

**Effect of Propolis and Garlic on Nile Tilapia *Oreochromis niloticus*  
Fillets during Frozen Storage**

Samya I. A. Hassanin<sup>1\*</sup> and El-Said A. El-Daly<sup>2</sup>

1. Processing and Quality Control Department, Central Laboratory for Aquaculture  
Research, Agricultural Research Center

2. Meat Hygiene Department, Fac. of Vet. Medicine- Zagazig University Egypt

\*Corresponding Author

**ABSTRACT**

This investigation was done to determine the quality changes of Nile tilapia (*Oreochromis Niloticus*) fillets which were treated by minced garlic (G) at 1, 2 and 3% aqueous solution, natural honey bees product propolis extract (P) at 0.2, 0.4 and 0.6% aqueous solution and their mixture (1:1–v/v) for 30 min (4°C) at a ratio of 1 fillets: 1 solution (w /v) in addition to control fillets soaked in distilled water. The research aims to study the effect of treatments on quality attributes of fillets. Some biochemical properties as well as microbiological and sensory changes were evaluated during frozen storage at  $-18\pm 1^{\circ}\text{C}$  for 6 months. Based on the obtained results the concentration form mixture of 3% G and 0.6% P decreased chemical changes and microbiological content with high organoleptic properties compared with the control and other treatments during storage tilapia fillets at  $-18\pm 1^{\circ}\text{C}$ . The propolis and garlic can be used as natural food additives for fish products in order to improve their quality; accordingly they increase the shelf-life and provide both the protein and fat at optimal levels during frozen storage at  $-18\pm 1^{\circ}\text{C}$ .

**Keywords:** Nile tilapia; Fillets; Freezing; Propolis extract; Garlic.

**INTRODUCTION**

Freezing and frozen storage have largely been employed to retain fish sensory and nutritional properties. However, fish species have shown a highly unsaturated lipid composition and an important presence of prooxidant molecules that lead to rancidity development and quality loss (Richards and Hultin, 2002). In frozen conditions, lipid oxidation compounds have shown to facilitate protein denaturation and nutritional losses Rostamzad *et al.* (2011). From other sides, many fish species are filleted to satisfy consumer demand and adds value to product, although this

depends very much on the type of market. In general, filleting is primarily a means of food presentation intended to facilitate culinary preparation Antonio *et al.*, (2011). To extend the shelf life, a great deal of attention is being directed toward to the employment of antioxidants to prevent lipid oxidation. Recent efforts are focused on the replacement of synthetic antioxidants by natural ones, because of possible adverse side effects of synthetic antioxidants and beneficial effects of natural antioxidants which may provide nutritional and therapeutic effects (Sarkardei and Howel, 2008). Some spices, herbs and plants are generally used in food stuffs for enhancing the flavor or color

attributes. Moreover these materials have antimicrobial and antioxidant activity (Bayder *et al.*, 2004). Soaking pretreatment of fish fillets in naturally antioxidants led to lipid oxidation inhibition Aubourg *et al.*, (2004).

Propolis (bee glue) is a solid substance produced by honey bees after mixing their own waxes with resinous collected from plants. Afterward, it is utilized for sterilizing hives of honey bees. Traditionally, propolis has been used as a medicine, due to its biological properties such as antimicrobial, antifungal, antiprotozoal, and antiviral (Cuesta *et al.*, 2005). The antimicrobial effect of propolis resulted from the synergistic effects of its components. Propolis influences the cytoplasmic membrane and inhibits enzyme activity as well as motility of bacteria (Koru *et al.*, 2007). Moreover, its phenolic components have antioxidative effects Geckil *et al.* (2005) and Kumar *et al.* (2008). From the previous study propolis was tested as food preserver in beef burger at level of 0.3% to improve quality of product (Moghazy and El-Shaarawy, 2001). The garlic is one of the edible plants which commonly used as a flavor enhancement and antioxidant purposes. During the last decade, the antimicrobial activity of garlic and garlic derived organosulfur compounds was widely investigated against both food spoilage bacteria and food borne pathogens (Leuschner and Ielsch, 2003). In addition, garlic is appreciated for its medical properties. A wide range of microorganisms including, bacteria, fungi, protozoa and viruses have been shown to be sensitive to crushed garlic preparations Harris *et al.* (2001). The present work was designed to study the quality aspects of Nile tilapia (*Oreochromis Niloticus*) fillets presoaked in minced garlic (G) at 1, 2 and 3% aqueous solution, propolis extract (P) at 0.2, 0.4 and 0.6% aqueous solution and in a combination mixture at 0.2, 0.4 and 0.6% aqueous solution (1:1-v/v) before frozen storage at  $-18\pm 1^{\circ}\text{C}$  for 6 months.

## MATERIALS AND METHODS

### *Preparation of fish and treatments*

The crude propolis (honey bees glue) sample was obtained from Faculty of Agriculture, Zagazig University. Propolis was manually purified from impurities. Then aqueous solutions of propolis extract were prepared with concentrations 0.2% (P1), 0.4% (P2) and 0.6% (P3) according to the (Osman and Taha, 2008 and Guo *et al.*, 2011). The fresh garlic bulbs (*Allium sativum L.*): Garlic were purchased from, local markets at Zagazig, Sharkia. The dry skins of the garlic bulb were removed before use; then the cloves were peeled and crushed finely by using a kitchen hand held grater. Water solution of minced garlic with concentrations 1% (G1), 2% (G2) and 3% (G3) were prepared.

Nile tilapia was obtained from a local aquaculture farm located at Abbassa Abu-Hammad Sharkia, with an average weight  $300\pm 50\text{g}$ . Fish kept on ice (1h) in boxes till delivery to the laboratory. Then, fish was carefully gutted, dressed, filleted by hand and washed with tap water. The weight of each fillet was 110 g. Thereafter, Fillets were divided into 4 groups; first group was immersed in water (control; treatment). The second, third and fourth group were divided to 3 subgroups immersed in 1, 2 and 3% aqueous solution of minced garlic (G1, G2 and G3 treatments); 0.2, 0.4 and 0.6% aqueous solution of propolis extract (P1, P2 and P3 treatments) and in a combination mixture (1:1-v/v) of aqueous solution minced garlic and propolis (GP1, GP2 and GP3 treatments) respectively. The fillets samples were submerged in solutions ( $4^{\circ}\text{C}$ ) at a ratio of 1:1 (w/v). After 30 minutes fillets were removed from all solutions and then drained on sanitized stainless-steel grill for 2 min at room temperature. Treated fillets packaged in individual polyethylene bags and kept in a freezer at  $-18\pm 1^{\circ}\text{C}$ . Sampling was undertaken on the raw fillets (initial material) and every 2 months for analyses.

## PROPOLIS AND GARLIC ON NILE TILAPIA FILLETS DURING FROZEN STORAGE

### Chemical evaluation

Total protein and crude fat content were determined as mentioned in AOAC (2000). Total Volatile Bases Nitrogen (TVBN, mg/100g.) and Thiobarbituric acid (TBA, mg malonaldehyde/kg) values were determined as described by Kirk and Sawyer (1991). Peroxide Values (PV) was 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 evaluation: 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).

### Organoleptic evaluation

Both raw and cooked tilapia fillet samples were assessed every two months during storage period. Panelists were asked to evaluate uncooked fillet samples for odor and texture, while the cooked samples assessed for taste. Before presentation to the panel, fillet samples were steam cooked for 20 minutes and served warm to the panelists. The samples were coded using letters and randomly presented to the panelists. A group of 10 judges were always

called upon for scoring beginning grades ranging from zero to 10 as ascribed by Teeny and Miyauchi (1972) according to 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 total protein, crude fat, TVBN, TBA and PV values TBC and PsBC bacterial count as well as sensory data were analyzed using analysis of variance (ANOVA) and the means were separated by Duncan's test (1955) at a probability level of  $P < 0.05$  SAS (2000).

## RESULTS AND DISCUSSION

### Chemical evaluation

Data listed in Tables (1 and 2) showed the changes in total protein and fat % content of tilapia fillets treated with different concentrations of minced garlic (G), propolis extract (P) and their mixture during storage at

Table (1): Effect of different concentrations from minced garlic (G), propolis extract (P) and their mixture (1:1 – v/v) on total protein (%) content of tilapia fillets during storage for 6 months at  $-18 \pm 1^\circ\text{C}$  (on dry weight bases).

Treatments	Control	(G)			(P)			(G + P 1:1)			
	0%	G1	G2	G3	P1	P2	P3	GP1	GP2	GP3	
Storage period/ months	0	82.61± 0.04 <sup>a</sup>	82.61± 0.02 <sup>a</sup>	82.61± 0.04 <sup>a</sup>	82.61± 0.02 <sup>a</sup>	82.61± 0.03 <sup>a</sup>	82.61± 0.03 <sup>a</sup>	82.61± 0.03 <sup>a</sup>	82.61± 0.03 <sup>a</sup>	82.61± 0.04 <sup>a</sup>	82.61± 0.05 <sup>a</sup>
	2	81.01± 0.07 <sup>b</sup>	81.31± 0.05 <sup>b</sup>	81.62± 0.03 <sup>ab</sup>	81.82± 0.07 <sup>a</sup>	81.56± 0.02 <sup>b</sup>	81.81± 0.04 <sup>ab</sup>	82.18± 0.07 <sup>a</sup>	81.87± 0.07 <sup>b</sup>	82.16± 0.01 <sup>a</sup>	82.33± 0.03 <sup>a</sup>
	4	79.41± 0.09 <sup>c</sup>	80.01± 0.09 <sup>c</sup>	80.48± 0.04 <sup>c</sup>	80.87± 0.02 <sup>b</sup>	80.45± 0.06 <sup>c</sup>	81.01± 0.07 <sup>b</sup>	81.24± 0.05 <sup>b</sup>	80.92± 0.08 <sup>c</sup>	81.67± 0.02 <sup>b</sup>	81.93± 0.02 <sup>a</sup>
	6	78.04± 0.03 <sup>e</sup>	78.76± 0.05 <sup>cd</sup>	79.19± 0.06 <sup>d</sup>	79.89± 0.07 <sup>b</sup>	79.05± 0.08 <sup>d</sup>	80.13± 0.02 <sup>bc</sup>	80.90± 0.07 <sup>ab</sup>	79.95± 0.04 <sup>c</sup>	80.91± 0.02 <sup>b</sup>	81.50± 0.03 <sup>a</sup>

<sup>a-f</sup> Means within a row with the different superscript are significantly different ( $p < 0.05$ ).

Values are expressed as Mean ± SE.

HASSANIN AND EL-DALY

Table (2): Effect of different concentrations from minced garlic (G), propolis extract (P) and their mixture (1:1 – v/v) on total lipids (%) content of tilapia fillets during storage for 6 months at -18±1°C (on dry weight bases).

Treatments	Control		(G)			(P)			(G + P 1:1)		
	0%		G1	G2	G3	P1	P2	P3	GP1	GP2	GP3
Storage period/ months	0	9.75±	9.75±	9.75±	9.75±	9.75±	9.75±	9.76±	9.75±	9.76±	9.76±
		0.04 <sup>a</sup>	0.02 <sup>a</sup>	0.03 <sup>a</sup>	0.01 <sup>a</sup>	0.04 <sup>a</sup>	0.02 <sup>a</sup>	0.03 <sup>a</sup>	0.04 <sup>a</sup>	0.02 <sup>a</sup>	0.03 <sup>a</sup>
	2	8.63±	8.93±	9.22±	9.49±	8.95±	9.13±	9.53±	9.38±	9.44±	9.59±
		0.01 <sup>b</sup>	0.01 <sup>ab</sup>	0.04 <sup>a</sup>	0.01 <sup>a</sup>	0.01 <sup>ab</sup>	0.02 <sup>a</sup>	0.05 <sup>a</sup>	0.04 <sup>ab</sup>	0.03 <sup>a</sup>	0.02 <sup>a</sup>
	4	7.62±	8.11±	8.71±	9.00±	8.15±	8.51±	9.30±	8.08±	9.34±	9.47±
		0.02 <sup>c</sup>	0.07 <sup>b</sup>	0.05 <sup>ab</sup>	0.02 <sup>a</sup>	0.07 <sup>b</sup>	0.05 <sup>ab</sup>	0.04 <sup>a</sup>	0.06 <sup>b</sup>	0.04 <sup>ab</sup>	0.03 <sup>a</sup>
	6	6.76±	7.51±	8.05±	8.57±	7.28±	7.92±	8.93±	7.71±	8.95±	9.32±
		0.04 <sup>d</sup>	0.03 <sup>c</sup>	0.04 <sup>b</sup>	0.04 <sup>a</sup>	0.02 <sup>c</sup>	0.06 <sup>b</sup>	0.05 <sup>a</sup>	0.02 <sup>c</sup>	0.01 <sup>ab</sup>	0.02 <sup>a</sup>

<sup>a-d</sup> Means within a row with the different superscript are significantly different (p<0.05).

Values are expressed as Mean ± SE.

-18±1°C for 6 months. Total protein was decreased for all samples and a significant decrease (p<0.05) was found in total protein % content for control.

The total protein content was 82.61 % for fillets at zero time of storage period. At the end of storage period the highest protein content was 81.50% in fillets treated by mixture of 3% G + 0.6% P, while the least protein content was 78.04% recorded for control samples. The decrease in total protein may be due to protein denaturation resulted from direct effect of freezing and/or autolytic deterioration associated with the actions of endogenous enzymes and bacteria during storage. Also the results support of present findings by Oriakpono and Ndome (2012) they found a significant decrease in the crude protein content during storage of *Tilapia guineensis* at -18°C after four weeks. They attributed the reduction in crude protein to water soluble protein leaching out with melting ice as well as degradation of the initial crude protein to volatile products as total volatile bases (TVB), trimethylamine (TMA) hydrogen sulphide and ammonia during storage.

The initial fat content in fillets was 9.75 to 9.76% for row samples (Table 2). From the results fat content had gradual significant decreased (p<0.05) during storage at -18±1°C. At the end of frozen storage the least

fat content was 6.76% for control, while the highest level in fat was (9.32%) in fillets treated with mixture of 3% G with 0.6% P. The present findings were increment with Arannilewa *et al.* (2005) in *Tilapia* and Gandotra *et al.* (2012) in *Labeo Rohita (Ham-Buch)* fish. These workers found a significant loss in total lipid content when stored at low temperature. Oriakpono and Ndome (2012) revealed this loss due to enzymatic hydrolysis in addition to auto-oxidation of polyunsaturated fatty acids found in fish tissues to other products as aldehydes, free fatty acids, ketones, and peroxides that is the major cause of deterioration of fish. Furthermore, the highest total protein and fat content in treated samples compared to control may be due to propolis extract and minced garlic which play an important role in retarded the changes in protein and fat.

Total Volatile Bases Nitrogen (TVBN) which is a product of proteolytic changes in fish meat. The upper limit when a fish can be considered spoiled lies between 35 and 40 mg/100g Fan *et al.* (2009). The initial (TVBN) values in fillet samples ranged from 14.91 to 14.90 mg/100g flesh, which were indicative for freshness of raw fish material and high quality. The data in Table 3 indicated a gradual significantly increase (P<0.05) in TVBN value contents in all samples up to the end of storage period. The control samples had the highest

PROPOLIS AND GARLIC ON NILE TILAPIA FILLETS DURING FROZEN STORAGE

Table (3): Effect of different concentrations from minced garlic (G), propolis extract (P) and their mixture (1:1 – v/v) on the Total Volatile Bases Nitrogen values (TVBN mg/100g) of tilapia fillets during storage for 6 months at -18±1°C.

Treatments	Control	(G)			(P)			(G + P 1:1)			
	0%	G1	G2	G3	P1	P2	P3	GP1	GP2	GP3	
Storage period/ months	0	14.91±	14.90±	14.90±	14.90±	14.90±	14.90±	14.90±	14.90±	14.90±	14.90±
		0.03 <sup>a</sup>	0.03 <sup>a</sup>	0.02 <sup>a</sup>	0.03 <sup>a</sup>	0.02 <sup>a</sup>	0.02 <sup>a</sup>	0.03 <sup>a</sup>	0.02 <sup>a</sup>	0.02 <sup>a</sup>	0.03 <sup>a</sup>
	2	18.51±	17.67±	16.90±	15.60±	17.10±	16.42±	15.40±	17.59±	16.45±	15.30±
		0.03 <sup>a</sup>	0.01 <sup>b</sup>	0.03 <sup>c</sup>	0.04 <sup>d</sup>	0.05 <sup>bc</sup>	0.05 <sup>c</sup>	0.04 <sup>d</sup>	0.03 <sup>b</sup>	0.05 <sup>c</sup>	0.07 <sup>d</sup>
	4	22.20±	20.81±	19.90±	18.14±	18.77±	17.89±	16.96±	18.08±	17.60±	16.48±
		0.05 <sup>a</sup>	0.03 <sup>b</sup>	0.04 <sup>c</sup>	0.03 <sup>d</sup>	0.03 <sup>c</sup>	0.07 <sup>d</sup>	0.05 <sup>e</sup>	0.06 <sup>d</sup>	0.07 <sup>de</sup>	0.07 <sup>e</sup>
	6	26.30±	22.91±	21.30±	19.83±	22.68±	20.55±	19.25±	19.87±	18.51±	17.13±
		0.06 <sup>a</sup>	0.04 <sup>b</sup>	0.04 <sup>c</sup>	0.03 <sup>d</sup>	0.01 <sup>ab</sup>	0.04 <sup>c</sup>	0.07 <sup>cd</sup>	0.03 <sup>d</sup>	0.04 <sup>de</sup>	0.04 <sup>f</sup>

<sup>a-f</sup> Means within a raw with the different superscript are significantly different (p<0.05).

Values are expressed as Mean ± SE.

content of TVBN (26.30 mg/100 g) at the end of storage period compared to other treatments. Its increase is related to the activity of spoilage bacteria and endogenous enzymes because enzymes are still active, but at lower rates.

Similar results have been obtained previously by Hülya and Kayisoglu (2008) and Fan *et al.* (2009). From other side the lowest (TVBN) value was (17.13 mg/100 g) in samples treated by mixture (3%G + 0.6%P). This may be attributed to the antimicrobial effect related to the main components (phenolic and sulfur-containing compounds) found in propolis and garlic as reported by Harris *et al.*, (2001) and Enzo, *et al.* (2007).

Peroxide values (PV) and thiobarbituric acid values (TBA) were used as an index for lipid oxidation in fish and its products. Fish and fishery products of good quality will have TBA value less than 2.0 while poor quality TBA value greater than 2.7 mg. malonaldehyde /Kg will probably have smell and taste rancid Bonnell (1994).

The present study showed gradual significant increase in PV and TBA values for all groups but PV values revealed low level after 4 months during storage period (Table 4 and 5). The developments of PV and TBA values were very slow in the groups of treated by 3%G + 0.6% P, P and G respectively significantly (p<0.05) compared to control samples without

Table (4): Effect of different concentrations from minced garlic (G), propolis extract (P) and their mixture (1:1 – v/v) on Peroxide Values (PV milliequivalent peroxide / kg) of tilapia fillets during storage for 6 months at -18±1°C

Treatments	Control	(G)			(P)			(G + P 1:1)			
	0%	G1	G2	G3	P1	P2	P3	GP1	GP2	GP3	
Storage period/ months	0	14.33±	14.32±	14.30±	14.31±	14.32±	14.31±	14.30±	14.32±	14.31±	14.29±
		0.02 <sup>a</sup>	0.04 <sup>a</sup>	0.04 <sup>a</sup>	0.03 <sup>a</sup>	0.04 <sup>a</sup>	0.01 <sup>a</sup>	0.02 <sup>a</sup>	0.03 <sup>a</sup>	0.04 <sup>a</sup>	0.02 <sup>a</sup>
	2	16.97±	15.61±	15.30±	14.85±	15.02±	14.77±	14.53±	14.80±	14.62±	14.35±
		0.03 <sup>a</sup>	0.07 <sup>b</sup>	0.07 <sup>c</sup>	0.03 <sup>d</sup>	0.05 <sup>c</sup>	0.06 <sup>b</sup>	0.05 <sup>b</sup>	0.07 <sup>cd</sup>	0.02 <sup>d</sup>	0.07 <sup>d</sup>
	4	18.55±	16.91±	16.37±	15.47±	15.76±	15.26±	14.77±	16.55±	15.37±	14.55±
		0.04 <sup>a</sup>	0.04 <sup>b</sup>	0.04 <sup>c</sup>	0.07 <sup>d</sup>	0.06 <sup>cd</sup>	0.03 <sup>d</sup>	0.06 <sup>e</sup>	0.06 <sup>bc</sup>	0.09 <sup>d</sup>	0.08 <sup>e</sup>
	6	17.91±	16.04±	15.92±	15.00±	15.31±	14.81±	14.17±	16.27±	14.83±	13.93±
		0.05 <sup>a</sup>	0.07 <sup>ab</sup>	0.02 <sup>b</sup>	0.07 <sup>c</sup>	0.08 <sup>cd</sup>	0.08 <sup>d</sup>	0.09 <sup>e</sup>	0.01 <sup>ab</sup>	0.03 <sup>e</sup>	0.08 <sup>f</sup>

<sup>a-f</sup> Means within a raw with the different superscript are significantly different (p<0.05).

Values are expressed as Mean ± SE

## HASSANIN AND EL-DALY

**Table (5): Effect of different concentrations from minced garlic (G), propolis extract (P) and their mixture (1:1-v/v) on Thiobarbituric acid values (TBA) mg malonaldehyde/kg of tilapia fillets during storage for 6 months at -18±1°C.**

Treatments	Control	(G)			(P)			(G + P 1:1)			
	0%	G1	G2	G3	P1	P2	P3	GP1	GP2	GP3	
Storage period/ months	0	0.22±	0.22±	0.21±	0.21±	0.21±	0.21±	0.20±	0.21±	0.20±	0.20±
		0.003 <sup>a</sup>	0.003 <sup>a</sup>	0.002 <sup>a</sup>	0.002 <sup>a</sup>	0.001 <sup>a</sup>	0.002 <sup>a</sup>	0.001 <sup>a</sup>	0.001 <sup>a</sup>	0.002 <sup>a</sup>	0.001 <sup>a</sup>
	2	0.91±	0.78±	0.69±	0.65±	0.68±	0.51±	0.43±	0.56±	0.40±	0.35±
		0.006 <sup>a</sup>	0.003 <sup>b</sup>	0.004 <sup>c</sup>	0.003 <sup>c</sup>	0.002 <sup>c</sup>	0.007 <sup>bc</sup>	0.005 <sup>cb</sup>	0.006 <sup>cb</sup>	0.007 <sup>cb</sup>	0.004 <sup>d</sup>
	4	1.57±	1.45±	1.15±	1.13±	1.30±	1.20±	0.88±	1.15±	0.95±	0.76±
		0.005 <sup>a</sup>	0.001 <sup>ab</sup>	0.005 <sup>b</sup>	0.007 <sup>c</sup>	0.005 <sup>ab</sup>	0.004 <sup>c</sup>	0.006 <sup>d</sup>	0.004 <sup>c</sup>	0.003 <sup>d</sup>	0.007 <sup>d</sup>
	6	2.14±	1.71±	1.64±	1.50±	1.69±	1.46±	1.26±	1.59±	1.34±	1.01±
		0.006 <sup>a</sup>	0.002 <sup>b</sup>	0.005 <sup>b</sup>	0.004 <sup>b</sup>	0.005 <sup>b</sup>	0.006 <sup>c</sup>	0.003 <sup>d</sup>	0.006 <sup>c</sup>	0.006 <sup>c</sup>	0.004 <sup>d</sup>

<sup>a-d</sup> Means within a row with the different superscript are significantly different ( $p < 0.05$ ).

Values are expressed as Mean ± SE.

treatment. Asgharzadeh *et al.* (2010) reported that the increase in PV and TBA during freezing may be due to lipid hydrolysis and also to ice crystals formation in tissues which could injure the cell and cause the release of pro-oxidant enzymes (lipooxygenases and peroxidases) and chemical pro-oxidant molecules (hemoproteins and metal ions) which caused lipid oxidation.

Moreover, samples treated with mixture of 3%G + 0.6%P showed the lowest amount of PV (13.93 milliequivalent peroxide/ kg.) and TBA (1.01 mg malonaldehyde/kg) compared to control which had PV (17.91 milliequivalent peroxide/ kg.) and TBA (2.14 mg malonaldehyde/kg) at the end of storage period. The values of PV and TBA revealed that the highest antioxidant activity was in mixture of minced garlic with propolis extract which showed high accumulative inhibition of lipid peroxidation due to they exhibited a synergistic property of antioxidant activities in their mixture when compared with individual ones. Geckil *et al.* (2005) and Kumar *et al.* (2008) reported that phenolic components have antioxidative effects in propolis. Garlic has also been shown to have antioxidant properties due to its compounds (alliin, allicin, ajoene and allylpropyl) which inhibited the lipid oxidation Harris *et al.* (2001).

After 4 months of storage, PV values 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 leading to decrease in (PV) detection in fish fillets. Nearly similar results were reported by Alghazeer *et al.* (2008) they found that the PV value rose sharply until 16 weeks and then fell dramatically in all mackerel fish samples in the presence and absence of green tea antioxidant during the frozen storage (up to 26 weeks).

### Microbiological evaluation

For determination of freshness quality of fish before and during frozen storage, total bacterial count (TBC) and psychrophilic bacterial count (PsBC) were analyzed. The results presented in Table 6 indicate that TBC Log 10 CFU/g in all treatments showed gradual significant decrease ( $P < 0.05$ ) from initial load Table (6). Obemeata *et al.* (2011) assessed the microbiological analysis of *Tilapia guineensis* at -18 °C for 4 weeks. They founded the bacterial counts decreased during frozen storage

As it can be inferred, that maximum TBC was observed in control samples (3.98 Log10 CFU/g). While TBC of treated fillets with (P) and (G) individually were less than that of control samples especially samples treated in mixture of 3%G + 0.6% P (2.05 Log10 CFU/g). At the end of storage period the order of antimicrobial activity of the different treated

PROPOLIS AND GARLIC ON NILE TILAPIA FILLETS DURING FROZEN STORAGE

Table (6): Effect of different concentrations from minced garlic (G), propolis extract (P) and their mixture (1:1 – v/v) on the total bacterial count (TBC) Log<sub>10</sub> CFU/g contents of tilapia fillets during storage for 6 months at -18±1°C.

Treatments	Control	(G)			(P)			(G + P 1:1)			
	0%	G1	G2	G3	P1	P2	P3	GP1	GP2	GP3	
Storage period/ months	0	4.59±	4.58±	4.57±	4.55±	4.57±	4.56±	4.50±	4.54±	4.50±	4.48±
		0.011 <sup>a</sup>	0.004 <sup>a</sup>	0.002 <sup>a</sup>	0.012 <sup>a</sup>	0.003 <sup>a</sup>	0.001 <sup>a</sup>	0.003 <sup>a</sup>	0.004 <sup>a</sup>	0.003 <sup>a</sup>	0.001 <sup>a</sup>
	2	4.44±	4.34±	4.22±	4.01±	4.39	3.85±	3.39±	4.10±	3.70±	3.05±
		0.001 <sup>a</sup>	0.002 <sup>a</sup>	0.005 <sup>ab</sup>	0.007 <sup>b</sup>	0.002 <sup>a</sup>	0.003 <sup>ab</sup>	0.007 <sup>ab</sup>	0.008 <sup>a</sup>	0.005 <sup>ab</sup>	0.003 <sup>b</sup>
	4	4.15±	4.17±	3.84±	3.58±	3.87±	3.60±	3.14±	3.55±	3.21±	2.52±
		0.005 <sup>a</sup>	0.005 <sup>a</sup>	0.007 <sup>ab</sup>	0.005 <sup>b</sup>	0.004 <sup>ab</sup>	0.003 <sup>b</sup>	0.007 <sup>b</sup>	0.008 <sup>ab</sup>	0.006 <sup>ab</sup>	0.003 <sup>c</sup>
	6	3.99±	3.64±	3.37±	3.01±	3.40±	3.26±	2.45±	3.00±	2.75±	2.05±
		0.005 <sup>a</sup>	0.006 <sup>ab</sup>	0.008 <sup>ab</sup>	0.006 <sup>b</sup>	0.008 <sup>ab</sup>	0.008 <sup>ab</sup>	0.003 <sup>c</sup>	0.005 <sup>b</sup>	0.005 <sup>c</sup>	0.018 <sup>d</sup>

<sup>a-d</sup> Means within a raw with the different superscript are significantly different (p<0.05).

Values are expressed as Mean ± SE.

groups was (G + P) > (P) > (G) > control respectively.

On other side, gradual psychrotrophic organisms grow very slowly, (PsBC) Log<sub>10</sub> CFC/g during storage period Table (7). At the end of storage period PsBC was (3.15 Log<sub>10</sub> CFC/g) in control group. However, the least psychrophilic bacterial count was in treated fillet samples with mixture of 3%G +0.6%P (1.42 Log<sub>10</sub> CFC/g). Elzbita and Marina (1987) revealed the developing psychrophilic bacteria due to the presence of psychrophilic microflora cells and spores which activated at low temperature the results are in agreement with those obtained by Suvanich *et al.* (2000).

Obemeata *et al* (2011) report that *Pseudomonas*, *Staphylococcus*, *Proteus* and *Bacillus* spp bacteria were psychrotrophic microorganisms isolated from the -18°C stored Tilapia fish samples.

Generally, the reduction in numbers of microorganisms as indicated previously may be due to the mechanical damage of bacterial cell caused by crystals during freezing as reported by Block (1992). Obemeata *et al* (2011) stated that freezing of fish at -18 ± 1°C created an unfavorable environmental condition for the growth and the survival of the micro-organisms. Furthermore, the reduction in numbers of bacteria related to the synergistic antimicrobial

Table (7): Effect of different concentrations from minced garlic (G), propolis extract (P) and their mixture (1:1 – v/v) on psychrophilic bacterial count (Log<sub>10</sub> CFU/g) contents of tilapia fillets during storage for 6 months at -18±1°C.

Treatments	Control	(G)			(P)			(G + P 1:1)			
	0%	G1	G2	G3	P1	P2	P3	GP1	GP2	GP3	
Storage period/ months	0	1.63 ±	1.55±	1.49 ±	1.38±	1.38 ±	1.37 ±	1.39 ±	1.44±	1.33±	1.30 ±
		0.017 <sup>a</sup>	0.151 <sup>a</sup>	0.016 <sup>a</sup>	0.015 <sup>a</sup>	0.021 <sup>a</sup>	0.022 <sup>a</sup>	0.021 <sup>a</sup>	0.021 <sup>a</sup>	0.03 <sup>a</sup>	0.020 <sup>a</sup>
	2	2.13 ±	1.94±	1.75 ±	1.59±	1.78 ±	1.58 ±	1.39 ±	1.71±	1.44±	1.36 ±
		0.018 <sup>a</sup>	0.17 <sup>a</sup>	0.018 <sup>ab</sup>	0.016 <sup>b</sup>	0.012 <sup>ab</sup>	0.020 <sup>c</sup>	0.020 <sup>cd</sup>	0.022 <sup>ab</sup>	0.020 <sup>c</sup>	0.021 <sup>d</sup>
	4	2.78 ±	2.24±	2.03 ±	1.89±	2.24 ±	1.79 ±	1.42 ±	2.20 ±	1.74±	1.39 ±
		0.017 <sup>a</sup>	0.021 <sup>b</sup>	0.020 <sup>bc</sup>	0.019 <sup>c</sup>	0.025 <sup>b</sup>	0.026 <sup>c</sup>	0.025 <sup>d</sup>	0.01 <sup>ab</sup>	0.026 <sup>c</sup>	0.027 <sup>d</sup>
	6	3.15 ±	2.69 ±	2.44 ±	2.15 ±	2.72 ±	2.31 ±	1.88 ±	2.51±	2.11±	1.42 ±
		0.021 <sup>a</sup>	0.019 <sup>b</sup>	0.021 <sup>bc</sup>	0.018 <sup>c</sup>	0.023 <sup>a</sup>	0.023 <sup>b</sup>	0.027 <sup>ab</sup>	0.023 <sup>a</sup>	0.023 <sup>c</sup>	0.021 <sup>d</sup>

<sup>a-d</sup> Means within a raw with the different superscript are significantly different (p<0.05).

Values are expressed as Mean ± SE.

## HASSANIN AND EL-DALY

activity of garlic and propolis. Koch and Lawson (1996) reported that garlic have sulfur-containing compounds (*A. Allicin*, *A. Alliin* and *allinase enzymes*) which are responsible for antimicrobial properties. From other side the active ingredients in propolis are a group of phenolic compounds as well as cinnamic, flavonoids, aromatic acids and benzopyranes, which are well known for its strong antimicrobial activity Hegazi *et al.*, (2000); Harris *et al.*, (2001) and Kumar *et al.*, (2008).

### Organoleptic evaluation

All the initial samples at zero time had high scores for odor, texture and taste (Table 8, 9 and 10). This means that all samples were fresh according to Huss (1995). Throughout the frozen storage period there were significant decreases ( $p < 0.05$ ) in sensory scores for control and all treated samples. According to different concentrations of treatments the maximum odor, texture and taste ( $p < 0.05$ ) scores were obtained in fillets treated by mixture of 3% G + 0.6% P (GP3) compared to control. These could be attributed to the skinned off tilapia fillets enabling a faster diffusion of antioxidant and antimicrobial compounds in G and P to the muscle and so that synergic effects could lead to a greater preservative behavior and delay the quality loss when compared with control not treated samples Leuschner and Ielsch (2003) and Enzo *et al.* (2007). Dessouki *et al.* (1980) reported that soaking of meat in propolis

solution was more effective during frozen meat and meat flavor had maximum scores.

The score significantly decreased at the end of the storage period, minimum odor, texture and taste scores shown in control fillets. Moreover the chemical quality of fillets did not reach the critical values however; the decrease in the sensory scores was faster than chemical changes during storage for 6 months. Oriakpono *et al.* (2011) reported that, biochemical reactions especially occur in proteins and lipids with increasing time affect sensory properties and cause unpleasant odor, taste and texture changes. Rostamzad *et al.* (2011) revealed that fat in fish are inclined to oxidation during storage and hydroperoxides are the output of oxidation. Reaction between these products with other molecules leads to undesired sensory and chemical changes.

Conclusion: The results showed that the combination of minced garlic (G) with propolis extract (P) may be related to the highest antimicrobial and antioxidants efficacy of their compounds in frozen fish muscle. This led to delayed lipid oxidation and protected the fish protein against denaturation during frozen. The presoaking in aqueous solution of G, P either individually or in combination form is recommended as a natural preservative for fish fillets to increase the shelf-life during frozen storage at  $-18 \pm 1^\circ\text{C}$ .

**Table (8): Effect of different concentrations from minced garlic (G), propolis extract (P) and their mixture (1:1-v/v) on odor of tilapia fillets during storage for 6 months at  $-18 \pm 1^\circ\text{C}$ .**

Treatments	Control	(G)			(PE)		(G + P 1:1)				
	0%	G1	G2	G3	P1	P2	P3	GP1	GP2	GP3	
Storage period/ months	0	8.9 ± 0.01 <sup>a</sup>	8.9 ± 0.02 <sup>a</sup>	8.9 ± 0.01 <sup>a</sup>	8.9 ± 0.01 <sup>a</sup>	8.9 ± 0.01 <sup>a</sup>	8.9 ± 0.02 <sup>a</sup>	8.9 ± 0.01 <sup>a</sup>	8.9 ± 0.02 <sup>a</sup>	8.9 ± 0.02 <sup>a</sup>	8.9 ± 0.01 <sup>a</sup>
		7.0 ± 0.01 <sup>bc</sup>	7.4 ± 0.01 <sup>b</sup>	7.6 ± 0.04 <sup>b</sup>	7.9 ± 0.01 <sup>ab</sup>	7.3 ± 0.06 <sup>b</sup>	7.6 ± 0.01 <sup>b</sup>	8.0 ± 0.01 <sup>a</sup>	7.7 ± 0.01 <sup>b</sup>	8.1 ± 0.07 <sup>ab</sup>	8.3 ± 0.02 <sup>a</sup>
	4	5.0 ± 0.08 <sup>c</sup>	5.7 ± 0.01 <sup>c</sup>	6.0 ± 0.09 <sup>c</sup>	6.6 ± 0.09 <sup>b</sup>	5.9 ± 0.08 <sup>c</sup>	6.2 ± 0.06 <sup>c</sup>	7.1 ± 0.01 <sup>b</sup>	6.5 ± 0.08 <sup>c</sup>	7.0 ± 0.01 <sup>b</sup>	7.6 ± 0.05 <sup>a</sup>
		3.3 ± 0.01 <sup>e</sup>	4.1 ± 0.09 <sup>d</sup>	4.8 ± 0.01 <sup>c</sup>	5.4 ± 0.05 <sup>b</sup>	4.4 ± 0.02 <sup>d</sup>	5.0 ± 0.01 <sup>cd</sup>	5.8 ± 0.02 <sup>c</sup>	5.2 ± 0.08 <sup>b</sup>	5.8 ± 0.01 <sup>ab</sup>	6.8 ± 0.05 <sup>a</sup>

<sup>a-e</sup> Means within a raw with the different superscript are significantly different ( $p < 0.05$ ).

Values are expressed as Mean ± SE.

PROPOLIS AND GARLIC ON NILE TILAPIA FILLETS DURING FROZEN STORAGE

Table (9): Effect of different concentrations from minced garlic (G), propolis extract (P) and their mixture (1:1-v/v) on texture of tilapia fillets during storage for 6 months at -18±1°C.

Treatments	Control	(G)			(P)			(G + P 1:1)			
	0%	G1	G2	G3	P1	P2	P3	GP1	GP2	GP3	
Storage period/ months	0	8.7±	8.7±	8.7±	8.7±	8.7±	8.7±	8.7±	8.7±	8.7±	8.7±
		0.04 <sup>a</sup>	0.03 <sup>a</sup>	0.02 <sup>a</sup>	0.01 <sup>a</sup>	0.04 <sup>a</sup>	0.02 <sup>a</sup>	0.01 <sup>a</sup>	0.02 <sup>a</sup>	0.03 <sup>a</sup>	0.04 <sup>a</sup>
	2	6.2 ±	6.8 ±	7.2±	7.5 ±	7.2±	7.7 ±	7.9	7.5±	7.9 ±	8.1 ±
		0.09 <sup>d</sup>	0.06 <sup>cd</sup>	0.08 <sup>c</sup>	0.04 <sup>b</sup>	0.06 <sup>c</sup>	0.01 <sup>b</sup>	±0.05 <sup>a</sup>	0.04 <sup>b</sup>	0.05 <sup>a</sup>	0.02 <sup>a</sup>
	4	5.4 ±	5.6 ±	6.7±	7.0 ±	6.2±	6.9±	7.4±	6.7 ±	7.2 ±	7.5 ±
		0.05 <sup>d</sup>	0.02 <sup>d</sup>	0.06 <sup>c</sup>	0.08 <sup>b</sup>	0.09 <sup>c</sup>	0.06 <sup>b</sup>	0.06 <sup>a</sup>	0.06 <sup>c</sup>	0.01 <sup>ab</sup>	0.06 <sup>a</sup>
	6	3.9 ±	4.5 ±	5.1±	5.6 ±	4.6±	5.3 ±	5.8 ±	5.4 ±	5.9 ±	.5±
		0.06 <sup>e</sup>	0.02 <sup>d</sup>	0.09 <sup>c</sup>	0.02 <sup>b</sup>	0.07 <sup>d</sup>	0.07 <sup>c</sup>	0.02 <sup>b</sup>	0.05 <sup>c</sup>	0.02 <sup>b</sup>	0.07 <sup>a</sup>

<sup>a-c</sup> Means within a raw with the different superscript are significantly different (p<0.05). Values are expressed as Mean ± SE.

Table (10): Effect of different concentrations from minced garlic (G), propolis extract (P) and their mixture (1:1-v/v) on taste of tilapia fillets during storage for 6 months at -18±1°C.

Treatments	Control	(G)			(P)			(G + P 1:1)			
	0%	G1	G2	G3	P1	P2	P3	GP1	GP2	GP3	
Storage period/ months	0	9.0±	9.0±	9.0±	9.0±	9.0±	9.0±	9.0±	9.0±	9.0±	9.0±
		0.04 <sup>a</sup>	0.02 <sup>a</sup>	0.03 <sup>a</sup>	0.04 <sup>a</sup>	0.02 <sup>a</sup>	0.03 <sup>a</sup>	0.04 <sup>a</sup>	0.03 <sup>a</sup>	0.02 <sup>a</sup>	0.04 <sup>a</sup>
	2	6.8 ±	7.0 ±	7.2±	7.6 ±	7.4 ±	7.8 ±	8.0 ±	7.7 ±	8.1 ±	8.6 ±
		0.03 <sup>e</sup>	0.07 <sup>d</sup>	0.07 <sup>c</sup>	0.05 <sup>b</sup>	0.06 <sup>bc</sup>	0.01 <sup>b</sup>	0.06 <sup>ab</sup>	0.01 <sup>b</sup>	0.01 <sup>ab</sup>	0.05 <sup>a</sup>
	4	5.5±	6.0 ±	6.3 ±	6.6 ±	6.5 ±	7.0 ±	7.3 ±	7.1 ±	7.7 ±	8.1 ±
		0.06 <sup>e</sup>	0.09 <sup>de</sup>	0.06 <sup>e</sup>	0.06 <sup>d</sup>	0.03 <sup>e</sup>	0.07 <sup>d</sup>	0.07 <sup>c</sup>	0.08 <sup>d</sup>	0.01 <sup>b</sup>	0.06 <sup>a</sup>
	6	3.4 ±	4.1	5.0 ±	5.5 ±	4.4 ±	5.2 ±	5.6 ±	5.1 ±	5.8 ±	6.6 ±
		0.08 <sup>e</sup>	±0.03 <sup>de</sup>	0.03 <sup>c</sup>	0.09 <sup>b</sup>	0.03 <sup>e</sup>	0.01 <sup>c</sup>	0.01 <sup>bc</sup>	0.01 <sup>c</sup>	0.01 <sup>b</sup>	0.07 <sup>a</sup>

<sup>a-d</sup> Means within a raw with the different superscript are significantly different (p<0.05). Values are expressed as Mean ± SE.

REFERENCES

- Alghazeer, R.; Suhur, S. and Nazlin, K. H. (2008). Aldehyde formation in frozen mackerel (*Scomber scombrus*) in the presence and absence of instant green tea. Food Chemistry 108, 801–810.
- Antonio, J. B. and Sánchez-Alonso, I. (2011). First processing steps and the quality of wild and farmed fish. Review, J. of Food Science 76 (1): 1-5.
- AOAC. (2000). Official methods of Analysis, K. Helrich (Ed.). Vol. I and II. Association of Official Analytical Chemists, Arlington, VA.
- Arannilewa, S.T.; Salawu, S.O.; Sorungbe, A.A. and Ola-Salawu, B.B. (2005). Effect of frozen period on the chemical, microbiological and sensory quality of frozen, tilapia fish (*Sarotherodon galiaenus*). African J. of Biotechnology, 4 (8): 852-855.
- Asgharzadeh, A; Bahareh, S.; Santiago, P. A. and Hedayat, H. (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.
- Aubourg, S.; Lugasi A.; Hóvári J.; Piñeiro C.; Lebovics V. and Jakóczy I. (2004). Damage inhibition during frozen storage of horse mackerel (*Trachurus trachurus*) fillets by a previous plant extract treatment. J. of Food Science, 69. (2): 136-141
- Baydar, H.; Sağdic, O.; Gülcan, Ö. and Karadoğan, T. (2004). Antibacterial activity and composition of essential oils from Origanum, Thymbra, and Satureja species with commercial importance in Turkey J. of Food Control, 15: 169-172.

## HASSANIN AND EL-DALY

- Block, E. (1992).** The organosulphur chemistry of the genus *Allium* - implication for the organic chemistry of sulphur. Review. J. of Angewandte Chemie- International, 31: 1135-1178.
- Bonnell, A.D. (1994).** Quality assurance in seafood processing. In: Quality Assessment, Chapter 5, Academic Press, New York, USA, 72.
- Cuesta, A.; Rodríguez, A. ; Esteban, M. A. and Meseguer, J. (2005).** In vivo effects of propolis, a honeybee product, on gilthead seabream innate immune responses. Fish and Shellfish Immunology, 18, 71-80.
- Dessouki, T.M.; El-Dashlouty, A. A.; El-Ebzary, M.M. and Heikal, H.A. (1980).** Propolis and some other natural antioxidants for fats of frozen meat. J. of Agricultural Research Review, 58 (3): 311-321.
- Duncan, D.B. (1955).** Multiple range and F test. Biometrics, 11: 1-42.
- Elzbita, D. and Marina, M. (1987).** Effect of frozen storage at -30°C on the survival of chosen indicator microorganisms in minced fish. ACTA Ichthyologica Et Piscatoria, vol. xvii Fasc.I
- Enzo, A.T.; Edmundo, R.; Marta, E.O. and Ampelio, F.C. (2007).** Food preservative based on propolis: bacteriostatic activity of propolis polyphenols and flavonoids upon *Escherichia coli*. J. Food Chemistry, 104 (3): 1025-1029.
- Fan, W.; Sun, J.; Chen, Y.; Qiu, J.; Zhang, Y. and Chi, Y. (2009).** Effects of chitosan coating on quality and shelf life of silver carp during frozen storage. J. Food Chemistry 115: 66-70.
- Gandotra, R.; Koul, M.; Gupta, S. and Sharma, S. (2012).** Change in Proximate Composition And Microbial Count By Low Temperature preservation In Fish Muscle Of Labeo Rohita (*Ham-Buch*). J. of Pharmacy and Biological Sciences, 2278-3008, 2, (1): 13-17.
- Geckil, H.; Ates, B.; Durmaz, G.; Erdogan, S. and Yilmaz, I., (2005).** Antioxidant, free radical scavenging and metal chelating characteristics of propolis. American Journal of Biochemistry and Biotechnology, 1(1): 27-31.
- Guo, X.; Chen, B.; Luo, L.; Zhang, X.; Dai, X. and Gong, S. (2011).** Chemical compositions and antioxidant activities of water extracts of chinese propolis. J. of Agriculture Food Chemistry, 59 (23): 12610-12616.
- Harrigan, W.F. and Margaret, E.M. (1976).** Laboratory method in food and dairy microbiology. A subsidiary of Harcourt Brace Jovanoich, Academic Press, Landon, N.Y. Sanfrancisco.
- Harris, J. C.; Cottrell, S. L.; Plummer, S. L. and Lloyd, D. (2001).** Antimicrobial properties of garlic. J. Appl. Microbiol. and Biotechnol. 57: 282- 286.
- Hegazi, A.G.; El-Hady, F.A.A. and Abd-Allah, F.A.M. (2000).** Chemical composition and antimicrobial activity of European propolis. Zeitschrift für Naturforschung section C, Biosci., 55 (1-2): 70-75.
- Hülya, O. H. and Kayisoglu, S. (2008).** Quality changes In whole, gutted and filleted three fish species (*Gadus Euxinus*, *Mugil Cephalus* and *Engraulis Encrasicolus*) at frozen storage period (-26°C). Acta Sciences Pol., Technol. Aliment. 7 (3): 15-28.
- Huss, H.H. (1995).** Quality and quality changes in fresh fish. FAO fisheries technical paper 348.
- Kirk, R. and Sawyer, R. (1991).** Pearson's Composition and Analysis of Foods, 9<sup>th</sup> ed., 642 - 643. Longman Scientific and Technical, Singapore, Singapore.
- Koch, H.P. and Lawson, L. D. (1996).** Garlic, the science and therapeutic application of (*Allium sativum L.*) and related species, in: Retford D.C. (Ed.), Williams and Wilkins, Baltimore, 1-233.
- Koru, O.; Toksoy, F.; Tunca, M.Y.; Baysallar, M.; Uskudar, G. A.; Akca, E. and Ozkok, T. A. (2007).** In vitro antimicrobial activity of propolis samples from different geographical origins against certain oral pathogens. Anaerobe, 13, 140-145.
- Kumar, N.; Mueen, A. K. K.; Raman, D. and Ahmed, H. (2008).** Antioxidant and antimicrobial activity of propolis from Tamil Nadu zone. J. Medicinal Plants Research, 2 (12): 361-364.
- Leuschner, R. G. K. and Ielsch, V. (2003).** Antimicrobial effects of garlic, clove and red hot chilli on *Listeria monocytogenes* in broth model

## PROPOLIS AND GARLIC ON NILE TILAPIA FILLETS DURING FROZEN STORAGE

- systems and soft cheese. Int. J. of Food Sci. and Nut. 54: 127-133.
- Moghazy, E.A. and El-Shaarawy, M.O.A. (2001).** Quality attributes of beef burger as affected by using propolis and frozen storage Egypt. J. Agric. Res., 79 (4) : 1149-1151.
- Obemeata, O.; Nnenna, F.P. and Christopher, N. (2011).** Microbiological assessment of stored *Tilapia guineensis*. Afric. J. Food Sci. 5(4):242-247.
- Oriakpono, O. and Ndome, C. (2012).** Organoleptic assessment and proximate analysis of stored *Tilapia Guineensis*. Annual Review & Research in Biology 2(2): 46-52.
- Oriakpono, O.; Frank-Peterside, N. and Ndome, C. (2011).** Microbiological assessment of stored *Tilapia guineensis*. African J. of Food Sciences, 5(4): 242 – 247.
- Osman, M. F. and Taha, E. A. (2008).** Antioxidant activity of water extract of propolis from different regions in In Kafr El-Sheikh Governorate. Alex. J. Fd. Sci. Technology special volume conference 83-89.
- Richards, M. and Hultin, H. (2002).** Contributions of blood and blood components to lipid oxidation in fish muscle. J. of Agricultural and Food Chemistry, 50, 555-564.
- Rostamzad, H.; Shabanpour, B.; Kashaninejad, M. and Shabani, A. (2011).** antioxidative activity of citric and ascorbic acids and their preventive effect on lipid oxidation in frozen persian sturgeon fillets. Latin American Applied Research 41:135-140.
- Sarkardei, S. and Howell, N. (2008).** Effect of natural antioxidants on stored freeze-dried food product formulated using horse mackerel (*trachurus trachurus*). J. of Food Science and Technology, 43: 309-315.
- SAS. (2000).** SAS User's Guide: statistics, SAS Institute INC., Cary, NC.
- Suvanich, V.; Jahncke, M.L. and Marshall, D.L. (2000).** Changes in selected chemical quality characteristics of Channel catfish frame mince during chill and frozen storage. J. of Food Sciences, 65 (1): 24-29.
- Swanson, K.M.; Busta, F.F.; Peterson, E.H. and Johnson, M.G. (1992).** Colony count methods, p. 75-95. In C. Vanderzant and D.F. Splittoesser (Ed). Compendium of methods for the microbiological examination of foods, 3<sup>rd</sup> Ed. American Public Health Association, Washington, D.C.
- Teeny, F.M. and Miyauchi, D. (1972).** Preparation and utilization of frozen block of minced block fish muscle. J. Milk and Food Technology, 35 (7): 414- 417.

تأثير البروبيلس والثوم على شرائح البلطي النيلي خلال التخزين بالتجميد

\*سامية ابراهيم على حسنين ، سعيد أبوزيد الدالى\*\*

\*قسم بحوث مراقبة الجودة والتصنيع ، المعمل المركزى لبحوث الثروة السمكية، مركز البحوث الزراعيه

\*\* قسم مراقبة الاغذية، كلية الطب البيطرى، جامعة الزقازيق، مصر.

أجريت هذه الدراسة لتقييم تغيرات الجودة لشرائح البلطي النيلي بدون جلد منقوعة في منتج طبيعي للنحل (صمغ النحل - البروبيلس المستخلص بالماء) ومحلول الثوم. وكانت المعاملات التالية: بغمرها على درجة حرارة الغرفة 4م لمدة 30ق في محاليل تركيز صفر، 1، 2، 3% من محلول الثوم، تركيز 0,2 ، 0,4 ، 0,6% من صمغ النحل المستخلص بالماء ، ومخلوط من (صمغ النحل + مفروم الثوم ) بنسبة 1:1 بالوزن من كل تركيز، وكنترول تم غمرها في الماء. وذلك لمعرفة تأثير استخدام صمغ النحل و مفروم الثوم على بعض الخواص الكيميائية، الحسية والمحتوى البكتريولوجى خلال تخزين بالتجميد عند - 18 ± 1م لمدة 6 أشهر.

النتائج المتحصل عليها أوضحت أن المعاملة التى استخدم فيها تركيز 0,6% مستخلص صمغ النحل و3% لمفروم الثوم بنسبة 1:1 بالوزن مناسباً لخفض التغير في الخواص الكيميائية والمحتوى البكتريولوجى مع أعلى تقييم في الخواص الحسية لشرائح البلطي النيلي المخزنة عند - 18 ± 1م . وعلى ذلك يمكن التوصية بان استخدام مستخلص صمغ النحل مفروم الثوم كمادة حافظة طبيعيه تتميز بأن لها خصائص مضادة للاكسدة وللميكروبات وبالتالي تحافظ على جودة شرائح سمك البلطي وتطيل مدة الصلاحيه وتقدم افضل مستوى ليروتين والدهن خلال التخزين بالتجميد .