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

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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% CO₂ +10% O₂) 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 Brenner, 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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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 CO₂ 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 are 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 holding capacity. Addition of phosphates to seafood products inhibited the growth of bacteria in stored fish in ice (Kim, et al., 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; Daczewska-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 al., 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 al.*, 2004) was obtained from Helyopoles Company Industrial Gases, Alexandria.

**Polyethylene bags**

High-density polyethylene bags (20x35 cm 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 al.*, 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 for 45 min until the volume of boric acid solution reach to 150 mL. Boric acid containing methyl red reagent (0.016 g methyl red and 0.083 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 (0.2883 g 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.

\[ \text{TBA No. (as mg malonaldehyde/kg sample)} = 7.8 \text{ D} \]

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 5 days 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 at 4°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 value 7.0. 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 pH value compared with the sample kept in air. This was probably due to the dissolving of some atmospheric CO₂ 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 CO₂ concentration to decline due to the absorption of CO₂ 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 (Gokodlu 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).

<table>
<thead>
<tr>
<th>Treatment</th>
<th>0</th>
<th>3</th>
<th>6</th>
<th>9</th>
<th>12</th>
<th>15</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>6.31±0.07</td>
<td>6.52±0.03</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
</tr>
<tr>
<td>MAP</td>
<td>6.31±0.07</td>
<td>6.28±0.21</td>
<td>6.42±0.14</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
</tr>
<tr>
<td>STPP +MAP</td>
<td>6.31±0.07</td>
<td>6.35±0.05</td>
<td>6.39±0.27</td>
<td>6.44±0.04</td>
<td>6.52±0.12</td>
<td>6.61±0.22</td>
</tr>
</tbody>
</table>

Values are Mean±SD.
ND = Not determined because unacceptable by the panelists.
MAP = packed in modified atmosphere condition (90% CO₂ +10% O₂).
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).

<table>
<thead>
<tr>
<th>Treatment</th>
<th>0</th>
<th>3</th>
<th>6</th>
<th>9</th>
<th>12</th>
<th>15</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>10.38±0.11</td>
<td>19.22±0.17</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
</tr>
<tr>
<td>MAP</td>
<td>10.38±0.11</td>
<td>16.56±0.05</td>
<td>22.35±0.10</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
</tr>
<tr>
<td>STPP +MAP</td>
<td>10.38±0.11</td>
<td>11.65±0.16</td>
<td>13.72±0.33</td>
<td>16.22±0.04</td>
<td>20.15±0.08</td>
<td>25.10±0.14</td>
</tr>
</tbody>
</table>

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% CO₂ +10% O₂).
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. glutathione 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).

<table>
<thead>
<tr>
<th>Treatment</th>
<th>0</th>
<th>3</th>
<th>6</th>
<th>9</th>
<th>12</th>
<th>15</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>0.55±0.20</td>
<td>1.21±0.32</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
</tr>
<tr>
<td>MAP</td>
<td>0.55±0.20</td>
<td>0.95±0.16</td>
<td>1.25±0.10</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
</tr>
<tr>
<td>STPP + MAP</td>
<td>0.55±0.20</td>
<td>0.71±0.10</td>
<td>0.92±0.48</td>
<td>1.19±0.11</td>
<td>1.54±0.42</td>
<td>1.98±0.12</td>
</tr>
</tbody>
</table>

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% CO₂+10% O₂).
STPP= Treatment with sodium tripolyphosphate.

Therefore, CO₂-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 CO₂ 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/cm². increased with extend during storage to be 1.92 log_{10} CFU/cm². 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 dioxide has been reported by (Haines, 1993). 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.**

<table>
<thead>
<tr>
<th>Treatment</th>
<th>log$_{10}$ CFU/ g</th>
<th>Storage time Days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>2.25 4.20 ND ND ND ND</td>
<td>0 3 6 9 12 15</td>
</tr>
<tr>
<td>MAP</td>
<td>2.25 2.96 3.92 ND ND ND</td>
<td>0 3 6 9 12 15</td>
</tr>
<tr>
<td>STPP + MAP</td>
<td>2.25 2.56 2.89 3.07 3.49 3.95</td>
<td>0 3 6 9 12 15</td>
</tr>
</tbody>
</table>

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.**

<table>
<thead>
<tr>
<th>Treatment</th>
<th>log$_{10}$ CFU/ g</th>
<th>Storage time Days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>1.07 1.92 ND ND ND</td>
<td>0 3 6 9 12 15</td>
</tr>
<tr>
<td>MAP</td>
<td>1.07 1.43 1.80 ND ND ND</td>
<td>0 3 6 9 12 15</td>
</tr>
<tr>
<td>STPP + MAP</td>
<td>1.07 1.27 1.38 1.53 1.70 1.91</td>
<td>0 3 6 9 12 15</td>
</tr>
</tbody>
</table>

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 to MAP 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 for 15 days.

**REFERENCES**


SHELF – LIFE OF TILAPIA FISH DURING STORAGE AT 4°C


زيادة القدرات التخزينية والمحافظة على جودة أسماك البلطي النيلية على درجة مئوية

أيمن أبو اليزيد
قسم تكنولوجيا الأغذية، كلية الزراعة- ساها باشا - جامعة الإسكندرية

من الأهمية بمكان الاهتمام بتحسين نوعية الغذاء للمستهلك. فمن المعروف أن الأسماك سريعة التهديرون التلف. لذلك، في هذه الدراسة يتم معالجة الأسماك بتزويجات مختلفة من الصوديوم تراي بوليفوسفات قبل تعبئتها في الجو الغازي المعدل (90% ثاني أكسيد الكربون + 10% أوليكسجين). أظهرت النتائج أن سمك البلطي المعدل بمحلول تراي بوليفوسفات تحت الجو الغازي المعدل أكثر فاعلية من التركيزات الأخرى، مما أدأ إلى تخفيض العددين الكلي للبكتريا والإضافةента المحافظة على جودة الأسماك. أظهر التحليل الكيميائي للعينات أن قيم الرقم الهيدروجيني والقواعد النيتروجينية الكلية وكذلك اختبار الثيوباربتيوريك أسيد تراوحت بين 0.13-0.26 و 0.08-0.35 ومجم مالونالدهيد / كجم خلال 0.1 يوما من التخزين، على التوالي. وأوضحت النتائج أن معالمة سمك البلطي بالمحلول المعدن الصوديوم تراي بوليفوسفات تحت الجو الغازي المعدل أدت إلى تقليل التغيرات الغير مرغوب فيها أيضاً إلى تحسين خصائص الجودة للسمك أثناء التخزين على درجة مئوية مقارنة مع العينات الأخرى.