Benha University
Faculty of Veterinary Medicine
Food Hygiene and Control Department

Quality Evaluation of Some Fresh Water Fish in Egyptian Markets

A Thesis *Submitted to*
Faculty of Veterinary Medicine
Benha University

Presented By

Ahmed Mohammed Mostafa Hassan Mostafa

B.V. Sc., 2011, Fac. Vet. Med., Benha University
M.V. Sc., Meat Hygiene, Fac. Vet. Med., Benha University 2016

For the degree of Ph.D.

(Meat Hygiene)

Under Supervision of

Prof. Dr.
Hemmat Moustafa Ibrahim
Professor of Meat Hygiene and course coordinator of Food Quality and control program (FQCP)
Faculty of Veterinary Medicine
Benha University

Prof. Dr.
Mohamed Ahmed Hassan
Professor of Meat Hygiene and Head of Food Hygiene and Control Dept.,
Faculty of Veterinary Medicine
Benha University

Prof. Dr.
Reham Abd ElAziz Amin
Professor of Meat Hygiene
Faculty of Veterinary Medicine
Benha University

Prof. Dr.
Omayma Mohammed Al-Taher Labib Maghraby
Chief Researcher of Food Hygiene
Animal Health Researcher Institute, Dokki, Agricultural Research Center.

2020

CONTENTS

Title	Page No.
1. Introduction	**1**
2. Review of Literature	**6**
2.1. Sensory profile of fresh water fish	**6**
2.2. Chemical profile of fresh water fish	**10**
2.3. Bacteriological profile of fresh water fish	**16**
2.4. Effect of sodium tripolyphosphate on the quality of *Nile tilapia* fillets	**24**
3. Material and Methods	**33**
PART I: - Quality of some freshwater fish *(Bagrus bayad, Clarias gariepinus,* and *Nile tilapia)* in Egyptian markets	**33**
3.1. Samples collection	**33**
3.2. Sensory evaluation	**33**
3.3. Chemical examination	**35**
3.3.1. pH determination	**35**
3.1.2. Determination of Total volatile basic nitrogen.	**35**
3.3.3. Determination of trimethylamine	**36**
3.3.4. Determination of Thiobarbituric acid	**36**
3.4. Bacteriological examination:	**37**
3.4.1. Preparation of samples	**37**
3.4.2. Determination of Aerobic plate count	**37**
3.4.3. Determination of Psychrotrophic count.	**37**
3.4.4. Determination of coliforms count	**38**

PART II: - Effect of food-grade sodium tripolyphosphate on the quality of *Nile tilapia* fillets	**38**
1. Fish fillets preparation	**38**
2. Preparation of dipping solutions and fish fillets dipping	**38**
3. Packaging and storage of treated fish fillets samples	**39**
4. Weight gain (WG)% determination	**39**
5. Sensory evaluation	**39**
6. Chemical examination	**40**
6.1. Determination of Ph	**40**
6.2. Determination of Total volatile basic nitrogen	**40**
6.3. Determination of trimethylamine	**40**
6.4. Determination of Thiobarbituric acid	**40**
6.5. Moisture % determination	**41**
6.6. Total phosphate content determination	**41**
7. Bacteriological examination	**42**
7.1. Preparation of samples	**42**
7.2. Determination of Aerobic plate count	**42**
7.3. Determination of Psychrotrophic count	**42**
7.4. Determination of coliforms count	**42**
• **Statistical Analysis**	**42**
4. Results	**43**
5. Discussion	**76**
6. Conclusions and Recommendations	**103**
7. Summary	**107**
8. References	**116**
9.Arabic summary	**١**

LIST OF TABLES

Table No.	Title	Page No.
(A)	Quality Index Method scheme used to identify the quality index demerit score (Larsen *et al.* 1992)	34
(B)	A modified Quality Index Method scheme developed for de-skinned Tilapia (Oreochromis niloticus) fillets (Cyprian et al., 2014).	40
(1)	Statistical analytical results of Quality Index score (QI) of the examined samples of freshwater fish (n=30).	43
(2)	Statistical analytical results of pH value of the examined samples of freshwater fish (n=30).	44
(3)	Acceptability of the examined samples of freshwater fish based on their pH value (n=30).	45
(4)	Statistical analytical results of TVB-N (mg/100g) of the examined samples of freshwater fish (n=30).	46
(5)	Acceptability of the examined samples of freshwater fish based on their TVB-N (n=30).	47
(6)	Statistical analytical results of TMA (mg/100g) of the examined samples of freshwater fish (n=30).	48
(7)	Acceptability of the examined samples of freshwater fish based on their TMA (n=30).	49
(8)	Statistical analytical results of TBA (mg MAD/kg) of the examined samples of freshwater fish (n=30).	50
(9)	Acceptability of the examined samples of freshwater fish based on their TBA (n=30).	51

Table No.	Title	Page No.
(10)	Statistical analytical results of APC (log cfu/g) of the examined samples of freshwater fish (n=30).	52
(11)	Acceptability of the examined samples of freshwater fish based on their APC/g (n=30).	53
(12)	Statistical analytical results of Psychrotrophic count (PTC) (log cfu/g) of the examined samples of freshwater fish (n=30).	54
(13)	Acceptability of the examined samples of freshwater fish based on their PTC /g (n=30).	55
(14)	Incidence of Coliforms count (CC) isolated from the examined samples of freshwater fish (n=30).	56
(15)	Statistical analytical results of Coliforms count (CC) (log cfu/g) of the examined samples of freshwater fish (n=30).	57
(16)	Acceptability of the examined samples of freshwater fish based on their Coliforms count (n=30).	58
(17)	Statistical analytical results of weight gain% in the examined treated samples of Tilapia fillet with STPP at zero time (n=12).	59
(18)	Statistical analytical results of Quality Index (QI) in the examined treated samples of Tilapia fillet with STPP during refrigeration storage at 4^{o}C (n=12).	60
(19)	Statistical analytical results of pH value in the examined treated samples of Tilapia fillet with STPP during refrigeration storage at 4^{o}C (n=12).	61
(20)	Statistical analytical results of TVB-N (mg/100g) in the examined treated samples of Tilapia fillet with STPP during refrigeration storage at 4^{o}C (n=12).	62

Table No.	Title	Page No.
(21)	Reduction % of the mean values of TVB-N in the examined samples of refrigerated Tilapia fillet treated with different concentrations of STPP.	63
(22)	Statistical analytical results of TMA (mg/100g) in the examined treated samples of Tilapia fillet with STPP during refrigeration storage at 4^{o}C (n=12).	64
(23)	Reduction % of the mean values of TMA in the examined samples of refrigerated Tilapia fillet treated with different concentrations of STPP.	65
(24)	Statistical analytical results of TBA (mg MDA/kg) in the examined treated samples of Tilapia fillet with STPP during refrigeration storage at 4^{o}C (n=12).	66
(25)	Reduction % of the mean values of TBA in the examined samples of refrigerated Tilapia fillet treated with different concentrations of STPP.	67
(26)	Statistical analytical results of moisture content in the examined treated samples of Tilapia fillet with STPP during refrigeration storage at 4^{o}C (n=12).	68
(27)	Statistical analytical results of phosphate content in the examined treated samples of Tilapia fillet with STPP during refrigeration storage at 4^{o}C (n=12).	69
(28)	Statistical analytical results of APC (log cfu/g) in the examined treated samples of Tilapia fillet with STPP during refrigeration storage at 4^{o}C (n=12).	70

Table No.	Title	Page No.
(29)	Reduction % of the mean values of APC in the examined samples of refrigerated Tilapia fillet treated with different concentrations of STPP.	71
(30)	Statistical analytical results of Psychrotrophic count (log cfu/g) in the examined treated samples of Tilapia fillet with STPP during refrigeration storage at 4^{o}C (n=12).	72
(31)	Reduction % of the mean values of Psychrotrophic count in the examined samples of refrigerated Tilapia fillet treated with different concentrations of STPP.	73
(32)	Statistical analytical results of Coliforms count (log cfu/g) in the examined treated samples of Tilapia fillet with STPP during refrigeration storage at 4^{o}C (n=12).	74
(33)	Reduction % of the mean values of Coliforms count in the examined samples of refrigerated Tilapia fillet treated with different concentrations of STPP.	75

LIST OF FIGURES

Figures No.	Title	Page No.
(1)	Mean values of quality index score (QI) of the examined samples of freshwater fish.	43
(2)	Mean values of pH value in the examined samples of freshwater fish.	44
(3)	Acceptability of the examined samples of freshwater fish based on their pH value.	45
(4)	Mean values of TVB-N (mg/100g) of the examined samples of freshwater fish.	46
(5)	Acceptability of the examined samples of freshwater fish based on their TVB-N.	47
(6)	Mean values of TMA (mg/100g) of the examined samples of freshwater fish.	48
(7)	Acceptability of the examined samples of freshwater fish based on their TMA.	49
(8)	Mean values of TBA (mg MAD/kg) of the examined samples of freshwater fish.	50
(9)	Acceptability of the examined samples of freshwater fish based on their TBA.	51
(10)	Mean values of APC (log cfu/g) in the examined samples of freshwater fish	52
(11)	Acceptability of the examined samples of freshwater fish based on their APC/g.	53
(12)	Mean values of PTC (log cfu/g) of the examined samples of freshwater fish	54

Figures No.	Title	Page No.
(13)	Acceptability of the examined samples of freshwater fish based on their PTC /g.	55
(14)	Incidence of Coliforms count isolated from the examined samples of freshwater fish.	56
(15)	Mean values of Coliforms count (log cfu/g) of the examined samples of freshwater fish.	57
(16)	Acceptability of the examined samples of freshwater fish based on their Coliforms count.	58
(17)	Mean values of weight gain% in the examined treated samples of Tilapia fillet with STPP at zero time.	59
(18)	Mean values of QI in the examined treated samples of Tilapia fillet with STPP during refrigeration storage at 4^{o}C.	60
(19)	Mean values of pH value in the examined treated samples of Tilapia fillet with STPP during refrigeration storage at 4oc.	61
(20)	Mean values of TVB-N (mg/100g) in the examined treated samples of Tilapia fillet with STPP during refrigeration storage at 4^{o}C.	62
(21)	Reduction % of the mean values of TVB-N in the examined samples of refrigerated Tilapia fillet treated with different concentrations of STPP.	63
(22)	Mean values of TMA (mg/100g) in the examined treated samples of Tilapia fillet with STPP during refrigeration storage at 4^{o}C (n=12).	64
(23)	Reduction % of the mean values of TMA in the examined samples of refrigerated Tilapia fillet treated with different concentrations of STPP.	65

Figures No.	Title	Page No.
(24)	Mean values of TBA (mg MDA/kg) in the examined treated samples of Tilapia fillet with STPP during refrigeration storage at 4°C.	66
(25)	Reduction % of the mean values of TBA in the examined samples of refrigerated Tilapia fillet treated with different concentrations of STPP.	67
(26)	Mean values of moisture content in the examined treated samples of Tilapia fillet with STPP during refrigeration storage at 4°C.	68
(27)	Mean values of phosphate content in the examined treated samples of Tilapia fillet with STPP during refrigeration storage at 4°C.	69
(28)	Mean values of APC (log cfu/g) in the examined treated samples of Tilapia fillet with STPP during refrigeration storage at 4°C.	70
(29)	Reduction % of the mean values of APC in the examined samples of refrigerated Tilapia fillet treated with different concentrations of STPP.	71
(30)	Mean values of Psychrotrophic count (log cfu/g) in the examined treated samples of Tilapia fillet with STPP during refrigeration storage at 4°C.	72
(31)	Reduction % of the mean values of Psychrotrophic count in the examined samples of refrigerated Tilapia fillet treated with different concentrations of STPP.	73

Figures No.	Title	Page No.
(32)	Mean values of Coliforms count (log cfu/g) in the examined treated samples of Tilapia fillet with STPP during refrigeration storage at 4^{o}C.	74
(33)	Reduction % of the mean values of Coliforms count in the examined samples of refrigerated Tilapia fillet treated with different concentrations of STPP.	75

7. SUMMARY

7.1. Quality of some freshwater fish *(Bagrus bayad, Clarias gariepinus,* and *Nile tilapia)* in Egyptian markets:

Ninty random samples of fish represented by fresh *Bagrus bayad*, *Clarias gariepinus*, and *Nile tilapia* (30 of each) collected from different Egyptian fish markets located in Qaluobia, Cairo, and Giza governorates. Fish samples were kept and transferred to the laboratory without undue delay in an insulated icebox. The collected samples were subjected to sensory, chemical, and bacteriological examinations to evaluate the quality indices of the different fish species.

Quality index scores ranged from 1 to 5 with an average of 2.67±0.25 in Bagrus bayad examined samples, from 3 to 8 with an average of 4.93±0.24 in Clarias gariepinus examined samples and from 1 to 6 with a mean value of 3.73±0.24 for the examined Nile tilapia samples. The differences between the examined samples were significant ($P<0.05$). The highest QI scores of Clarias gariepinus than of Nile tilapia and of Bagrus bayad was reflecting to pH, TVB-N, TMA, TBA, APC, PTC, and CC. But in total, this QI score appeared that the examined fish samples in this Thesis were of good quality.

pH values of the examined Bagrus bayad, Clarias gariepinus, and Nile tilapia samples varied from 6.08 to 6.48, 6.22 to 6.67, and 6.15 to 6.49, respectively. The average pH values were 6.38±0.02, 6.29±0.02, and 6.32±0.01, respectively. There were significant differences among the examined Nile tilapia and Clarias gariepinus and between Clarias gariepinus and Bagrus bayad samples ($P<0.05$). There were no significant differences ($P>0.05$) among examined Nile tilapia and Bagrus bayad samples. All the examined samples were accepted in pH values according

to "EOS" (2005), except one Clarias gariepinus sample (3.33%) was unaccepted.

Total volatile basic nitrogen values of the examined Bagrus bayad, Clarias gariepinus, and Nile tilapia samples were varied from 8.68 to 17.92, 11.76 to 21.28, and 7.28 to 18.48 mg N/100g with an average of 12.71 ± 0.43, 16.76 ± 0.46 and 14.54 ± 0.51 mg N/100g, respectively.There were significant differences among different species of examined samples ($P<0.05$). All examined samples (100%) were accepted in TVB-N according to "EOS" (2005).

Trimethylamine (mg N/100g) values in the examined samples varied from 2.52 to 7.56 with an average of 5.49 ± 0.21 in Bagrus bayad, from 4.20 to 8.74 with an average of 6.75 ± 0.19 in Clarias gariepinus, and from 2.69 to 8.23 with an average of 6.19 ± 0.23 in Nile tilapia. There were significant differences ($P<0.05$) among examined Nile tilapia and Bagrus bayad samples and between the examined Clarias gariepinus and Bagrus bayad samples. There were no significant differences ($P>0.05$) among examined Nile tilapia and Clarias gariepinus samples. All examined samples (100%) were accepted in TMA according to "EOS" (2005).

Thiobarbituric acid (mg malonaldehyde/kg) varied from 0.36 to 1.07 with an average of 0.57 ± 0.03 in the examined Bagrus bayad samples, 0.53 to 1.70 with an average of 0.91 ± 0.06 in the examined Clarias gariepinus samples and 0.42 to 1.48 with an average of 0.82 ± 0.05 in the examined Nile tilapia samples. There were significant differences ($P<0.05$) among the examined Nile tilapia and Bagrus bayad samples and between the examined Clarias gariepinus and Bagrus bayad samples. All examined samples (100%) were accepted in TBA according to "EOS" (2005).

Aerobic plate count (log cfu/g) of the examined *Bagrus bayad, Clarias gariepinus, , and Nile tilapia* samples ranged from 3.6 to 4.84, 4.08 to 5.83, and 3.9 to 5.32 fish meat with mean values of 4.28 ± 0.06, 4.93 ± 0.07, and 4.82 ± 0.08, respectively. There was a significant difference ($P<0.05$) between the mean values of APC of the examined samples of *Nile tilapia and Bagrus bayad* and between *Clarias gariepinus and Bagrus bayad*. All examined samples (100%) were accepted in APC according to "EOS" (2005).

Psychrotrophic count of the examined Bagrus bayad, Clarias gariepinus and Nile tilapia samples differed from 3.3 to 4.57, 3.78 to 5.71, and 3.3 to 4.98 log cfu/g fish flesh with a mean value of 4.00 ± 0.06, 4. 47 ± 0.08, and 4.24 ± 0.09 log cfu/g, respectively. The differences associated with the examined samples of fish were significant ($P<0.05$) on the base of Psychrotrophic count among (Nile tilapia, Clarias gariepinus, and Bagrus bayad). All examined samples (100%) were accepted in PTC according to "EOS" (2005).

Coliforms incidence in Clarias gariepinus was 96.7%, higher than its incidence in Nile tilapia 93.3%, that is also higher than TC incidence in Bagrus bayad 86.7%. The minimum and the maximum coliform count log cfu/g in Bagrus bayad was 1 and 1.90, Clarias gariepinus was 1 and 2.45 and Nile tilapia was 1 and 1.85. While the mean coliform counts mean log cfu/g of the same samples respectively were 1.38±0.06, 1.57±0.06, and 1.45±0.05. The only significance difference was present between Bagrus bayad and Clarias gariepinus ($P<0.05$). All examined Bagrus bayad and Tilapia nilotica samples were within the premissible limit. Only one sample (3.33%) of Clarias gariepinus was unaccepted and unfit for consumption.

According to all the above-mentioned results it is observed that Clarias gariepinus had higher QI score, pH, TVB-N, TMA,TBA, APC,

PTC and CC than those of Nile tilapia than Bagrus bayad. Therefore, there was a superiority of *Bagrus bayad* were more than *Nile tilapia* followed by *Clarias gariepinus* samples.

7.2. Effect of food-grade sodium tripolyphosphate on the quality of *Nile tilapia* fillets:

Perfectly, three groups of *Nile tilapia* fish samples were collected from different Egyptian fish markets located in Cairo, El- Kalubia, and Giza at the harvesting day. Each group was divided into four subgroups. Furthermore, each fish was gutted, beheaded, cleaned, and filleted into 2 pieces of around 100 g weight for any piece. Furthermore, the samples were wrapped in sterile bags from polyethylene and were transferred directly to the laboratory in an icebox in sterile conditions within 2 hrs from sample purchasing.

The food-grade sodium tripolyphosphate was used for the preparation of 2%, 5%, and 10% solution in previously chilled distilled water at 4^{o}C. Furthermore, the samples were divided into four subgroups; the 1^{st} group was dipped into distilled water (control), the 2^{nd} group was dipped into 2% (w/v) solution /10 min, while the 3^{rd} was dipped into 5% (w/v) solution /10 min and the 4^{th} was dipped into 10% (w/v) solution /10 min in a refrigerator, after that, the dipping solution was removed. After that, the samples were left for draining about 1 min.

Treated and controlled samples of *Nile tilapia* fish fillets were labeled and packaged inside sterile stomacher bags, after that, stored at 4 ± 1^{o}C in the refrigerator. The experiment was repeated in triplicate. All previous groups (control and treated groups) of samples were subjected to sensory, physicochemical, and bacteriological examination at zero-day then, periodically every 3 days (0, 3rd, 6th, 9th, 12th, and 15th).

The value of weight gain (%) after 10 min. of dipping ranged from 3.44 to 3.74, 6.13 to 6.46, 7.49 to7.76 and 9.34 to 9.76 with an average of 3.58 ± 0.12, 6.28 ± 0.14, 7.61 ± 0.11 and 9.52 ± 0.18 at zero time of examination of control, 2%STPP, 5%STPP, and 10%STPP treated samples, respectively. There were significant differences in the mean values of weight gain% ($P<0.05$) of the examined samples.

The average value of QI scores at the 0 days of examination was the same 0.00±0.00 for the control, 2%STPP, 5%STPP, and 10% STPP treated Nile tilapia fillet samples. These values were increased as the days of refrigeration storage increased in all samples till reaching 13.00±0.00, 12.67±0.47, 11.00±0.82 and 9.67±0.47 at the day of ending of refrigeration storage time (15^{th} day) for the same examined treated Nile tilapia fillet samples, respectively. The significant differences were detected between all STPP treated samples with the control one in 3^{rd}, 6^{th}, 9^{th} and12^{th} day of examination ($P<0.05$) except on the 15^{th} day.

The average value of pH at the 0 days of examination was 6.34±0.04, 6.50±0.07, 6.70±0.04, and 6.82±0.02 for the control, 2%STPP, 5%STPP, and 10% STPP treated Nile tilapia fillet samples, respectively. These values increased as the days of refrigeration storage increased in all samples till reaching 7.35±0.06, 7.14±0.03, 6.97±0.07, and 7.20±0.03 at the day of ending of refrigeration storage time (15^{th} day) for the same treated examined Nile tilapia fillet samples, respectively. The significant differences were detected between all STPP treated samples with the control one in all refrigeration storage days ($P<0.05$) except on the 12^{th} day where a higher increase of control sample pH makes it reach nearly to pH of 2%STPP and 5%STPP.

The mean value of TVB-N (mg/100g) at the zero days of examination were 10.17±0.10, 9.45±0.07, 6.75±0.12, and 6.66±0.05 for control, 2%STPP, 5%STPP and 10%STPP Nile tilapia treated fillet

samples, respectively during refrigeration storage. This TVB-N content was referred to the good quality of fillet used in this experiment. These values were increased as the days of cold storage at 4^{o}c increased in all samples till reaching 36.36±0.10, 23.47±0.14, 19.22±0.09, and 17.68±0.13at the day of ending of refrigeration storage period (15^{th} day) for the same examined treated Nile tilapia fillet samples, respectively. The significant differences were detected between all STPP treated samples with the control one in all refrigeration storage time (15^{th} days) ($P<0.05$). The highest reduction % of TVB-N was 51.38% on the 15^{th} day of 10% STPP treated and cold stored samples. The lowest reduction % of TVB-N was 7.08% at the zero days of 2% STPP treated and cold stored samples.

The mean value of TMA (mg/100g) at the 0 days of refrigeration storage were 2.54±0.09, 1.32±0.09, 0.57±0.05, and 0.64±0.09 for control, 2%STPP, 5%STPP and 10%STPP treated Nile tilapia fillet samples, respectively. These values were increased as the days of refrigeration storage increased in all samples till reaching 18.84±0.09, 12.97±0.1, 10.08±0.05, and 9.15±0.05 at the day of ending of refrigeration storage time (15^{th} day) for the same examined *Nile tilapia* fillet samples, respectively. The significant differences were detected between all STPP treated samples with the control one in all refrigeration storage days ($P<0.05$). The highest reduction % of TMA was 77.56% at the 0 days of 5% STPP treated samples. While the lowest reduction % of TMA was 31.16 at the 15^{th} days of 2% STPP treated samples.

The average value of TBA (mg MAD/kg) at the 0 days of examination were 0.46±0.03, 0.12±0.03, 0.10±0.01, and 0.09±0.01 for the control, 2%STPP, 5%STPP, and 10% STPP treated Nile tilapia fillet samples, respectively. These values were increased as the days of storage increased in all samples till reaching 2.16±0.07, 1.37±0.07, 1.25±0.03

and1.15±0.04 at the day of ending of refrigeration storage (15th day) for the same STPP treated Nile tilapia fillet samples, respectively. The significant differences were detected between all STPP treated samples with the control one in all refrigeration storage days ($P<0.05$). The highest reduction % of TBA was 80.43% at the zero days of 10% STPP treated samples. The lowest reduction % of TBA was 30.68 at the 6th days of 10% STPP treated samples.

The average values of moisture % at the 0 days of examination was 78.25±0.10, 81.29±0.04, 82.04±0.08, and 83.60±0.05 for the control, 2%STPP, 5%STPP, and 10% STPP treated Nile tilapia fillet samples, respectively. These values were decreased as the days of refrigeration storage increased in all samples till reaching 74.14±0.09, 77.31±0.06, 79.15±0.08, and 79.85±0.08 at the day of ending of refrigeration storage (15th day) for the same examined Nile tilapia fillet samples, respectively. The significant differences were detected between all groups of samples in all examination days ($P<0.05$).

The mean values of phosphate content (mg/kg) as P at the 0 days of examination were 1496.0 ± 35.9, 2185.3 ± 109.7, 3285.3 ± 54.9, and 5045.3 ± 90.4 for the control, 2%STPP, 5%STPP, and 10% STPP treated Nile tilapia fillet samples, respectively. These values were decreased as the days of storage increased in all samples till reaching 1217.3 ± 54.9, 1686.7 ± 54.9, 2317.3 ± 54.9, and 4033.3 ± 90.4 at the day of ending of examination (15th day) for the same examined Nile tilapia fillet samples, respectively. The significant differences were detected between all the examined samples in all refrigeration storage period ($P<0.05$). The 5% STPP and 10% STPP samples groups were unfit for human consumption where the total phosphate content was exceed the permissible limit.

The initial APC (log cfu/g) was 4.71, 3.88, 3.81 and 3.73 in the control, 2% STPP, 5% STPP and 10% STPP fillet samples, respectively.

While, it was 7.95, 6.81, 6.48 and 6.50 (log cfu/g) at 15th day from refrigeration storage for the same examined samples respectively. There were significant differences (P<0.05) among control with all STPP treated samples in all days of refrigeration storage. The highest reduction % of APC was 26.62% on the 3rd day of 10% STPP treated samples. The lowest reduction % of APC was 14.30% on the 12th day of 2%STPP treated samples during chill storage.

The initial Psychrotrophic bacterial count was 2.94, 2.67, 2.20, and 2.36 (log cfu/g) in the control, 2% STPP, 5% STPP, and 10% STPP treated fillet samples during chill storage, respectively. While it was 7.47, 6.17, 5.64, and 5.45 (log cfu/g) at the 15th day from refrigeration storage for the same examined samples respectively. There were significant differences (P<0.05) among control with all STPP treated samples in all days of examination during chill storage. The highest reduction % of the Psychrotrophic count was 32.99% on the 9th day of 10% STPP treated samples during refrigeration storage. While the lowest reduction % of PTC was 7.30% on the 3rd day of 2% STPP treated samples during refrigeration storage.

Coliforms count was 1, 1, 1, and 1(log cfu/g) at the initial day for the control, 2% STPP, 5% STPP, and 10% STPP fillet treated samples, respectively. It was 2.12, 2.04, 2.03, and 2.08 (log cfu/g) at the 15th day from refrigeration storage for the same examined treated samples respectively. There were no significant differences (P>0.05) among all examined samples at 0 days, 3rd, 6^{th,} or on 15th day. The highest reduction % of the total coliform count was 20% at the 6th day of 10% STPP treated samples during refrigeration storage. While, the lowest reduction % of TC was 0.00% at the zero days of 2%, 5%, and 10% STPP treated samples during refrigeration storage.

Depending on all the above-mentioned experimental results, it appeared that using 2%STPP is best than 5%STPP and 10%STPP for the preservation of Nile tilapia fillets during refrigeration storage. As it preserves on the total phosphate content in its permissible limit recorded by Codex Alimentarius (166-1989).