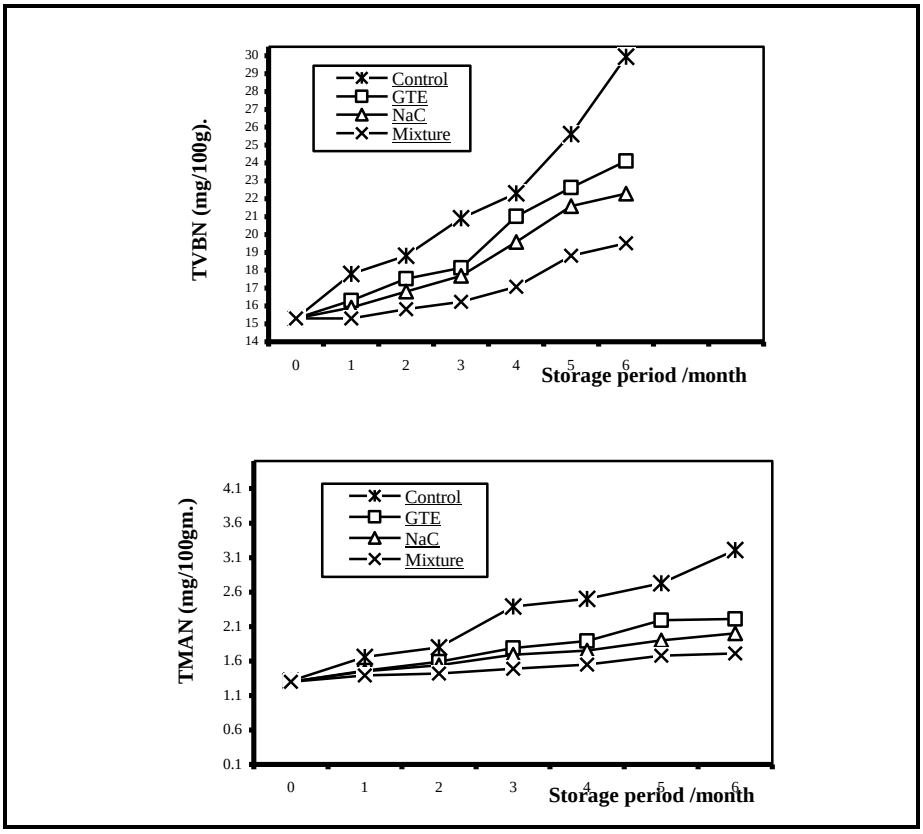
GTE[1] = 200 ppm green tea extracts, NaC[2] =2% sodium citrate, Mixture[3] = 200 ppm GTE + 2% NaC (1:1, v/v).

At zero time of storage period the initial total volatile bases nitrogen value (TVBN) was 15.30 (mg/100g) and trimethylamine nitrogen value (TMAN) was 1.31 (mg/100g) for control, GTE, NaC and their mixture as all samples were fresh.

While at the end of storage period TVBN values were 29.95, 24.12, 22.29 and 19.51 (mg/100g), also TMAN values were 3.21, 2.21, 2.00 and 1.71 (mg/100g) for control, GTE, NaC and their mixture, respectively. The values of TVBN and TMAN showed a progressive significant increases ($P<0.05$) for all samples till the end of storage (Fig.1). The lowest TVBN and TMAN values were observed in treated samples by mixture of GTE with NaC. These results may be due to chemical composition of GTE which containing polyphenols with NaC, play an important role in protein precipitation and enzyme inhibition and have anti-bacterial activities (Sallam, 2007b and Fan *et al.,* 2008). Moreover the highest TVBN and TMAN were showed in control samples.

The increase in TVBN and TMAN values could be due to the activity of endogenous enzymes activities and bacterial growth led to the decomposition and degradation of endogenous compounds into non-protein N-compounds as well as the conversion of TMAO to TMA as described by Lakshmisha *et al.* (2008). Nevertheless, the TVB-N values in the different samples analyzed, throughout the entire storage period, were all below the maximum value of 30 - 40 mgN/100g as the upper limit for fresh water fish consumption (Connel, 1990).

Fig. (1): Effect of green tea extracts (200 ppm GTE), sodium citrate (2% NaC) and their mixture (1:1, v/v) on total volatile bases nitrogen values (TVBN, mg/100g) and trimethylamine nitrogen (TMAN, mg/100g) of silver carp fillets storage at - 20±1ºC for 6 months.



The changes of thiobarbituric acid values (TBA) values less than 2 mg malonaldehyde /kg is considered to be the upper limit, above which fishery products have poor quality (Bonnell, 1994).

All samples were fresh and the initial peroxide value (PV) was 14.50 (milliquivalents peroxide/ kg.) as well as TBA value was 0.71 (mg. malonaldehyde /100g) for control, GTE, NaC and their mixture at zero time of storage period. The highest levels of PV values were 19.81, 18.27, 17.17 and 16.33 (milliquivalents peroxide/ kg.) at end of fourth month. While at the end of storage period PV values were 18.82, 17.61,

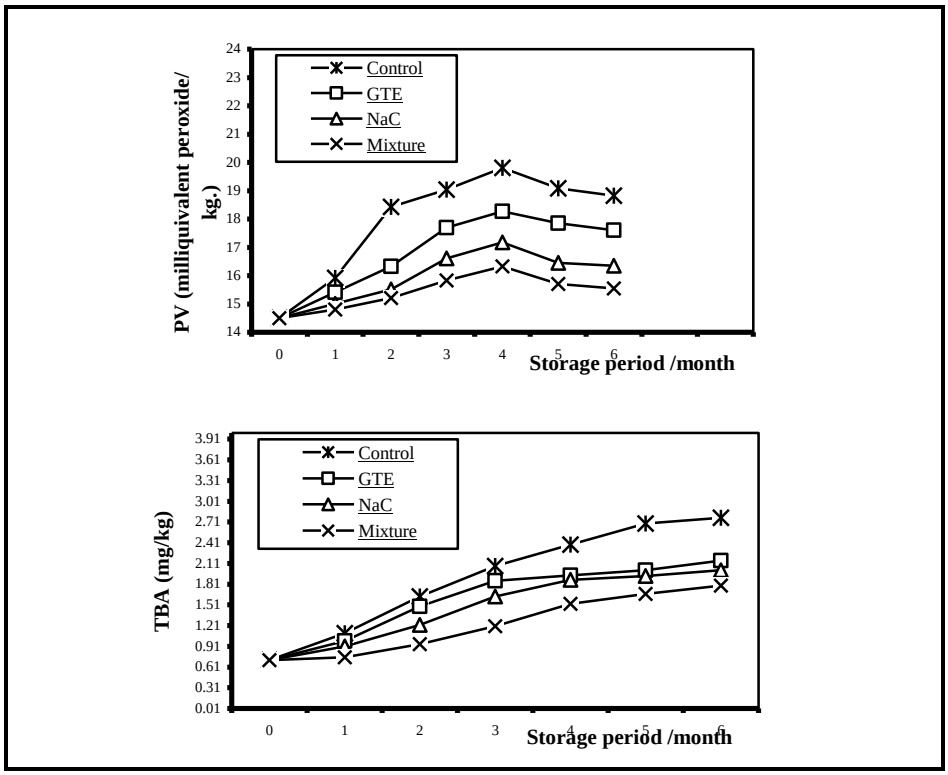
16.35 and 15.55 (milliquivalents peroxide/ kg.), also TBA values were 2.77, 2.15, 2.01 and 1.79 (mg. malonaldehyde /100g) for control, GTE, NaC and their mixture, respectively.

The results revealed gradual increases in the (PV) and (TBA) values (Fig. 2). The increase of TBA and PV values were very slow in fillets treated with mixture of GTE and NaC significantly ($p<0.05$) compared to untreated control samples. These results may be due to anti-oxidative activity of green tea extract as well as sodium citrate, which play an important role in enzyme inhibition and have beneficial anti-bacterial activities in fish muscles (Lee *et al*., 2002 and Sallam, 2007b).

The highest TBA and PV values were obtained in untreated control samples. These results could be due to ice crystals formation in tissues which could injure the cell and cause the release of pro-oxidant enzymes (lipoxygenases and peroxidases) and chemical pro-oxidant molecules (hemoproteins and metal ions) which caused lipid oxidation and conversion of some lipids into aldhydes and ketones. Similar results were recorded by Asgharzadeh *et al.* (2010) and Abu-Salem *et al.* (2011). In addition Rostamzad *et al.* (2010) revealed that salts of citric acid act as chelators of free radicals in biological systems and synergists of other antioxidants and thus slow down oxidation and rancidity development delaying improper changes in sea food. Bozkurt (2006) mentioned that the antioxidative property of green tea extract is due to the presence of catechins, apicatechins, epicatechin gallate, epigallocatechin, and epigallocatechin gallate, which are free radical scavengers, metal chelators and inhibitors of enzymes. At the end of storage period, peroxide values (PV) showed decreases in all fillet samples. This could be explained by the fact that peroxides are prone to interact with biological constituents present in fish muscles and decomposition of peroxides as oxidation progresses lading to decrease in (PV) detection

in spite of the increasing fish damage similar results were reported by Maria (2009).

Fig. (2): Effect of green tea extracts (200 ppm GTE), sodium citrate (2% NaC) and their mixture (1:1, v/v) on peroxide values (PV) milliquivalent peroxide/ kg. Lipid) and thiobarbituric acid values (TBA, mg/kg) content of silver carp fillets during storage at - 20±1ºC for 6 months.

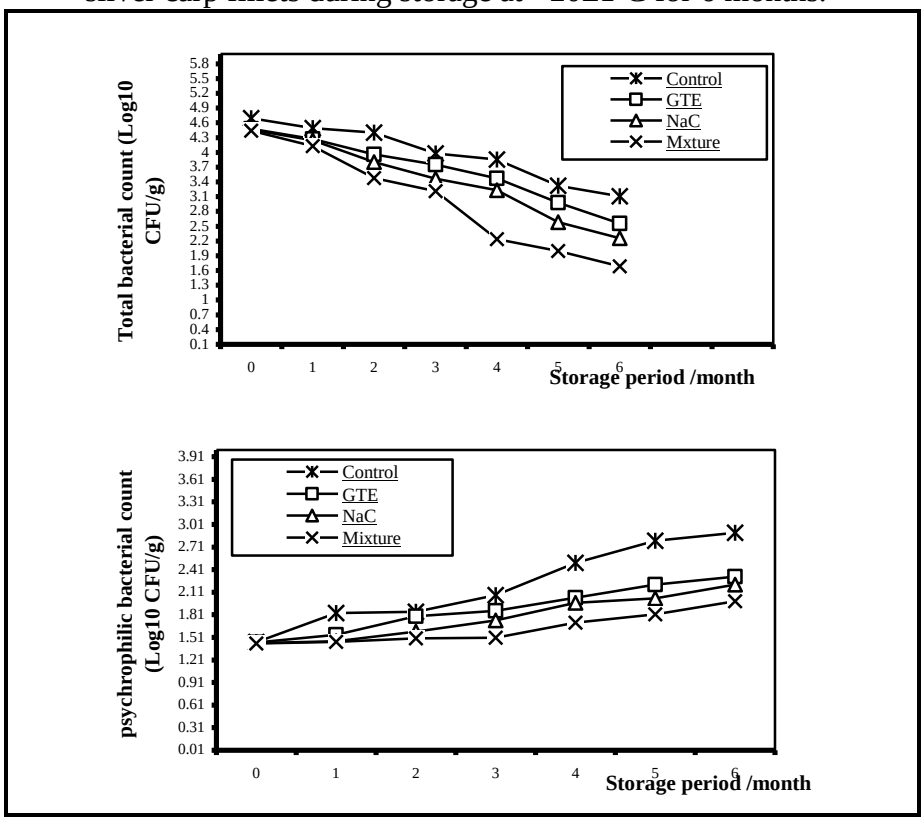


Microbiological evaluation: The storage life of fish is affected by the initial microbial load of the fish and storage temperature. If less than 10^6 microorganisms/g samples, total bacterial counts (TBC) limit is considered acceptable (Ozogul *et al*., 2005). The achieved results presented in (Fig. 3) showed the changes in bacterobiological count of fish fillets treated with GTE, NaC separately and their mixture (1:1, v/v) during storage at - 20±1ºC for 6 months.

The initial TBC were 4.691, 4.580, 4.461 and 4.441 (Log 10 CFU/g) for control, samples treated with GTE, NaC and their mixture, respectively at zero time of storage period. While at the end of storage period TBC were 3.108, 2.556, 2.256 and 1.687 (Log 10 CFU/g) for control, samples treated with GTE, NaC and their mixture, respectively. The levels of TBC showed gradual significant decreases ($P<0.05$) in untreated control and treated samples. As it can be inferred, that the lowest content of total bacterial were detected in fish fillets treated with mixed solutions (GTE with NaC) followed by fillets treated with NaC then GTE, respectively compared to untreated control samples at the end of storage period. Generally, the reduction in numbers of microorganisms may be due to the mechanical damage of bacterial cell caused by crystals during freezing and thawing on the microflora contaminating flesh samples (Chevalier *et al.*, 2001).

On other side, the initial psychrophilic bacterial counts (PsBC) were 1.445, 1.443, 1.433 and 1.431 (Log 10 CFU/g) for control, samples treated with GTE, NaC and their mixture, respectively at zero time of storage period. While at the end of storage period were 2.900, 2.316, 2.210 and 1.990 (Log 10 CFU/g) for control, samples treated with GTE, NaC and their mixture, respectively. Psycrophilic bacteria (PsBC) indicated gradual increases during freezing storage in control more than treated samples (Fig. 3). The lowest level of PsBC was detected in fillets treated with mixture from GTE with NaC, followed by NaC then GTE, while the highest level in control samples. However, the increases of PsBC may be due to the presence of psycrophilic spores forming bacteria which are reactivated during freezing. These results are in agreement with those obtained by Boknaes *et al*., (2000). The obtained results could be attributed to antimicrobial properties of green tea and sodium citrate. The results agree with those reported by Sallam (2007b), Lakshmisha *et al.* (2008) and Erol *et al*., (2009). Also antimicrobial activities of green tea extract have been reported previously by Higdon and Frei (2003).

Fig. 3: Effect of green tea extracts (200 ppm GTE), sodium citrate (2% NaC) and their mixture (1:1, v/v) on total bacterial count (TBC) and psychrophilic bacterial count (PsBC) Log10 CFU/g in silver carp fillets during storage at - 20±1ºC for 6 months.



Sensory evaluation of fillets storage at -20±1ºC and treated with GTE, NaC individually and mixture of them (1:1, v/v) illustrated in Tables (2). Throughout the storage period, there were significant decreases ($p<0.05$) in sensorial criteria for all treatments. The decreases in the texture scores were higher then the decreases in color and odor at the end of freezing storage period similar results reported by Ozogul *et al.* (2005). The highest scores were found in fish fillets treated with mixture from (GTE with NaC) followed by samples treated with NaC then GTE, While the lowest scores in sensorial criteria were in control untreated samples. In general, the gradual decrease in sensory scores

may be attributed to polyunsaturated fatty acids (PUFA) in fish which susceptible to lipid oxidation and denaturation of the muscle proteins.

Table (2): Effect of green tea extracts, sodium citrate and their mixture on odor, color, texture and over all acceptability of silver carp fillets during storage at -20±1ºC for 6 months.

Parameter		Odor				Color			
PEE %		Control	GTE[1]	NaC[2]	Mixture[3]	Control	GTE[1]	NaC[2]	Mixture[3]
Storage period/ months	0	8.9± 0.07[a]	8.9± 0.06[a]	8.9± 0.07[a]	8.9± 0.07[a]	9.0± 0.09[a]	9.0± 0.07[a]	9.0± 0.06[a]	9.0± 0.05[a]
	1	8.1± 0.05[c]	8.4± 0.06[b]	8.6± 0.05[b]	8.8± 0.04[a]	8.4± 0.05[b]	8.6± 0.05[ab]	8.7± 0.06[ab]	8.9± 0.05[a]
	2	7.4± 0.08[d]	7.9± 0.07[b]	8.2± 0.06[b]	8.5± 0.06[a]	7.6± 0.05[c]	8.2± 0.06[b]	8.4± 0.07[b]	8.6± 0.06[a]
	3	7.0± 0.04[d]	7.4± 0.08[c]	7.8± 0.05[bc]	8.1± 0.03[a]	7.1± 0.04[d]	7.7± 0.06[c]	7.9± 0.04[bc]	8.3± 0.05[a]
	4	6.3± 0.07[d]	7.0± 0.07[cd]	7.1± 0.08[c]	7.7± 0.05[a]	6.5± 0.06[d]	7.2± 0.05[d]	7.4± 0.07[c]	7.9± 0.04[a]
	5	5.5± 0.04[e]	6.4± 0.06[d]	6.5± 0.04[d]	7.4± 0.04[a]	5.7± 0.04[e]	6.7± 0.03[d]	6.9± 0.07[cd]	7.5± 0.05[a]
	6	4.6± 0.06[e]	5.6± 0.04[d]	5.9± 0.05[d]	6.8± 0.06[a]	5.0± 0.05[e]	6.2± 0.05[d]	6.4± 0.03[c]	6.9± 0.04[a]
		Texture				Over all -acceptability			
	0	8.8± 0.07[a]	8.8± 0.06[a]	8.8± 0.05[a]	8.8± 0.04[a]	89.0± 0.06[a]	89.0± 0.05[a]	89.0± 0.06[a]	89.0± 0.05[a]
	1	8.0± 0.07[b]	8.2± 0.07[b]	8.3± 0.07[ab]	8.7± 0.05[a]	81.7± 0.07[b]	84.0± 0.07[ab]	85.3± 0.06[ab]	88.0± 0.06[a]
	2	7.1± 0.08[c]	7.6± 0.08[ab]	7.8± 0.05[ab]	8.2± 0.06[a]	73.7± 0.08[c]	79.0± 0.05[b]	81.3± 0.04[b]	84.3± 0.04[a]
	3	6.4± 0.03[d]	7.0± 0.08[c]	7.3± 0.04[bc]	7.8± 0.06[a]	68.3± 0.05[d]	73.7± 0.08[c]	76.7± 0.06[c]	80.7± 0.05[a]
	4	5.6± 0.05[d]	6.5± 0.03[d]	6.8± 0.07[cd]	7.5± 0.05[a]	61.3± 0.05[e]	69.0± 0.05[d]	71.0± 0.07[c]	77.0± 0.03[a]
	5	4.8± 0.04[e]	5.9± 0.07[d]	6.3± 0.07[c]	7.0± 0.04[a]	53.3± 0.05[e]	63.3± 0.06[de]	65.7± 0.05[d]	73.0± 0.03[a]
	6	4.2± 0.03[e]	5.3± 0.06[d]	5.6± 0.04[c]	6.7± 0.05[a]	46.0± 0.04[e]	57.0± 0.05[d]	59.7± 0.06[c]	68.0± 0.04[a]

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

Values are expressed as mean ± SE.

GTE[1] = 200 ppm green tea extracts, NaC [2] =2% sodium citrate, Mixture[3] = 200 ppm GTE + 2% NaC (1:1, v/v).

As well as the formation of ice crystals led to structural damage of membranes, which cause quality deterioration in sensory properties and nutritional value of the products during freezing storage Asgharzadeh *et al.* (2010). The results are in agreement with Bozkurt (2006). From other side the highest scores for fillets treated with mixed solutions may be due to the synergistic effect of GTE with NaC as antioxidant (Lee, *et al.,* 2002) and (Haghparast *et al.,* 2010).

Results indicated that, the pre-soaking of fish fillets in the mixture of 200 ppm GTE and 2% NaC (1:1- v/v) then storage at - 20±1ºC was better than individual treatment with either GTE or NaC. It can be concluded that, green tea extracts and sodium citrate safe as natural preservatives owing to their antimicrobials and antioxidants properties to extend the shelf-life and maintain fish fillets qualities and nutritional value during frozen storage.

EFERENCES

Abu-Salem, F. M.; E. A. Abou-Arab; H. M. Ibrahim and A. A. Abou-Arab. 2011. Effect of adding green tea extract, thyme oil and/or their combination to luncheon roll meat during refrigerate storage. J. of American Science, 7 (7): 538-548.

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

AOAC, 2000. Official methods of analysis, 16th ed. Association of Official Analytical Chemists, Washington, DC.

Asgharzadeh, A; S. Bahareh; P. A. Santiago and H. Hedayat. 2010. Chemical changes in silver carp (*Hypophthalmichthys molitrix*) minced muscle during frozen storage: Effect of a previous washing process. Grasas Y Aceites, 61 (1), Enero-Marzo, 95-101.

Banerjee, S. 2006. Inhibition of mackerel (*Scomber scombrus*) muscle lipoxygenase by green tea polyphenols. Food Research International J., 39: 486–491.

Boknaes, N.; C. Osterberg; J. Nielsen and P. Dalgaard. 2000. Influence of freshness and frozen storage temperature on quality of thawed cod fillets stored in modified atmosphere packaging. Lebensmittel-Wissenschaft und-Technologie, 33 (3): 244-248.

Bonnell, A.D. (1994). Quality assurance in seafood processing. In: Quality Assessment, Chapter 5, Academic Press, New York, USA, p. 72.

Bozkurt, H. 2006. Utilization of natural antioxidants: green tea extract and (*Thymbra spicata*) oil in Turkish dry- fermented sausage. Meat Science, 73 (3): 442-450.

Chevalier, D.; A. Siqueira-Muñoz; A. Le Bail; B.K. Simpson and M. Ghoul. 2001. Effect of freezing conditions and storage on ice crystal and drip volume in turbot (*Scophthalmus maximus*). Evaluation of pressure shift freezing vs. air-blast freezing. Innovative Food Science and Emerging Technologies, 1:193–201.

Connel, J. J. 1990. Control of fish quality. Published by Fishing News Book, a Division of Black Well, Scientific Publication, Cambridge, UK.

Del Nobile, M.A.; M.R. Corbo; B. Speranza; M. Sinigaglia; A. Conte and M. Caroprese. 2009. Combined effect of MAP and active compounds on fresh blue fish burger. International Journal of Food Microbiology 135: 281–287.

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

Erol, N. T.; F. Sari; G. Polat and Y. S. Velioğlu. 2009. Antioxidant and antibacterial activities of various extracts and fractions of fresh tea leaves and green tea. Tarim Bilimleri Dergisi, 15 (4): 371-378.

Fan, W.; Y. Chi and S. Zhang. 2008. The uses of a tea polyphenol dip to extend the shelf life of silver carp (*Hypophthalmicthys molitrix*) during storage in ice. Food Chemistry, 108: 148 -153.

Gonclaves, A. A. and C. S. Guidobono Gindri. 2009. The effect of glaze uptake on quality of frozen shrimp. Journal of Food Engineering, 90: 285-290.

Haghparast, S.; H. Kashiri; B. Shabanpour and M.H. Pahlavani. 2010. Antioxidant properties of sodium acetate, sodium citrate and sodium lactate on lipid oxidation in rainbow trout (*Onchorhynchus mykiss*) sticks during refrigerated storage (4°C). Iranian Journal of Fisheries Sciences, 9 (1): 73-86.

Harrigan, W.F. and E.M. Margaret. 1976. Laboratory method in food and dairy microbiology.A subsidiary of Harcout Brace Jovanoich, Academic Press, Landon, N.Y., Sanfrancisco.

Higdon, J. V. and B. Frei. 2003. Tea catechins and polyphenols: health effects, metabolism, and antioxidant functions. Critical Reviews in Food Science and Nutrition, 43: 89-143.

Kirk, R. and R. Sawyer. 1991. Pearson's Composition and Analysis of Foods, 9th ed., 642-643. Longman Scientific and Technical, Singapore.

Lakshmisha, I.P.; C.N. Ravishankar; G. Ninan; C.O. Mohan and T.K. Gopal. 2008. Effect of freezing time on the quality of Indian mackerel (*Rastrelliger kanagurta*) during frozen storage. Journal of Food Sciences, 73 (7): 345-53.

Lee, Y.L.; T. Cesario; J. Owens; E. Shanbrom and L. D. Thrupp. 2002. Antibacterial activity of citrate and acetate. Nutrition, 18: 665-666.

Maria, M. 2009. Biochemical and textural properties of frozen stored (-22°C) gilthead seabream (*Sparus aurata*) fillets. African Journal of Biotechnology, 8 (7): 1287-1299.

Ojagh, S.M.; M.A. Sahari; M. Rezaei and S.V. Hosseini. 2011. Applicability of B-Carotene and green tea polyphenols as two natural antioxidants in preservation of Common Kilka (*Clupeonella Cultriventris Caspia*) with ice. International Journal of Agriculture: Research and Review. 1 (4): 174-181.

Ozogul, Y.; G. Ozyurt; F. Ozogul; E. Kuley and A. Polat. 2005. Freshness assessment of European ell (*Anguilla anguilla*) by sensory, chemical and microbiological methods. Food chemistry, 92: 745-751.

Rostamzad, H.; B. Shabanpour; M. Kashaninejad and A. Shabani. 2010. Inhibitory impacts of natural antioxidants (ascorbic and citric acid) and vacum packaging on lipid oxidation in frozen Persian sturgeon fillets. Iranian Journal of Fisheries Sciences, 9 (2): 279-292.

Sallam, K.I. 2007a. Chemical, sensory and shelf life evaluation of sliced salmon treated with salts of organic acids. Food Chem.; 101(2): 592-600.

Sallam, K.I. 2007b. Antimicrobial and antioxidant effect of sodium acetate, sodium lactate and sodium citrate in refrigerated sliced salmon. Food Control, 18: 566-575.

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

Siddaiah, D.; G.V.S. Reddy and T.C. Chandrasekhar. 2001. Changes in lipids, proteins and kamaboko forming ability of silver carp (*Hypophthalmichthys molitrix*) mince during frozen storage. Food J. Research International, 34: 47-53.

Singh, R. and A. Balange. 2005. Characteristics of pink perch (*Nemipterus jaaponicus*) surimi at frozen temperature. Journal of Food Processing and Preservation, 29 (1): 75-83.

Swanson, K.M.; F.F. Busta; E.H. Peterson and M.G. Johnson. 1992. Colony count methods, p. 75-95. In C. Vanderzant and D. F. Splittoesser (eds.). Compendium of methods for the 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 minced block fish muscle. Journal of Milk and Food Technology, 35: (7) 414.

Theron, M.M. and J.F.R. Lues. 2007. Organic acids and meat preservation: A review, Food Rev. Int., 23: 141- 158.

Tokur, B.S.; E. Atici; G.l. Ozyurt and C.E. Ozyurt. 2006. Chemical and sensory quality changes of fish fingers, made from mirror carp *(Cyprinus carpio L.*, 1758), during frozen storage (-18°C). Food Chemistry, 99: 335–341.

تأثير مستخلص الشاى الاخضروسترات الصوديوم على جودة شرائح سمك المبروك الفضى خلال التخزين بالتجميد

سامية ابراهيم على حسنين و احمد ذكار حسب الله

قسم بحوث التصنيع ومراقبة الجودة، المعمل المركزى لبحوث الثروة السمكية، مركز البحوث الزراعية ، مصر

الملخص العربى

أجريت هذه الدراسة لتقييم بعض الخواص الكيميائية والميكروبيولوجية والحسية لشرائح سمك المبروك الفضى المعاملة بالغمر لمدة عشرون دقيقة فى مستخلص الشاى الأخضر(٢٠٠ جزء فى المليون) ومحلول سترات الصوديوم (٢%) والمحلول الخليط منهما بنسبة ١:١ والتجميد والتخزين على درجة حرارة −٢٠± ٢°م لمدة ٦ أشهر. أظهرت النتائج أن أعلى مستويات للبروتين ،الدهن والخواص الحسية فى العينات التى تمت معاملتها بالمحلول الخليط مستخلص الشاى الأخضر (٢٠٠ جزء فى المليون) + ومحلول سترات الصوديوم (٢%) يليها المعاملة بمحلول سترات الصوديوم (٢%) يتبعها العينات المعاملة بمستخلص الشاى الأخضر (٢٠٠ جزء فى المليون) مقارنة بالكنترول. حدث زيادة لجميع العينات فى مستويات كل من حمض الثيوباربتيوريك والقواعد النيتروجينية الطيارة والأمين ثلاثى الميثيل،مستوى البيروكسيد والبكتيريا المحبة للبرودة. وانخفاض تدريجى للعدد الكلى للبكتيريا أثناء فترة التخزين وكان أقل مستوى لهذة التحاليل فى العينات المعاملة بالمحلول الخليط.

اوضحت النتائج إلى أن شرائح سمك المبروك الفضى المنقوعة فى خليط: مستخلص الشاى الأخضر (٢٠٠ جزء فى المليون) مع محلول سترات الصوديوم (٢%) بنسبة ١:١ والتجميد والتخزين، أفضل من المعاملات الأخرى المنفردة بمحلول سترات الصوديوم (٢%) أو مستخلص الشاى الأخضر (٢٠٠ جزء فى المليون) ، وعلى ذلك فإنة يمكن التوصية باستخدام خليط من مستخلص الشاى الأخضر و سترات الصوديوم كمادة حافظة طبيعيه مضادة للاكسدة وللبكتيريا بجانب التجميد وذلك للمحافظةعلى القيمة الغذائية وعلى جودة شرائح سمك وبالتالى إطالة صلاحيتها.