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EFFICIENCY OF TRISODIUM PHOSPHATE IN EXTENDING THE SHELF LIFE OF QUAIL CARCASSES

(With 6 Tables)

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كفاءه ثلاثى فوسفات الصوديوم في اطالة فترة صلاحية السمان

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تـم اجراء هذه الدراسه لمعرفه كفاءه معالجه ذبائح السمان بمحلول ثلاثى فوسفات الصوديوم (٨%) اثناء الحفظ بالتبريد والتجميد عند ٤م و-١٨م على التوالى. وقد تبين من هذه الدراسه ان غمـس السمان فى محلول ثلاثى فوسفات الصوديوم لمد دقيقه ادي الى زياه مده صلاحيه السمان ثلاثه ايام عند تخزينها بالتبريد عند درجه ٤م حيث وجدت فروق معنويه بين قياسات الـرقم الهيدروجيـنى وكمـيه السـائل المستخلص والمواد النيتروجينيه الطياره بين العينات المعالجـه والغـير معالجـه حيث بلغت قيمه الرقم الهيدروجينى ٦,٨ عند اليوم السادس في العيـنات الغير معالجه بينما بلغ نفس القيمه فى اليوم العاشر في العينات المعالجه. اما بالنسبه لكمـيه السائل المستخلص بلغت ١٠ مللى في اليوم السادس فى العينات الغير معالجه و اليوم التاسـع فـى العيـنات المعالجـه .فـى حين ان المواد النيتروجينيه الطياره وصلت قيمتها ٢٠مجم/١٠٠ جم في اليوم الثالث والخامس فى العينات الغير معالجه والمعالجه على التوالى. كمـا اسفرت النتائج على ان المحتوى الميكروبيولجي للعينات المعالجه كان اقل من العينات الغـير معالجه بمقدار واحد الى اثنين لوج وخاصه الميكروبات المحبه للبروده والميكروبات المعويـه. بيـنما لم تلاحظ فروق معنويه عند تخزين السمان المعالج عند درجه -١٨م بين قـراءات العيـنات المعالجه والغير معالجه. هذا وقد اوصت الدراسه باستخدام محلول ثلاثى فوسفات الصوديوم (٨%) لاطاله مده صلاحيه السمان اثناء الحفظ بالتبريد بالاضافه الى اتباع الاشتراطات الصحيه اثناء ذبح وتجهيز السمان.

SUMMARY

Quail meat may contain different types of pathogenic and spoilage microorganisms which may be transmitted to human through mishandling of the carcasses, consuming undercooked quail meat or by cross contamination. This study was undertaken to evaluate the

efficiency of quail carcasses dipping in solution of 8% trisodium phosphate in extending their shelf life during chilling and freezing storage. The obtained results revealed that there is a significant difference in pH, E.R.V and TVN values between the control and the treated groups. Moreover the given results declare the effect of trisodium phosphate in retarding spoilage of quail meat as treatment of quail carcasses by TSP significantly decrease the log count of aerobic plate count, psychotropic, staphylococcus, enterobacterecea, yeast and mould counts during chilling storage at 4^0C and increase the shelf life time 3 days more than the control group. While the use of TSP at freezing (-12^0C) had no significant effect rather than the freezing process.

Key words: *Quail carcasses, trisodium phosphate, shelflife.*

INTRODUCTION

Quail meat is gaining increase popularity as a table delicacy among consumers and is a good alternative for those searching for foods, especially animal protein, with low fat and cholesterol content .Moreover; it is an excellent source of vitamin B_6 niacin and good source of vitamins B_1, B_2 pantothenic acid as well as minerals and fatty acids.

The wild quails are exposed to antemortem stress factors (inclement weather, and fatigue), which cause depletion of muscle glycogen and consequent deviation of ultimate pH which lead to rapid deterioration. In addition, the stress factors make the gut more permeable to be invaded by different kinds of bacteria, which lead to high bacterial population in muscles and reduce meat quality as well as shelf life. Hence quail carcasses are not subjected to any examination and inspection before and after slaughtering and preparation for markets and all processes are done under uncontrolled ways and served after complete evisceration and washing either frozen or fresh to the consumers. Therefore contamination of quail meat with pathogenic and spoilage microorganisms is common as reported by different researchers, (El Dengawy and Nasar 2001) who monitored the microbiological quality of slaughtered wild quail and reported that the psychrotrohic count ranged from10^3 to 10^4, *Staphylococcus aureus* count ranged from 10^2 to 10^3 but they failed to detect Salmonella and *Clostridum perfringens*. Higher values were reported by Mostafa (2001) where the mean values of aerobic plate count, psychrotrophic count and *Staphylococcus aureus* counts of frozen and fresh quail carcasses were $11x\ 10^5$& $2.6x\ 10^6$, $1.2x10^4$& and 7.2×10^3 & $2.7x10^4$ respectively.

Quail meat have been reported to contain pathogen of public health importance like *Salmonella typhimurium*, *Salmonella entriditis*, *Staphylococcus aureus*, *E. coli Erysiplothrix insidiosa*, *Strepiococcus*, *Pseudomonas aeruginosa* and *Paseurella multocida* (Ghoneim *et al.* 1980 and Saleh *et al.*, 2002).

Immersion and spray treatments of poultry carcasses for the purpose of reducing or eliminating pathogenic and spoilage bacteria have been described by many researchers (Sawaya *et al.*, 1995, Zeitoun *et al.*, 1994, Hawang and Beuchat 1995a,). These treatments have been shown to significantly reduce populations of *Salmonella* (Hawang and Beuchat 1995b, Lillard 1994, Rodriguez *et al.*, 1996, Wang *et al.*, 1997, Li *et al.*, 1997, Yang *et al.*, 1998), *Campylobacter* (Slavik *et al.*, 1994) and *Listeria monocytogens* (Rodriguez *et al.*, 1996).

Little information about the effectiveness of immersion treatment of quail carcasses is available, so this study was undertaken to determine the efficiency of trisodium phosphate in extending the shelf life of quails carcasses stored at chilling and freezing temperature.

MATERIALS and METHODS

Samples analyzed: -

A total of 90 raised healthy quails 45 days age of both sexes were investigated and then collected from quail farms and transferred to the laboratory without exhaustion in clean and disinfected cages. The quails were rested for about 2-3 hours and provided with good ventilation place and clean water. The birds were slaughtered by sterile knife and left for 3 minutes for efficient bleeding in special clean funnel, then scalded in clean water tempered at 53^0C for 3 minutes. Defeathering and evisceration were carried out with attention to the carcasses not to be contaminated from the internal organs or external sources. The carcasses were washed by clean tape water then by cold water tempered at 10^0C to reduce the temperature.

Treatment of quail carcasses with trisodium phosphate

The carcasses were divided into 3 groups each group consisted of 30 birds, the first and the second group were immersed in 8% sodium tripolyphosphate solution at 10^0 C for one minute then the birds allowed to drip in a sterile wire screen for 10 minutes before placing in plastic bags, sealing and storing as follows:

The first group was subjected to chilling storage at 4^0C and examined every day until the samples organoleptically rejected.

The second group-was subjected to freezing storage at –18 ^{0}C and examined every week till the measured parameters became unaccepted. the third group which does not subjected to the immersion technique in trisodium phosphate was divided into two subgroups: one acted as a control group for chilling storage at 4^{0}C and the second acted as the control group for the freezing storage at -18^{0}C, and examined in the same way.

The treated quail carcasses were subjected to the following examinations:

1-Measurement of Extract-Release Volume (ERV) was conducted according to Roland and Roland (1991).

2- Measurement of pH-value was determined according to the method recommended by Dodge and Staddman (1960).

3-Determination of Total Volatile Nitrogen was done by Conway's micro diffusion technique recommended by FAO (1980).

4-Microbiological examinations.

a- Determination of Aerobic plate counts (APC),-Psychotropic count, Enterobacteriaceae count, *Staphylococcus aureus* count were carried out according to the technique recommended by APHA (1992)

b- Determination of total yeast and mould counts were carried out according to Deak and Beuchat (1996).

Statistical analysis

The results were analyzed using the general linear model of the statistical analysis system procedure (SAS Institute, Cary, N.C.).

RESULTS

Table 1: Effect of trisodium phosphate on pH, ERV and TVN during chilling storage at 4^{0}C.

Storage period	PH		ERV		TVN	
	Control	Treated	Control	Treated	Control	Treated
0 time	5.8	6.13	28^a	16^b	14.0	14.0
1st day	5.8	6.15	29^a	18^b	15.0	14.0
2nd day	5.9	6.2	32^a	20^b	18.2	15.4
3rd day	6.0	6.25	28^a	19^b	20.2	17.0
4th day	6.31	6.3	20	18	21.4	19.6
5th day	6.5	6.4	15	16	29.5^a	20.0^b
6th day	6.8^a	6.45^b	10	15	39.2^a	21.4^b
7th day	-	6.5	-	12	-	22.5
8th day	-	6.63	-	11	-	26.6
9th day	-	6.7	-	10	-	29.5
10th day	-	6.8	-	8	-	36.4

Table 2: Effect of trisodium phosphate on the total aerobic bacterial, psychrotrophic, Enterobacteriaceae Log counts during chilling storage at 4^0C.

Storage period	TAP		Psychrotrophic		Enterobacteriaceae	
	Control	Treated	Control	Treated	Control	Treated
0 time	3.17	3.00	2.47	2.00	3.69^a	2.30^b
1st day	3.69	2.50	3.69	2.50	3.95^a	2.69^b
2nd day	4.50	3.17	4.69	3.00	4.60^a	2.95^b
3rd day	5.30	3.90	5.20	3.95	4.60^a	3.00^b
4th day	6.30^a	4.15^b	6.30^a	4.50^b	5.11^a	3.69^b
5th day	7.40^a	5.20^b	7.00^a	4.90^b	5.69^a	3.95^b
6th day	8.50^a	6.00^b	8.20^a	5.69^b	6.30^a	4.77^b
7th day	-	7.00	-	5.69	-	5.00
8th day		8.47	-	5.95	-	5.60
9th day		9.30	-	6.30	-	5.95
10th day		9.50	-	7.47	-	6.47

Results in the same row with different letters were significantly different at P>0.

Table 3: Effect of trisodium phosphate on Staphylococcus aureus, yeast and mould log counts during chilling storage at 4^0C.

Storage period	Staphylococcus aureus count		Yeast count		Mould count	
	Control	Treated	Control	Treated	Control	Treated
0 time	2.00	1.20	1.47	1.00	2.50	1.50
1st day	3.10	2.25	2.47	1.50	2.90	2.00
2^{nd} day	3.50^a	2.29^b	3.43	2.30	3.00	2.50
3rd day	2.30a	1.00^b	3.90	2.90	3.50	2.69
4th day			4.50	3.20	4.60^a	2.95^b
5th day			5.69^a	3.50^b	4.90^a	3.30^b
6th day			6.77^a	4.00^b	5.69^a	3.6^b
7th day			-	5.00	-	4.00
8th day			-	5.47	-	4.30
9th day			-	5.90	-	4.69
10^{th} day			-	5.95	-	4.90

Table 4: Effect of trisodium phosphate on pH, ERV during freezing storage at -18^{0}C.

Storage period	pH		ERV	
	Control	Treated	Control	Treated
0 time	5.75^a	6.14^b	35^a	21^b
1st day	5.80^a	6.14^b	32^a	20^b
2nd day	5.82^a	6.15^b	30^a	18^b
3rd day	5.89^a	6.16^b	28^a	16^b
4th day	5.93^a	6.18^b	26^a	16^b
5th day	6.00^a	6.20^b	25^a	15^b
6th day	6.00^a	6.30^b	24^a	13^b
7th day	6.20	6.45	22^a	11^b
8th day	6.00	6.55	20^a	10^b
9th day	6.15	6.60	19^a	9^b
10th day	6.20	6.60	18.5^a	8.5^b

Results in the same row with different letters were significantly different at P>0.05

Table 5: Effect of trisodium phosphate on the total aerobic bacterial, psychrotrophic, Enterobacteriaceae Log counts during freezing storage at -18C^0

Storage period	TAP		Psychrotrophic		Enterobacteriaceae	
	Control	Treated	Control	Treated	Control	Treated
0 time	3.20	3.00	2.47	2.00	3.69^a	2.30^b
1st day	3.60	3.00	3.90^a	2.69^b	3.30^a	2.30^b
2nd day	3.50	2.95	3.95^a	2.77^b	3.00^a	2.20^b
3rd day	3.30	2.90	3.95^a	2.90^b	3.00^a	2.10^b
4th day	3.20	2.80	3.95^a	2.95^b	2.90^a	2.00^b
5th day	3.00	2.80	4.00^a	3.00^b	2.50	2.00
6th day	2.90	2.70	4.47^a	3.47^b	2.30	1.90
7th day	2.80	2.40	4.69^a	3.69^b	2.00	1.50
8th day	2.60	2.00	4.90^a	3.77^b	2.00	1.50
9th day	2.40	1.95	4.95^a	3.90^b	1.50	1.40
10th day	2.30	1.90	5.30^a	3.95^b	1.45	1.30

Table 6: Effect of trisodium phosphate on Staphylococcus aureus, yeast and mould log counts during freezing storage at -18^{0}C.

Storage period	Staphylococcus aureus count		Yeast count		Mould count	
	Control	Treated	Control	Treated	Control	Treated
0 time	2.00	1.20	1.47	1.00	2.50	1.50
1st day	1.95	1.20	1.47	1.00	2.50	1.00
2nd day	1.77	1.00	1.40	<1.00	2.30	<1.00
3rd day	1.60	1.00	1.40	<1.00	2.00	<1.00
4th day	1.33	<1.0	1.20	<1.00	1.90	<1.00
5th day	1.30	<1.0	<1.00	<1.00	1.80	<1.00
6th day	1.20	<1.0	<1.00	<1.00	1.60	<1.00
7th day	<1..00	<1 .0	<1.00	<1.00	1.40	<1.00
8th day	<1.0	<1.0	<1.00	<1.00	1.00	<1.00
9th day	<1.0	<1.0	<1.00	<1.00	<1.00	<1.00
10th day	2.00	1.20	<1.00	<1.00	<1.00	<1.00

Results in the same row with different letters were significantly different at P>0.05

DISCUSSION

Effect of trisodium phosphate on pH, E.R.V. and TVN during chilling storage at 4^{0}C:-

The results given in Table (1) revealed that, the pH values increased in the treated group and began from 6.13 until reached 6.8 at 10th day, while the control one reached 6.8 at 6th day. These results were significant at p>0.05 and agreed with those reported by Prabhakara-Reddy *et al.* (1992) Singh and Panda (1992). Regarding the E.R.V. it is noticed that, there was a significant difference between the control and treated groups at p>0.05. The values begin to increase at zero time from 16 ml to 20 ml at the 2nd day then begin to decrease until reached 8 ml at the 10th day in comparison to the control group, which reached 10 ml at the 6th day. The results were agreed with those reported by, Prabhakara-Reddy and Narahari (1990), Ronald and Ronald (1991) and Mostafa (2001). From the above mentioned results it can be concluded that the polyphosphate had a significant effect on ERV by preventing the volume to be increased rapidly and mask the incipient spoilage determination.

Meanwhile the T.V.N. reached 20.0mg/100gm in the treated group at the 5th day, while it reached the same value in the control groups at the 3rd day. The significant differences between the control and treated

groups declare the pronounced effect of polyphosphate on retarding the protein hydrolysis. (The acceptable limit according to the E.S.S 1996 not more than 20.mg N /100gm).

Effect of trisodium phosphate on the total aerobic bacterial, psychotropic and Enterobacteriaceae counts during chilling storage at 4^0C:-

From the results given in Table (2) it is noticed that the total aerobic bacterial log count reached the unacceptable limit (log 8) at the 8^{th} day in the treated group, while in the control group the value reached log 8.5 at 6^{th} day. The differences between the two groups were significantly differrent at $p>0.05$.

These results showed the reduction effect of polyphosphate on APC log count, and it estimated by about 2 logs from the 3^{rd} day. This was attributed to the high pH of the trisodium phosphate and it is ability to remove the thin layer of the lipids from the quail's skin and therefore is considered to have a bactericidal activity (Giese 1993). These results agreed with those reported by Lillard (1994), Panda *and Singh (*1995), Salvat *et.al.* (1997) and Coppen *et al.* (1998).

Regarding the effect of trisodium phosphate on psychotropic count, the obtained results revealed that trisodium phosphate had a pronounced effect on the psychotropic count, it reached log 7.47 at the 10^{th} day, while in the control group the Psychotropic count reached log 8.20 at the 6^{th} day. It is noticed that the reduction reached 2.5 log. Concerning the Enterobacteriaceae count at zero time was log 3.69 and log 2.30 in control and treated groups respectively, and at 6^{th} days the value reached log 6.3 and log 4.77 respectively. Meanwhile the, Enterobacteriaceae log count reached log 6.47 value at 10^{th} day for treated quails.

The Enterobacteriaceae group includes most of pathogenic bacteria and constitutes a public health hazard. From the obtained results, it was achieved that addition of trisodium phosphate had a great effect on reduction of Enterobacteriaceae count; these results agreed with those reported by Coppen *et al.* (1998).

Effect of polyphosphate on *Staphylococcus aureus* count, yeast and mould counts during chilling storage at 4^0C :

Regarding the results recorded in Table (3) it is noticed that there is a significant difference at $p>0.05$ between *Staphylococcus aureus* count of the treated and control groups at zero time, the counts in the control and treated groups were log 2 and log 1.2 respectively, and at the 3rd day the counts were log 2.30 and log 1.00 respectively. The low

temperature is known to have an injury effect on Gram-positive bacteria, the combination between low temperature and addition of trisodium phosphate lead to high power effect on the growth and multiplication of *Staphylococcus aureus*.

The results obtained in Table (3) declared that trisodium phosphate had a significant effect on the yeast count by about 2.7 logs, as the count of the treated group was 5.95 log counts at 10^{th} day while the control group reached 6.77 log counts at the six day. There is a significant difference at $p>0.05$.

The mould counts in the treated and control group has the same significant difference, where it reached 4.9 log count at 10^{th} day and 5.69 at 6^{th} day. It is obviously clear that mould and yeast flourish at acid side, so the increased pH due to addition of trisodium phosphate inhibits the growth of yeast and mould and increased the shelf life time by 4 days. Populations of yeast on chicken wings treated with trisodium phosphate have been observed to decrease (Ismail *et al.* 2001).

Effect of polyphosphate on pH and ERV during the freezing storage at-18^{0}C:

The results shown in Table (4) revealed that there is a significant difference between the control and trisodium phosphate treated groups. The treated one had high pH values ranged from 6.14 to 6.60 during the storage period. While pH values of the control group varied from 5.75 to 6.20.

Regarding the ERV values there is a significant difference between the two groups, the control group showed higher values than that of the trisodium phosphate treated group. This may be attributed to the alkaline effect of trisodium phosphate which tighten the water inside the cells and limit its immovability.

Therefore, the pH and ERV parameters are not considered as accurate methods for detection of incipient spoilage in cases in which polyphosphate are used.

Effect of polyphosphate on total aerobic bacterial log count, psychotropic and Enterobacteriaceae counts during freezing storage at -18^{0}C:

Freezing does not destroy spoilage organisms; it merely stops their growth temporarily. During the freezing process, microbial growth can occur when freezing does not take place rapidly or when the freezer temperature is above 0 F (Babara-willenberg 2003).

The results achieved in Table (5) revealed that there is slight effect of trisodium phosphate on the total bacterial count during the

freezing storage period. While, there is a significant difference in the psychotropic count between the control and treated group. There was 2-log count difference after the 10^{th} week between the two groups.

The obtained results declared that addition of trisodium phosphate had great effect on the psychotropic count reduction during freezing storage period, and the spoilage bacteria of meat are mainly psychotropic in nature. Therefore, addition of polyphosphate leads to prolonging the shelf life time of the treated carcasses.

Regarding the effect of polyphosphate on the Enterobacteriaceae count during freezing storage, it is noticed that there is a significant difference started from zero time until the 7^{th} week between the treated carcasses and the control one.

Effect of trisodium phosphate on *Staphylococcus aureus*, yeast and mould counts during freezing storage at -18^{0}C:

The results given in Table (6) revealed no significant difference between the two examined groups

It is apparent from the obtained results that the use of trisodium phosphate had a bactericidal effect and prolonged the shelf-life time of the fresh quail samples three days at chilling storage temperature (4^0 C). While, the freezing storage of trisodium phosphate treated quail carcasses had no significant effect on the microbiological profile. So dipping of dressed quail carcasses in 8% solution of trisodium phosphate in cold water not more than 10^0 C for one minute is recommended for extension of quail shelf life.

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