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Maintaining Quality and Extending Shelf –Life of Tilapia *Oreochromis Niloticus* Fish during Storage at 4˚C

ABOUEL-YAZEED, A. M.
Food Science and Technology Dept., Fac. Agric. (Saba Basha), Alex. Univ. Alexandria, Egypt.

ABSTRACT

Keeping food quality among consumers is of high importance. In this study in order to maintain and improve the quality of fish meat, effect of pretreatment with polyphosphates have profound effects on the functional properties of the food products. Experiments were carried out to avoid drip during storage of Tilapia (*Oreochromis niloticus*)fish under modified atmosphere packaging (MAP).The results showed that Tilapia fish pretreatment with 2% solution of sodium tripolyphosphate (STPP) combined with modified atmosphere packaging (90% CO_2+10% O_2) was more effective than other treatments in reduction of microbial counts (psychrotrophic, *Enterobacteriacae*) and keeping quality of fish. Physicochemical of fish samples showed that pH values, total volatile bases nitrogen (TVB-N) values and thiobarbituric acid,(TBA mg malonaldehyde/kg) were ranged between 6.31- 6.61, 10.38 - 25.10 and 0.55 -1.98 mg malonaldehyde/kg during 15 days of storage at 4˚C, respectively . The data revealed that pretreatment of tilapia with STPP prior to keeping in MAP effectively retarded the exudates loss(as drip loss) and improved the physicochemical properties of tilapia during storage at 4˚C compared with samples stored in air and those kept under (MAP) only.

Keywords: **Tilapia *Oreochromis niloticus*, Phosphate treatment, MAP, Shelf life, Fish quality.**

INTRODUCTION

Tilapia *(Oreochromis niloticus*) is one of the most important economic freshwater fish of Egypt, *Oreochromis niloticus* considered one of an excellent quality fish characterized and rich vitamins with firmly textured rusticity and good sensorial properties of flesh making it more suitable and an appetizing fish to the consumers (Boscolo *et al.,* 2001; Corpei, 2001; Maregoni, 2006). Marketing studies indicated that consumer's preferred the fresh fish than the frozen one. Therefore, the extension of fish shelf life and maintaining the quality is essentially for allowing the market to get good profitability(Connell, 1990).

Fresh fish are highly perishable products due to their biological composition. Spoilage of fish muscle reactions such as oxidation of lipids, reactions due to activities of the fish's own enzymes, and the metabolic activities of microorganisms. These activities lead to a short shelf life in fish and other seafood products (Statham and Bremner, 1989; Ashie, *et al*., 1996; Gram and Huss, 1996; Gobantes, *et al*., 1998).

Shelf life and fish quality is very important due to increasing consumer demand for fish consumption. In this case, correct methods of packaging can help to the quality preservation. (Sahoo & Kumar, 2005).

Modified atmosphere packaging (MAP) offers multiple advantages to the fish industry and the consumer. Various atmospheres have been examined in fish packaging (Parkin *et al*.,

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1981; Barnett et al., 1987; Stammen *et al.,* 1990; Farber, 1991; Reddy, *et al*., 1994; Randell ,*et al*., 1995; Randell, *et al*., 1997; Gimenez, *et al*., 2002; Sivertsvik, *et al*., 2002). MAP extends the shelf-life of fish and fishery products (Statham, 1984; Farber, *et al.,* 1990).

MAP is widely used as a supplement to ice or refrigeration to delay spoilage and extend the shelf-life of fresh fishery products (Sivertsvik ,*et al.*, 2002). The shelf-life increased as a result of lag phase extension of several aerobic spoilage bacteria and retardation of enzymatic spoilage (Ashie ,*et al*., 1996; Pastoriza, *et al*, 1996). Shelf-life of fish under CO_2 atmosphere storage could be extended (Reddy, *et al*, 1995; Debevere & Boskou, 1996) . However, loss in water-holding capacity of fish stored under MAP generally occurred (Masniyom, *et al*, 2002).

Since, carbon dioxide acts as an antimicrobial agent (Stammen *et al.,* 1990), it inhibits the growth of microorganisms during the logarithmic phase and extends the lag phase (Genigeorgis, 1985; Ohlsson, 1994; Church, 1994; Philips, 1996). Addition of polyphosphates to seafood products reduced the drip loss in fish stored under MAP (Alvarez, *et al.,* 1996), inhibited the growth of bacteria in fish stored in ice (Kim, *et al*., 1995; Zaika, *et al.,* 1997) and retarded the oxidation of unsaturated fatty acid in seafood products (Dziezak, 1990).

Polyphosphates is legally permitted additives that are widely used to aid processing or to improve eating quality of many foods, particularly meat and fish products (Aitken, 2001).

Use of polyphosphates in seafood inhibit the growth of bacteria in fish stored in ice and retard the oxidation of unsaturated fatty acids in seafood products (Masniyom, *et al*., 2005). Therefore the use of such materials in refrigeration can play an effective role in maintaining fish quality. Phosphates can inhibit the growth of Gram negative bacteria in fish stored in ice (Kim *et al*., 1995) and polyphosphates reduce drip loss in fish stored under MAP conditions (Alvarez *et al*., 1996). So, phosphate compounds have been used in fishery holding capacity. products to improve the functionality, especially to increase the water Addition of phosphates to seafood products inhibited the growth of bacteria in stored fish in ice (Kim, *et a*l.,1995) and retarded the oxidation of unsaturated fatty acid in seafood products (Masniyom, *et al.*, 2005).

Microbiological, biochemical, and sensory methods have been used to assess the freshness and quality of fish during handling and storage, the main quality parameters for fresh fish being aroma, flavor, texture and appearance reaction. The sensory characteristics of fish are clearly visible to the consumer and are essential for consumer satisfaction (Reineccius, 1990).

Non-sensory methods based on biochemical, physical and/or microbiological analyses are also used to evaluate the quality of fresh fish including total volatile basic nitrogen (TVB-N) , pH and thiobarbituric acid (TBA) (Gill, 1992). These spoilage indicators referred to a variety of biochemical, microbial, enzymatic and physical mechanisms (Connell, 1990; Daczkowska-Kozon, 1993). Undesired off-odors and flavours occurring during spoilage are mainly caused by products of bacterial growth and metabolism. In addition to off-odors and flavours, microbial growth may lead to the production of slime, visible colonies and changes in texture (Gram *et a*l., 2002).

Traditionally, tilapia has been used almost fresh consumption and some part is introduced to the process (fillet ,frozen,…*etc*) industry. Due to the high current volume of production, it could be used by the industry to develop other process products. Thus, certain processes such as salting and packaging could be used to obtain a product which is well accepted by consumer as reported by Chaijan (2011). In Egypt , tilapia which caught from Lake Nasser is frozen.

Though the shelf life of tilapia (*Oreochromis niloticus*) fish could be extended by(MAP), drip was produced. This problem causes unacceptability of fish. Therefore the use of phosphate in combination with (MAP) would provide an effective mean to improve the quality of fish. Thus the objective of this study was to determine the combined effect of phosphate and (MAP) on the shelf life of tilapia (*Oreochromis niloticus*)fish by monitoring chemical , microbiological and sensory changes throughout the storage at 4˚C.

MATERIALS AND METHODS

Materials

Fish sample

Fresh tilapia (*Oreochromis niloticus*) (25 kg) with an average weight of 200 g was obtained from Barseek Fish Farming, Kafr El-Dawar, Behera Governorate, Egypt.

Fish was placed (in ice tanks) in crushed ice with a fish/ice ratio of 1:3 (w/w) and transported to the Department of Food Sciences, Faculty of Agriculture, Saba Bacha, Alexandria University. within 1 hr. from the caught.

Gas packaging

A combination of gases (90% CO_2+10% O_2) (Arashisara *et a*l., 2004)was obtained from Helyopoles Company Industrial Gases, Alexandria.

Polyethylene bags

High-density polyethylene bags (20×35cm size) were obtained from Lowtes Company, Borg El-Arab, Alexandria.

Methods

Phosphate pretreatments

Different concentrations of sodium tripolyphosphate (STPP) (1, 1.5, 2 , 2.5 and 3 %) were dissolved in distilled water. Fish were soaked in solution (4 °C) for 10 min. and drained for 10 min at 4 °C. Then stored under MAP at 4 °C for one week. Sensory evaluation odor(general appearance, skin, surface slime, scales and stiffness) and odor(fishy ,smell) . Showed that 2% (2 g/100 ml) of STPP was more effective than the other concentration ratio.

Preparation of fish, packaging and storage of samples

Fresh tilapia (*Oreochromis niloticus*) were immediately washed, headed, eviscerated as described by (Etemadian *et a.*, 2012) with stainless steel knife, washed again and drained for 20 min on a sanitized stainless steel throughout refrigerated storage**.** Samples were prepared and randomly divided into three groups. First group sample was taken to serve as control, packaged in air package and stored at 4˚C. The second group, fresh fish was packed in high density polyethylene bags (HDPE) then flushed with a gas mixture (90% CO_2 +10% O_2) and sealed to be assigned as (MAP) and stored at 4˚C. In the third group, Fish samples treated with (STPP) were packed in high density polyethylene bags (HDPE) ,Flushed with a gas mixture of (90% CO_2+10% O_2) and assigned as (STPP + MAP), and sealed to store at 4˚C. Samples were taken for chemical, microbiological and sensory analyses with interval 3 days up to 15 days.

Chemical analyses

pH measurement

The pH measurement was carried out using pH-meter type JENCO (Micro pH-vision 6071) . Fish samples (2 g) was homogenized thoroughly with 10 ml distilled water and the homogenate was subjected to pH determination according to the method of Masniyom ,*et al.* ,(2005).

Determination of total volatile base-nitrogen (TVB - N)

TVB-N in samples was determined according to the method proposed by Parvaneh (2007). Ten grams of fish samples were homogenised with 2 g MgO, 300 mL distilled water, and three drops of anti-foam and some boiling stones were added. The blend was heated for45 min until the volume of boric acid solution reach to 150 ml. Boric acid containing methyl red reagent (0.016 g methyl red and0.083 g bromocresol green in 100 section of ethanol), which initially due to its acidic characteristics was red, but gradually alkalic and became to the green odor in the end of experiment by distillation system. Finally, the solution obtained from the accumulation of distillation titre by 0.1 N sulphuric acid to reach the onion skin color.

Determination of thiobarbituric acid (TBA) value

Thiobarbituric acid (TBA) was determined according to the method proposed by Tarladgis *et al*., (1960), and Kilinc *et al*., (2007). Ten grams of fish samples were homogenised for 2 min with 97.5 mL distilled water and 2.5 mL 4 N HCl solution, and three drops of anti-foam and some boiling stones were added. The blend was distilled until a 50 mL solution was obtained. Five millilitres of the distillate and 5 mL of TBA reagent(0.2883g thiobarbituric acid in 90% glacial acetic acid) were blended and heated in a boiling water bath for 35 min. After cooling under running water for 1 min, the absorbance was measured at 538 nm (using Spectrophotometer T 80 UV/vis Spectrometer PG Instrument Lta) against a blank, which was 5 mL of distilled water with 5 mL TBA reagent.The absorbance (D) against the blank at 538 nm using 1 cm cell. TBA was expressed as mg malonaldehyde/kg sample.

TBA No (as mg malonaldehyde/kg sample) = 7.8 D.

Microbiological analysis

Preparation of samples

Ten grams of fish samples were homogenized in 90 ml sterile physiological saline 0.9%supplemented by 0.1% peptone. Decimal dilutions were then made in duplicate in a sterile physiological saline containing 0.1% peptone. Several dilutions were prepared to be used for counting psychrotrophic aerobic bacteria, *Enterobacteriaceae* group, Microbial counts were expressed as the logarithm of colony forming units per g ($\log_{10}$ CFU/g).

Psychotropic aerobic bacteria

Determined using plate count agar media (PCA. Oxoid C. M 325). incubated for 5days at 22˚C (Vander, 2002).

Enterobacteriaceae group count

Counts were determined by plating appropriate dilutions of samples on violet red bile glucose agar (VRBGA. Oxoid, C. M. 485) appropriate sample dilution (1 ml) was pour plate on a VRBGA media, and incubated for 24 h at 37˚C according to (Mossel *et al.*, 1979).

Color and odor evaluation

The sensory evaluation was used to evaluate quality of fish, and the end of the shelf-life (all samples were stored at4˚C)was reached when the average value of the samples were judged as unacceptable by the panelists. five members participated in scoring all the tested quality attributes of fish. The five panelists at Department of Food Science, Faculty of Agriculture, Saba-Bacha, Alexandria University. Each group of samples were labeled and randomly selected. Panelists were asked to evaluate each batch of samples, presented in a randomized (Patsias, *et al.*, 2006) order to assign scores for color: (general appearance, skin, surface slime, scales and stiffness) and odor (fishy ,smell) .The odor of fish at the moment of opening the pack, on a nine-point hedonic scale (9=like extremely; 8=like very much; 7=like moderately; 6=like slightly; 5=neither like nor dislike; 4=dislike slightly; 3=dislike moderately; 2=dislike very much; 1=dislike extremely).

Statistical analysis

The results of the analyses are reported as mean (mean of five samples) values ± SD for triplicate samples.

RESULTS AND DISCUSSION

Chemical analyses

Changes in the pH

The detection of pH values is one of the most frequently used physical quality control for fish, seafood and fish products, which is affected by the changes in the lipid hydrolysis, microorganisms or enzymes. (Varlik *et al*., 2000).

Changes in pH values of tilapia during storage are presented in Table (1). The initial pH of the fish sample was(6.31), a similar value has been reported by(Simeonidou *et al.*, 1998). The pH of live fish muscle is close to the value7.0. However post-mortem pH can vary from 6.0 to 7.1 depending on season, species and other factors. The data indicated that sample pretreated with phosphates showed an increase in pH was observed. This result was compatible to the results of Kilinc *et al*., (2009). Statham (1984) reported that pH values were slightly reduced in fish flesh with the dissociation of carbonic acid in general. Sample kept under MAP without phosphate pretreatment showed the slight decrease in pHvalue compared with the sample kept in air. This was probably due to the dissolving of some atmospheric CO_2 in the liquid phase of the muscle tissue, which was associated with the increased carbonic acid (Ordonez, *et al*., 2000).

It is an expected result for CO_2 concentration to decline due to the absorption of CO_2 during storage (Jakobsen & Bertelsen, 2002).

Similar results related to the changes in the headspace atmospheres were reported in other studies (O'Grady *et al.*, 2000; Kennedy *et al.*, 2004; Ercolini, *et al*., 2006; Koutsoumanis *et al*., 2008). During storage, pH of air stored tilapia increased throughout the storage time, presumably due to the production of basic amines (Debevere & Boskou, 1996; Pastoriza *et al.*, 1996). and also associated with the increase in psychrophilic bacterial counts. The result was similar with Masniyom, *et al.*, (2005). Regardless of phosphate pretreatment, pH of sample stored under MAP was quite constant throughout the storage. This might be due to the buffering capacity of muscle, which could maintain the pH of muscle with increasing carbonic acid. Furthermore, phosphates have been found to exhibit buffering activity in the muscle of fish (Sofos, 1986).

Changes in TVB-N

Total volatile bases-nitrogen (TVB-N) is a product of bacterial spoilage and the content is often used as an index to assess the keeping quality and shelf life of seafood products (Masniyom *et al.*,, 2005; Erkan *et al.*, 2006; Mendes & Goncalvez, 2008; Fernandez, *et al*., 2009).

TVB-N is a term that includes measurement of trimethylamine, dimethylamine, ammonia and other compounds associated with seafood spoilage, which increases as spoilage progresses. For several fish species, TVB-N values were reported to increase curvilinearly or linearly with time, and a level of 30 mg muscle TVB-N/100 g has been considered the upper limit above which some fishing products are considered spoiled and unfit for human consumption (G okodlu *et al*., 1998).

Total volatile bases-nitrogen (TVB-N) of all samples is depicted in (Table 2). Generally, content in all treatments ranged between 10.38 mg/100 g and 25.10 mg/100g. However, sample stored in air had the higher TVB-N, compared with samples kept under MAP with and without phosphate pretreatment throughout the storage (3days) . The spoilage pattern of fresh seafood generally shows an increase in TVB-N concentration,which closely parallels the bacterial population. (Mitsubayashi, *et al.*, 2004; Siripatrawan, *et al.*, 2009). However, TVB are considered responsible for unpleasant ‘fishy’ odor. (Huss, 1988).

Table (1) ***Changes in pH values in tilapia fish stored under different conditions at 4˚C (Values are mean of three determinations).***

	pH values Storage time (Days)					
Treatment	0	3	6	9	12	15
Control	6.31± 0.07	6.52± 0.03	ND	ND	ND	ND
MAP	6.31± 0.07	6.28± 0.21	6.42± 0.14	ND	ND	ND
STPP +MAP	6.31± 0.07	6.35± 0.05	6.39± 0.27	6.44± 0.04	6.52± 0.12	6.61± 0.22

Values are Mean±SD .
ND = Not determined because unacceptable by the panelists.
Control = Air- packed in polyethylene plastic bags.
MAP = packed in modified atmosphere condition (90% CO_2+10% O_2).
STPP= Treatment with sodium tripolyphosphate.

Table (2): ***Changes in (TVB-N) values in tilapia fish stored under different conditions at 4˚C (Values are mean of three determinations) .***

	(TVB-N) values Storage time Days					
Treatment	0	3	6	9	12	15
Control	10.38 ± 0.11	19.22± 0.17	ND	ND	ND	ND
MAP	10.38 ± 0.11	16.56± 0.05	22.35± 0.10	ND	ND	ND
STPP +MAP	10.38 ± 0.11	11.65± 0.16	13.72± 0.33	16.22± 0.41	20.15± 0.08	25.10 ± 0.14

Values are Mean±SD
ND = Not determined because unacceptable by the panelists.
Control = Air- packed in polyethylene plastic bags.
MAP = packed in modified atmosphere condition (90% CO_2+10% O_2).
STPP= Treatment with sodium tripolyphosphate.

Connell, (1995) and Shakila *et al*.,(2005) reported that the TVB-N values of good quality fish are generally less than 25 mg /100 g muscle and above 25–30 mg /100 g indicate that fish is decomposed and inedible.

Changes in Thiobarbituric acid (TBA) content

TBA index is a widely used indicator for the assessment of degree of lipid oxidation (Nishimoto *et al*., 1985). Lipid oxidation in fish after death due to high levels of unsaturated fatty acid is very important and the main factor in sensory deterioraton (Guillén & Ruiz, 2004).

The increase in TBA was observed in all samples during storage period increased Table **(**3**).** The TBA values increased from an initial 0.55mg malonaldehyde/kg of fish to 1.98mg malonaldehyde/kg of fish treated with STPP under MAP during 15 days storage period . Higher increase in TBA value was observed in stored under MAP compared with phosphate pretreatment(3days**)** .

This was may be due to the formation of carbonic acid in muscle which probably caused the inactivation of antioxidative enzymes, e.g. gluthathione peroxidase, resulting in the higher oxidation in the muscle (Renerre, *et al*., 1996).

Table (3): Changes in (TBA) in tilapia fish stored under different conditions at 4˚C (Values are mean of three determinations).

	TBA mg malonaldehyde/kg Storage time Days					
Treatment	0	3	6	9	12	15
Control	0.55± 0.20	1.21± 0.32	ND	ND	ND	ND
MAP	0.55± 0.20	0.95 ± 0.16	1.25± 0.10	ND	ND	ND
STPP + MAP	0.55± 0.20	0.71± 0.10	0.92± 0.48	1.19± 0.11	1.54± 0.42	1.98 ± 0.12

Values are Mean±SD
ND = Not determined because unacceptable by the panelists.
Control = Air- packed in polyethylene plastic bags.
MAP = packed in modified atmosphere condition (90% CO_2+10% O_2).
STPP= Treatment with sodium tripolyphosphate.

Therefore, CO_2-enriched packaging effectively inhibited the spoilage caused by microorganisms, but it could not prevent the chemical deterioration, especially lipid oxidation. However, phosphate pretreatment could lower TBA value of samples kept under MAP to some extent. From the result, samples pretreated with phosphate tended to have lower TBA values during the storage. Lipid in fish muscle typically has a high percentage of polyunsaturated fatty acids and is consequently prone to oxidative reaction (Stammen, *et al.*, 1990).

Phosphates potentially retarded the oxidation in seabass slices through the chelation of prooxidant metal ions (Smith, *et al*., 1984).

Shakila, *et al*., (2005) reported that TBA value of 1–2 mg malondialdehyde/kg muscle is an acceptable limit.

Microbiological analysis

Psychrotrophic aerobic bacteria counts ($\log_{10}$ CFU/ g) of all samples increased with increasing time of storage at 4˚C Table (4) **.** Psychrophilic bacteria counts of fish treated with STPP under MAP samples ranged between 2.25 $\log_{10}$ CFU/ g and 3.95 $\log_{10}$ CFU/ g) during 15 days.

However, psychrophilic bacterial counts in samples pretreated with phosphate and kept under MAP were lower than those of other samples. These results agreed with Colin and Salvat (1996) ,who reported that washing fish with TSP solution substantially reduced the population of Gram-negative bacteria and Gram-positive pathogens. Phosphates can inhibit the growth of Gram negative bacteria in fish stored in ice (Kim, *et al.*, 1995) and poly phosphates reduce drip loss in fish stored under MAP conditions (Alvarez ,*et al.*, 1996). It is known that antimicrobial effect of CO_2 prolongs lag phase of bacterial growth and increases generation time (Philips, 1996).

Scullen and Zaika (1994) reported that growth inhibition of *Listeria monocytogenes* by sodium polyphosphate increased with decreasing temperature. Growth inhibition induced by sodium polyphosphate was accompanied by changes in cellular morphology(Zaika, *et al.*, 1991).

On the other hand, *Enterobacteriaceae* counts ($\log_{10}$ CFU/ g) contents of all samples are depicted in (Table 5). Initial *Enterobacteriaceae* count at zero time in control sample was 1.07 $\log_{10}$ CFU/cm^2,increased with extend during storage to be 1.92 $\log_{10}$ CFU/cm^2 . The results indicated that pretreatment by phosphate solution prior to storage under MAP was more effective in reducing microbial numbers compared with the use of only MAP. Compatible with our results, Chouliara, *et al.* (2007) reported that *Enterobacteriaceae* grew under MAP conditions at a slower rate than under aerobic packaging.

The inhibition of *Enterobacteriaceae* by carbon dioxid has been reported by (Haines, 1993). has Growth inhibition induced by sodium polyphosphate was accompanied by changes in cellular morphology (Zaika, *et al.*, 1991). indicating that phosphates might show the synergistic effect on the retardation of bacterial growth in the sample kept under MAP. Marshall and Jindal (1997) reported that TSP reduced aerobic, total coliform and *Enterobacteriaceae* counts in the meat from catfish.

Color and odor evaluation:

Evaluating freshness and quality of different fish species are based on changes sensory, associated with chemical and physical changes and microbiological growth.(Gokodlu, *et al.*, 1998). It is well known that fish meat properties change along decreasing freshness. In addition, magnitude of change depends on the original condition of the muscle (Ocano-Higuera *et al.*, 2006). All samples developed color(surface color parameters for the tilapia fish)and fishy odor(odor should be considered as attributes of extreme freshness) as the storage time increased (Table 6).

Table (4): Changes in psychrotrophic aerobic bacteria counts (log_{10} CFU/ g) in tilapia fish stored under different conditions at 4˚C.

	log_{10} CFU/ g Storage time Days					
Treatment	0	3	6	9	12	15
Control	2.25	4.20	ND	ND	ND	ND
MAP	2.25	2.96	3.92	ND	ND	ND
STPP + MAP	2.25	2.56	2.89	3.07	3.49	3.95

ND = Not determined because unacceptable by the panelists.
Control = Air- packed in polyethylene plastic bags.
MAP = packed in modified atmosphere condition (90% CO_2+10% O_2).
STPP= Treatment with sodium tripolyphosphate.

Table (5): Changes in Enterobactriaceae counts (log_{10} CFU/ g) in tilapia fish stored under different conditions at 4˚C.

	log_{10} CFU/ g Storage time Days					
Treatment	0	3	6	9	12	15
Control	1.07	1.92	ND	ND	ND	ND
MAP	1.07	1.43	1.80	ND	ND	ND
STPP + MAP	1.07	1.27	1.38	1.53	1.70	1.91

ND = Not determined because unacceptable by the panelists.
Control = Air- packed in polyethylene plastic bags.
MAP = packed in modified atmosphere condition (90% CO_2+10% O_2).
STPP= Treatment with sodium tripolyphosphate.

Table (6): Changes in colour and odour in tilapia fish stored under different conditions at 4˚C (Values are mean of three determinations).

	values of colour Storage time days						values of odour Storage time days					
Treatment	0	3	6	9	12	15	0	3	6	9	12	15
Control	9.0	6.8	ND	ND	ND	ND	8.8	6.6	ND	ND	ND	ND
MAP	9.0	8.2	6.8	ND	ND	ND	8.8	8.0	6.6	ND	ND	ND
STPP +MAP	9.0	8.4	7.8	7.6	6.6	5.6	8.8	8.2	7.6	7.4	6.4	5.4

A 9-point hedonic scale was used with 9=like extremely; 8=like very much; 7=like moderately; 6=like slightly; 5=neither like nor dislike;4=dislike slightly; 3=dislike moderately; 2=dislike very much; 1=dislike extremely.
ND = Not determined because unacceptable by the panelists.
Control = Air- packed in polyethylene plastic bags.
MAP = packed in modified atmosphere condition (90% CO_2+10% O_2).
STPP= Treatment with sodium tripolyphosphate.

Deterioration occurred of control sample after 3 days of storage as evidenced by strong fishy and putrid odor. Undesired off-odors and flavours occurring during spoilage are mainly caused by products of bacterial growth and metabolism. In addition to off-odors and flavours, microbial growth may lead to the production of slime and changes in texture (Gram(a&b) *et al*., 2002). Sample pretreated with phosphate and kept under MAP exhibited the higher score for color and odor, compared to control and sample stored under MAP. Our results indicated that sample pretreated with phosphate prior toMAP effectively extended the shelf-life of tilapia with high acceptability. Masniyom ,*et al.* (2005) reported that the shelf life increased of sea bass slices packaged under MAP with phosphate compared to MAP only.

CONCLUSION

Pretreatment of tilapia with STPP prior to keeping in MAP effectively retarded the exudates loss and maintaining quality the physicochemical and sensory properties of tilapia during storage at 4˚C for15 days.

REFERENCES

Aitken, A. (2001). Polyphosphates in fish processing. Torry Advisory Note, 31, 1–4.

Alvarez, J. A., Pozo, R., & Pastoriza, L. (1996). Effect of a cryoprotectant agent (sodium tripolyphosphate) on hake slices preserved in modified atmosphere packing. Food Science Technology International, 2, 177–181.

Arashisara,X., Hisara,O., Kayab,M., Yanika,T., (2004). Effects of modified atmosphere and vacuum packaging on microbiological and chemical properties of rainbow trout(*Oncorynchus mykiss*) fillets. International Journal of Food Microbiology 97 ,209– 214.

Ashie, I.N.A., Smith, J.P., Simpson, B.K., (1996). Spoilage and shelflife extension of fresh fish and shellfish. Critical Reviews in Food Science and Nutrition 36, 87–121.

Barnett, H.J., Conrad, J.W., Nelson, R.W., (1987). Use of laminated high and low density polyethylene flexible packaging to store trout (Salmo gairdneri) in a modified atmosphere. Journal of Food Protection 50, 645– 651.

Boscolo, W. R., Hayashi, C., Soares, C. M. and Meurer, F. (2001). Desempenho e Características de Carcaça de Machos Revertidos de Tilápias do Nilo(*Oreochromis niloticus*), Linhagens Tailandesa e Comum, nas Fases; Inicial e de Crescimento. Revista Brasileira de Zootecnia 30 (5): 1391-1396.

Chaijan,M., (2011). Physicochemical changes of tilapia (*Oreochromis niloticus*) muscle during salting. Food Chemistry 129, 1201–1210.

Chouliara, E., Karatapanis, A., Savvaidis, I. N., & Kontominas, M. G. (2007). Combined effect of oregano essential oil and modified atmosphere packaging on shelf-life extension of fresh chicken breast meat stored at 4 °C. Food Microbiology, 24, 607−617.

Church, N., (1994). Developments in modified-atmosphere packaging and related technologies. Trends in Food Science and Technology 5, 345–352.

Colin, P., & Salvat, G. (1996). Decontamination of poultry carcasses using trisodium phosphate treatment. In: Hinton, M. H., Rowlings, C., (Eds.), Factor affecting the microbial quality of meat, vol. 4. Microbial methods for the meat industry. Bristol: University of Bristol Press (Concerted Action CT94-1456).

Connell, J. J. (1990). Control of fish quality 3rd Ed. (Oxford: Fishing News Books). pp: 1-227. Corpei, A. 2001: Product Profile Tilapia (210): 127-138.

Connell, J.J., (1995). Control of Fish Quality, 4th Edition. Fishing News Books Limited, London.

Corpei, A. (2001). Product Profile Tilapia. Expansion of Ecuador's Export Commodities, CBI Project. pp1-44.

Daczkowska-Kozon, E.(1993). Effect of fishing season on total count of cold-tolerant microbes on iced Baltic herring. Acta Ichth. Piscat 23: 103-111.

Debevere, J., & Boskou, G. (1996). Effect of modified atmosphere packaging on the TVB/TMA producing microflora of cod fillets. International Journal of Food Microbiology, 31, 221–229.

Dziezak, J. D. (1990). Phosphates improve many foods. Food Technology, 44, 80–91.

Ercolini, D. ,Russo, F., Torrieri, E.,Masi, P.,&Villani, F. (2006). Changes in thespoilage-related microbiota of beef during refrigerated storage under different packaging conditions. Applied and Enviromental Microbiology, 4663−4671.

Erkan, N., Ozden, O., Alakavuk, D. U., Yildirim, S. Y., & Lnugur, M. (2006). Spoilage and shelf life of sardines (Sardina plichardus) packed in modified atmosphere. Journal of European Food Research Technology, 222, 667–673.

Etemadian,Y., Shabanpour,B., Mahoonak,A.S., Shabani,A., (2012). Combination effect of phosphate and vacuum packaging on quality parameters of Rutilus frisii kutum fillets in ice. Food Research International 45 (2012) 9–16.

Farber, J.M., (1991). Microbial aspects of modified-atmosphere packaging technology - a review. Journal of Food Protection 54, 58– 70.

Farber, J.M., Warburton, D.W., Gour, L. and Milling, M. (1990). Microbiological quality of foods packaged under modified atmospheres. Food Microbial. 7, 327-334.

Fernandez, K., Aspe, E., & Roeckel, M. (2009). Shelf-life extension on fillets of Atlantic Salmon *Salmo salar* using natural additives, superchilling and modified atmosphere packaging. Journal of Food control, 20, 1036–1042.

Genigeorgis, C., (1985). Microbial and safety implications of the use of modified atmospheres to extend the storage life of fresh meat and fish. International Journal of Food Microbiology1, 237– 251.

Gill, T.A.,(1992). Chemical and biochemical indices in seafood quality. In: Huss, H.H., Jacobsen, M., Liston, J. (Eds.), Quality Assurance in the Fish Industry. Developments in Food Science, Vol. 30.

Gimenez, B., Roncales, P., Beltran, J.A., (2002). Modified atmosphere packaging of filleted rainbow trout. Journal of the Science of Food and Agriculture 82, 1154– 1159.

Gobantes, I., Choubert, G., Gomez, R., (1998). Quality of pigmented (Astaxanthin and Canthaxanthin) rainbow trout *Oncorhynchus mykiss* fillets stored under vacuum packaging during chilled storage.Journal of Agriculture Food and Chemistry 46, 4358–4362.

Gokodlu, N., ozden, o., & Erkan, N. (1998). Physical, chemical and sensory analyses of freshly harvested sardines (Sardina pilchardus) stored at 4 ˚C. Journal of Aquatic Food Product Technology, 7, 5–15.

Gram, L., Huss, H.H., (1996). Microbial spoilage of fish and fish products. International Journal of Food Microbiology 33, 121– 137.

Gram, L.,(a) Dalgaard, P.,(2002). Fish spoilage bacteria problems and solutions. Current Opinion in Biotechnology 13, 262– 266.

Gram, L., (b) Ravn, L., Rasch, M., Bruhn, J.B., Christensen, A.B., Givskov, M., (2002). Food spoilage — interactions between food spoilage bacteria. International Journal of Food Microbiology 78, 79–97.

Gram, L., Ravn, L., Rasch, M., Bruhn, J.B., Christensen, A.B., Givskov, M., (2002). Food spoilage — interactions between food spoilage bacteria. International Journal of Food Microbiology 78, 79–97.

Guillén, M. D., & Ruiz, A. (2004). Formation of hydroperoxy- and hydroxyalkenals during thermal oxidative degradation of sesame oil monitored by proton NMR. Journal of Food Lipid Science and Technology, 106, 680–687.

Haines, R.B. (1993) .The influence of carbon dioxide on the rate of multiplication of certain bacteria as judged by viable plate counts. J. Sot. Chem. Ind. 52, 13T-17T.

Huss, H.H. (1988).Fresh fish - quality and quality changes. FAO, Danish International Development Agency, Rome, Sagraf.

Jakobsen, M., & Bertelsen, G. (2002). The use of CO_2 in packaging of fresh red meats and its effects on chemical quality of changes in the meat: A review. Journal of Muscle Foods, 13, 143−168.

Kennedy, C., Buckley, D. J., & Kerry, J. P. (2004). Display life of sheep meats retail packaged under atmospheres of various volumes and compositions. Meat Science, 68, 649−658.

Kilinc, B., Cakli, S., Dincer, T., & Cadun, A. (2007). Effects of phosphates treatment on the quality of frozen-thawed fish species. Journal of Muscle Foods, 20(4), 377–391.

Kilinc, B., Cakil, S., Csdun, A., & Sen, B. (2009). Effect of phosphate dip treatments on chemical, microbiological, color, textural, and sensory changes of rainbow trout (Oncorynchus mykiss) fillets during refrigerated storage. Journal of Food Product Technology, 18, 108–119.

Kim, C. R. H., Hearnsberger, J. O., Vickery, A. R., White, C. H., & Marshall, D. L. (1995). Extending shelf life of refrigerated catfish fillets using sodium acetate and monopotassium phosphate. Journal of Food Protection, 58, 644–647.

Koutsoumanis, K. P., Stamatiou, A. P., Drosinos, E. H., & Nychas, G. – J. E. (2008). Control of spoilage microorganisms in minced pork by a self developed modified atmosphere induced by the respiratory activity of meat flora. Food Microbiology, 25, 915−921.

Maregoni, N. G. (2006). Produçáo de tilápia do Nilo *Oreochromis niloticus* (Linhagem Chitralada), cultivada em tanques-rede, sob diferentes densidades de estocagem. Revista Archivos de Zootecnia 55.

Marshall, D., & Jindal, V. (1997). Microbiological quality of catfish frames treated with selected phosphates. Journal of Food Protection,60, 1081–1083.

Masniyom, P., Benjakul, S., & Visessanguan, W. (2002). Shelf-life extension of refrigerated seabass slices under modified atmosphere packaging. Journal of the Science of Food and Agriculture, 82, 873–880.

Masniyom, P., Soottawat, B., & Visessanguan, W. (2005). Combination effect of phosphate and modified atmosphere on quality and shelf-life extension of refrigerated seabass slices. Journal of Food Science and Technology, 38, 745–756**.**

Mendes, R., & Goncalvez, A. (2008). Effect of soluble CO_2 stabilisation and vacuum packaging in the shelf life of farmed sea bream and sea bass fillets. Journal of Food Science and Technology, 43, 1678–1687.

Mitsubayashi, K., Kubotera, Y., Yano, K., Hashimoto, Y., Kon, T., & Nakakura, S. (2004). Trimethylamine biosensor with flavin- containing monooxygenase type 3 (FMO3) for fish-freshness analysis. Sensors and Actuators B: Chemical, 103, 463–467.

Mossel, D. A. A., Eelderink, L., Koopmans, M., and Rossem, F. V. (1979)**.** Influence of carbon source, bile salts, and incubation temperature on recovery of *Enterobacteriaceae* from foods using

MacConkey-type agars. Journal of Food Protection, 42, 470–475.

Nishimoto, J., Suwetja, I.K., Miki, H., (1985). Estimation of keeping freshness period and practical storage life of mackerel muscle during storage at low temperatures. Mem. Fac. Fish. Kagoshima Univ. 34, 89–96.

Ocano-Higuera, V. M., Maeda-Martinez, A. N., Lugo-Sanchez, M. E., & Pacheco- Aguilar, R. (2006). Postmortem biochemical and textural changes in the adductor muscle of catarina scallop stored at 0 ˚C. Journal of Food Biochemistry, 30(4), 373–389.

O'Grady, M. N., Monahan, F. J., Burke, R. M., & Allen, P. (2000). The effect of oxygen level and exogenous ∝-tocopherol on the oxidative stability of minced beef in modified atmosphere packs. Meat Science, 55, 39−45.

Ohlsson, T., (1994). Minimal processing-preservation methods of the future—an overview. Trends in Food Science and Technology 5,341– 344.

Ordonez, J. A., Lopez-Galvaz, D. E., Fernandez, M., Hierro, E., & Hoz, L. (2000). Microbial and physicochemical modifications of hake (Merluccius merluccius) steaks stored under carbon dioxide enriched atmosphere. Journal of the Science of Food and Agriculture, 80, 1831–1840.

Parkin, K.L., Wells, M.J., Brown, W.D., (1981). Modified atmosphere storage of rockfish fillets. Journal of Food Science 47, 181– 184.

Parvaneh, V. (2007). Quality control and the chemical analysis of food. Tehran: University of Tehran Press. Chap. 4.

Pastoriza, L., Sampedro, G., Herrera, J. J., & Cabo, M. L. (1996). Effect of modified atmosphere packaging on shelf life of iced fresh hake slices. Journal of the Science of Food and Agriculture,71,541–547.

Patsias, A., Chouliara, I., Badeka, A., Savvaidis, I. N. and Kontominas, M.G. (2006). Shelf-life of a chilled precooked chicken product stored in air and under modified atmospheres: microbiological, chemical, sensory attributes. Food Microbiology 23, 423–429.

Philips, O.C.A., (1996). Review, modified atmosphere packaging and its effects on the microbiological quality and safety of produce. International Journal of Food Science and Technology31, 463– 479.

Randell, K., Ahvenainen, R., Hattula, T., (1995). Effect of the gas/ product ratio and CO_2 concentration on the shelf-life of MA packed fish. Packaging Technology and Science, 205– 218.

Randell, K., Hattula, T., Ahvenainen, R.,(1997). Effect of packaging method on the quality of rainbow trout and Baltic herring fillets. Lebensmittel-Wissenschaft und –Technologie 30, 56–61.

Reddy, N.R., Shreiber, C.L., Buzard, K.S., Skinner, G.E., Armstong, D.J., (1994). Shelf life of fresh tilapia fillets packaged in high barrier film with modified atmospheres. Journal of Food Science 59, 260–264.

Reddy, N. R., Villanueva, M., & Kautter, D. A. (1995). Shelf life of modified atmosphere packaged fresh tilapia fillets stored under refrigeration and temperature abuse conditions. Journal of Food Protection, 58, 908–914.

Reineccius, G., (1990). Off-flavours in foods. Crit. Rev. Food Nutr. 29, 381–402.

Renerre, M., Dumont, F., & Gateellier, P. H. (1996). Antioxidant enzyme activities in beef in relation to oxidant of lipid and myoglobin. Meat Science, 43, 111–121.

Sahoo, J., & Kumar, N. (2005). Quality of vacuum packaged muscle foods stored under frozen conditions: A review. Journal ofand Food Science Technology, 42, 209–213.

Scullen, O. J., & Zaika, L. L. (1994). Effect of temperature, salt and pH on growth inhibition of Listeria monocytogenes by sodium polyphosphate. Presented at 18th annual meeting of IAMFES, San Antonio, TX, July 31–August 3.

Shakila, R., Jeyasekaran, G., & Vijayalakshmi, S. (2005). Effect of vacuum packaging on the quality characteristics of seer fish *Scomberomorus commersonii* chunks during refrigerated storage. Journal of Food Science and Technology, 42, 438–443.

Simeonidou, S., Govaris, A., Vareltzis, K., (1998). Quality assessment of seven Mediterranean fish species during storage on ice. Food Res. Int. 30, 479–484.

Siripatrawan, U., Sanguandeekul, R., & Narakaew, V. (2009). An alternative freshness index method for modified atmosphere packaged abalone using an artificial neural network. LWT – Food Science and Technology, 42, 343–349.

Sivertsvik, M., Jeksrud, W.K., Rosnes, M.J.T., (2002). A review of modified atmosphere packaging of fish and fishery products—significance of microbial growth, activities and safety. International Journal of Food Science and Technology37, 107–127.

Smith, L. A., Simmons, S. L., McKeith, F. K., Bechtel, P. L., & Brady, P. L. (1984). Effects of sodium tripolyphosphate on physical and sensory properties of beef and pork roasts. Journal of Food Science, 49, 1636–1639.

Sofos, J. N. (1986). Use of phosphate in low-sodium meat products. Food Technology, 40, 52–69.

Stammen, K., Gerdes, D., Caporaso, F., (1990). Modified atmosphere packaging of seafood. Food Sciences and Nutrition 29, 301– 331.

Statham, J. (1984) Modified atmosphere storage of fisheries' products, the state of the art. Food Technol. Aust. 36, 233-239.

Statham, J.A., Bremner, H.A., (1989). Shelf-life extension of packaged seafoods — a summary of a research approach. Food Australia 41, 614– 620.

Tarladgis, B. G., Watts, B. M., Younathan, M. S., & Dugan, L. J. (1960). A distillation method for the quantitative determination of malonaldehyde in rancid foods. Journal of the American Oil Chemists' Society, 37, 44–48.

Vander, S. C., Jacxsens, L., Devlieghere, F. and Debevere, J. (2002). Combined high Oxygen atmosphere with low oxygen atmospheres packaging to improve the keeping quality of strauberries and raspberries. Postharvest Biology and technology, 26:49–58.

Varlik, C., Baygar, T., Özden, Ö., Erkan, N., & Metin, S. (2000). Sensory evaluation and determination of some physical and chemical characteristics of shrimp during gold storage. Turkish Journal of Veterinary and Animal Sciences, 24, 181–185.

Zaika, L. L., Cooke, P., & Dobson, T. (1991). Effect of sodium polyphosphates on ultrastructure of Listeria monocytogenes. Presented at 91st general meeting of the American Society. For microbiology, Dallas, TX (pp. 5–9).

Zaika, L. L., Scullen, O. J., & Fanelli, J. S. (1997). Growth inhibition of Listeria monocytogenes by sodium polyphosphate as affected by polyvalent metal ions. Journal of Food Science, 62, 867–869.

زيادة القدره التخزينيه والمحافظه على جودة اسماك البلطى النيلى على ٤ درجه مئوى.

أيمن أبو اليزيد
قسم تكنولوجيا الأغذية ، كلية الزراعة – سابا باشا – جامعة الإسكندرية

من الاهميه بمكان الاهتمام بتحسين نوعيه الغذاء للمستهلك . فمن المعروف أن الاسماك سريعه التدهور والتلف. لذلك في هذه الدراسه يتم معالجة الاسماك بتركيزات مختلفه من الصوديوم تراى بولى فوسفات قبل تعبئتها فى الجو الغازى المعدل (٩٠ % ثانى اكسيد الكربون + ١٠ % ا كسجين) . أظهرت النتائج أن سمك البلطي المعامل بمحلول تركيز ٢٪ من الصوديوم تراى بولى فوسفات تحت الجو الغازى المعدل اكثر فاعليه من التركيزات الاخرى مما أدى الى تخفيض العدد الكلى للبكتريا بالاضافه الى المحافظه على جودة الاسماك . أظهر التحليل الكيميائي للعينات أن قيم الرقم الهيدروجيني و القواعد النيتروجينيه الكليه وكذلك اختبار الثيوباربتيوريك اسيد تراوحت بين ٦,٣١- ٦,٦١ و ١٠,٣٨ – ٢٥,١٠ و ٠,٥٥ – ١,٩٨ م مجم مالونالدهيد / كجم خلال ١٥ يوما من ا لتخزين، على التوالي. وأوضحت النتائج ان معاملة سمك البلطى بالصوديوم تراى بولى فوسفات تحت الجو الغازى المعدل أدت الى تقليل التغيرات الغير مرغوبه وأيضا الى تحسين خصائص الجوده للسمك أثناء التخزين على ٤ °م مقارنة مع العينات الاخرى .