

닭고기 저장 신기술의 개발 및 수출산업화 연구

Extending Shelf-Life of Refrigerated Chicken and Its
Industrial Application

위생적 냉장 닭고기의 산업적 생산기술 개발

Improving Safety of Refrigerated Chicken and Its Industrial
Application

서강정보대학(전남대학교)

농림부행정자료실



0005400

농 립 부

“ “ ” (“ ”)

2000 11 7

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:
:
:

.

.

. 500g 가
. 1997
가 ,

가
, , 가 ,

. , , 가 , 가

가

. 가
(GRAS, Generally Reconized as a Safe) , ,

(TSP)

.

.

()

2

,

6

.

1 :

1.

o

o

o

2.

o

o

o

o

3.

o

o

2 :

4.

Salmonella spp.

o

o

o

o

5.

o

o

o

6.

HACCP system

1.

1.

('97. 11. - '98. 4.)

('98. 6. - '98. 8.)

(500g)

가

가

가

가

Huli-Huli 가

가

BPG

가

(defeathering),

(evisceration),

(washing),

(air chilling),

10

25ppm

(2 ± 2°C)

4

(0 ± 2°C)

(APC)

(GNC)

가

(GT)

가

pH, TBA,

가

가
가
(4c) 가
(10c) Huli-Huli 가
가

2.

('98. 11. - '99. 4.) ('99. 6. - '99. 8.) (500g)
GRAS 0-1% (, ,)
0-7.5% (TSP, SPP, TSPP)

가
4c
104 CFU/g

GRAS TSP (tri sodium phosphate)
가

(dipping method) (spray
washing method) TSP

가
(2±
2c) 1% (v/v) , 1% (v/v)
, 1% (w/v) 5-7.5% (w/v) TSP

(cross contamination)

4c
12-16 가
가
TSP

(shelf-life) TSP

(, ,) (TSP, SPP, TSPP) . (%)

. 1%

pH, , Hunter color L

a 가 가 . Hunter color b TBA가

TSP

. pH, TBA, Hunter color

가

. 4cC TSP

pH

pH가 .

가

. 1% , ,

Hunter color L, a b가 4cC, 12 가 .

Hunter color L, a b가 4cC, 8 12

가 . 2.5-7.5% (w/v) TSP

Hunter color color a b 가 12 가 .

TBA가 가 가 .

4cC

. 가 4cC ,

가

가 가

TBA . 가

(4cC)

가 .

3.

('99. 11. - '00. 4.) ('00. 5. - '00. 8.) (500g)

GRAS

0-1% (, ,) ,

OPP/PE . , ,

가 가

,
0-180 (dipping method) (spray
washing method)

(OPP/PE film)
가
(after evisceration) 0-3% , ,

2-3% ,
10 1.5 atm 150
(P < .05)

가 0-6%

60 - 150
1% 150 가 1-3%

90-150 0.5-1.5
log unit 3.0 log unit

가 1-5%

150 OPP/PE 4C
1% 12 3-5%

16
GRAS ,

가
1%

(dipping method)
가
(spraying method) 1.3 3%

0.82 가
가

,
가 (%) (, ,)

1-2% 90
, Hunter color L a 가 가

OPP/PE 3% 1-5% 150 pH
 Hunter color L가 8 4c TBA가 16

1-3%
 4c
 (shelf-life)

4. *Salmonella* spp.
 54% 5 가 *Salmonella*
 76% 가 50 5
 가 , 가
 . *Salmonella* 가
 .
 4
 가
Salmonella 60 11
Salmonella

5. (%) (, ,) (TSP, SPP, TSPP)
Salmonella
 , TSP (4c), (1 ± 2c)
Salmonella typhimurium 1%
 가 . 1% 10
S. typhimurium . 2%

10 4℃ 3% 5

S. typhimurium TSP 5% 10

1% 1-5% TSP 10 1%

가 . *S. typhimurium* 가 1%

TSP (1.5atm

30 , 1m) (4-10℃), (2℃)

Salmonella typhimurium 1% 가

1% 10 105 CFU/ml *S. typhimurium* 8 S.

typhimurium 10℃ 4

S. typhimurium 5% 10 105 CFU/ml S.

typhimurium

8 *S. typhimurium* .

(Topax-66, -64, P3-oxonia active) *Salmonella*

1%

5% TSP, SPP, TSPP *S. typhimurium* 가

4℃ *Salmonella*

1%

5-7.5% TSP

TSP

Salmonella 가

가

6. HACCP system

Salmonella

spp. '99. 11-

'00. 4 .

HACCP system 가

Salmonella *Salmonella*

가 500g

2 (0-4℃)

Salmonella

Topax-66, -64

HACCP system

235

235 48 가 20.4%

Salmonella spp.

Salmonella spp.

bleed knife 41 7

17.1% 39 6 15.4%

40 12 30%

39 10

25.6%

37 8 21.6%

39 5 (12.8%)

가 *Salmonella* spp. 25

가 47.2% *S. muenchen*

S. typhimurium 6 (11.1%)가 *S. schwarzengrund* *S. essen* 3

5.6% 가 *S. montevideo* *S. petahikve*가 2

가 3.7% *Salmonella* spp. 가 13

(*Salmonella* ; Non Typhable *Salmonella*,

NIS). Topax-66, -64, P3-oxonia

active *Salmonella* spp.

Topax-66, -64, P3-oxonia active

가 *Salmonella*

가

(CCP) 4 , 1 , 3 ,

5 , 4 , 5 , 4 , 3 ,

3 ,

()

2.

가

가

, 가

가

1)

:

2)

:

SUMMARY

()

Experimental 1 : Evaluation of shelf-life of refrigerated chicken during winter and summer

Microbiological and physicochemical shelf-life in refrigerated chicken is associated with low microbial numbers during storage and handling in winter and summer. Aerobic plate counts (APC), gram-negative bacterial counts (GNC), and sensory evaluations on chicken carcass during retail and refrigerated storages ($3\pm 1^{\circ}\text{C}$ and 10°C) were evaluated. APC and GNC on whole chicken in retail store after storage of 7 days at $3\pm 1^{\circ}\text{C}$ increased to 3.11 and 3.89 log units compared to the initial controls. APC and GNC on whole chicken after storage of 7 days at 10°C increased to 5.43 and 5.03 log units. Sensory scores of chicken carcass obtained from retail store were in the "liked less" category after storage of 7 days compared to fresh controls. These results indicated that chicken carcasses during refrigerated (10°C) storage rapidly allowed the growth of aerobic spoilage bacteria during storage period, which could not be microbiologically acceptable after storage of 7 days. Chicken carcasses microflora were evaluated for aerobic microorganism after defeathering, evisceration, washing, chilling, and sanitizing during a commercial chicken processing and storage at wholesale and retail sale levels. Sampling was at between December 1997, and March, 1998. Tap water washing and sanitizing with 25 ppm chlorine for 10 sec significantly reduced APC and GNC on chicken carcasses from a commercial chicken-processing plant. After 4 days at $2\pm 2^{\circ}\text{C}$, APC and GNC on chicken carcasses in retail store rapidly increased compared to those in wholesale store. Chicken wings from retail store significantly decreased generation time (GT) compared to other chicken carcasses. Shelf-life of refrigerated chicken and meat has been associated with its keeping quality such as discoloration and lipid oxidation during storage and handling in wholesale and retail stores. Consumer perceptions of those product quality may find their basis in physical characteristics of the product, which could be partially related to quality grades. pH, color, and thiobarbituric acid (TBA) values of chicken meat obtained from a commercial chicken-processing plant

and retail and wholesale stores were evaluated. After storage of 7 days, chicken leg and breast meat obtained from a commercial chicken-processing plant ($0 \pm 2^\circ\text{C}$) had a significantly difference pH and TBA values compared to those obtained from a retail ($3 \pm 1^\circ\text{C}$) and wholesale stores ($1 \pm 1^\circ\text{C}$). Chicken leg and wing meat obtained from a commercial chicken-processing plant had a significantly different Hunter color a and b values after storage of 7 days compared to those obtained from retail and wholesale stores. TBA values of whole chicken meat obtained from a commercial chicken-processing plant before and after chilling were a significantly different compared to those of after evisceration. On the basis of these results, chicken meat from the retail and wholesale stores in winter should be applied to a further suitable storage methods for enhancing its quality.

Key words : chicken, aerobic plate counts, commercial chicken processing

Experimental 2 : Extending Shelf-life of refrigerated chicken in winter and summer

Aerobic bacteria in refrigerated muscle food products can reduce product shelf-life and potentially decrease food safety during storage and handling. Organic acids and phosphates, as antimicrobial surface treatments of fresh foods, have been used to prevent growth of bacteria on muscle food during extended chill storage. Decontamination of fresh muscle foods is highly dependent on acidulant and phosphate type, concentration, and exposure time. Although organic acids and phosphates have antimicrobial effectiveness on fresh muscle foods, there are limited studies on quality changes induced by organic acid and phosphates treatments.

The purpose of the present study was to evaluate refrigerated shelf-life and quality changes of chicken (average weight of 500g) surface treated with acetic acid (AA), lactic acid (LA), or citric acid (CA). The effects of AA, LA, or CA dip treatments on APC, Hunter color values, and sensory evaluation scores of chicken wings stored at 4°C were assessed. Chicken were immersed in solutions containing 1-3% individual acids for 5-10 min. Exposure for 10 min significantly reduced APC on the surface of chicken for 16 days during storage at 4°C . AA had greater antimicrobial activity than LA or CA. AA treatment yielded lighter, less red, and less yellow colored wings than untreated controls. Odor scores of chicken wings treated with acids were lower than untreated controls, with LA giving better scores than the other

acids during 12 days of storage. Appearance scores of acid-treated wings were similar to controls throughout storage. Untrained panelists did not observe color differences suggested by Hunter color data. Treatment of chicken with 1-3% acidulant would be recommended over the other acids due to greater antimicrobial effect and more favorable sensory results.

The trisodium phosphate (TSP) plays a major role in poultry and meat processing due to its antimicrobial activity, water holding capacity, and lipid oxidation property. Recently, TSP is used to reduce the level of *Salmonella* and other microorganisms in chicken carcasses by the approval of the United States Department of Agriculture (USDA). The effects of trisodium phosphate (TSP) and acetic acid (AA) on gram-negative bacterial counts (GNC), pH, thiobarbituric acid (TBA), and sensory evaluations values of chicken stored at 4°C were investigated. Chicken legs were treated with 5 - 15% (w/v) phosphates or a combination of 2.5 - 7.5% TSP and 1.5% (v/v) acetic acid (AA) for 10 min. After 4 days of storage, chicken legs treated with 7.5 - 10% TSP for 10 min significantly ($P < 0.05$) reduced GNC compared to the controls and 5.0% TSP treatments. GNC on chicken legs treated with a combination of TSP and AA had no significant ($P > 0.05$) difference between treatments. However, a combination of 2.5% TSP and 1.5% AA increased antimicrobial activity than treatment of 5% TSP alone. Chicken legs treated with TSP showed gradual increase of pH values compared to the controls during storage at 4°C. Odor and appearance scores of chicken treated with 5-10% TSP solutions were similar to untreated controls during 12 days of storage.

Based on these results, AA, LA, CA or TSP solution should be used for extending microbiological shelf-life of refrigerated chicken after defeathering, evisceration, washing, chilling, and sanitizing during a commercial chicken processing and storage at wholesale and retail sale levels in winter and summer.

Key words : chicken, commercial chicken processing, wholesale, retail, acidulant, TSP

Experimental 3 : Improving safety and shelf-life for industrial application of refrigerated chicken

For improving safety and shelf-life of refrigerated chicken (average weight of 500g per chicken), microbiological and sensory evaluations of chicken treated with acetic acid(AA), lactic acid (LA), or citric acid (CA) during a commercial chicken

processing step were assessed. Chicken were dipped in or sprayed with 1-3% AA, LA or CA at exposure times of 0-10 min or 0-180 sec. Chicken which sprayed with 2-3% AA, LA or CA for 10 sec at 1.5 atm after evisceration and then dipped for 150 sec at final processing step significantly reduced aerobic plate counts (APC) on the surface of chicken for storage of 16 days at 4°C. Chicken dipped in 1-3% acidulant for 90-150 sec had a significantly inhibitory effect for preventing the growth of APC, which decreased APC to 0.5-1.5 log unit compared to the controls after acid treatments. Microbiological shelf-life of chicken dipped in 1-5% AA for 150 sec and packaged with OPP/PE film during storage at 4°C increased for storage of 12 days to 16 days. For odor scores, chicken treated with 1-3% LA resembled untreated chicken for during storage days at 4°C. However, odor scores of chicken treated with 1-3% AA were lower to untreated chicken due to chemical odor during storage days. Thiobarbituric acid (TBA) values of chicken treated with 1-3% acidulants significantly increased from initial days to 12 days of storage compared to controls. pH values of chicken treated with 1-3% acidulants significantly decreased at initial days compared to control, which were consistent with the results for storage of 12 days at 4°C. Chicken dipped in 1-3% AA or LA were a significantly higher Hunter color L+ values than controls during storage of 4 and 8 days. Chicken dipped in 1-3% AA or LA were a significantly lower Hunter color a+ values than controls during storage of 16 days.

On the basis of these results, chicken dipped in or sprayed with 1-3% of AA, LA or CA at exposure times for 150 sec before final processing could increase microbiological shelf-life during storage at 4°C, which could be used for its industrial production and application.

Key words : chicken, shelf-life, acetic acid, lactic acid, citric acid,

Experimental 4 : *Salmonella* spp. incidence and distribution during subsequent chicken processing steps

Food borne Diseases caused by *Salmonella* are most commonly traced to poultry products. A study was conducted to determine the presence of *Salmonella* in processing carcasses in a commercial poultry slaughterhouse and to identify microbial hazards in the various steps of processing. The incidence of *Salmonella* was done at six sampling points in a poultry slaughterhouse: (1) Pre-scald, (2) Post-scald, (3)

Post-pick, (4) Post-evisceration, (5) Post-water chilling and (6) Final products.

Samples were taken from the plant's slaughter line on eleven different occasions. A total of 235 chicken carcasses was tested, *Salmonella* spp. were isolated from 48 (20.4%) of the 235 chicken tested. *Salmonella* incidence rates decreased to 12.8% in final products. The serotypes isolated from chicken carcasses were *S. montevideo* (3.7%), *S. typhimurium* (11.1%), *S. muenchen* (46.3%), *S. essen* (5.6%), *S. schwarzengrund* (5.5%), *S. petatitkve* (3.7%) and non typable *Salmonella* (24.7%). It has been suggested that there are many stages in poultry processing where cross-contamination of carcasses may occur. Antimicrobial drug susceptibility tests of *Salmonella* isolated were performed by agar disc diffusion method, using 10 antibiotics as follows : cefotaxime (CTX), ampicillin (AM), gentamicin (GM), ciprofloxacin (CIP), cefhalothin (CF), chloramphenicol (C), nalidixic acid (NA), sulfamethoxazole trimethoprim (SXT), tetracyclin (TE) and kanamycin (K). Most of strains were highly susceptible to CTX, GM, CIP, CF, C, and SXT, whereas highly resistant to TE, moderately resistant to AM, NA, and K.

Key words : chicken, *Salmonella*, poultry slaughterhouse

Experimental 5 : Enhancing safety of refrigerated chicken during winter and summer

Our objective was to evaluate the antimicrobial effects on *Salmonella typhimurium* in refrigerated chicken legs dipped with organic acid. For each treatment, Chicken (average weight of 500 ± 30 g) legs were treated with 0.5-2%(v/v) organic acid and 2.5-10% (w/v) TSP solutions at exposure times of 10 minutes. Controls were sprayed with tap water only at exposure times of 10 minutes. Treated chicken legs were packed in Whirl-pak bags and stored at 4 °C. Samples were appropriately diluted with 1% peptone water and plated on XLT4 agar for *Salmonella typhimurium*. Treatments of 1.0% acetic acid for 10 minutes significantly decreased the growth of *Salmonella typhimurium* for 16 days. Treatments of 2.5-10% (w/v) TSP and 0.5-2%(v/v) acetic acid for 10 minutes significantly reduced the growth of *Salmonella typhimurium* on chicken legs during storage of 12 days compared to controls. However controls treated with tap water rapidly increased the growth of *Salmonella typhimurium* to 2.31 log units for 16 days. No *Salmonella typhimurium* were found in any samples treated with 2.0%

acetic acid for 16 days. It was concluded that increasing levels of organic acid by 1.0% exposure times of 10 minutes were an effective preservative for preventing the growth of *Salmonella typhimurium* which could be used to ensure the safety of refrigerated chicken legs. And we can achieve better microbial quality on the poultry meat during processing after using appropriate detergents and sanitizers.

Key words : chicken, *Salmonella typhimurium*, organic acid, TSP

Experimental 6 : Evaluation of HACCP system and safety of refrigerated chicken

There was a limited reported on the effectiveness of spray-washing for decontamination of chicken legs treated with organic acid. Our objective was to evaluate the antimicrobial effects on *Salmonella typhimurium* in refrigerated chicken legs rinsed and dipped with organic acid. For each treatment, Chicken (average weight of 500 ± 30 g) legs were sprayed with 1-3% organic acid at 1.0 atm for 10 seconds. Controls were sprayed with tap water only at 1.0 atm for 10 seconds. Treated chicken legs were packed in Whirl-pak bags and stored at 4 °C. Samples were appropriately diluted with 1% peptone water and plated on XLT4 agar for *Salmonella typhimurium*. Treatments of 1-2% organic acid at 1.0 atm for 10 sec significantly decreased the growth of *Salmonella typhimurium*. However controls treated with tap water rapidly increased the growth of *Salmonella typhimurium* to 5.02 log units. No *Salmonella typhimurium* were found in any samples treated with 3.0% organic acid. Chicken (average weight of 500 ± 30 g) legs were treated with 1-5%(v/v) organic acid solutions at exposure times of 150 seconds. Treatments of and 3-5%(v/v) acetic acid for 150 seconds significantly reduced the growth of *Salmonella typhimurium* on chicken legs during storage of 16 days compared to controls. And to reduce microbial contamination of poultry meat during processing, we established a Hazard Analysis critical control points (HACCP) model which includes critical limits for each CCP, monitoring procedures and corrective actions. It is expected that microbial quality will be improved with the implementation of the HACCP plan.

Key words : *Salmonella*, chicken, organic acid, HACCP

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1

(Dicken , 1990 ; Hathcox, 1995 ; Kim, 1998 ; Kim Marshall, 1999).

(*Pseudomonas* spp.) (Cox, 1998 ; Kim, 1998; Giese, 1992; Hamby, 1987).

(Kim, 1998).

가 (Kim, 1998 ; Kim and Marshall, 1999; Ledesma, 1996).

가 ,

가 (Kim , 1994, Kotula Pandya, 1995 ; Kim Marshall, 1999; Mendonca , 1989). Kim(1998)

, 4cC

가 .

, '97

가

가 .

가

, '97 6.1 kg

20.8% .

가 가

. (white meat) (red meat)

, 가 (, 1995; , 1980).

(, 1990 ; , 1987 ; Kim, 1998 ; Kim , 1999). , ,

가

, 가 (Kim, 1998 ; Kim

, 1999).

가

가 (Kim, 1998 ; Kim , 1999).

(Ahn , 1995 ; , 1995).

가

(Hwang Beuchat, 1995; Kim, 1998; Rathgeber Waldroup, 1995).
가 가 1992

가

가
(500g) 가

가

(Kim, 1998 ; , 1990).

(Kim , 1998 ; Woolthuis Smulders, 1985)).

가 (Kim Marshall, 1999, Ki m , 1998).

가

(500g)

(500g)

, , , trisodium phosphate (TSP), sodium pyrophosphate
(SPP) sodium tripolyphosphate (STPP)
(dipping method) (spraying method) .
(HACCP)

1

1) 1

1 (97. 10- 98. 10)		1. 2. 3.
		1.
		1. <i>(Salmonella spp.)</i> 2.
		1. TBA가 2. 3. 가 4. 가 5. SAS program

2) 2

2 (98. 10- 99. 10)		1. 2. 3.
		1. 2. HACCP
		1. <i>(Salmonella spp.)</i> 2.
		1. 2. TBA가 3. 4. 가 5. 6. SAS program

3) 3

3 (99. 10- 2000. 10)	○ 1 ○	- - - - - 가
	○ 2 ○	- - - HACCP -

2

1 :

1

3 .

1.

2.

3.

1.

Experimental 1 : Evaluation of Shelf-life of refrigerated chicken during winter and summer

Summary

Microbiological and physicochemical shelf-life in refrigerated chicken is associated with low microbial numbers during storage and handling in winter and summer. Aerobic plate counts (APC), gram-negative bacterial counts (GNC), and sensory evaluations on chicken carcasses during retail and refrigerated storages ($3\pm 1^{\circ}\text{C}$ and 10°C) were evaluated. APC and GNC on whole chicken in retail store after storage of 7 days at $3\pm 1^{\circ}\text{C}$ increased to 3.11 and 3.89 log units compared to the initial controls. APC and GNC on whole chicken after storage of 7 days at 10°C increased to 5.43 and 5.03 log units. Sensory scores of chicken carcasses obtained from retail store were in the "liked less" category after storage of 7 days compared to fresh controls. These results indicated that chicken carcasses during refrigerated (10°C) storage rapidly allowed the growth of aerobic spoilage bacteria during storage period, which could not be microbiologically acceptable after storage of 7 days. Chicken carcasses microflora were evaluated for aerobic microorganism after defeathering, evisceration, washing, chilling, and sanitizing during a commercial chicken processing and storage at wholesale and retail sale levels. Sampling was at between December 1997, and March, 1998. Tap water washing and sanitizing with 25 ppm chlorine for 10 sec significantly reduced APC and GNC on chicken carcasses from a commercial chicken-processing plant. After 4 days at $2\pm 2^{\circ}\text{C}$, APC and GNC on chicken carcasses in retail store rapidly increased compared to those in wholesale store. Chicken wings from retail store significantly decreased generation time (GT) compared to other chicken carcasses. Shelf-life of refrigerated chicken and meat has been associated with its keeping quality such as discoloration and lipid oxidation during storage and handling in wholesale and retail stores. Consumer perceptions of those product quality may find their basis in physical characteristics of the product, which could be partially related to quality grades. pH, color, and thiobarbituric acid (TBA) values of chicken meat obtained from a commercial chicken-processing plant

and retail and wholesale stores were evaluated. Sampling was at between December, 1997 and March, 1998. After storage of 7 days, chicken leg and breast meat obtained from a commercial chicken-processing plant ($0 \pm 2^{\circ}\text{C}$) had a significantly difference pH and TBA values compared to those obtained from a retail ($3 \pm 1^{\circ}\text{C}$) and wholesale stores ($1 \pm 1^{\circ}\text{C}$). Chicken leg and wing meat obtained from a commercial chicken-processing plant had a significantly different Hunter color a and b values after storage of 7 days compared to those obtained from retail and wholesale stores. TBA values of whole chicken meat obtained from a commercial chicken-processing plant before and after chilling were a significantly different compared to those of after evisceration. On the basis of these results, chicken meat from the retail and wholesale stores in winter should be applied to a further suitable storage methods for enhancing its quality.

Key words : chicken, aerobic plate counts, pH, TBA, retail, wholesale

가

(Hwang Beuchat, 1995; Kim 1998; Rathgeb er Waldroup, 1995). 가 가 19

92 가 ,

가 .
(500g) 가 가

(Kim 1998 ; , 1990).

가

가 ,

가 .

(cross-contamination)

(500g)

(500g) ,

가

1.

500g 가 ,
가 0-4C 3 .

2.

2 (0-4C) (20-30C)

3.

()

4.

Standard rinse Whirl-pak bag 50g 50ml 0.1%(w/v)
peptone water(Difco) 1 : 1 1 shaking 0.1ml

0.1%(w/v) peptone water(Difco)

(1998)

spiral plating method spread plating method

standard plate count agar(Difco)

30C, 48

MacConkey agar(Difco) 30C, 48 (Salmonella

) Violet red agar(Difco) 30C, 48

Log₁₀CFU/ml

5.

Przybylski (31)

colorimeter

Hunter color(HunterLab, Color

Difference Meter, Model D-25M)

colorimetric analytical method L, a, b,

scale

single processor optical sensor가

6. TBA가

TBA(2-Thiobarbituric acid)가

Salih (1987) . TBA 가 ng malonaldehyde/kg sample
TEP(1, 1, 3, 3-tetrahydroxypropane)

7. pH

(1998) . , pH flat type surface
electrode 4 pH pH meter(AccumetR
Model 50, Fisher Scientific Co.) .

8. 가

가 9 point hedonic scale 10
. , , , 4
가 . 5 가
1-4 , 가 1 가 6-9 , 가
9 .

9.

, , TBA가, , pH 가
SAS program (1991) .

1.

1)

500g

(1 2).

1

4. 73 Log CFU/g 7 5. 97 Log CFU/g ,
 4. 09 Log CFU/g 7 5. 43 Log CFU/g 가 .
 3. 4 Log CFU/g 7
 5. 60 Log CFU/g 가, 3. 28 Log CFU/g 7
 5. 35 Log CFU/g 가 . 1-2
 4 6. 69 Log CFU/g 7
 7. 3 Log CFU/g , 4 6. 49 Log CFU/g 7
 7. 2 Log CFU/g 가 .
 4 6. 54 Log CFU/g 7 7. 0 Log
 CFU/g , 4 6. 31 Log CFU/g 7 7. 17
 Log CFU/g 가 .

1. APC* and GNC* on chicken carcasses obtained from a wholesale store (Chosun Nongchook Co.) of Fine Korea Company Ltd. during between December 1997 and March 1998.

Chicken parts	Log CFU/g					
	APC			GNC		
	0 d	4 d	7 d	0 d	4 d	7 d
Wing	4.73c	5.77b	5.97b	3.4ab	4.79b	5.60a
Leg	4.41b	5.75b	5.43a	3.0a	4.64ab	5.39a
Breast	4.3ab	5.30a	5.30a	3.0a	4.87b	5.28a
Whole chicken	4.09a	5.45ab	5.43a	3.28ab	4.51a	5.35a

*Means of 2 replication. aCounts within the same column with different superscripts are significantly different (P < 0.05).

1. APC* and GNC* on chicken carcasses obtained from a retail store (Young Kwang Co.) of Fine Korea Company Ltd. during between December 1997 and March 1998.

Chicken parts	Log CFU/g			
	APC		GNC	
	4 d	7 d	4 d	7 d
Wing	6.69b	7.30a	6.54b	7.00ab
Leg	6.15a	7.00a	5.35a	7.00ab
Breast	6.02a	7.00a	5.53a	6.78a
Whole chicken	6.49b	7.20a	6.31b	7.17c

*Means of 2 replication. a-bCounts within the same column with different superscripts are significantly different (P < 0.05).

4
가
가 107 CFU/g
4 7
가
.
Listeria spp. 10 *Yerishina* spp.
Pseudomonas spp.
.
Pseudomonas, Acinetobacter/
Mbraxella, Lactobacillus spp. Micrococcus
90% (,
1996). *Pseudomonas P. geniculata, P. fragi, P.*
rugosa, P. fluorescens, P. mephitica, P. putida
, (筋漿)
(, 1997a).
2)
500g
(3).
4.39 Log CFU/g
4.52 Log CFU/g 가 4.42 Log CFU/g
4.65 Log CFU/g
4 5.5 Log CFU/g 7 6.61
Log CFU/g 가
4 4.61 Log CFU/g 7 6.13 Log CFU/g 가
.
4 6.58
Log CFU/g 7 6.71 Log CFU/g 가

Log CFU/g 가 . 가

3. APC* and GNC* on chicken carcasses obtained from a wholesale store and a retail store on chicken produced by Fine Korea Company Ltd during between December 1997 and March 1998.

Chicken parts	Log CFU/g					
	0 d	APC 4 d	7 d	0 d	GNC 4 d	7 d
Wing	A1	4.39 ± 0.035a			3.53 ± 0.071a	
	B2	4.39 ± 0.035a	6.12 ± 0.162b	7.00 ± 0.163c	3.53 ± 0.071a	5.00 ± 0.012b
	C3	4.39 ± 0.035a	6.51 ± 0.000b	7.25 ± 0.099c	3.53 ± 0.071a	6.15 ± 0.049c
Leg	A	4.52 ± 0.106a			3.69 ± 0.043a	
	B	4.52 ± 0.106a	5.36 ± 0.012a	6.48 ± 0.016b	3.69 ± 0.043a	4.69 ± 0.049a
	C	4.52 ± 0.106a	6.14 ± 0.085b	6.31 ± 0.013b	3.69 ± 0.043a	5.19 ± 0.120b
Breast	A	4.42 ± 0.014a			3.23 ± 0.071a	
	B	4.42 ± 0.014a	5.40 ± 0.012a	6.41 ± 0.012b	3.23 ± 0.071a	4.33 ± 0.014a
	C	4.42 ± 0.014a	6.24 ± 0.282b	6.50 ± 0.191b	3.23 ± 0.071a	5.72 ± 0.163bc
Whole chicken	A	4.65 ± 0.014a			3.62 ± 0.028a	
	B	4.65 ± 0.014a	5.50 ± 0.057a	6.61 ± 0.438b	3.62 ± 0.028a	4.61 ± 0.035a
	C	4.65 ± 0.014a	6.38 ± 0.163b	6.71 ± 0.014b	3.62 ± 0.028a	6.41 ± 0.012cd

*Means of 2 replication (Mean ±: standard deviation). 1Chickens from a commercial chicken-processing plant. 2Chickens from wholesale store during storage of 4 days (0 ± 2σ) and 7 days (1 ± 1σ). 3Chickens from retail sale store during storage of 4 days (2 ± 2σ) and 7 days (3 ± 1σ). aCounts within the same column with different superscripts are significantly different (P < 0.05).

(cold chain system) 가 . 가 (cold chain system) 가 . 가 (1999)

pH, TBA, pH, TBA, (3 ± 1σ)
 (0 ± 2σ) 7 가 (P < 0.05)
 (1 ± 1σ) Hunter color a b가
 7
 TBA
 3)
 5 500g
 (4). 5.05 Log CFU/g
 5.48 Log CFU/g
 5.04 Log CFU/g 4.94 Log CFU/g
 4.12 Log CFU/g
 3.9 Log CFU/g
 4.17 Log CFU/g 3.99 Log CFU/g
 3.95 Log CFU/g
 3.29 Log CFU/g

4. APC* and GNC* on whole chicken carcasses during a commercial chicken-processing procedures at five different processing steps from Fine Korea Company Ltd conducted in between December 1997 and March 1998.

Treatment	Log CFU/g	
	APC	GNC
After defeathering	5.05 ± 0.071b	3.90 ± 0.064a
After evisceration	5.48 ± 0.001c	4.17 ± 0.021c
After washing	5.04 ± 0.005b	3.99 ± 0.330a
After chilling	4.94 ± 0.064b	3.95 ± 0.332a
After sanitizing	4.12 ± 0.170a	3.29 ± 0.000b

*Means of 2 replication (Mean ± : standard deviation). 125 ppm chlorine dipping for 10 sec. aCounts within the same column with different superscripts are significantly different (P < 0.05).

(shackle)

1997a).

106 107/cm²

104 106/cm², 103 104/cm²
 102 103/cm² (, 1997a).
 가 105 107/cm² 가 ,
 , 101 102/cm² .
 103/Me 101 104/Me
 가
 (Kim 1998).

(2)

1)

500g 10cC
 (5). 5 10cC 4.39
 Log CFU/g 7 8.9 Log CFU/g , 4.65 Log
 CFU/g 7 9.08 Log CFU/g 가 .
 3.53 Log CFU/g 7 8.15 Log CFU/g ,
 3.62 Log CFU/g 7 8.65 Log CFU/g 가 .

Pseudomonas, Acinetobacter
 / *Mbraxella, Aeromonas* (gram negative bacteria) *Micrococcus, Staphy*
Iococcus (gram positive bacteria)
 (, 1994 ; , 1997a). *Salmon*
lla spp., Campylobacter spp., Staphylococcus spp. Escherichia coli
 , *Listeria monocytogenes*
 . *Salmonella spp. Campylobacter spp.*

가 • (, 1997a).

5. APC* and GNC* on refrigerated (10cC) chicken carcasses stored at laboratory during between December 1997 and March 1998.

Chicken parts	Log CFU/g					
	APC			GNC		
	0 d	4 d	7 d	0 d	4 d	7 d
Wing	4.39a	8.46a	8.90b	3.53a	8.32a	8.15a
Leg	4.52a	8.18a	8.48a	3.69a	8.34a	8.30a
Breast	4.42a	8.53a	9.02b	3.23a	8.09a	8.70bc
Whole chicken	4.65a	8.55a	9.08b	3.62a	8.11a	8.65b

*Means of 2 replication. aCounts within the same column with different superscripts are significantly different (P < 0.05).

2)

6
 , , 30g 500g 10cC
 , 4 7 30cC 1
 3. 33 Log CFU/g 7
 7. 91 Log CFU/g 가
 4. 0 Log CFU/g 7 8. 0 Log CFU/g 가
 2. 3 Log CFU/g 7 6. 75 Log
 CFU/g 가
 3. 16 Log CFU/g 7 7. 9 Log CFU/g 가
 가

6. APC* and GNC* on refrigerated (10cC) chicken carcasses stored at temperature abuse for 1hr at 30cC during between December 1997 and March 1998.

Chicken parts	Log CFU/g					
	APC			GNC		
	0 d	4 d	7 d	0 d	4 d	7 d
Leg A1	3. 90b	6. 50a	7. 41a	3. 0b	6. 24a	6. 30a
B2	3. 33a	6. 80a	7. 91b	2. 3a	6. 62a	6. 75a
Whole chicken A	3. 83b	-	-	3. 09b	-	-
B	4. 00b	7. 18b	8. 0b	3. 16b	8. 00b	7. 90b

*Means of 2 replication. 1Chicken stored at 10cC. 2Chicken incubated at 30cC for 1hr after storing at 10cC for each 3 day. aCounts within the same column with different superscripts are significantly different (P < 0.05).

)

가

4

가

2

가

2)

2-1)

('98. 5 - '98. 7)

500g

. 1-7 '98 6-7

, , 가 , .

4.68 Log CFU/g

4.54 Log CFU/g

4

4.97 Log CFU/g

7

5.22 Log CFU/g

4

4.88 Log CFU/g

7

4.90 Log CFU/g

, 가

4

4.08 Log CFU/g

7

4.68 Log CFU/g

,

4

3.81 Log CFU/g

7

4.32 Log CFU/g

가

4

4.39 Log CFU/g

7

6.86 Log CFU/g

,

4

4.9 Log CFU/g

7

6.67 Log CFU/g

가

4

4.2 Log CFU/g

7

6.7 Log CFU/g

,

4

4.11 Log CFU/g

7

6.81 Log CFU/g

가

7

가

가 107 CFU/g

4

7

가

7. APC* and GNC* on chicken carcasses obtained from a wholesale store and a retail store on chicken produced by Fine Korea Company Ltd during between June and July 1998.

Chicken parts		Log CFU/g					
		APC			GNC		
		0 d	4 d	7 d	0 d	4 d	7 d
Wing	A1	4.68			3.92		
	B2	4.68	4.97a	5.22b	3.92	4.08b	4.68b
	C3	4.68	4.39b	6.86a	3.92	4.20a	6.70a
Leg	A	4.78			3.75		
	B	4.78	4.77b	4.95b	3.75	4.47b	4.52b
	C	4.78	5.00a	6.22a	3.75	4.15a	6.15a
Breast	A	4.72			3.75		
	B	4.72	5.12a	5.53b	3.75	4.08b	4.13b
	C	4.72	4.90b	6.57a	3.75	4.44a	6.57a
Whole chicken	A	4.54			4.05		
	B	4.54	4.88	4.90b	4.05	3.81b	4.32b
	C	4.54	4.90	6.67a	4.05	4.11a	6.81a

*Means of 2 replication. A1=Chicken from Fine Korea Co. Ltd. B2=Chicken from Chosun NongChook Co. during storage of 4 days (0±2°C) and 7 days (1±1°C). C3=Chicken from Young Kwang Co. during storage of 4 days (2±2°C) and 7 days (2±2°C). aCounts within the same column with different superscripts are significantly different (P < 0.05).

가 (, 1997a). (), , (*Staphylococcus aureus*) 7 (*Clostridium botulinum*) A, B 10 E 3.5 5 *Salmonella* spp. 6 가 (, 1997a).

2)

1) 4°C

30g , 20g 500g 4°C
3 1 35°C
(8).

8 4°C 4.33 Log CFU/g 7
5.41 Log CFU/g , 5.45 Log CFU/g 7

6.64 Log CFU/g 가 . 3.13 Log CFU/g
 7 5.42 Log CFU/g , 5.0 Log CFU/g
 7 5.71 Log CFU/g 가 . 4c
 (35c)
 4.15 Log CFU/g 7 6.08 Log CFU/g ,
 5.76 Log CFU/g 7 6.22 Log CFU/g 가 .
 3.64 Log CFU/g 7 6.04 Log CFU/g ,
 5.13 Log CFU/g 7 6.71 Log CFU/g 가
 가 .

8. APC* and GNC* on refrigerated (4c) chicken carcasses stored at temperature abuse for 1hr at 35c before analysis during July 1998.

Chicken parts	Log CFU/g					
	APC			GNC		
	0 d	3 d	7 d	0 d	3 d	7 d
Leg A1	4.33a	4.93b	5.41b	3.13b	4.30b	5.42b
B2	4.15b	5.49a	6.08a	3.64a	5.10a	6.04a
Wing A	5.16a	5.19b	5.70b	4.19a	4.87b	5.93
B	4.45b	5.58a	5.91a	3.95b	5.20a	5.88
Whole chicken A	5.45b	5.48a	6.64a	5.00b	5.50b	5.71b
B	5.76a	5.00b	6.22b	5.13a	5.80a	6.71a

*Means of 2 replication. 1Chicken stored at 4c. 2Chicken incubated at 35c for 1hr after storing at 4c for each 3 day. aCounts within the same column with different superscripts are significantly different (P < 0.05).

2) 10c

30g , 20g 500g 10c
 3 1 35c
 (9).
 9 10c 4.46 Log CFU/g 7
 7.95 Log CFU/g , 5.12 Log CFU/g 7
 8.02 Log CFU/g 가 . 3.84 Log CFU/g
 7 7.25 Log CFU/g 가 .
 4.25 Log CFU/g 7 8.04 Log CFU/g ,
 4.88 Log CFU/g 7 8.05 Log CFU/g 가 .
 4c (35c)
 4.71 Log CFU/g 7 8.5 Log CFU/g ,

5.2 Log CFU/g 7 8.5 Log CFU/g 가
 7.86 Log CFU/g , 3.91 Log CFU/g 7
 8.26 Log CFU/g 가 4.25 Log CFU/g 7
 10c 4
 가 .

9. APC* and GNC* on refrigerated (10c) chicken carcasses stored at temperature abuse for 1hr at 35c during between June and July 1998.

Chicken parts	Log CFU/g					
	APC			GNC		
	0 d	3 d	7 d	0 d	3 d	7 d
Leg A1	4.46b	6.44	7.95b	3.84	5.24	7.25b
B2	4.71a	6.31	8.50a	3.91	5.48	7.86a
Wing A	4.98b	6.00b	8.15b	4.25b	5.30b	8.04b
B	5.21a	7.09a	8.43a	4.79a	6.47a	8.29a
Whole chicken A	5.12	6.48b	8.02b	4.88a	5.60b	8.05
B	5.20	6.80a	8.50a	4.25b	6.24a	8.26

*Means of 2 replication. Chicken stored at 10c. Chicken incubated at 35c for 1hr after storing at 10c for each 3 day. aCounts within the same column with different superscripts are significantly different (P < 0.05).

3)

(6)

4

500g

(10).

4.85 Log CFU/g,

5.0 Log CFU/g,

5.45

Log CFU/g,

4.97 Log CFU/g

3.52 Log CFU/g,

4.13 Log CFU/g,

4.06 Log CFU/g,

4.44 Log

CFU/g

10. APC* and GNC* on chicken wings during a commercial chicken-processing procedures at five different processing steps from Fine Korea Company Ltd conducted in June 1998.

Treatment	Log CFU/g	
	APC	GNC
After defeathering	4.85b ± 0.0032	3.52c ± 0.03
After evisceration	5.00b ± 0	4.13b ± 0.01
Before water chilling	5.45a ± 0.09	4.06b ± 0.01
Final product	4.97b ± 0.04	4.44a ± 0.10

*Means of 2 replication. aCounts within the same column with different superscripts are significantly different (P < 0.05).

(7)

4

500g

(11).

5.38 Log CFU/g

5.36 Log CFU/g

5.30 Log CFU/g

5.21 Log CFU/g

3.68 Log CFU/g

3.51 Log CFU/g

3.38 Log CFU/g

3.95 Log CFU/g

)

가

1997 12

1998 3

10 25ppm

(APC)

(GNC)

(P < 0.05)

4

(P < 0.05)

가

(GT)

(P < 0.05)

가

1997 12

1998 1

(3 ± 1°C) 7

APC

GNC

3.11

3.89

log units

가

10°C

7

APC

GNC

5.43 5.03 log units

가

가

10°C

(APC) (GNC)

가 ($P < 0.05$) , (4-10c)

(35c)

10c

가 ($P < 0.05$)

가

(25-50ppm)

가

(4c) (10c)

가

가

2.

(1)

1)

(air chilling)

2)

1997 12 23-30 Pacific Poultry Co., LTD. Huli-Huli
Chicken 가 (1), , , , ,

Brent H. Hancock . ,

6% Chlorine chilling tank

25-50ppm . dry chlorinating granule

PPG3 (calcium hypochlorite tablets) Butterfield's phosphate diluent (BPD)

HACCP syatem CCP .

Simple Green, Foam High Pressure Hot Water (2)

50cF .

12

1 .

tray Packaging (3) .

가 40cF 5

6 . , ,

Escherichia coli *Salmonella* , (

) () . 22,000

Chlorine 가 BPD

그림.1,2,3. 미국 Pacific Poultry Co. LTD. 의 닭고기 도계과정

그림 1

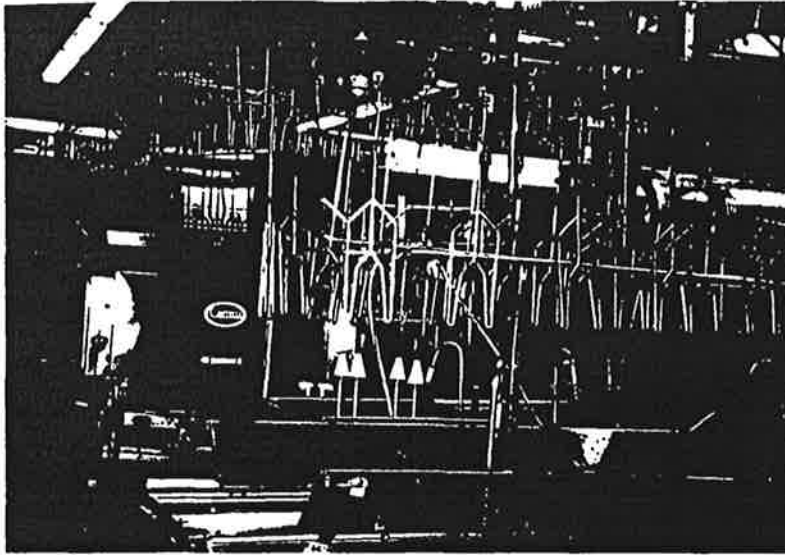


그림 2

그림 3

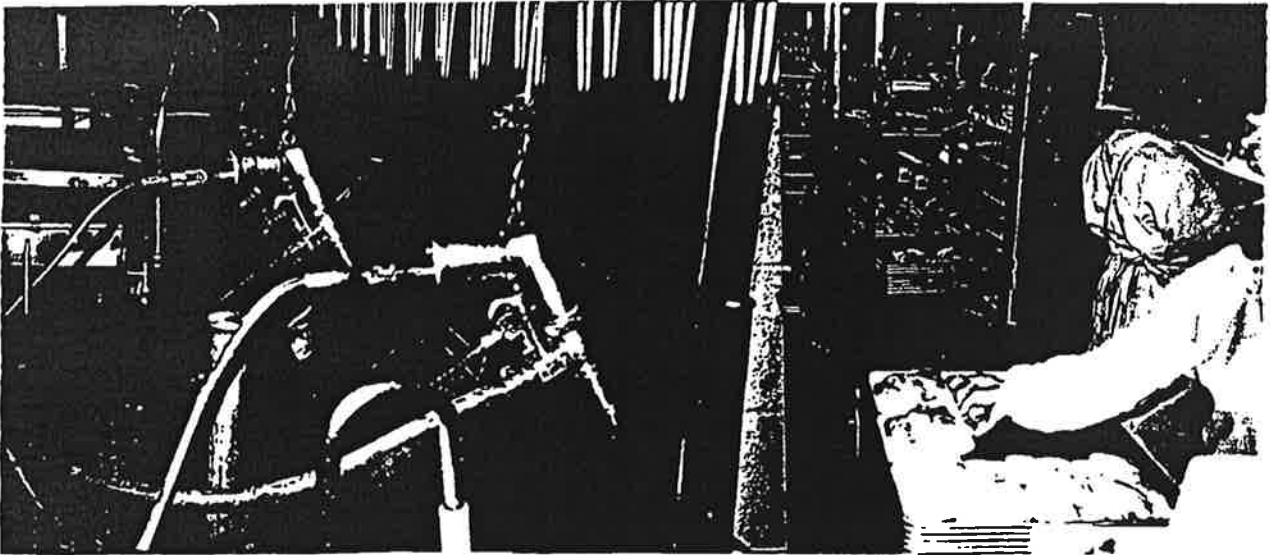


그림.1,2,3. 미국 Pacific Poultry Co. LTD. 의 닭고기 도계과정

(3-1)

1)

Chicken parts	TBA	pH		TBA
		4 days	7 days	
Leg	A) 1	6.84a	7.45b	
	B) 2	6.61a	6.78a	
	C) 3	6.28a	7.04b	
Breast	A	6.32a	7.01b	
	B	6.02a	6.26b	
	C	6.23a	6.38a	
Wing	A	6.88a	7.68b	
	B	6.49a	6.67b	
	C	6.45a	7.12b	

Table 12. Mean pH values^{a)} on chicken meat obtained from retail and wholesale stores during between December, 1997 and January, 1998.

Chicken parts		pH values	
		4 days	7 days
Leg	A) 1	6.84a	7.45b
	B) 2	6.61a	6.78a
	C) 3	6.28a	7.04b
Breast	A	6.32a	7.01b
	B	6.02a	6.26b
	C	6.23a	6.38a
Wing	A	6.88a	7.68b
	B	6.49a	6.67b
	C	6.45a	7.12b

a) Means within the same row with different superscripts are significantly different (P<0.05). b) Means of 3 replications. 1) Chicken obtained from a commercial chicken-processing plant during storage at 0±2°C. 2) Chicken obtained from wholesale store during storage of 4 days (0±2°C) and 7 days (1±1°C). 3) Chicken obtained from retail store during storage of 4 days (2±2°C) and 7 days (3±1°C).

Table 13. Mean color values^{a)} on chicken meat obtained from retail and wholesale stores during between December, 1997 and January, 1998.

Chicken parts		4 days			7 days		
		L	a	b	L	a	b
Leg	A) 1	63.69c	7.19a	2.27d	62.34c	8.39a	4.18b

Breast	B ²	63.05c	6.46b	1.35d	62.43c	6.87b	1.59d
	C ³	62.39c	6.62ab	1.76d	62.83c	6.87b	0.69d
	A	65.01bc	4.81c	8.37a	65.54bc	6.02b	8.44a
	B	69.25b	4.53c	4.23c	71.79a	5.95b	3.69bc
Wing	C	71.44a	4.12cd	4.52c	71.89a	4.90c	4.24b
	A	70.41a	5.82bc	6.09b	68.64b	9.96a	9.13a
	B	72.23a	6.71ab	3.60cd	71.25a	6.73b	2.59c
	C	71.97a	3.78d	1.89d	70.65a	6.51b	2.41c

adMeans within the same column with different superscripts are significantly different ($P < 0.05$). a)Means of 3 replications. 1)Chicken obtained from a commercial chicken-processing plant during storage at $0 \pm 2^\circ\text{C}$. 2)Chicken obtained from wholesale store during storage of 4 days ($0 \pm 2^\circ\text{C}$) and 7 days ($1 \pm 1^\circ\text{C}$). 3)Chicken obtained from retail store during storage of 4 days ($2 \pm 2^\circ\text{C}$) and 7 days ($3 \pm 1^\circ\text{C}$).

Table 14. Mean TBA values^a) on chicken meat obtained from retail and wholesale stores during between December, 1997 and January, 1998.

Chicken parts		TBA values	
		4 days	7 days
Leg	A ¹)	0.116b	0.084c
	B ²)	0.128a	0.113a
	C ³)	0.117b	0.105b
Breast	A	0.095 c	0.076c
	B	0.113b	0.109ab
	C	0.117b	0.102b

adMeans within the same column with different superscripts are significantly different ($P < 0.05$). Means of 3 replications. 1)Chicken obtained from a commercial chicken-processing plant during storage at $0 \pm 2^\circ\text{C}$. 2)Chicken obtained from wholesale store during storage of 4 days ($0 \pm 2^\circ\text{C}$) and 7 days ($1 \pm 1^\circ\text{C}$). 3)Chicken obtained from retail store during storage of 4 days ($2 \pm 2^\circ\text{C}$) and 7 days ($3 \pm 1^\circ\text{C}$).

Table 15. Mean TBA values^a) on whole chicken meat obtained from a commercial chicken-processing plant at each processing steps during between December, 1997 and January, 1998.

Treatment	TBA values
After defeathering	$0.17 \pm 0.03a$
After evisceration	$0.13 \pm 0.01a$
Before chilling	$0.09 \pm 0.01b$
After chilling	$0.09 \pm 0.01b$

adMeans within the same column with different superscripts are significantly different ($P < 0.05$). a)Means of 3 replications.

2)

1) pH value

16
 , , pH
 pH value 7 가 ,
 pH value 7 ,
 pH value 7 가 가 pH value
 7 가 , 가 pH
 value 7 .
 pH value 7 가 ,
 pH value 7 .

16. Mean pH values* on chicken carcasses obtained from a wholesale store (Chosun Nongchook Co.) and a retail store (Young Kwang Co.) on chicken produced by Fine Korea Company Ltd during between December 1997 and March 1998.

Chicken parts		pH	
		4 d	7 d
Leg	A1	6.84	7.45
	B2	6.61	6.78
	C3	6.28	7.04
Breast	A	6.32	7.01
	B	6.02	6.26
	C	6.23	6.38
Wing	A	6.88	7.68
	B	6.49	6.67
	C	6.45	7.12

*Means of 3 replications. 1Chicken from Fine Korea Co. Ltd. 2Chicken from Chosun Nongchook Co. during storage of 4 days (0±2°C) and 7 days (1±1°C). 3Chicken from Young Kwang Co. during storage of 4 days (2±2°C) and 7 days (3±1°C).

2) TBA가

17
 , , TBA
 () , , TBA value 7
 , 가 .
 TBA value malonaldehyde
 dicarbonyl compound .
 Pseudomonas spp. , 7

17. Mean TBA values* on chicken carcasses obtained from a wholesale store and a retail store on chicken produced by Fine Korea Company Ltd during between December 1997 and March 1998.

Chicken parts		TBA	
		4 d	7 d
Leg	A1	0.116	0.084
	B2	0.128	0.113
	C3	0.117	0.105
Breast	A	0.095	0.076
	B	0.113	0.109
	C	0.117	0.102
Wing	A	0.022	0.020
	B	0.022	0.013
	C	0.022	0.011

*Means of 3 replications. 1Chicken from Fine Korea Co. Ltd. 2Chicken from Chosun NongChook Co. during storage of 4 days ($0 \pm 2\text{C}$) and 7 days ($1 \pm 1\text{C}$). 3Chicken from Young Kwang Co. during storage of 4 days ($2 \pm 2\text{C}$) and 7 days ($3 \pm 1\text{C}$).

3)

18 , ,
 , Hunter colorimeter
 L value 7 , a
 b value 가 L
 value 7 , a b value .
 L value 7 , b value
 가 L value 7
 , a value 가 가
 L a value 7 가 , b value .
 가 L, a, b value 7
 . () L value 7
 , a b value 가 .
 L value 7 , b value 가 .
 L value 7 , b value
 가 .

18. Mean color values* on chicken carcasses obtained from a wholesale store (Chosun Nongchook Co.) and a retail store (Young Kwang Co.) on chicken produced by Fine Korea Company Ltd during between December 1997 and March 1998.

Chicken parts		4 d			7 d		
		L	a	b	L	a	b
Leg	A1	63.69	7.19	2.27	62.34	8.39	4.18
	B2	63.05	6.46	1.35	62.43	6.87	1.59
	C3	62.39	6.62	1.76	62.83	6.87	0.69
Breast	A	65.01	4.81	8.37	65.54	6.02	8.44
	B	69.25	4.53	4.23	71.79	5.95	3.69
	C	71.44	4.12	4.52	71.89	4.9	4.24
Wing	A	70.41	5.82	6.09	68.64	9.96	9.13
	B	72.23	6.71	3.60	71.25	6.73	2.59
	C	71.97	3.78	1.89	70.65	6.51	2.41

*Means of 3 replications. 1Chicken from Fine Korea Co. Ltd. 2Chicken from Chosun Nongchook Co. during storage of 4 days (0±2°C) and 7 days (1±1°C). 3Chicken from Young Kwang Co. during storage of 4 days (2±2°C) and 7 days (3±1°C).

4) 가

19

가 . 10

가 9 point hedonic scale .

5

6-9 , 가 9 ,

1-4 , 가 1

4 7

4

가 , 7

19. Mean sensory evaluation* on chicken carcasses obtained from a wholesale store (Chosun Nongchook Co.) and a retail store (Young Kwang Co.) on chicken produced by Fine Korea Company Ltd during between December 1997 and March 1998.

Whole chicken	Odor score			Appearance score		
	0d	4d	7d	0d	4d	7d
A1	5.1	4.9	3.2	4.9	4.9	3.9
B2	-	4.5	3.8	-	4.5	4.1
C3	-	4.9	3.4	-	4.8	3.1

*Means of 3 replications. 1Chicken from Fine Korea Co. Ltd. 2Chicken from Chosun NongChook Co. during storage of 4 days ($0 \pm 2\text{d}$) and 7 days ($1 \pm 1\text{d}$). 3Chicken from Young Kwang Co. during storage of 4 days ($2 \pm 2\text{d}$) and 7 days ($3 \pm 1\text{d}$).

)

가

(2)

1)

3

(0-10°C)

500g

a) pH value

20

('98.5-7)

pH

pH value

7

pH value

7

가

pH value

7

pH value

7

20. Mean pH values* on chicken carcasses obtained from a wholesale store (Chosun Nongchook Co.) and a retail store (Young Kwang Co.) on chicken produced by Fine Korea Company Ltd during between June and July 1998.

Chicken parts		pH		
		0d	4 d	7 d
Leg	A1	6.94		
	B1	6.94	7.08□	6.95□
	C1	6.94	7.00□	7.38□
Breast	A	6.42		
	B	6.42	6.23□	6.15□
	C	6.42	6.34□	6.77□
Wing	A	6.91		
	B	6.91	6.74a	6.78a
	C	6.91	6.96□	7.70b

Means of 3 replications. 1Chicken from Fine Korea Co. Ltd. 2Chicken from Chosun NongChook Co. during storage of 4 days ($0 \pm 2c$) and 7 days ($1 \pm 1c$). 3Chicken from Young Kwang Co. during storage of 4 days ($2 \pm 2c$) and 7 days ($3 \pm 1c$).

b) TBA가

21 ('98.5-7) , TBA
TBA value 3 (P < 0.05)
가 TBA 가
3 (P < 0.05)
TBA value 3

21. Mean TBA values* on chicken carcasses obtained from a wholesale store (Chosun Nongchook Co.) and a retail store (Young Kwang Co.) on chicken produced by Fine Korea Company Ltd during between June and July 1998.

Chicken parts		TBA		
		0d	3d	7d
Leg	A1	1.629		
	B2	1.629	1.520a	0.822a
	C3	1.629	1.063b	0.461b
Breast	A	1.465		
	B	1.465	1.812a	0.686a
	C	1.465	1.200b	0.483b
Wing	A	1.539		
	B	1.539	1.585a	0.436a
	C	1.539	1.101b	0.568b

*Means of 3 replications. 1Chicken from Fine Korea Co. Ltd. 2Chicken from Chosun NongChook Co. during storage of 4 days ($0 \pm 2c$) and 7 days ($1 \pm 1c$). 3Chicken from Young Kwang Co. during storage of 4 days ($2 \pm 2c$) and 7 days ($3 \pm 1c$).

1-c)

22 ('98. 5-7)

Hunter colorimeter L value
 7 a b value 가
 L value 7 (P <
 0.05)가 a b value
 가 L a b value 7
 a, b value
 3 (P < 0.05)

22. Mean color values* on chicken carcasses obtained from a wholesale store (Chosun Nongchook Co.) and a retail store (Young Kwang Co.) on chicken produced by Fine Korea Company Ltd during between December 1997 and March 1998.

Chicken parts		0d			3d			7d		
		L	a	b	L	a	b	L	a	b
Leg	A1	66.03	5.20	-3.54						
	B2	66.03	5.20	-3.54/	59.60	5.78b	-1.56b/	61.48	7.42a	-3.68b
	C3	66.03	5.20	-3.54/	58.60	7.65a	-1.13a/	62.93	6.06b	-1.01a
Breast	A	74.11	3.24	3.13						
	B	74.11	3.24	3.13/	68.23b	2.8b	5.10b/	70.07	4.40b	3.57b
	C	68.99	12.65	1.99/	70.44a	5.66a	6.38a/	69.00	5.09a	7.10a
Wing	A	70.64	5.38	0.76						
	B	70.64	5.38	0.76/	68.44a	6.04b	3.78/	64.73	5.81b	1.95b
	C	70.64	5.38	0.76/	67.03b	8.23a	4.23/	63.75	7.28a	3.95a

*Means of 3 replications. 1Chicken from Fine Korea Co. Ltd. 2Chicken from Chosun Nongchook Co. during storage of 4 days (0±2c) and 7 days (1±1c). 3Chicken from Young Kwang Co. during storage of 4 days (2±2c) and 7 days (3±1c).

2)

23 (10c) (10c) 3 35c
 1) ('98. 5-7) ()
 500g) TBA
 가 (P < 0.05)

23. Mean TBA values* on refrigerated (10c) chicken carcasses stored at temperature abuse for 1 hr at 35c during between June and July 1998.

Chicken parts	0d	3d	7d
Breast A1	0.131b	0.449a	1.397b
B2	0.311a	0.327b	1.691a
Leg A	0.558a	0.539b	1.261b
B	0.326b	0.645a	2.004a

*Means of 3 replications. 1Chicken stored at 10c. 2Chicken incubated at 35c for 1hr after storing at 10c for each 3 day.

24 (4c) (4c) 3 35c 1
) ('98.5-7) (500g
) , odor score .
 (P < 0.05)

24. Mean odor scores* on refrigerated (4c) chicken carcasses stored at temperature abuse for 1 hr at 35c during between June and July 1998.

Whole chicken	0d	3d	7d
A1	4.90b	4.33a	3.57a
B2	5.13a	3.20b	2.67

*Means of 3 replications. 1Chicken stored at 4c. 2Chicken incubated at 35c for 1hr after storing at 4c for each 3 day.

25 (4c) (4c) 3 35c 1
) ('98.5-7) (500g
) , odor score .
 (P < 0.05)

25. Mean odor scores* on refrigerated (10c) chicken carcasses stored at temperature abuse for 1 hr at 35c during between June and July 1998.

Whole chicken	0d	3d	7d
A1	4.87b	3.43	2.13a
B2	5.20a	3.43	1.77

*Means of 3 replications. 1Chicken stored at 10c. 2Chicken incubated at 35c for 1hr after storing at 10c for each 3 day.

26 (4c) (4c) 3 35c 1
) ('98.5-7) (500g
) , appearance score .
 3 (P < 0.05)

26. Mean appearance scores* on refrigerated (4c) chicken carcasses stored at

temperature abuse for 1 hr at 35°C during between June and July 1998.

Whole chicken	0d	3d	7d
A1	5.30a	4.27a	3.43a
B2	5.37a	3.83b	3.20b

Means of 3 replications. 1Chicken stored at 4°C. 2Chicken incubated at 35°C for 1hr after storing at 4°C for each 3 day.

27 (10°C) (10°C) 3 35°C
 1) ('98.5-7) (500g
) , appearance score
 가 3 (P < 0.05)

27. Mean appearance scores* on refrigerated (10°C) chicken carcasses stored at temperature abuse for 1 hr at 35°C during between June and July 1998.

Whole chicken	0d	3d	7d
A1	5.23a	3.90b	2.83a
B2	5.33a	4.03a	1.77b

*Means of 3 replications. 1Chicken stored at 10°C. 2Chicken incubated at 35°C for 1hr after storing at 10°C for each 3 day.

)
 pH, TBA, color,
 가 (P < 0.05)
 ,
 (4-10°C) (35°C)
 10°C
 (P < 0.05)

가
 가
 (cross-contamination) 가

Salmonella

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2.

Experimental 2 : Extending Shelf-life of refrigerated chicken in winter and summer

Summary

Aerobic bacteria in refrigerated muscle food products can reduce product shelf-life and potentially decrease food safety during storage and handling. Organic acids and phosphates, as antimicrobial surface treatments of fresh foods, have been used to prevent growth of bacteria on muscle food during extended chill storage. Decontamination of fresh muscle foods is highly dependent on acidulant and phosphate type, concentration, and exposure time. Although organic acids and phosphates have antimicrobial effectiveness on fresh muscle foods, there are limited studies on quality changes induced by organic acid and phosphates treatments.

The purpose of the present study was to evaluate refrigerated shelf-life and quality changes of chicken (average weight of 500g) surface treated with acetic acid (AA), lactic acid (LA), or citric acid (CA). The effects of AA, LA, or CA dip treatments on APC, Hunter color values, and sensory evaluation scores of chicken wings stored at 4°C were assessed. Chicken were immersed in solutions containing 1-3% individual acids for 5-10 min. Exposure for 10 min significantly reduced APC on the surface of chicken for 16 days during storage at 4°C. AA had greater antimicrobial activity than LA or CA. AA treatment yielded lighter, less red, and less yellow colored wings than untreated controls. Odor scores of chicken wings treated with acids were lower than untreated controls, with LA giving better scores than the other acids during 12 days of storage. Appearance scores of acid-treated wings were similar to controls throughout storage. Untrained panelists did not observe color differences suggested by Hunter color data. Treatment of chicken with 1-3% acidulant would be recommended over the other acids due to greater antimicrobial effect and more favorable sensory results.

The trisodium phosphate (TSP) plays a major role in poultry and meat processing due to its antimicrobial activity, water holding capacity, and lipid oxidation property. Recently, TSP is used to reduce the level of salmonella and other microorganisms in

chicken carcasses by the approval of the United States Department of Agriculture (USDA). The effects of trisodium phosphate (TSP) and acetic acid (AA) on gram-negative bacterial counts (GNC), pH, thiobarbituric acid (TBA), and sensory evaluations values of chicken stored at 4°C were investigated. Chicken legs were treated with 5 - 15% (w/v) phosphates or a combination of 2.5 - 7.5% TSP and 1.5% (v/v) acetic acid (AA) for 10 min. After 4 days of storage, chicken legs treated with 7.5 - 10% TSP for 10 min significantly ($P < 0.05$) reduced GNC compared to the controls and 5.0% TSP treatments. GNC on chicken legs treated with a combination of TSP and AA had no significant ($P > 0.05$) difference between treatments. However, a combination of 2.5% TSP and 1.5% AA increased antimicrobial activity than treatment of 5% TSP alone. Chicken legs treated with TSP showed gradual increase of pH values compared to the controls during storage at 4°C. Odor and appearance scores of chicken treated with 5-10% TSP solutions were similar to untreated controls during 12 days of storage.

Based on these results, AA, LA, CA or TSP solution should be used for extending microbiological shelf-life of refrigerated chicken after defeathering, evisceration, washing, chilling and sanitizing during a commercial chicken processing and storage at wholesale and retail sale levels in winter and summer.

가

(*Pseudomonas* spp.) (*Salmonella* spp.)

(Dubbert, 1988 ; Kim 1998; Wolthuis Smulders, 1985).

,

.

가

,

가 (Kim 1998 ; Kim , 1999).

가

(Dubbert, 1988 ; Kim Marshall, 1999 ; Kim , 1998).

가

.

,

4C

가 (Kim 1998 ; Kim , 1999).

가 , 가 (Ahn , 1995 ; , 1995).

,

,

(Hwang Beuchat, 1995; Kim 1998; Rathgeber Waldrou p. 1995).

,

(Kim , 1998 ; Wolthuis Smulders, 1985)).

,

가 (Kim Marshall, 1999, Kim , 1998).

가

.

가

(Bell *et al.*, 1986 ; Kim , 1998 ; Kim Marshall, 1999 ; Wolthuis and Smulders, 1985).

,

,

가 (Kim, 1998). (500g)

(500g)

, tri so
di um phosphate (TSP), sodi um pyrophosphate (SPP) sodi um tri polyphosphate (SIPP)
(di ppi ng method) (sprayi ng method)

1.

가 ,
 $500 \pm 30g$ 1,500
 5 10 (30 \times 5 \times 10
)

2.

$500 \pm 30g$ 가 ()
 , , 가 , . 0 4
 3
 ,
 ,
 . (APC; aerobic plate counts)

(GNC; gram-negative bacterial counts) , TBA가, pH,
 가 , , .

3.

GRAS 0 2.0% , 0 2.0% 0 2.0%
 0 10% TSP (sodium tripolyphosphate), SPP (sodium pyrophosphate) 0 5% STPP
 (sodium tripolyphosphate)

, , .
 0 10%
 2 5L
 0 10 , 0 30 , .

4.

2 (0 10)
 (30 35C)

5.

,

6.

Stomacher Lab Blender (standard rinse method) (AOAC, 1984)
50g 50ml 0.1% (w/v)
peptone water (Difco, USA) 2 0.1ml
Whirl-pak bag (Difco, USA) 50g 50ml
0.1% (w/v) peptone water (Difco, USA) 1 : 1 1 shaking
0.1ml 0.1% (w/v) peptone water
(Difco, USA) Kim (1995) spiral plating
method standard
plate count agar (Difco, USA) 30 , 48
MacConkey agar (Difco, USA) 30 , 48
Log10CFU/g

7.

Hunter color (Hunter
Lab, Color Difference Meter, Model D-25M) colorimetric analytical method
L, a, b, scale single processor optical sensor가

8. TBA가

TBA(2-Thiobarbituric acid)가
Salih (1987) TBA가 mg malonaldehyde/kg sample
TEP (1, 1, 3, 3-tetra thoxypropane)

9. pH

Kim (1998) pH flat type surface
electrode 4 pH pH meter (AccumetR
Model 50, Fisher Scientific Co.)

10. 가

가 9 (9 point hedonic scale) 10

4

가 . 5 가
1 4 , 가 1 가 6 9
, 가 9 .

11.

, ,
.

12.

, , ,
(GNC), (APC), TBA가, , pH 가
SAS program (1991) .

1.
가.
(1)

(GRAS) (%) , (500g) 5 10
 가 1% (v/v) , 1% (w/v) 5
 2
 Whirl-Pak sample bag 4 16
 (Fig. 1 2).
 Fig. 1 가 3.92 log
 unit 8 7.27 log unit 가 1% 5
 가 3.58 log unit 8 3.93 Log₁₀ CFU/g
 16 6.69 log unit 가 4 16
 (P < 0.05) 1%
 5 가 12
 1% 16

Ray Sandine (1991)
 pH
 pH (H+)
 Fig. 2 가 3.00 log
 unit 8 7.20 log unit 가 1% 5
 가 2.58 log unit ,
 (P < 0.05) 1% 5
 가 12 (P < 0.05)
 16
 1% 5 4
 4 1%
 16 (P < 0.05)
 Kim (1998) 0.5 1.5% 1.5kg 4C

pH

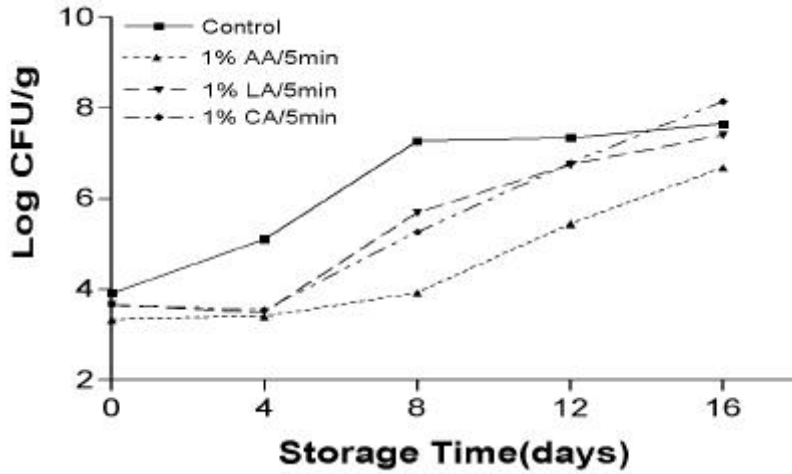


Fig. 1. APC* on refrigerated (4) chicken breast treated with 1% acetic acid(AA), 1% lactic acid(LA), and 1% citric acid(CA) for 5minutes between December 1998 and March 1999.

가 가 107 CFU/g
 , 1% 16

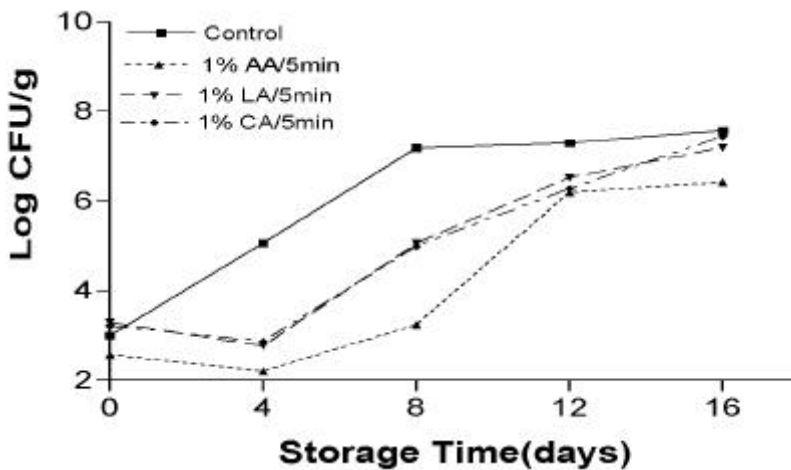


Fig. 2. GNC* on refrigerated (4) chicken breast treated with 1% acetic acid(AA), 1% lactic acid(LA), and 1% citric acid(CA) for 5 minutes.

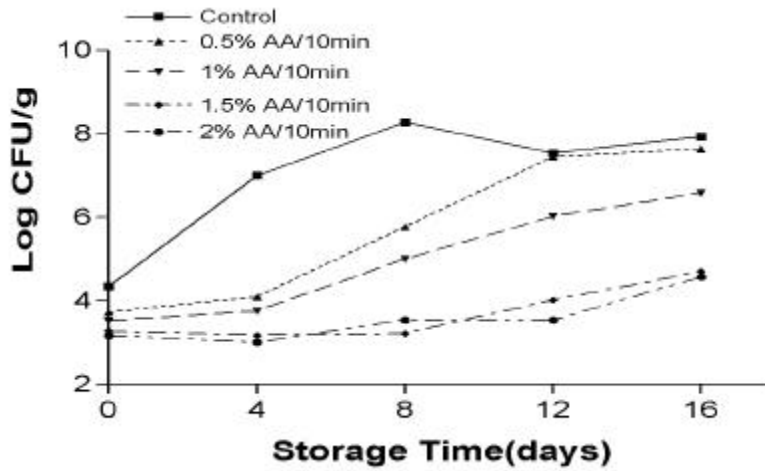


Fig. 3. APC* on refrigerated (4) chicken breast treated with different levels of acetic acid(AA) for 10 minutes.

0.5 2% (v/v) 10 가
 2 Whirl-Pak sample bag
 4 16 (Fig. 3). Fig. 3
 가 4.34 log unit 8
 8.27 log unit 가 . 0.5 2% 8
 , 0.5% 12
 . 1.0 2.0% 16
 , 4 16 1.5 2.0% 1.0%
 (P < 0.05)

가 Kim (1998) 0.5% 1.5%
 가 4C , 8
 1.0%
 가 (P < 0.05)

(2) Phosphate

(500g)
 (GRAS) (%) TSP (trisodium phosphate, Spectrum Quality Product Co., USA), SPP (sodium pyrophosphate, Spectrum Quality Product Co., USA)

SIPP (sodium tripolyphosphate, Spectrum Quality Product Co., USA)

5 10
 5% (w/v) TSP, SPP, SIPP 10
 가 Whirl-Pak sample
 bag 4 16 (Fig. 4
 5). Fig. 4 4.30 log
 unit 8 7.66 log unit 가 5% TSP, SPP TSPP
 10 (P < 0.05)
 5% TSP 10 16
 SPP SIPP 4
 8

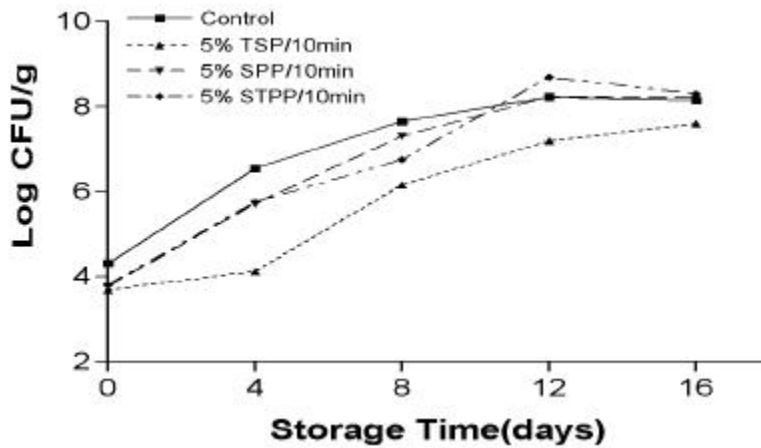


Fig. 4. APC* on refrigerated (4) chicken legs treated with 5% TSP (trisodium phosphate), 5% SPP (sodium pyrophosphate), and 5% SIPP (sodium tripolyphosphate) for 10 minutes.

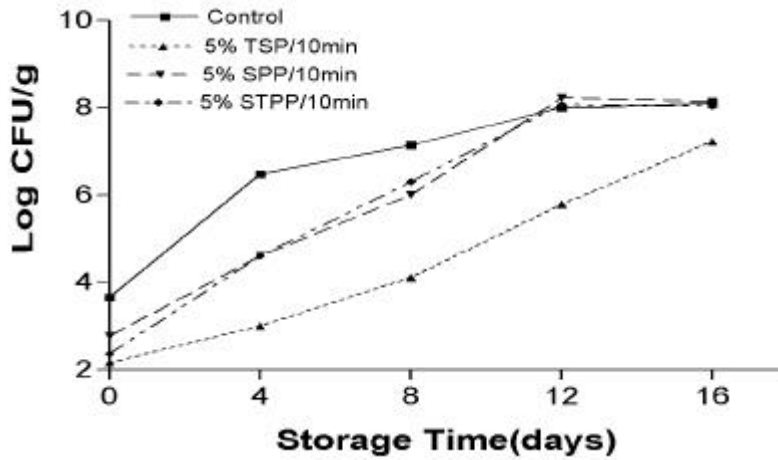


Fig. 5. GNC* on refrigerated (4) chicken legs treated with 5% TSP (trisodium phosphate), 5% SPP(sodium pyrophosphate), and 5% STPP (sodium tripolyphosphate) for 10 minutes.

Fig. 5

8 7.15 log unit 가 . 5% TSP, 5% SPP 5% STPP

10 5% TSP 16

(P < 0.05) SPP STPP

12 가 . 5% TSP 10

5% SPP 5% STPP (P < 0.05)

4

가 . 5% TSP

가 8 .

Kin Marshall (1999) trisodium phosphate (TSP) 0 10%

4C 16

. TSP

1993 (FDA) , US Federal

Regulation (GRAS; generally

recognized as a safe) . (1999) 5 7.5% TSP 1%

10 4C 가 ,

. Molins (1991) TSP

가 107 CFU/g

(3)

500g
 (Fig. 6 8).
 5.6 log unit 가
 2.5 10% TSP 10 4 (1
 ± 2) 8 4 1±2
 8.06 log unit 6.86 log unit (Fig.
 6 7). (1±2) 2.5% TSP 10
 4.72 log unit . 4 1±2 4 7.4 log
 unit 5.43 log unit 4
 (1±2) 2.5 10% TSP 10 8

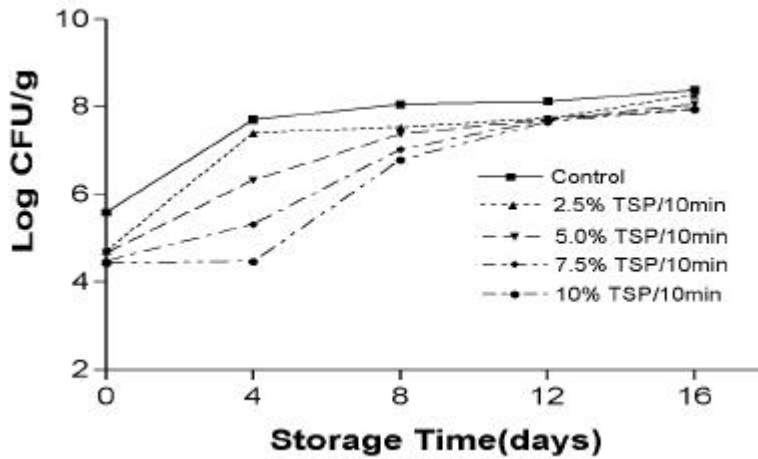


Fig. 6. APC* on chicken wings treated with different levels of TSP (trisodium phosphate) during storage at 4 .

가 5.60 log unit 가
 4 10% TSP 가 가 8
 (P < 0.05)
 가 TSP 가

가 ($P < 0.05$)

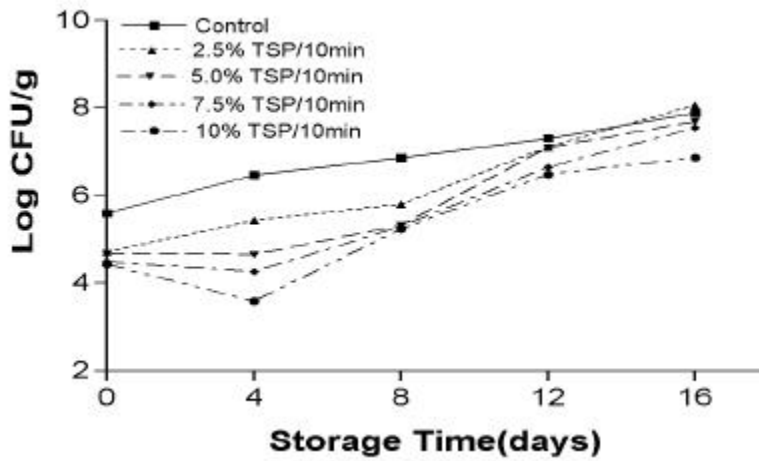


Fig. 7. APC* on refrigerated (1 ± 2) chicken wings treated with different levels of TSP(trisodium phosphate) for 10 minutes during storage at retail store.

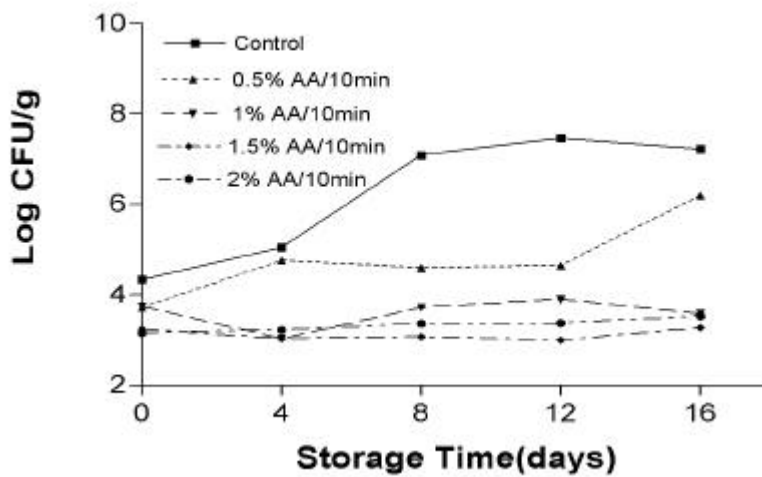


Fig. 8. Mean APC values* on chicken wings treated with different levels of acetic acid for 10 minutes during storage at 4 .

4.34 log unit

10 0.5 2.0% 10

16 (4)

(Fig. 8). 0.5 2.0% 10

0.62 1.18 log unit 16 1±2

8

1% 16

10 0.5 2.0% (1±2)

16

4

가

(1)

('98. 11 '99. 4.)

1% (dipping method) 0 10

2 Whirl-Pak Sample bag 4

16

Table 1 5

pH 6.70 8 7.19 가 1% , ,

5 pH (P < 0.05)

12 glycogen

가 가 pH

가 pH
 pH 가
 (Kim, 1998; Molins, 1991).

Table 1. Changes of pH values* on refrigerated (4) chicken legs treated with 1% acetic acid, 1% lactic acid, and 1% citric acid for 5 minutes.

Storage time (days)	0	4	8	12	16
Control	6.70 ± 0.16b	6.97 ± 0.07b	7.19 ± 0.21b	7.07 ± 0.11a	7.36 ± 0.10a
1.0% AA1	5.15 ± 0.70a	6.36 ± 0.10a	6.45 ± 0.04a	6.63 ± 0.18a	7.47 ± 0.17a
1.0% LA2	4.71 ± 0.08a	6.58 ± 0.10ab	6.92 ± 0.08ab	7.09 ± 0.27a	7.42 ± 0.18a
1.0% CA3	5.07 ± 0.07a	6.48 ± 0.13a	7.09 ± 0.22ab	7.53 ± 0.32a	7.64 ± 0.14a

*Means of 3 replications (Mean ± standard error). 1AA=acetic acid, 1LA = lactic acid, 1CA = citric acid. Means within the same column with different superscripts are significantly different (P<0.05).

Table 2

TBA	0.163	8	0.141	1%	5
TBA			(P < 0.05)가		8

Gray (1996)

Salih (1987)

Siu Draper (1978)

TBA

가 Kin (1999)

TBA가

TBA가 가

가 Newburg Concon (1980) nalonaldehyde

Table 2. Changes of TBA values* on refrigerated (4) chicken legs treated with 1% acetic acid, 1% lactic acid, and 1% citric acid for 5 minutes.

Storage time (days)	0	4	8	12	16
Control	1.14 ± 0.07b	1.34 ± 0.03a	0.10 ± 0.02a	0.51 ± 0.05a	0.94 ± 0.10a
1.0% AA1	1.11 ± 0.19ab	1.37 ± 0.04a	1.12 ± 0.03b	0.93 ± 0.03b	1.24 ± 0.04b
1.0% LA2	0.91 ± 0.08a	1.34 ± 0.02a	0.98 ± 0.05a	1.08 ± 0.07b	0.76 ± 0.07c
1.0% CA3	0.92 ± 0.01a	1.26 ± 0.04a	0.89 ± 0.03a	0.63 ± 0.05a	1.13 ± 0.06ab

*Means of 3 replications (Mean ±: standard error). 1AA=acetic acid. 2IA = lactic acid. 3CA = citric acid. ±-means within the same column with different superscripts are significantly different (P<0.05).

Treatments	Storage time (days)				
	0	4	8	12	16
Control	67.9 ± 0.56a	63.8 ± 0.75a	64.2 ± 1.01a	69.6 ± 0.24a	60.4 ± 1.40a
1.0% AA1	70.0 ± 0.63b	65.9 ± 1.59a	69.0 ± 0.72b	70.0 ± 0.33a	66.3 ± 1.07b
1.0% IA2	71.0 ± 0.44b	65.6 ± 0.92a	66.8 ± 1.46ab	64.7 ± 2.11b	68.8 ± 1.12b
1.0% CA3	69.9 ± 0.90ab	67.2 ± 1.23a	66.7 ± 0.68ab	65.1 ± 0.62b	66.2 ± 0.82b

Table 3. Changes of Hunter color L values* on refrigerated (4) chicken legs treated with 1% acetic acid, 1% lactic acid, and 1% citric acid for 5 minutes.

Treatments	Storage time (days)				
	0	4	8	12	16
Control	67.9 ± 0.56a	63.8 ± 0.75a	64.2 ± 1.01a	69.6 ± 0.24a	60.4 ± 1.40a
1.0% AA1	70.0 ± 0.63b	65.9 ± 1.59a	69.0 ± 0.72b	70.0 ± 0.33a	66.3 ± 1.07b
1.0% IA2	71.0 ± 0.44b	65.6 ± 0.92a	66.8 ± 1.46ab	64.7 ± 2.11b	68.8 ± 1.12b
1.0% CA3	69.9 ± 0.90ab	67.2 ± 1.23a	66.7 ± 0.68ab	65.1 ± 0.62b	66.2 ± 0.82b

*Means of 3 replications (Mean ±: standard error). 1AA=acetic acid, 2IA = lactic acid, 3CA = citric acid. ±-means within the same column with different superscripts are significantly different (P<0.05).

Treatments	Storage time (days)				
	0	4	8	12	16
Control	67.9 ± 0.56a	63.8 ± 0.75a	64.2 ± 1.01a	69.6 ± 0.24a	60.4 ± 1.40a
1.0% AA1	70.0 ± 0.63b	65.9 ± 1.59a	69.0 ± 0.72b	70.0 ± 0.33a	66.3 ± 1.07b
1.0% IA2	71.0 ± 0.44b	65.6 ± 0.92a	66.8 ± 1.46ab	64.7 ± 2.11b	68.8 ± 1.12b
1.0% CA3	69.9 ± 0.90ab	67.2 ± 1.23a	66.7 ± 0.68ab	65.1 ± 0.62b	66.2 ± 0.82b

Table 4. Changes of Hunter color a values* on refrigerated (4) chicken legs treated with 1% acetic acid, 1% lactic acid, and 1% citric acid for 5 minutes.

(1999) 5 15% ISP (Hunter color a가) 가 (Hunter color L가) 가 (P < 0.05)

Table 4. Changes of Hunter color a values* on refrigerated (4) chicken legs treated with 1% acetic acid, 1% lactic acid, and 1% citric acid for 5 minutes.

Storage time (days)	0	4	8	12	16
Control	4.23 ± 0.89a	4.28 ± 0.62a	4.40 ± 0.47a	4.09 ± 0.47a	7.38 ± 0.41b
1.0% AA1	2.53 ± 0.65b	6.00 ± 0.67b	5.23 ± 0.58b	3.88 ± 0.67a	5.31 ± 0.61a
1.0% LA2	1.93 ± 0.33b	5.76 ± 0.85b	4.20 ± 0.90a	4.50 ± 1.42b	3.59 ± 0.39c
1.0% CA3	3.25 ± 0.33c	4.35 ± 0.40a	5.19 ± 0.58b	5.51 ± 0.93c	4.65 ± 0.62d

*Means of 3 replications (Mean ± standard error). 1AA=acetic acid, 1LA = lactic acid, 1CA = citric acid. †Changes of a within the same column with different superscripts are significantly different (P<0.05).

Table 5. Changes of Hunter color b values* on refrigerated (4) chicken legs treated with 1% acetic acid, 1% lactic acid, and 1% citric acid for 5 minutes.

Storage time (days)	0	4	8	12	16
Control	-1.91 ± 0.76a	-3.39 ± 0.73a	-0.01 ± 0.83a	2.58 ± 0.91a	1.50 ± 0.80a
1.0% AA1	-3.63 ± 0.73b	-3.30 ± 0.45a	0.03 ± 1.08a	-0.7 ± 0.84b	4.20 ± 1.99b
1.0% LA2	-3.76 ± 1.06b	-2.23 ± 0.73b	0.59 ± 1.11a	1.54 ± 1.61c	7.95 ± 1.69c
1.0% CA3	-4.13 ± 0.57c	-1.14 ± 1.07c	-1.18 ± 0.98a	1.65 ± 0.66c	3.65 ± 0.90d

*Means of 3 replications (Mean ± standard error). 1AA=acetic acid, 1LA = lactic acid, 1CA = citric acid. †Changes of b within the same column with different superscripts are significantly different (P<0.05).

Table 6	5				
odor	5.5	8	2.5	1%	,
5	odor				
	12				
		가	8		(P < 0.05)

Table 6. Changes of odor scores* on refrigerated (4) chicken legs treated with 1% acetic acid, 1% lactic acid, and 1% citric acid for 5 minutes.

Treatments	Storage time (days)				
	0	4	8	12	16
Control	5.50 ± 0.19b	3.75 ± 0.31a	2.50 ± 0.19a	1.25 ± 0.16a	1.00 ± 0.00a
1.0% AA1	4.50 ± 0.19a	3.50 ± 0.60a	4.50 ± 0.19b	2.63 ± 0.18b	1.75 ± 0.16b
1.0% LA2	4.75 ± 0.16a	3.50 ± 0.42a	5.00 ± 0.00b	1.75 ± 0.16a	1.25 ± 0.16a
1.0% CA3	5.00 ± 0.00a	3.38 ± 0.46a	4.50 ± 0.19b	1.00 ± 0.00a	1.00 ± 0.00a

*Means of 3 replications (Mean ± standard error). 1AA=acetic acid, 1LA = lactic acid, 1CA = citric acid. Means within the same column with different superscripts are significantly different (P<0.05).

Table 7

5	4.88	8	3.25	5	1%	(P < 0.05) 가
8						
가		8				(P < 0.05)

Table 7. Changes of appearance scores* on refrigerated (4) chicken legs treated with 1% acetic acid, 1% lactic acid, and 1% citric acid for 5 minutes.

Treatments	Storage time (days)				
	0	4	8	12	16
Control	4.88 ± 0.13a	4.38 ± 0.18a	3.25 ± 0.31a	1.25 ± 0.16a	1.25 ± 0.16a
1.0% AA1	4.88 ± 0.13a	3.88 ± 0.13b	4.75 ± 0.16b	2.50 ± 0.19b	1.50 ± 0.19a
1.0% LA2	4.75 ± 0.16a	3.38 ± 0.26b	6.92 ± 0.16c	1.63 ± 0.18a	1.25 ± 0.16a
1.0% CA3	5.00 ± 0.00a	3.00 ± 0.27b	7.09 ± 0.19c	1.13 ± 0.13a	1.00 ± 0.00a

*Means of 3 replications (Mean ± standard error). 1AA=acetic acid, 1LA = lactic acid, 1CA = citric acid. Means within the same column with different superscripts are significantly different (P<0.05).

Kim (1995) Kim (1998) 1.5% 10 가

4

(Table 8 10). 0.5

2.0%

10

2

Whirl-Pak Sample bag

4

16

. Table 8

Storage time (days)	0	4	8	12	16
Control	6.85 ± 0.10d	6.89 ± 0.06c	7.08 ± 0.08d	7.51 ± 0.11c	7.36 ± 0.09c
0.5%AA	5.89 ± 0.09c	6.81 ± 0.04c	6.80 ± 0.08c	6.83 ± 0.08b	7.44 ± 0.12c
1.0%AA	5.44 ± 0.09b	6.40 ± 0.15b	6.58 ± 0.02b	6.43 ± 0.03a	6.66 ± 0.03b
1.5%AA	4.93 ± 0.07a	6.75 ± 0.09c	6.27 ± 0.04a	6.34 ± 0.05a	6.35 ± 0.05a
2.0%AA	4.94 ± 0.05a	6.12 ± 0.05a	6.22 ± 0.09a	6.27 ± 0.04a	6.20 ± 0.04a

Table 8. Changes of pH values* on refrigerated (4) chicken legs treated with different levels of acetic acid for 10 minutes.

Storage time (days)	0	4	8	12	16
Control	6.85 ± 0.10d	6.89 ± 0.06c	7.08 ± 0.08d	7.51 ± 0.11c	7.36 ± 0.09c
0.5%AA	5.89 ± 0.09c	6.81 ± 0.04c	6.80 ± 0.08c	6.83 ± 0.08b	7.44 ± 0.12c
1.0%AA	5.44 ± 0.09b	6.40 ± 0.15b	6.58 ± 0.02b	6.43 ± 0.03a	6.66 ± 0.03b
1.5%AA	4.93 ± 0.07a	6.75 ± 0.09c	6.27 ± 0.04a	6.34 ± 0.05a	6.35 ± 0.05a
2.0%AA	4.94 ± 0.05a	6.12 ± 0.05a	6.22 ± 0.09a	6.27 ± 0.04a	6.20 ± 0.04a

*Means of 3 replications (Mean±: standard error). AA = acetic acid. †Means within the same column with different superscripts are significantly different (P<0.05).

TBA value
dicarbonyl compound
(Molins, 1991).

malonaldehyde
Pseudomonas spp.

Table 9. Changes of TBA values* on refrigerated (4) chicken legs treated with different levels of acetic acid for 10 minutes.

Storage time (days)	0	4	8	12	16
Control	0.84 ± 0.01b	1.58 ± 0.04c	1.07 ± 0.01b	1.13 ± 0.01b	0.84 ± 0.04a
0.5%AA	1.43 ± 0.04c	1.44 ± 0.03b	0.88 ± 0.07a	0.98 ± 0.02a	0.98 ± 0.03a
1.0%AA	1.31 ± 0.02a	1.14 ± 0.01a	1.07 ± 0.03b	1.24 ± 0.03b	1.16 ± 0.08ab
1.5%AA	1.44 ± 0.03c	1.22 ± 0.04b	1.95 ± 0.16c	2.03 ± 0.07c	1.19 ± 0.12ab
2.0%AA	1.30 ± 0.001	2.06 ± 0.04d	0.29 ± 0.02c	0.34 ± 0.01d	1.88 ± 0.10c

*Means of 3 replications (Mean±: standard error). AA = acetic acid. †Means within the same column with different superscripts are significantly different (P<0.05).

Table 10

L+가(價)	67.1	16	62.7	.
8			(P > 0.05)	가 2%
16	0.5	1.5%		L .

Table 10. Changes of Hunter color L values* on refrigerated (4) chicken legs treated with different levels of acetic acid for 10 minutes.

Storage time (days)	0	4	8	12	16
Control	67.1 ± 1.10a	61.4 ± 0.77a	64.6 ± 0.67a	62.0 ± 0.61a	62.7 ± 0.42ab
0.5%AA	66.7 ± 0.71a	65.8 ± 0.51lc	63.7 ± 0.28a	65.1 ± 0.56lc	61.3 ± 0.51a
1.0%AA	67.7 ± 0.80a	64.9 ± 1.35lc	64.4 ± 0.82a	68.1 ± 1.45c	61.8 ± 0.52a
1.5%AA	64.4 ± 0.37a	63.8 ± 0.64ab	66.7 ± 1.16a	64.6 ± 0.83ab	61.6 ± 0.39a
2.0%AA	66.1 ± 1.00a	65.4 ± 0.84lc	58.7 ± 7.43a	66.4 ± 0.87lc	63.8 ± 0.44lc

*Means of 3 replications (Mean ± standard error). AA = acetic acid. Means within the same column with different superscripts are significantly different (P < 0.05).

Table 11

a+가	4.3	16	17.7	.
16	0.5	1.5%		a (P < 0.05)

Table 12

Hunter color b	가	-1.8	16	-7.3	.	0.5	1.5%
2%			12		(P < 0.05)	가	가 (P >

0.05)

Table 11. Changes of Hunter color a values* on refrigerated (4) chicken legs treated with different levels of acetic acid for 10 minutes.

Storage time (days)	0	4	8	12	16
Control	4.3 ± 0.17a	19.3 ± 1.40lc	5.3 ± 0.45a	8.3 ± 0.40lc	17.7 ± 1.16a
0.5%AA	4.1 ± 0.47a	16.2 ± 1.04lc	6.8 ± 0.34ab	8.0 ± 0.29lc	24.3 ± 1.04lc
1.0%AA	3.8 ± 0.36a	21.2 ± 1.31cd	7.0 ± 0.48ab	6.4 ± 0.41a	23.7 ± 1.15b
1.5%AA	3.2 ± 0.27a	13.7 ± 0.62b	5.7 ± 0.28a	6.7 ± 0.39a	24.4 ± 0.41lc
2.0%AA	4.2 ± 0.60a	11.6 ± 0.65a	7.2 ± 0.29b	7.5 ± 0.35ab	17.4 ± 0.71a

*Means of 3 replications (Mean ± standard error). AA = acetic acid. Means within

the same column with different superscripts are significantly different (P<0.05).

Gill (1996)		oxynyoglobin	
		Deoxyoxyoglobin	oxynyoglobin
netnyoglobin			가
1cC	4	(1 ± 1cC)	(2 ± 2 3 ±
			(0 ± 2cC)
		(P < 0.05)	

Table 12. Changes of Hunter color b values* on refrigerated (4) chicken legs treated with different levels of acetic acid for 10 minutes.

Storage time (days)	0	4	8	12	16
Control	-1.8 ± 0.46 b	-7.6 ± 1.57 a	-2.4 ± 0.47 a	-1.5 ± 0.61 a	-7.3 ± 0.33 a
0.5%AA	-3.2 ± 0.74 a	-7.0 ± 0.63 a	-1.0 ± 0.51 a	-3.2 ± 0.87 a	-9.6 ± 0.56 c
1.0%AA	-3.2 ± 0.52 a	-6.8 ± 0.58 a	-2.7 ± 0.79 a	-0.3 ± 0.38 a	-8.6 ± 1.09 b
1.5%AA	-2.2 ± 0.86 b	-6.2 ± 0.48 a	-1.6 ± 0.71 a	-0.9 ± 0.73 a	-8.5 ± 0.67 b
2.0%AA	-0.4 ± 0.75 c	-5.7 ± 0.35 a	-2.9 ± 0.52 a	-1.1 ± 0.97 a	-8.5 ± 0.76 b

*Means of 3 replications (Mean ± standard error). AA = acetic acid. Means within the same column with different superscripts are significantly different (P<0.05).

Table 13, 14 10		가 9 point hedonic scale	
5		6 9 ,	가
9	,	1 4 ,	가
1		. Table 3-13	
10		odor	6.0 16 1.75
0.5%	10	odor	
가 8 16			가 (P >
0.05). Table 14		10	
	5.50 16 1.88		0.5 1%
10		가	(P > 0.05)
12 16		가	

Table 13. Changes of odor scores* on refrigerated (4) chicken legs treated with different levels of acetic acid for 10 minutes.

Storage time (days)	0	4	8	12	16
Control	6.00 ± 0.00 ^d	4.50 ± 0.19 ^{lc}	3.50 ± 0.19 ^a	1.63 ± 0.18 ^a	1.75 ± 0.16 ^a
0.5%AA	5.00 ± 0.00 ^{lc}	5.50 ± 0.19 ^d	4.00 ± 0.38 ^a	2.63 ± 0.18 ^{lc}	1.63 ± 0.38 ^a
1.0%AA	4.50 ± 0.19 ^b	4.00 ± 0.27 ^b	3.50 ± 0.19 ^a	2.13 ± 0.23 ^{ab}	2.25 ± 0.31 ^a
1.5%AA	4.50 ± 0.19 ^b	4.75 ± 0.16 ^c	3.50 ± 0.19 ^a	2.00 ± 0.00 ^{ab}	2.75 ± 0.42 ^a
2.0%AA	3.50 ± 0.19 ^a	3.75 ± 0.16 ^a	3.75 ± 0.31 ^a	2.25 ± 0.16 ^b	1.75 ± 0.37 ^a

*Means of 3 replications (Mean ± standard error). AA = acetic acid. Means within the same column with different superscripts are significantly different (P<0.05).

Table 14. Changes of appearance scores* on refrigerated (4) chicken legs treated with different levels of acetic acid for 10 minutes.

Storage time (days)	0	4	8	12	16
Control	5.50 ± 0.19 ^{ab}	4.50 ± 0.19 ^a	4.00 ± 0.00 ^{ab}	2.50 ± 0.19 ^a	1.88 ± 0.23 ^a
0.5%AA	5.75 ± 0.16 ^b	5.00 ± 0.00 ^a	4.25 ± 0.16 ^{lc}	2.50 ± 0.19 ^a	1.88 ± 0.30 ^a
1.0%AA	5.50 ± 0.19 ^{ab}	4.75 ± 0.16 ^a	4.25 ± 0.16 ^{lc}	1.88 ± 0.30 ^a	2.25 ± 0.16 ^a
1.5%AA	5.00 ± 0.27 ^a	5.00 ± 0.00 ^a	3.75 ± 0.16 ^a	2.13 ± 0.13 ^a	2.63 ± 0.26 ^a
2.0%AA	5.00 ± 0.00 ^a	4.75 ± 0.16 ^a	4.00 ± 0.00 ^{ab}	2.13 ± 0.23 ^a	1.88 ± 0.30 ^a

*Means of 3 replications (Mean ± standard error). AA = acetic acid. Means within the same column with different superscripts are significantly different (P<0.05).

2%

4

가 . Marshall Kim (1996)

(2) Phosphate

TSP (trisodium phosphate, Spectrum Product Quality Co., USA), SPP (sodium pyrophosphate, Spectrum Product Quality Co., USA) STPP (sodium tripolyphosphate, Spectrum Product Quality Co., USA)

500g

5% (w/v) TSP, SPP, STPP 10

가

2

Whirl-Pak sample bag

Storage time (days)	Treatments				
	0	4	8	12	16
Control	6.92 ± 0.06a	7.36 ± 0.22ab	7.16 ± 0.13a	7.54 ± 0.19a	7.68 ± 0.07ab
5.0% TSP1	10.40 ± 0.26b	7.72 ± 0.18b	7.45 ± 0.16a	7.62 ± 0.08a	7.92 ± 0.21a
5.0% SPP2	7.98 ± 0.17c	7.27 ± 0.04ab	7.72 ± 0.16a	7.63 ± 0.19a	7.81 ± 0.20ab
5.0% SIPP3	7.38 ± 0.11c	7.06 ± 0.06a	7.35 ± 0.08a	7.55 ± 0.12a	7.22 ± 0.06b

Table 15. Changes of pH values* on refrigerated (4) chicken legs treated with 5% TSP, 5% SPP, and 5% SIPP for 10 minutes.

Storage time (days)	Treatments				
	0	4	8	12	16
Control	0.00 ± 0.01a	1.35 ± 0.10a	0.88 ± 0.01ab	0.79 ± 0.01a	0.68 ± 0.04a
5.0% TSP1	1.00 ± 0.03b	1.22 ± 0.02a	0.87 ± 0.13a	1.12 ± 0.03b	0.70 ± 0.08a
5.0% SPP2	1.00 ± 0.01b	1.20 ± 0.27a	0.63 ± 0.03a	0.78 ± 0.00c	0.59 ± 0.03a
5.0% SIPP3	1.11 ± 0.02c	1.20 ± 0.02a	1.14 ± 0.04b	1.17 ± 0.02b	0.72 ± 0.04a

Table 16. Changes of TBA values* on refrigerated (4) chicken legs treated with 5% TSP, 5% SPP, and 5% SIPP for 10 minutes.

Storage time (days)	Treatments				
	0	4	8	12	16
Control	0.00 ± 0.01a	1.35 ± 0.10a	0.88 ± 0.01ab	0.79 ± 0.01a	0.68 ± 0.04a
5.0% TSP1	1.00 ± 0.03b	1.22 ± 0.02a	0.87 ± 0.13a	1.12 ± 0.03b	0.70 ± 0.08a
5.0% SPP2	1.00 ± 0.01b	1.20 ± 0.27a	0.63 ± 0.03a	0.78 ± 0.00c	0.59 ± 0.03a
5.0% SIPP3	1.11 ± 0.02c	1.20 ± 0.02a	1.14 ± 0.04b	1.17 ± 0.02b	0.72 ± 0.04a

Table 17. Changes of K₂₃₅ values* on refrigerated (4) chicken legs treated with 5% TSP, 5% SPP, and 5% SIPP for 10 minutes.

Storage time (days)	Treatments				
	0	4	8	12	16
Control	0.00 ± 0.01a	1.35 ± 0.10a	0.88 ± 0.01ab	0.79 ± 0.01a	0.68 ± 0.04a
5.0% TSP1	1.00 ± 0.03b	1.22 ± 0.02a	0.87 ± 0.13a	1.12 ± 0.03b	0.70 ± 0.08a
5.0% SPP2	1.00 ± 0.01b	1.20 ± 0.27a	0.63 ± 0.03a	0.78 ± 0.00c	0.59 ± 0.03a
5.0% SIPP3	1.11 ± 0.02c	1.20 ± 0.02a	1.14 ± 0.04b	1.17 ± 0.02b	0.72 ± 0.04a

Table 18. Changes of TBA values* on refrigerated (4) chicken legs treated with 5% TSP, 5% SPP, and 5% SIPP for 10 minutes.

Table 17				10			
L-가(價)	65.7	8	63.7	. 5%	TSP, SPP, TSPP	10	
		L-가		(P > 0.05)가			
16							

Table 17. Changes of Hunter color L values* on refrigerated (4) chicken legs treated with 5% TSP, 5% SPP, and 5% SIPP for 10 minutes.

Storage time (days)	0	4	8	12	16
Control	65.7 ± 0.32a	61.4 ± 0.44a	63.7 ± 0.24a	61.8 ± 0.37a	63.5 ± 0.08a
5.0% TSP1	64.5 ± 0.31a	64.5 ± 0.35a	64.4 ± 0.37a	56.4 ± 0.55a	64.6 ± 0.28a
5.0% SPP2	63.3 ± 0.28a	64.0 ± 0.61a	61.9 ± 0.34ab	59.8 ± 0.29a	62.9 ± 0.23a
5.0% SIPP3	55.7 ± 2.52a	65.0 ± 0.50a	59.4 ± 0.18b	62.5 ± 0.33a	55.9 ± 0.50a

*Means of 3 replications (Mean ± standard error). TSP = trisodium phosphate, SPP = sodium pyrophosphate, SIPP = sodium tripolyphosphate. Means within the same column with different superscripts are significantly different (P<0.05).

Table 18				10			
a+ 가	16.1	8	12.6	. 5%	TSPP	10	
		a+가		(P < 0.05) 가			16

Table 18. Changes of Hunter color a values* on refrigerated (4) chicken legs treated with 5% TSP, 5% SPP, and 5% SIPP for 10 minutes.

Storage time (days)	0	4	8	12	16
Control	16.1 ± 1.22a	13.9 ± 0.15a	12.7 ± 0.65a	10.5 ± 0.48a	9.75 ± 0.79b
5.0% TSP1	14.3 ± 0.67ab	10.6 ± 0.64ab	10.1 ± 0.66b	5.89 ± 0.24b	5.82 ± 0.34a
5.0% SPP2	13.1 ± 0.96ab	8.76 ± 0.63ab	7.28 ± 0.64c	6.93 ± 0.95b	6.95 ± 0.54a
5.0% SIPP3	11.9 ± 1.06b	5.02 ± 0.23b	10.5 ± 0.46b	7.30 ± 0.42b	13.4 ± 0.13c

*Means of 3 replications (Mean ± standard error). TSP = trisodium phosphate, SPP = sodium pyrophosphate, SIPP = sodium tripolyphosphate. Means within the same column with different superscripts are significantly different (P<0.05).

Table 19				10			
b+ 가	-8.6	8	-2.4	. 5%	SPP	TSPP	10
		b+가		16			(P < 0.05)

Table 19. Changes of Hunter color b values* on refrigerated (4) chicken legs treated with 5% TSP, 5% SPP, and 5% STPP for 10 minutes.

Storage time (days)	0	4	8	12	16
Control	-8.56 ± 0.88a	-8.44 ± 1.34a	-2.36 ± 0.21a	3.18 ± 1.15a	6.73 ± 1.77a
5.0% TSP1	-8.75 ± 0.65a	-5.94 ± 0.40c	-6.53 ± 1.01b	-4.13 ± 0.68b	1.24 ± 1.25b
5.0% SPP2	-6.16 ± 1.25c	-4.10 ± 1.50b	-5.94 ± 0.49c	-1.89 ± 0.73b	1.20 ± 0.83b
5.0% STPP3	-7.88 ± 0.40b	-6.08 ± 1.48c	-5.88 ± 0.57b	2.04 ± 0.57c	0.49 ± 0.75b

*Means of 3 replications (Mean ± standard error). TSP = trisodium phosphate, SPP = sodium pyrophosphate, STPP = sodium tripolyphosphate. Means within the same column with different superscripts are significantly different (P<0.05).

5%
Molins (1991), (red neat)

Table 20	odor	6.0	8	2.0	5%	TSP, SPP, TSP	10
	odor					(P < 0.05)	
		8					

Table 20. Changes of odor scores* on refrigerated (4) chicken legs treated with 5% TSP, 5% SPP, and 5% STPP for 10 minutes.

Storage time (days)	0	4	8	12	16
Control	6.00 ± 0.00a	3.50 ± 0.19a	1.75 ± 0.16a	1.00 ± 0.00a	1.00 ± 0.00a
5.0% TSP1	4.00 ± 0.00b	4.75 ± 0.16b	3.50 ± 0.19b	2.00 ± 0.00b	1.00 ± 0.00a
5.0% SPP2	5.00 ± 0.00c	4.75 ± 0.16b	2.50 ± 0.19c	1.00 ± 0.00a	1.00 ± 0.00a
5.0% STPP3	5.50 ± 0.07d	5.00 ± 0.00b	2.50 ± 0.19c	1.50 ± 0.13c	1.50 ± 0.16b

*Means of 3 replications (Mean ± standard error). TSP = trisodium phosphate, SPP = sodium pyrophosphate, STPP = sodium tripolyphosphate. Means within the same column with different superscripts are significantly different (P<0.05).

Table 21	appearance	5.50	8	2.5	5%	TSP	SIPP
10	appearance					가	
8	TSP, SPP		TSP				
		가	5.6 CFU/g	가			TSP,

SPP TSPP 가

Table 21. Changes of appearance scores* on refrigerated (4) chicken legs treated with 5% TSP, 5% SPP, and 5% SIPP for 10 minutes.

Storage time (days) \ Treatments	0	4	8	12	16
Control	5.50 ± 0.19a	4.50 ± 0.19b	2.50 ± 0.19a	1.00 ± 0.00a	1.00 ± 0.00a
5.0% TSP1	5.50 ± 0.19a	5.00 ± 0.00a	4.00 ± 0.00b	2.50 ± 0.19b	1.00 ± 0.00a
5.0% SPP2	6.50 ± 0.19b	4.75 ± 0.16b	3.50 ± 0.19b	1.50 ± 0.19c	1.00 ± 0.00a
5.0% SIPP3	6.00 ± 0.38b	5.00 ± 0.00a	3.25 ± 0.31b	1.75 ± 0.16c	1.75 ± 0.16c

*Means of 3 replications (Mean ± standard error). TSP = trisodium phosphate, SPP = sodium pyrophosphate, SIPP = sodium tripolyphosphate. Means within the same column with different superscripts are significantly different (P<0.05).

가 5.6 CFU/g

TSP, SPP TSPP 8
가 odor appearance 8

(Kim Marshall, 1999).

(3)

(500g)

(Table 3-22 3-25).

5.6 log unit

(1 ± 2)

Table 22

10 pH 8.02 8

7.63 가 . 2.5 10% TSP 10 pH

(P < 0.05) 16

가

Lewis (1986)

pH 가

Aust (1984) 가

pH 가 가 가

Table 22. Changes of pH values* on chicken legs treated with different levels of

trisodium phosphate (TSP) for 10 minutes during storage at retail store (1±2)

Storage time (days)	0	4	8	12	16
Control	7.02±0.07a	6.96±0.04a	7.63±0.15a	8.42±0.17a	7.89±0.23a
2.5% TSP	9.07±0.07b	7.46±0.09b	7.87±0.04a	8.03±0.03b	8.11±0.12a
5.0% TSP	8.95±0.33b	7.96±0.13c	8.30±0.06b	8.19±0.02ab	7.79±0.21a
7.5% TSP	9.39±0.51b	8.38±0.04d	8.51±0.04lc	8.25±0.10ab	8.05±0.11a
10.0% TSP	10.18±0.53c	8.47±0.06d	8.64±0.08c	8.48±0.05a	8.14±0.23a

*Means of 3 replications (Mean±: standard error). Means within the same column with different superscripts are significantly different (P<0.05).

Table 23

TBA	0.124	8	0.208	가	10	2.5	10%	TSP	10
16									
		7.5%	TSP			TBA가			(P
< 0.05)	가					7.5%			
TSP									

Table 23. Changes of TBA values* on chicken legs treated with different levels of trisodium phosphate (TSP) for 10 minutes during storage at retail store (1±2)

Storage time (days)	0	4	8	12	16
Control	0.86±0.01a	0.84±0.01a	1.04±0.06a	1.41±0.03a	0.80±0.02a
2.5% TSP	0.95±0.02b	0.71±0.05b	1.00±0.02a	1.60±0.02b	1.36±0.00b
5.0% TSP	0.98±0.04b	0.59±0.02c	0.70±0.05b	1.36±0.02a	1.16±0.02c
7.5% TSP	0.97±0.03b	0.61±0.02lc	1.00±0.08a	1.53±0.02b	1.23±0.04c
10.0% TSP	1.12±0.02c	0.04±0.02lc	1.01±0.02a	1.24±0.03c	0.96±0.00d

*Means of 3 replications (Mean±: standard error). Means within the same column with different superscripts are significantly different (P<0.05).

Table 24, 25

10	가	9 point hedonic scale
5	6 9 ,	가
9	1 4 ,	가
1	가	odor appearance

TSP 가 12 (P < 0.05)

Table 24. Changes of odor scores* on chicken legs treated with different levels of trisodium phosphate (TSP) for 10 minutes during storage at retail store (1±2)

Storage time (days) \ Treatments	0	4	8	12	16
Control	4.75 ± 0.16a	5.00 ± 0.00a	2.50 ± 0.19a	1.00 ± 0.00a	1.00 ± 0.00a
2.5% TSP	5.00 ± 0.00a	4.75 ± 0.46a	4.00 ± 0.00b	2.50 ± 0.19b	1.00 ± 0.00a
5.0% TSP	4.50 ± 0.19a	4.75 ± 0.46a	3.50 ± 0.19b	3.00 ± 0.00c	1.00 ± 0.00a
7.5% TSP	4.75 ± 0.16a	4.00 ± 0.00b	4.00 ± 0.38b	3.50 ± 0.19c	2.50 ± 0.19b
10.0% TSP	4.50 ± 0.19a	4.00 ± 0.00b	3.75 ± 0.16b	3.25 ± 0.31c	2.00 ± 0.00c

*Means of 3 replications (Mean±: standard error). Means within the same column with different superscripts are significantly different (P<0.05).

Table 25. Changes of appearance scores* on chicken legs treated with different levels of trisodium phosphate (TSP) for 10 minutes during storage at retail store (1±2)

Storage time (days) \ Treatments	0	4	8	12	16
Control	5.00 ± 0.00a	4.63 ± 0.18a	2.25 ± 0.16a	1.25 ± 0.16a	1.00 ± 0.07a
2.5% TSP	4.63 ± 0.18a	5.00 ± 0.00a	3.00 ± 0.00ab	2.00 ± 0.00b	1.00 ± 0.21a
5.0% TSP	4.88 ± 0.13a	4.75 ± 0.16a	3.50 ± 0.19bc	2.00 ± 0.00b	1.00 ± 0.20a
7.5% TSP	4.88 ± 0.30a	4.50 ± 0.19ab	4.00 ± 0.27c	2.75 ± 0.16c	2.00 ± 0.06b
10.0% TSP	4.63 ± 0.18a	4.00 ± 0.00b	3.25 ± 0.31bc	2.75 ± 0.16c	2.00 ± 0.20b

*Means of 3 replications (Mean±: standard error). Means within the same column with different superscripts are significantly different (P<0.05).

(1)

(가)

('99. 6 - '99. 8)

,

500g

1% (v/v)

1% (w/v)

10

2

Whirl-Pak

sample bag 4 16

(Fig. 11 12). Fig. 11

5.14 log unit 8 8.15 log unit 가 . 1%

10 3.63 log unit 8 4.68

Log₁₀ CFU/g, 16 6.92 log unit 가 16

(P < 0.05) . 1%

10 8

1%

16

. Fig. 12

unit 8 7.71 log unit 가 . 1%

4.11 log

10

1.30 log unit

. 1%

10 8

(P < 0.05)

16

4

가

4 8

. 1%

10 4

8 . 1%

16 (P < 0.05)

. 가 가 10⁷ CFU/g

, 1%

16

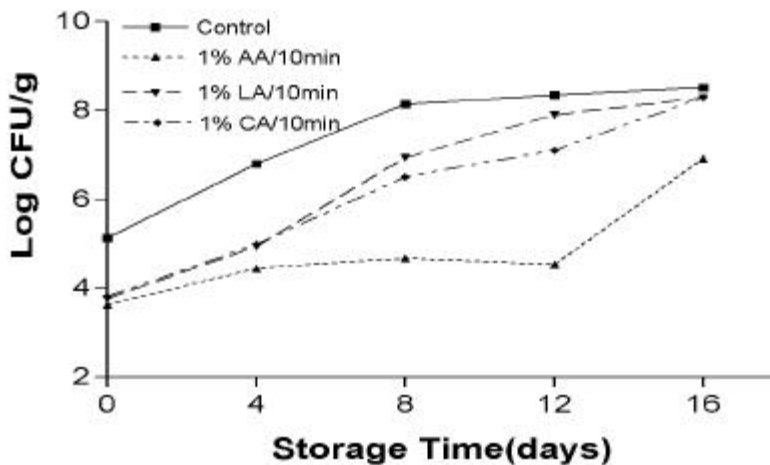


Fig. 11. APC* on refrigerated (4) chicken wings treated with 1% acetic acid (AA), 1% lactic acid (LA), and 1% citric acid (CA) for 10minutes.

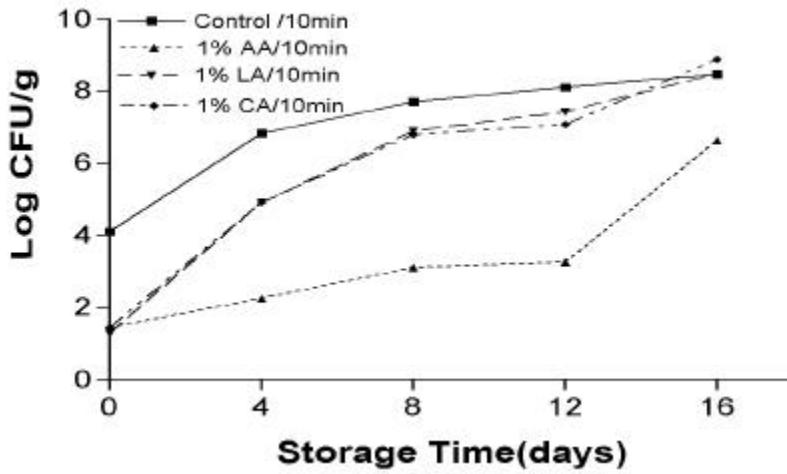


Fig. 12. GNC* on refrigerated (4) chicken wings treated with 1% acetic acid (AA), 1% lactic acid (LA), and 1% citric acid (CA) for 10minutes.

Kim (1998)

4C

4

Ray Sandine (1991)

Pseudomonas spp.

pH

가

(Ray Sandine, 1991).

()

('99. 6. '99. 8)

500g

ISP (trisodium

phosphate, Spectrum Quality Product Co., USA), SPP (sodium pyrophosphate, Spectrum

Quality Product Co., USA) STPP (sodium tripolyphosphate, Spectrum Quality Product

Co., USA)

5% (w/v) ISP, SPP, STPP 10

2

Whirl-Pak sample

bag 4 16

(Fig. 13

14). Fig. 13

5.56 log

unit 8 8.00 log unit 가 4 4
 . 5% TSP 10
 (P < 0.05) . 5% TSP 10
 8 12 5% SPP
 5% STPP 4 . Fig. 14
 (Spectrum Quality Product Co., USA) 5% TSP, 5% SPP, 5% STPP
 10 5% SPP TSP
 8 가 . 5% TSP 10
 5% SPP 5% TSP
 (P < 0.05) .

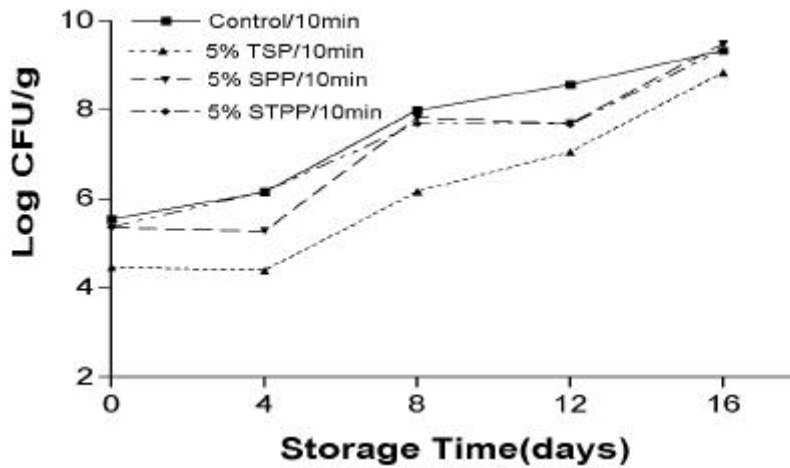


Fig. 13. APC* on refrigerated(4) chicken wings treated with 5% trisodium phosphate (TSP), 5% sodium pyrophosphate(SPP), and 5% sodium triphosphate(STPP) for 10minutes.

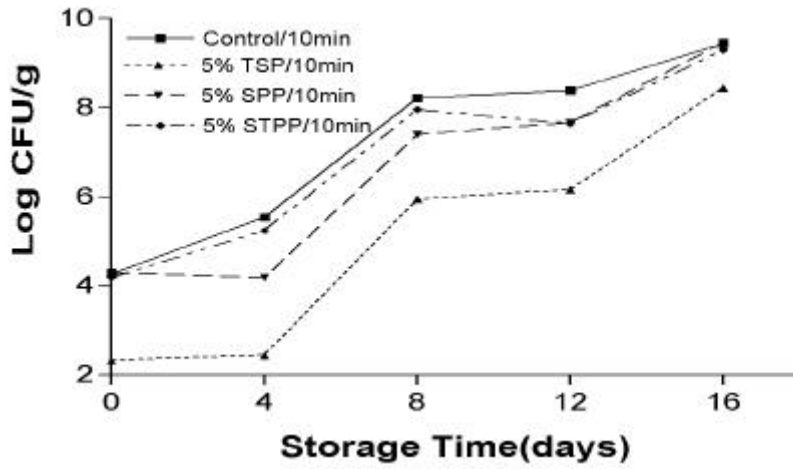
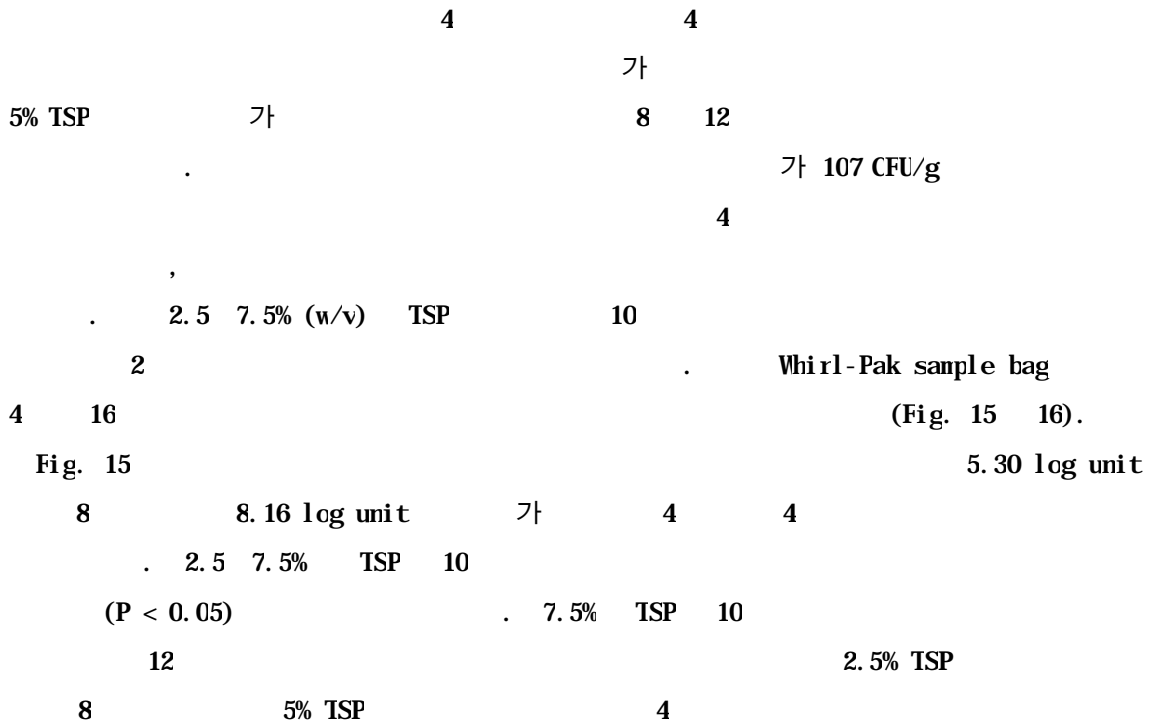


Fig. 14. GNC* on refrigerated(4) chicken wings treated with 5% trisodium phosphate (TSP), 5% sodium pyrophosphate(SPP), and 5% sodium tripolyphosphate(STPP) for 10minutes.



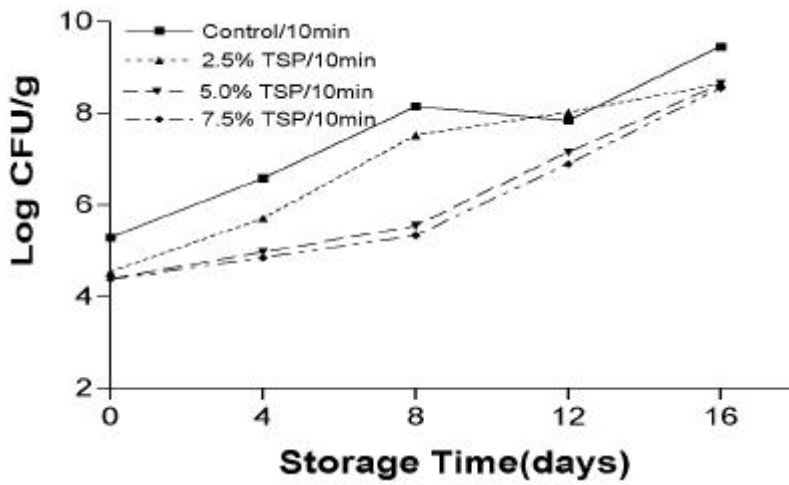


Fig. 15. APC* on refrigerated(4) chicken wings treated with different levels of trisodium phosphate (TSP) for 10minutes.

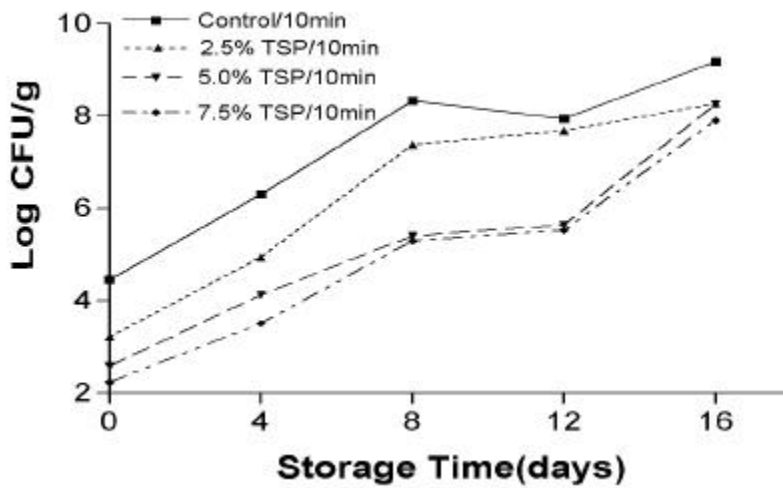


Fig. 16. GNC* on refrigerated (4) chicken wings treated with different levels of trisodium phosphate (TSP) for 10minutes.

Fig. 16

	2.5	7.5% ISP	10
	2.5%	TSP	8
가	7.5% ISP	10	16
	5% SPP	5% ISPP	(P < 0.05)

7.5% 가 TSP 가

12 . Rathgeber Waldroup (1995)

Brifisol KM (sodium acid pyrophosphate orthophosphoric acid)

Escherichia coli

, 4.4C 2 가 . Kim

Marshall (1999) TSP nonopotassium phosphate(MKP), sodium pyrophosphate(SPP)

monosodium phosphate(MSP) , 5 10%

TSP . 5% TSP

10 TSP 4C, 12 MKP, MSP SPP 3

log unit

(2)

(가)

('99. 6 '99. 8)

500g

1% (v/v) , 1% (w/v)

1.5 atm, 30 , 1h

2 . Whirl-Pak sample bag 4Co

16 (Fig. 17 18).

Fig. 17 5.56 log unit

8 7.19 log unit 가 . 1% 30

3.63 log unit 8 6.40 Log₁₀ CFU/g,

12 6.83 log unit 가 . 1%

30 8

1% 12 . Fig. 18

4.57 log unit 8

6.87 log unit 가 . 1% 30

2.55 log unit .

1% 12 , (P

< 0.05) . Voelthuis Smulders (1985)

(Longissimus muscle) 1.25% L-lactic acid 101 x 103 Pa

0.8-1.3 log CFU/cm² ,

Enterbacteriaceae 1.8 log CFU/cm² 1.3 log CFU/cm²

4 1% 1% 1% 1.5atm, 30
 4 1%
 12 (P <
 0.05) 가 가 107 CFU/g
 , 1% 12
 .

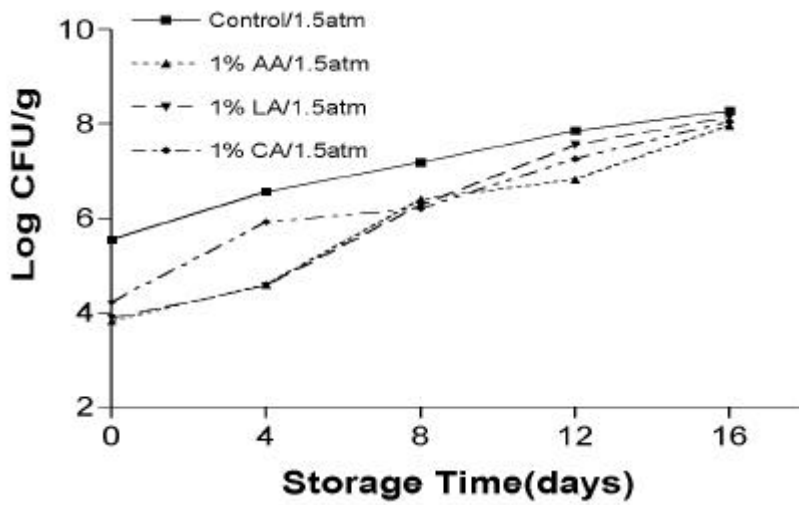


Fig. 17. APC* on refrigerated (4) chicken wings after spraying treatments with 1% acetic acid (AA), 1% lactic acid (LA), and 1% citric acid (CA) for 30 seconds.

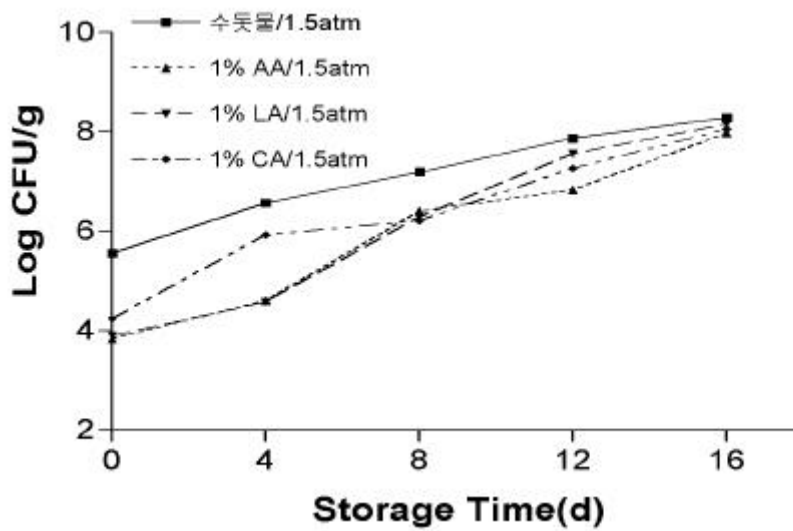


Fig. 18. GNC* on refrigerated (4) chicken wings after spraying treatments with 1% acetic acid (AA), 1% lactic acid (LA), or 1% citric acid (CA) for 30 seconds.

가
4

pH
(Kim, 1998; Ray Sandine, 1991).

() Phosphate

TSP (trisodium phosphate, Spectrum Quality Product Co., USA) ('99. 6. '99. 8) 500g

2.5 7.5% (w/v) TSP 10
1.5atn, 1n 30 2
Whirl-Pak sample bag 4 16

(Fig. 19 20). Fig. 19

5.18 log unit 4 7.41 log unit 가 4
2.5 7.5% TSP 1.5atn, 30

(P < 0.05)

5 7.5% TSP 8
2.5% TSP 0 4

Fig. 20

(Spectrum Quality Product Co., USA)

2.5 7.5% TSP 1.5 atn, 30 TSP
12

4 4

가 , 7.5% TSP

가 8

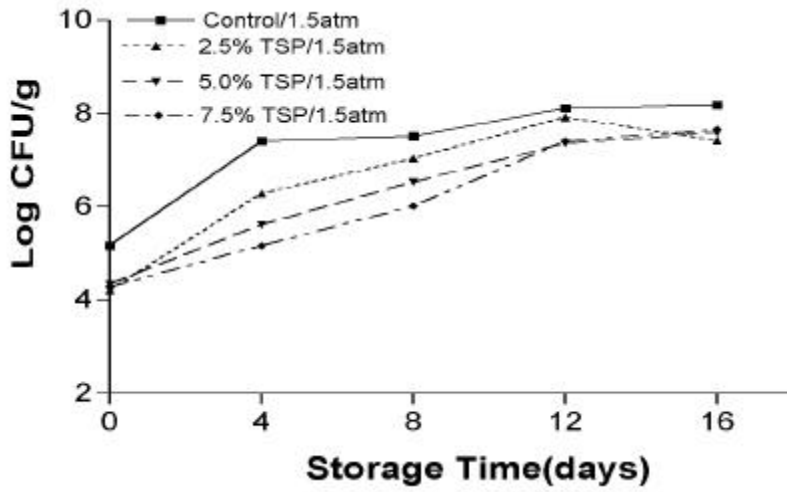


Fig. 19. APC* on refrigerated (4) chicken wings after spraying treatments with different levels of trisodium phosphate (TSP) for 30 seconds.

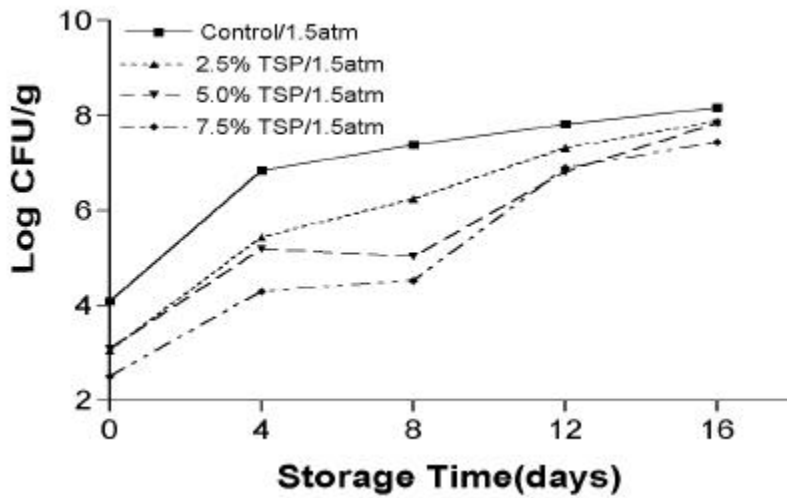


Fig. 20. GNC* on refrigerated (4) chicken wings after spraying treatments with different levels of trisodium phosphate (TSP) for 30 seconds .

가 TSP 가
 . TSP
 2L , 5L 가 .
 TSP TSP .

2.5 7.5% (w/v) TSP 10 ()
 1.5atm, 1n 30 2
 Whirl-Pak sample bag 10 16
 (Fig. 21 22). Fig. 21
 5.18 log unit 4 8.18 log unit 가
 1n 0 2.5 7.5% TSP 1.5atm, 30
 (P < 0.05)

2.5 7.5% TSP 10 0
 Fig. 22
 10 0
 가 , TSP

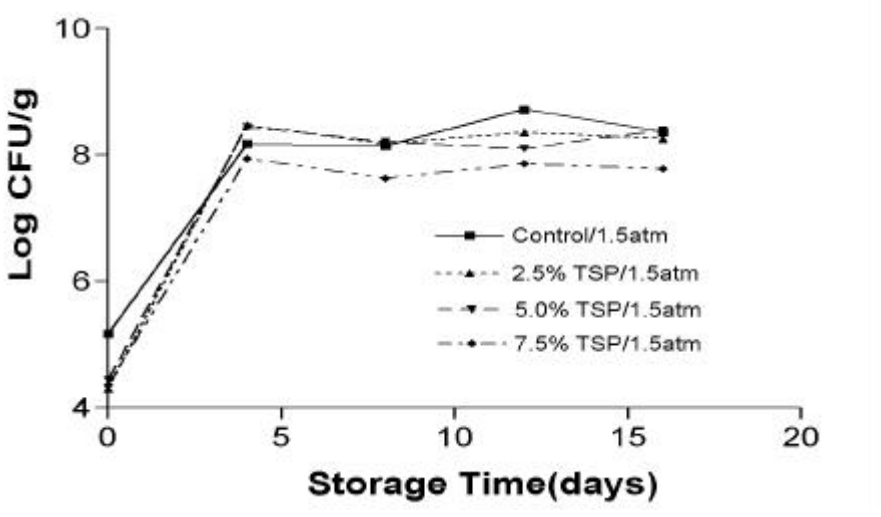


Fig. 21. APC* on refrigerated (10) chicken wings after spraying treatments with different levels of trisodium phosphate (TSP) for 30 seconds.

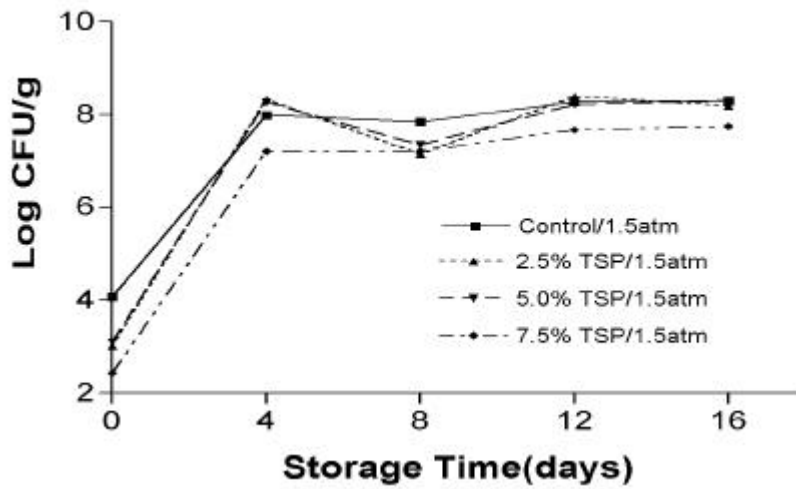


Fig. 22. GNC* on refrigerated (10) chicken wings after spraying treatments with different levels of trisodium phosphate (TSP) for 30 seconds.

(1)
(가)

bag	10		16		2	(Dipping method) Whirl-Pak Sample
	4	10	4	10		
10						가
1%						
(P < 0.05)						

Table 26. Changes of pH values* on refrigerated (4) chicken legs treated with 1% acetic acid (AA), 1% lactic acid (LA), and 1% citric acid (CA) for 10 minutes.

Storage time (days)	0	4	8	12	16
Control	6.46 ± 0.08c	6.81 ± 0.14c	7.32 ± 0.19b	7.75 ± 0.13b	7.28 ± 0.08a
1% AA	4.86 ± 0.12b	6.34 ± 0.07ab	6.28 ± 0.06a	6.88 ± 0.16a	7.01 ± 0.17a
1% LA	4.34 ± 0.06a	6.44 ± 0.05bc	6.41 ± 0.09a	6.54 ± 0.08a	7.41 ± 0.15a
1% CA	4.39 ± 0.05a	6.20 ± 0.11ab	6.45 ± 0.05a	7.07 ± 0.17a	7.14 ± 0.11a

*Means of 3 replications (Mean±: standard error). a-d means within the same column

with different superscripts are significantly different (P<0.05).

Table 27, 28

4

10

odor appearance

가 . 1%

10 odor 12

(P > 0.05)가 , odor appearance 16

. I가

가 , 1% 12

(Table 29).

Table 27. Changes of odor scores* on refrigerated (4) chicken legs treated with 1% acetic acid (AA), 1% lactic acid (LA), and 1% citric acid (CA) for 10 minutes.

Storage time (days)	0	4	8	12	16
Control	5.38 ± 0.18a	4.88 ± 0.30b	2.63 ± 0.32a	1.63 ± 0.26a	1.63 ± 0.26a
1% AA	4.50 ± 0.19a	4.88 ± 0.30b	3.75 ± 0.31a	2.63 ± 0.18b	2.25 ± 0.25a
1% LA	4.88 ± 0.30a	4.63 ± 0.26b	3.50 ± 0.19a	2.75 ± 0.17b	1.75 ± 0.31a
1% CA	4.88 ± 0.30a	3.88 ± 0.23b	2.88 ± 0.30a	2.25 ± 0.31ab	1.88 ± 0.15a

*Means of 3 replications (Mean±: standard error). Means within the same column with different superscripts are significantly different (P<0.05).

Table 28. Changes of appearance scores* on refrigerated (4) chicken legs treated with 1% acetic acid (AA), 1% lactic acid (LA), and 1% citric acid (CA) for 10 minutes.

storage time (days)	0	4	8	12	16
Control	5.75 ± 0.17a	5.13 ± 0.35a	2.88 ± 0.13a	2.13 ± 0.23a	1.25 ± 0.17a
1% AA	5.00 ± 0.27a	4.75 ± 0.31a	3.25 ± 0.31a	3.00 ± 0.27a	2.00 ± 0.27a
1% LA	5.38 ± 0.26a	4.63 ± 0.26a	2.63 ± 0.42a	3.13 ± 0.23a	1.63 ± 0.26a
1% CA	5.00 ± 0.26a	4.75 ± 0.17a	2.13 ± 0.40a	2.50 ± 0.38a	1.75 ± 0.31a

*Means of 3 replications (Mean±: standard error). Means within the same column with different superscripts are significantly different (P<0.05).

(2)

(가)

bag	10		16		1%		Whirl-Pak Sample
	4	10	4	10	4	10	
Table 29							
	pH	7.52	8	7.58	1%		
	10		pH		(P < 0.05)		
	8						

Table 29. Changes of pH values* on refrigerated (4) chicken legs after spraying treatments with 1% acetic acid (AA), 1% lactic acid (LA), or 1% citric acid (CA) for 30 seconds.

Storage time (days)	0	4	8	12	16
Control	7.52 ± 0.14b	6.87 ± 0.26a	7.58 ± 0.23b	7.64 ± 0.25ab	7.56 ± 0.16a
1.0% AA	5.74 ± 0.14a	6.94 ± 0.06a	6.70 ± 0.04a	7.75 ± 0.21b	7.18 ± 0.09a
1.0% LA	5.92 ± 0.71a	7.04 ± 0.09a	7.79 ± 0.09a	7.52 ± 0.20ab	7.75 ± 0.22a
1.0% CA	5.44 ± 0.16a	6.77 ± 0.15	6.99 ± 0.06a	6.94 ± 0.07a	7.81 ± 0.22a

*Means of 3 replications (Mean ± standard error). Means within the same column with different superscripts are significantly different (P<0.05).

Table 30, 31	4		10		1%	
	odor	appearance	가			
	10		odor	appearance	8	
12	(P > 0.05)가					

Table 30. Changes of odor scores* on refrigerated (4) chicken legs after spraying treatments with 1% acetic acid (AA), 1% lactic acid (LA), or 1% citric acid (CA) for 30 seconds.

Storage time (days)	0	4	8	12	16
Control	4.75 ± 0.31a	4.50 ± 0.19a	3.63 ± 0.32a	2.75 ± 0.25ab	1.50 ± 0.27a
1.0% AA	4.75 ± 0.16a	3.88 ± 0.125a	3.75 ± 0.366a	2.38 ± 0.263a	2.50 ± 0.189b
1.0% LA	4.63 ± 0.375a	4.00 ± 0.02a	3.88 ± 0.23a	3.38 ± 0.26b	2.00 ± 0.19ab
1.0% CA	4.63 ± 0.32a	3.75 ± 0.25a	3.38 ± 0.38a	3.63 ± 0.18b	1.50 ± 0.19a

*Means of 3 replications (Mean ± standard error). Means within the same column with different superscripts are significantly different (P<0.05).

Table 31. Changes of appearance scores* on refrigerated (4) chicken legs after spraying treatments with 1% acetic acid (AA), 1% lactic acid (LA), or 1% citric acid (CA) for 30 seconds.

Storage time (days)	0	4	8	12	16
Control	4.63 ± 0.18a	4.38 ± 0.07a	3.75 ± 0.41a	2.38 ± 0.26a	1.38 ± 0.18a
1.0% AA	5.00 ± 0.00a	4.13 ± 0.55a	4.00 ± 0.38a	2.75 ± 0.31a	2.63 ± 0.38b
1.0% LA	5.25 ± 0.16a	4.38 ± 0.38a	3.38 ± 0.59a	3.13 ± 0.31a	2.25 ± 0.25ab
1.0% CA	4.88 ± 0.29a	3.75 ± 0.53a	4.00 ± 0.46a	3.13 ± 0.39a	1.50 ± 0.33ab

*Means of 3 replications (Mean ± standard error). Means within the same column with different superscripts are significantly different (P<0.05).

Woolthuis Smulders (1985) 1.25% L- lactic acid
 가 , 2.0% 가
 가
 , 1% 가
 가 (P < 0.056)
 2.5-7.5% ISP
 Kim Marshall (1999) 5-10% ISP 4°C
 (1.5 kg) 가
 .
 .
 2.
 가.
 1)
 가)
 ('99. 6 '99. 8)
 , , 500g
 . 1% (v/v) , 1% (w/v)
 10 2
 Whirl-Pak sample bag (2 ± 1)
 16 (Fig. 23 24).
 Fig. 23 4.93 log unit

4 7.18 log unit 가 . 1% 10
 3.69 log unit 8 4.04 Log CFU/g, 16
 6.39 log unit 가 16 (P <
 0.05) . 1% 10
 8 1%
 16 . Fig. 24
 3.31 log unit 4 7.12
 log unit 가 . 1% 10
 2.25 log unit . 1%
 10 8 (P < 0.05)
 16
 1% 10
 8 . 1%
 16 (P < 0.05)
 가 가 107 CFU/g
 , 1% 16

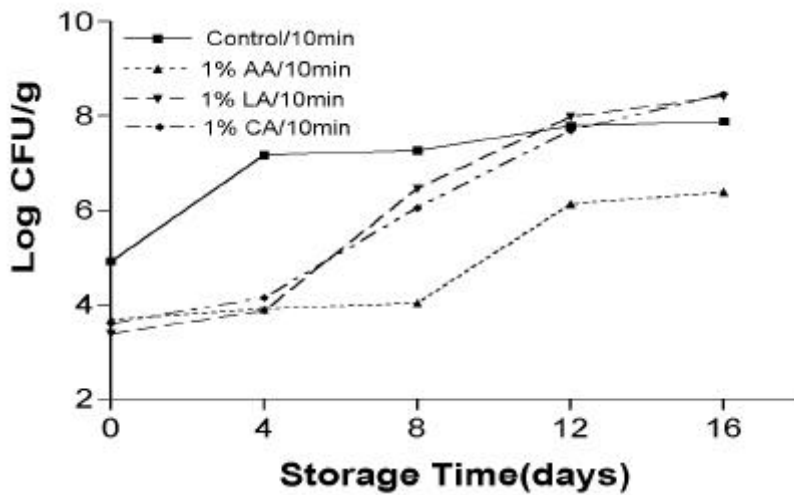


Fig. 23. APC* on refrigerated (2±2) chicken wings treated with 1% acetic acid, 1% lactic acid, and 1% citric acid for 10minutes.

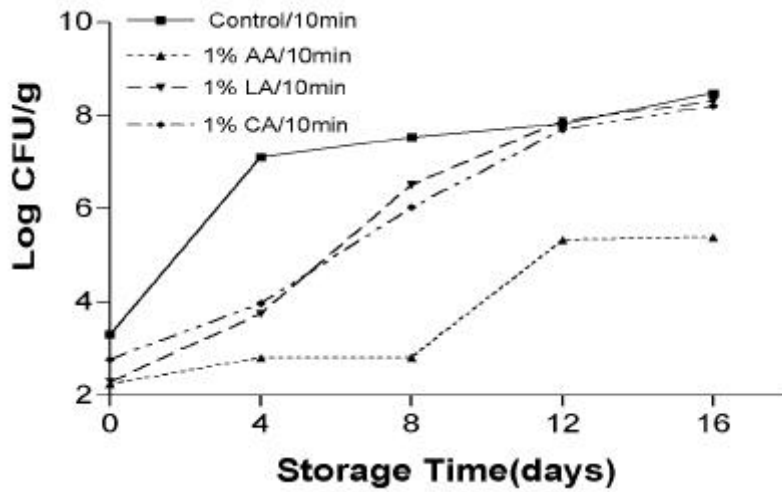


Fig. 24. GNC* on refrigerated (2±2) chicken wings treated with 1% acetic acid(AA), 1% lactic acid(LA), and 1% citric acid(CA) for 10minutes.

가
 , 1% , (10)
 12 16

() Phosphate

TSP (trisodium phosphate, Spectrum Quality Product Co., USA)

('99. 6. '99. 8) (2±2)

500g

2.5 7.5% (w/v) TSP 10

2

Whirl-Pak sample bag

(2±2) 16

(Fig. 25

26). Fig. 25

4.27 log

unit 8 6.19 log unit

가 . 7.5% TSP 10

(P < 0.05)

. 7.5%

TSP 10

12

. Fig. 26

(Spectrum Quality Product Co., USA)

2.5 7.5%

TSP 10

5% SPP TSPP

8

가

. 7.5% TSP 10

16

5% SPP 5% TSPP

(P < 0.05)

가

, 7.5% ISP 가 가 가
가 107 CFU/g

8 5 7.5% ISP

12

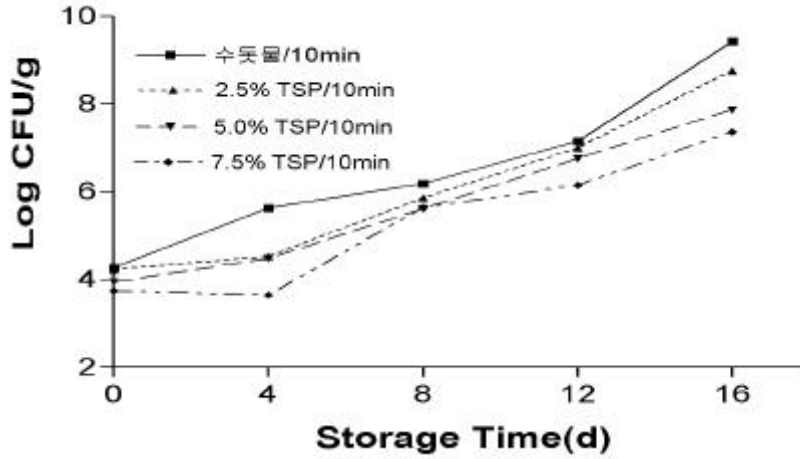


Fig. 25. APC* on refrigerated (2 ± 2) chicken wings treated with different levels of trisodium phosphate (ISP) for 10 min.

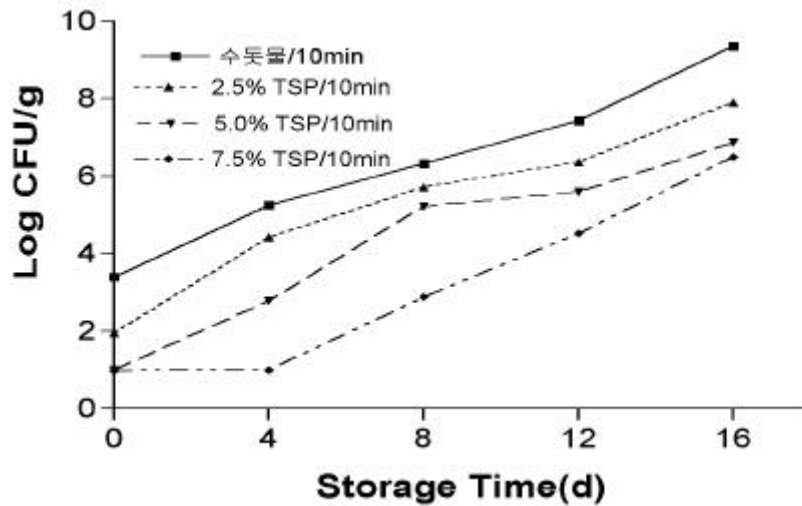


Fig. 26. GNC* on refrigerated (2 ± 2) chicken wings treated with different levels of trisodium phosphate (ISP) for 10 min.

7.5% 가 TSP 1%
TSP

(water holding capacity)

, *Salmonella* spp.

(Kin , 1994).

1)

가)

(%) ,

(dipping method)	10	16	2
Whirl-Pak sample bag	2 ± 2	16	
	2 ± 2	Table 33	
	10	pH 6.76	8
7.28 가	1%	10	
pH	(P < 0.05)		8

Table 33. Changes of pH values* on refrigerated (2±2) chicken legs treated with 1% acetic acid (AA), 1% lactic acid (LA), and 1% citric acid (CA) for 10 min

Storage time (days)	0	4	8	12	16
Control	6.76 ± 0.10c	6.80 ± 0.05b	7.28 ± 0.11c	7.63 ± 0.17c	7.61 ± 0.19c
1% AA	4.92 ± 0.04b	6.36 ± 0.02a	6.24 ± 0.06a	6.94 ± 0.06ab	6.83 ± 0.14ab
1% LA	4.25 ± 0.07a	6.45 ± 0.03a	6.80 ± 0.15b	7.34 ± 0.18atc	7.16 ± 0.12atc
1% CA	4.35 ± 0.02a	6.33 ± 0.05a	6.86 ± 0.10tc	7.31 ± 0.11atc	7.18 ± 0.08atc

*Means of 3 replications (Mean±: standard error). ±Means within the same column with different superscripts are significantly different (P<0.05).

Table 34, 35	2 ± 2	10
가	1%	16
	(odor)	(appearance)
	10	odor appearance
		I+가
		8
(Table 36).	Table 36 37	a+ b+가
	가	

Table 34. Changes of odor scores* on refrigerated (2±2) chicken legs treated with 1% acetic acid (AA), 1% lactic acid (LA), and 1% citric acid *(CA) for 10 min

Storage time (days) Treatments	0	4	8	12	16
Control	5.88 ± 0.23c	4.50 ± 0.33a	1.88 ± 0.29ab	1.88 ± 0.13a	1.63 ± 0.26a
1%AA	4.38 ± 0.18ab	4.50 ± 0.33a	3.13 ± 0.13tc	2.50 ± 0.33a	2.25 ± 0.25a
1%LA	5.00 ± 0.33atc	4.88 ± 0.35a	2.25 ± 0.16atc	1.63 ± 0.18a	1.75 ± 0.25a
1%CA	5.00 ± 0.19atc	5.00 ± 0.27a	2.13 ± 0.29ab	2.00 ± 0.27a	1.50 ± 0.27a

*Means of 3 replications (Mean±: standard error). ±Means within the same column with different superscripts are significantly different (P<0.05).

Table 35. Changes of appearance scores* on refrigerated (2±2) chicken legs treated with 1% acetic acid (AA), 1% lactic acid (LA), and 1% citric acid (CA) for 10 minutes.

Storage time (days) Treatments	0	4	8	12	16
control	5.75 ± 0.16tc	4.50 ± 0.50a	2.00 ± 0.27a	2.00 ± 0.19a	1.63 ± 0.26a
1%AA	4.75 ± 0.16atc	4.88 ± 0.48a	3.13 ± 0.29b	2.63 ± 0.26a	2.50 ± 0.19a
1%LA	4.00 ± 0.33ab	5.13 ± 0.35a	2.25 ± 0.25ab	2.25 ± 0.25a	2.25 ± 0.31a
1%CA	3.88 ± 0.44ab	4.38 ± 0.38a	2.13 ± 0.29ab	2.38 ± 0.26a	1.75 ± 0.25a

*Means of 3 replications (Mean±: standard error). ±Means within the same column with different superscripts are significantly different (P<0.05).

가 가
I+, a+ b+
가 . TBA가
4

Table 36. Changes of color-L values* on refrigerated (2±2) chicken legs treated with 1% acetic acid (AA), 1% lactic acid (LA), and 1% citric acid (CA) for 10 minutes.

Storage time (days) Treatments	0	4	8	12	16
Control	67.3 ± 0.66 ^{abc}	65.5 ± 0.56 ^a	66.9 ± 0.76 ^a	65.9 ± 1.28 ^a	67.9 ± 0.40 ^a
1%AA	69.7 ± 0.70 ^{bc}	69.2 ± 0.78 ^b	66.6 ± 1.22 ^a	65.1 ± 0.43 ^a	64.9 ± 1.01 ^a
1%LA	65.4 ± 0.68 ^{ab}	69.2 ± 0.42 ^b	68.1 ± 0.60 ^a	65.6 ± 0.97 ^a	60.3 ± 7.74 ^a
1%CA	67.6 ± 0.31 ^{abc}	70.0 ± 0.44 ^b	67.3 ± 0.57 ^a	66.1 ± 0.56 ^a	70.1 ± 0.86 ^a

^aMeans of 3 replications (Mean ± standard error). ^aMeans within the same column with different superscripts are significantly different (P<0.05).

Table 37. Changes of color-a values* on refrigerated (2 ± 2) chicken legs treated with 1% acetic acid (AA), 1% lactic acid (LA), and 1% citric acid (CA) for 10 minutes.

Storage time (days) Treatments	0	4	8	12	16
control	3.3 ± 0.49 ^a	3.6 ± 0.47 ^c	2.8 ± 0.47 ^a	2.8 ± 0.16 ^{abc}	1.9 ± 0.30 ^a
1%AA	2.8 ± 0.28 ^{ab}	2.1 ± 0.42 ^{abc}	3.1 ± 0.51 ^a	1.6 ± 0.36 ^{ab}	2.9 ± 0.44 ^a
1%LA	2.2 ± 0.43 ^b	1.0 ± 0.41 ^{ab}	2.7 ± 0.55 ^a	2.5 ± 0.36 ^{ab}	2.2 ± 0.63 ^a
1%CA	2.6 ± 0.28 ^b	1.7 ± 0.39 ^{ab}	2.8 ± 0.28 ^a	4.3 ± 0.66 ^c	3.4 ± 0.83 ^a

^aMeans of 3 replications (Mean ± standard error). ^aMeans within the same column with different superscripts are significantly different (P<0.05).

가

Table 38. Changes of color-b values* on refrigerated (2 ± 2) chicken legs treated with 1% acetic acid (AA), 1% lactic acid (LA), and 1% citric acid (CA) for 10 minutes.

Storage time (days) Treatments	0	4	8	12	16
Control	-1.7 ± 0.69 ^{ab}	-2.9 ± 0.59 ^b	2.1 ± 0.97 ^c	2.8 ± 1.46 ^b	0.8 ± 1.01 ^a
1%AA	-2.2 ± 0.37 ^a	5.5 ± 0.35 ^a	-3.3 ± 0.53 ^a	-2.4 ± 0.69 ^a	0.7 ± 0.64 ^a
1%LA	0.4 ± 0.53 ^b	-4.7 ± 0.61 ^{ab}	0.3 ± 0.56 ^{bc}	-0.9 ± 0.69 ^{ab}	1.5 ± 0.93 ^{ab}
1%CA	-0.9 ± 0.56 ^{ab}	-3.0 ± 0.71 ^b	-2.1 ± 0.43 ^{ab}	-0.5 ± 0.81 ^{ab}	5.4 ± 1.68 ^b

^aMeans of 3 replications (Mean ± standard error). ^aMeans within the same column with different superscripts are significantly different (P<0.05).

3.
가.
1)
가)

('99. 6 '99. 8)
500g
1% (v/v) , 1% (w/v)
10 2
Whirl-Pak sample bag 4 16 2
30 1 4
(Fig. 27 28). Fig. 27
6.51 log unit 4 8.37 log unit 가 . 1%
10 5.15 log unit 4 5.17
Log CFU/g, 8 7.44 log unit 가 . Fig. 28
5.43 log unit 4
7.95 log unit 가 . 1% 10
3.06 log unit 4 8 3.25 7.31 log unit
. 1% 10
4 (P < 0.05)

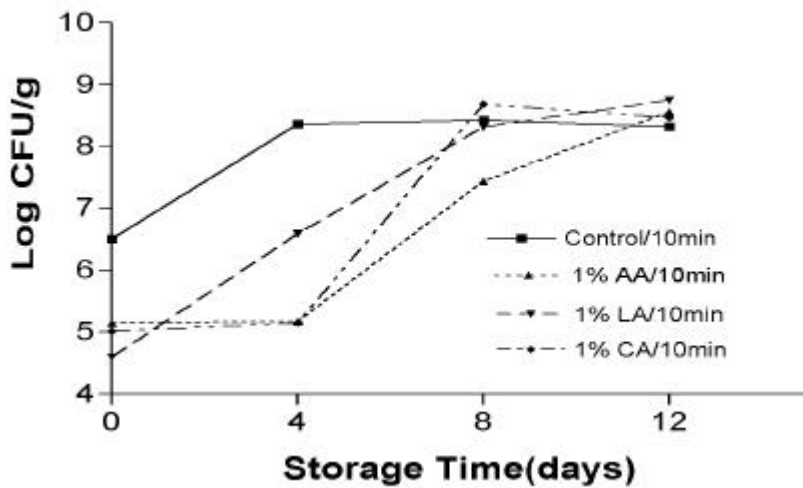


Fig. 27. APC* on refrigerated (4) chicken wings (temperature abuse for 1 hr at 30 at 2 days interval) treated with 1% acetic acid, 1% lactic acid, and 1% citric acid for 10minutes.

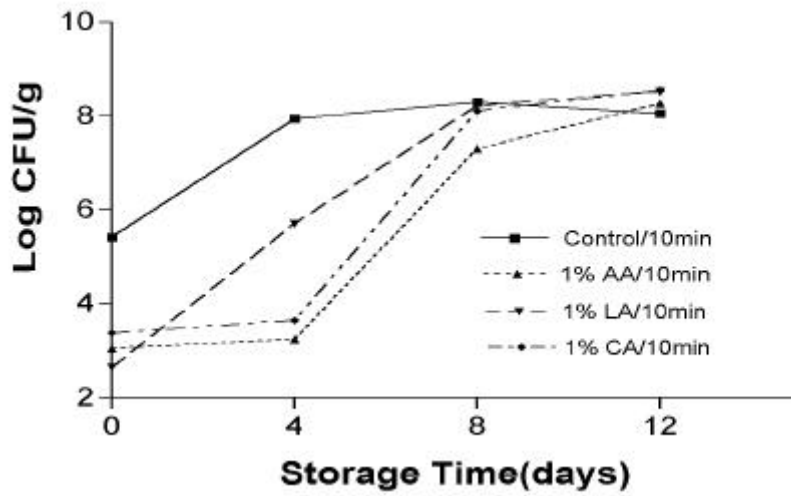


Fig. 28. GNC* on refrigerated (4) chicken wings (temperature abuse for 1 hr at 30 at 2 days interval) treated with 1% acetic acid, 1% lactic acid, and 1% citric acid for 10 minutes.

0.5 1.5% (v/v) 10
 2 Whirl-Pak sample bag 4 16
 2 30 1 4
 (Fig. 29 30).

Fig. 29 6.51 log unit
 4 8.37 log unit 가 1.5% 10
 4.79 log unit 4 5.88 Log CFU/g, 8
 7.09 log unit 가 . Fig. 30
 5.43 log unit 4 7.77 log unit
 가 . 1.5% 10
 2.14 log unit 4 8 2.51 5.06 log unit
 10 12
 (P < 0.05)
 1-1.5% 10 30C, 1
 2 log unit 3.5 log unit .
 1-1.5% 4C 2 30C, 1
 8
 6.5 log unit

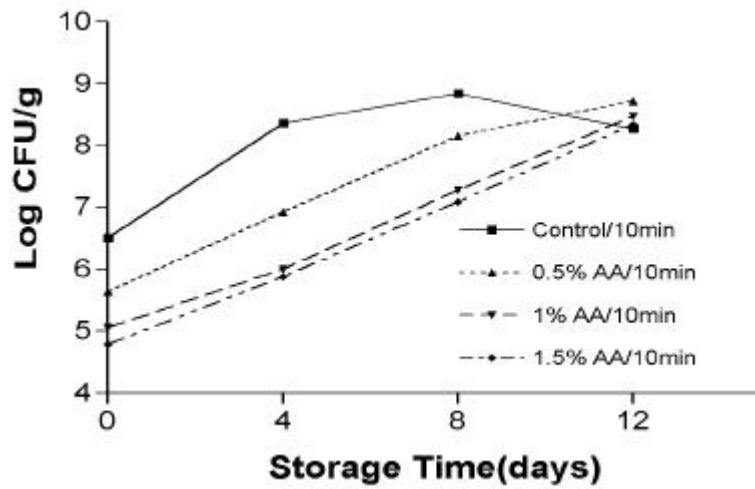


Fig. 29. APC* on refrigerated (4) chicken wings (temperature abuse for 1 hr at 30 at 2 days interval) treated with different levels of acetic acid for 10minutes.

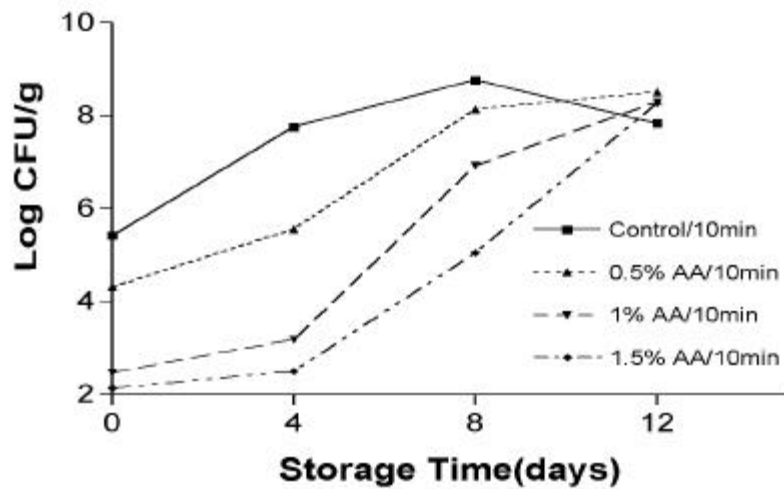


Fig. 30. GNC* on refrigerated (4) chicken wings (temperature abuse for 1 hr at 30 at 2 days interval) treated with different levels of acetic acid for 10minutes.

()

('99. 6 '99. 8)

TSP (trisodium phosphate, Spectrum Quality Product Co., USA)

	500g	.	2.5
7.5% (w/v) TSP	10		2

Whirl-Pak sample bag 4 16
 2 30 1 4
 (Fig. 31 32).
 Fig. 31 6.51 log unit
 4 8.37 log unit 가 . 7.5% TSP 10
 4.27 log unit 4 5.96 Log CFU/g, 8
 8.06 log unit 가 . Fig. 32
 5.43 log unit 4 7.77 log unit 가
 . 7.5% 10 2.30 Log
 unit 4 8 4.8 7.6 log unit
 . 7.5% TSP 10 12
 (P < 0.05)

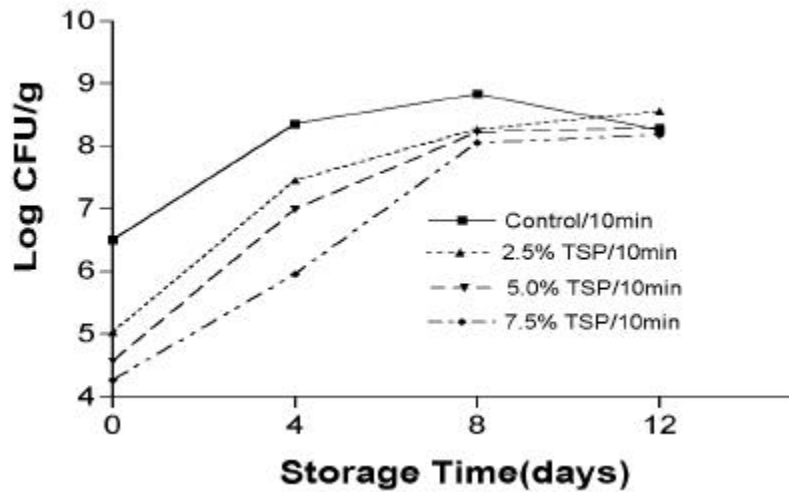


Fig. 31. APC* on refrigerated (4) chicken wings (temperature abuse for 1 hr at 30 at 2 days interval) treated with different levels of trisodium phosphate (TSP) for 10minutes.

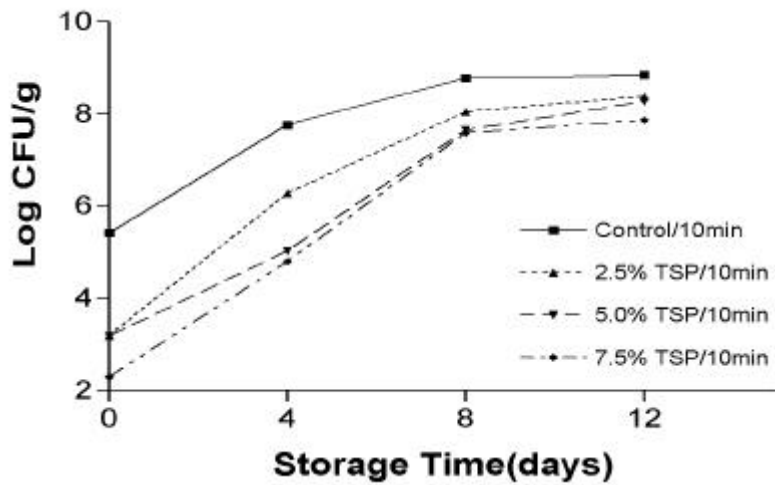


Fig. 32. GNC* on refrigerated (4) chicken wings (temperature abuse for 1 hr at 30 at 2 days interval) treated with different levels of trisodium phosphate (TSP) for 10 min.

Kim Marshall (1999) TSP (1.5 kg)
 , 5% TSP 4C 12
 3.0 log unit . Hwang Beuchat (1995)
 TSP
 7.5% TSP 가
 2 log unit 3 log unit . T
 SP 2 30C 1 4C 8
 (P < 0.05)
 4.
 , 5-10% TSP
 1%
 () 가
 1.5 atn, 30 40
 가 GRAS 22,000 1 5
 가 가

가 . 16 가
가
가 recall

4.

1)

가 1% , 5 4 ()
가 1% 가 (P <
0.05) . 0.5 2% 10 가
4 16 1.5 2% 0.5 1.0%
(P < 0.05)

가 5% TSP, 5% SPP 5% STPP 10 (1
±2) 5% TSP 가
(P < 0.05) . 가 가 107
CFU/g 1.0 2.0%

4cC 16

2)

, , , TSP, SPP STPP 4 ,
(P <
0.05) . Hunter colorimeter

가 9 point hedonic scale

8 12

(P < 0.05)

1% TSP

(P < 0.05)가 .

TSP

가 .

3)

() (4), ,
 (30 , 1) (. , , ,
) . 1% ,
 5-7.5% TSP 10
 1 1.5 log unit . 1%
 (10) (1.5atn, 30)
 4C 16 8
 . 1%
 4C 12 . 5-7.5%
 TSP (10) (1.5atn, 30)
 4C 8 4
 . (2±2)
 1% 5-7.5% TSP
 16 12 . 1%
 2. 5-7.5% TSP 16
 (P < 0.05) . 1% 5%
 TSP 10 30cC, 1 4C
 2 8 4
 .
 105
 CFU/g .
 1% 7.5% TSP 10
 104 CFU/g
 . 1% 5-7.5% TSP
 4
 가 가 . (%) , TSP
 가 .

4)

()
 (4), , (30 , 1) (, ,
 , ,) .

pH가

pH가

TBA가

Hunter L*, a*, b*가

가 4 8

가

가 가

가

가

가

가

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韓國食品年鑑. 1997. 6 . p. 154.

3.

Experimental 3 : Improving safety and shelf-life for Industrial application of refrigerated chicken

Summary

For improving safety and shelf-life of refrigerated chicken (average weight of 500g per chicken), Microbiological and sensory evaluations of chicken treated with acetic acid(AA), lactic acid (LA), or citric acid (CA) during a commercial chicken processing step were assessed. Chicken were dipped in or sprayed with 1-3% AA, LA or CA at exposure times of 0-10 min or 0-180 sec. Chicken which sprayed with 2-3% AA, LA or CA for 10 sec at 1.5 atm after evisceration and then dipped for 150 sec at final processing step significantly reduced aerobic plate counts (APC) on the surface of chicken for storage of 16 days at 4°C. Chicken dipped in 1-3% acidulant for 90-150 sec had a significantly inhibitory effect for preventing the growth of APC, which decreased APC to 0.5-1.5 log unit compared to the controls after acid treatments. Microbiological shelf-life of chicken dipped in 1-5% AA for 150 sec and packaged with OPP/PE film during storage at 4°C increased for storage of 12 days to 16 days. For odor scores, chicken treated with 1-3% LA resembled untreated chicken for during storage days at 4°C. However, odor scores of chicken treated with 1-3% AA were lower to untreated chicken due to chemical odor during storage days. Thiobarbituric acid (TBA) values of chicken treated with 1-3% acidulants significantly increased from initial days to 12 days of storage compared to controls. pH values of chicken treated with 1-3% acidulants significantly decreased at initial days compared to control, which were consistent with the results for storage of 12 days at 4°C. Chicken dipped in 1-3% AA or LA were a significantly higher Hunter color L+ values than controls during storage of 4 and 8 days. Chicken dipped in 1-3% AA or LA were a significantly lower Hunter color a+ values than controls during storage of 16 days.

On the basis of these results, chicken dipped in or sprayed with 1-3% AA, LA or CA at exposure times for 150 sec before final processing could increase microbiological shelf-life during storage at 4°C, which could be used for its industrial production and application.

가 (Kim, 1998 ; Woolthuis and Snulders, 1985)).

가 (Kim Marshall, 1999, Kim, 1998).

가

가 (Bell *et al.*, 1986 ; Kim, 1998 ; Kim Marshall, 1999 ; Woolthuis and Snulders, 1985).

가

(Kim, 1998).

가 (Kim, 1998 ; 1997).

CO₂ , MAP(modified atmosphere packaging) , MAP CO₂ : N₂ : O₂ . 70 80% 가

CO₂ 가 (PET) (PE) -50 (Kim, 1998).

100 , 30

가 130 160

96) Gill (1996)

Kim (1999)

pH, TBA가 (0±2) 가 (3±1)

(1±1) pH TBA가 (500g)

7 Hunter color a b가 가

Gill (1996)

oxynyoglobin

Deoxy- oxynyoglobin metnyog

lobin

metnyoglobin 가 (500g)

(500g)

(dipping method) (spraying method)

1.

(500g)

가 ,

500g

2,000

(Final Processing)

(%),

가 . 5

10

(60 x 5 x 10)

20

OPP/PE

(%)

OPP/PE

, pH, 가

2.

500g

가 ()

, 가 . 0c-4C

3

3.

, air chilling

0-3

4.

(0-10c)

OPP/PE

0-3%

2-5L

0-120

0-24

5.

500g

가

OPP/PE

6.

Stonacher Lab Blender honogenizer (17, 18) standard rinse
 AOAC (2) , 50g 50ml 0.1%(w/v)
 peptone water(Difco) 2 0.1ml
 Standard rinse Whirl-pak bag 50g 50ml
 0.1%(w/v) peptone water(Difco) 1 : 1 1 shaking 0.1ml
 0.1%(w/v) peptone water(Difco)
 (18, 19) spiral plating method spread plating
 method standard plate count
 agar(Difco) 30°C, 48
 Log₁₀(CFU/ml)

7.

Hunter color(HunterLab, Color Difference Meter,
 Model D-25M) colorimetric analytical method L, a, b, scale
 single processor optical sensor가

8. TBA가

TBA(2-Thiobarbituric acid)가
 Salih (38) TBA가 ng malonaldehyde/kg sample
 TEP(1, 1, 3, 3-tetrathoxypropane)

9. pH

(17) , pH flat type surface electrode
 4 pH pH meter(AccunetI, Model 50,
 Fisher Scientific Co.)

10. 가

가 9 point hedonic scale 10

. , , 4
가 . 5 가 1-4 ,
가 1 가 6-9 , 가
9 .

11.

12.

pH, TBA가, 가
SAS program .

1.

가)

1)

(after evisceration)

(final products)

500g
 1-3% , 1.5 atm
 10 2cC 30
 90-150 2-3% ,
 (aerobic plate counts, APC) . Table 1
 1-3% 1.5 atm 10
 2cC 30 150
 2% (aerobic plate
 counts, APC) 3% 10
 2% 150 (P <
 0.05) APC 가
 가
 150 3% 가

Table 1. APC values of chicken legs dipped in 2% acetic acid for 150 sec after spray washing at 1.5 atm for 10 sec and storage at 2cC during for 30 min.

Treatments	APC values	
	0d	
/10	3.94 ± 0.145c	
1%AA/10	3.75 ± 0.070ac	
2%AA/10	3.60 ± 0.020a	
3%AA/10	3.41 ± 0.070b	

Mean values with different superscripts in the same column are significantly different (P < 0.05).

Table 2
 1-3% 1.5
 atm 10 2cC 30
 150 3%
 (aerobic plate counts, APC) 1-3%

(P < 0.05)

APC 가

Table 4. APC values of chicken legs dipped in 3% citric acid for 150 sec after spray washing at 1.5 atm for 10 sec and storage at 2°C during for 30 min.

Treatments	APC values
	0d
/10	3.89 ± 0.020d
1%CA/10	3.28 ± 0.020b
2%CA/10	3.15 ± 0.035a
3%CA/10	3.47 ± 0.055c

Mean values with different superscripts in the same column are significantly different (P < 0.05).

Marshall (2000)

1-3% GRAS

2.

가.

1)

가)

(1999. 12. -2000. 3)

(final products)

500g

, 90-150

1-3%

(aerobic plate

counts, APC)

. Table 7

1-3%

90

4°C

1

(aerobic plate counts, APC)

. 2- 3%

90

(P < 0.05)

3%

, 90

1%

(P < 0.05)

Table 5. APC values of chicken legs dipped in different levels of acetic acid for 60 sec.

Treatments	APC values
	0 day
/90	5.13 ± 1.485a
1%AA/90	4.57 ± 0.000a
2%AA/90	4.20 ± 0.135c
3%AA/90	4.00 ± 0.010lc

Mean values with different superscripts in the same column are significantly different (P < 0.05).

가 3% 가
 가 , Kin Marshall (2000) 1.5Kg
 . Table 6 1-3%
 150 4C 1
 (aerobic plate counts, APC) . 1
 - 3% 150 가 (P <
 0.05).

Table 6. APC values of chicken legs dipped in different levels of acetic acid for 150 sec.

Treatments	APC values
	0d
/150	4.51 ± 0.075a
1%AA/150	3.84 ± 0.040b
2%AA/150	3.54 ± 0.120c
3%AA/150	3.20 ± 0.125d

Mean values with different superscripts in the same column are significantly different (P < 0.05).

TSP
 3 500g
 . 1% , 1% TSP 5% TSP 10 ,
 Fig. 9 . 5.08 log unit,
 4.35 log unit,
 3.30 log unit (Fig. 1). 1% , 1%
 TSP 5%TSP 10 가 4.88, 4.83,
 3.13 log unit . 1% , 1% TSP 5%TSP 10

가 4.24, 4.28, 2.75 log unit .
 1% , 1% TSP 5%TSP 10
 가 1.54, 2.62, 1.15 log unit .
 1% TSP
 1% (P < 0.05)
 1% 5% TSP
 (P < 0.05) . Kim (1998)

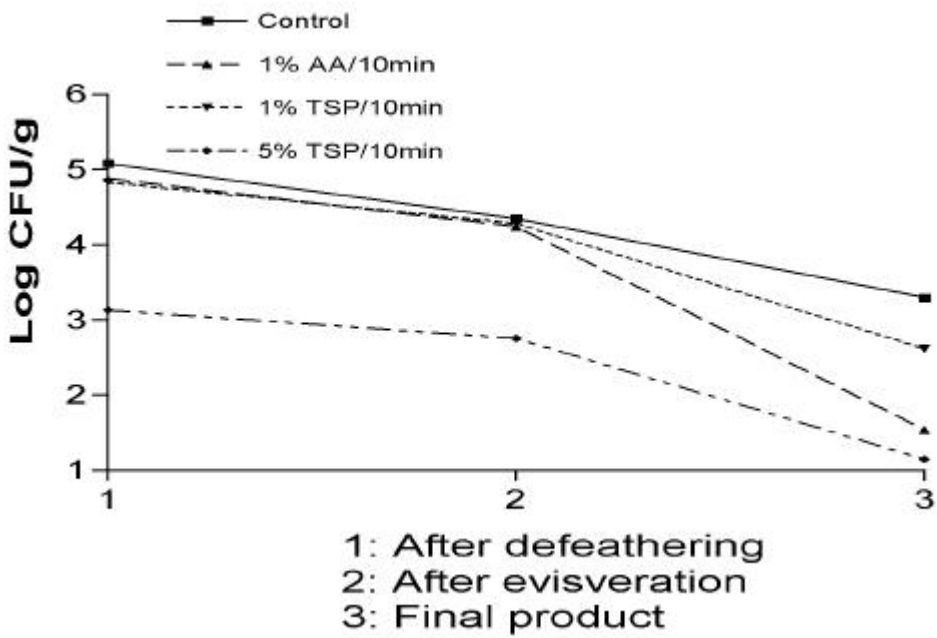


Fig. 1. Changes of GNC values* on chicken breast obtained from a commercial chicken-processing plant.

5.58 log CFU/g,
 5.34 log CFU/g,
 4.08 log CFU/g (Fig. 2). 1%
 , 1% TSP 5%TSP 10 가 5.31,
 5.38, 4.70 5% TSP (P < 0.05)
 . 1% , 1% TSP 5%TSP 10 가
 4.52, 5.02, 4.67 1% 5% TSP
 1% TSP (P < 0.05) .

1% , 1% TSP 5% TSP 10 가
 3.40, 3.98, 3.74 1% , 1% TSP 5% TSP
 (P < 0.05)

가 가

Salmonella spp.

가

TSP

가 가

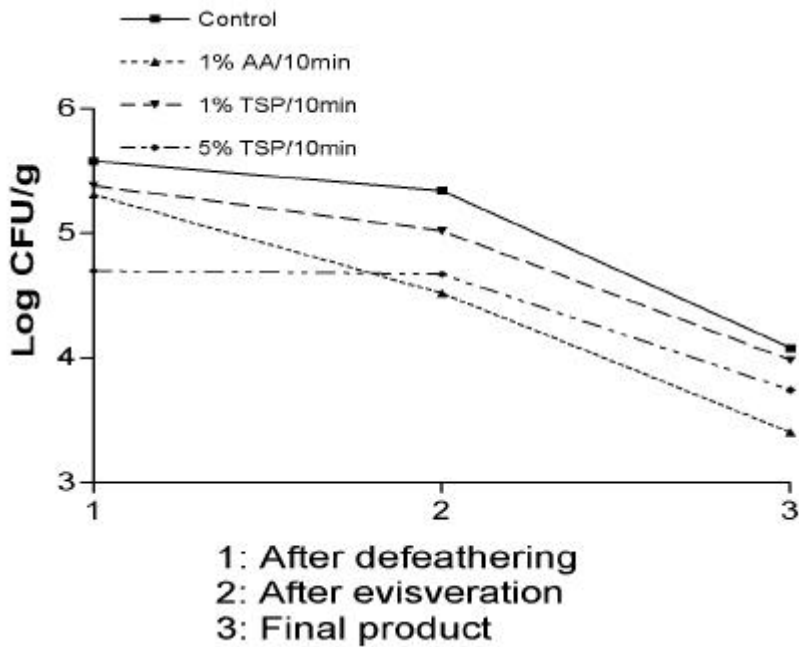
TSP

Salmonella spp.

가 가

(Seward , 1986). Post (1963) sodium polyphosphate (SPG) ,
 "hexametaphosphate" 0.1%

SPG Mg++ 2가



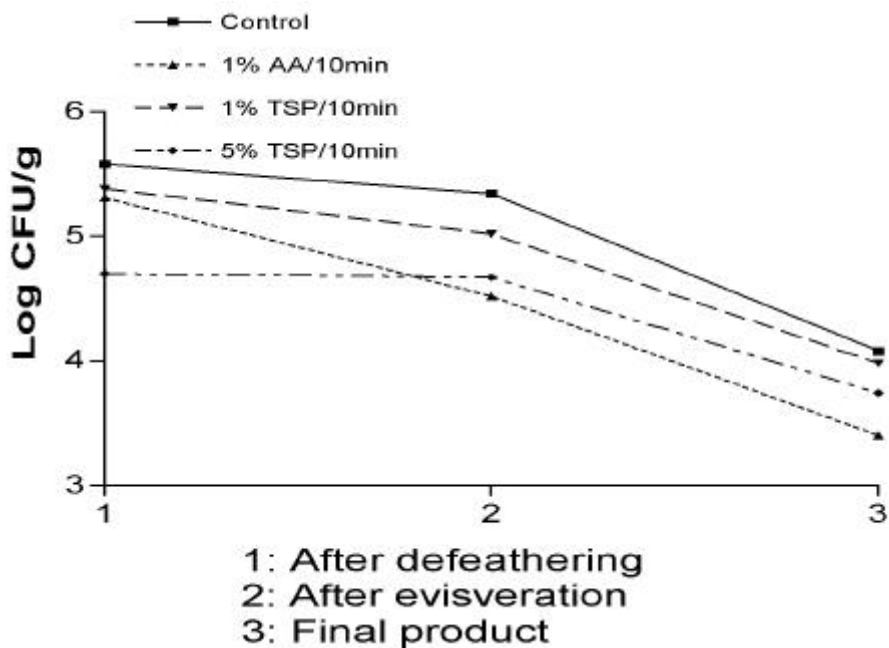


Fig. 2. Changes of APC values* on chicken breast obtained from a commercial chicken-processing plant.

) : (2000. 6-8) (final products)

. 500g , 90-150

1-3% ,

(aerobic plate counts, APC) . Table 7 1-3%

60 4C 1

(aerobic plate counts, APC) .

1- 3% 60 가 (P <

0.05). 3% 60 0.82 log unit

Table 7. APC values of chicken breast dipped in different levels of acetic acid for 60 sec.

Treatments	APC values
	0 day
/60	4.26±
1%AA/60	3.77±
2%AA/60	3.50±
3%AA/60	3.44±

Mean values with different superscripts in the same column are significantly different ($P < 0.05$).

Table 8

Treatments	APC values	
	4-6%	60
/60	4.13 ^a ±	60
4%AA/60	3.08 ^b ±	60
5%AA/60	3.05 ^b ±	60
6%AA/60	2.79 ^c ±	60

(aerobic plate counts, 60 sec.)

Mean difference: 1.34 log unit

Table 8. APC values of chicken breast dipped in different levels of acetic acid for 60 sec.

Treatments	APC values	
	1-3%	120
/120	4.81 ^a ±	120
1%AA/120	4.20 ^b ±	120
2%AA/120	3.59 ^c ±	120
3%AA/120	3.20 ^c ±	120

Mean values with different superscripts in the same column are significantly different ($P < 0.05$).

Table 9

Treatments	APC values	
	1-3%	120
/120	4.81 ^a ±	120
1%AA/120	4.20 ^b ±	120
2%AA/120	3.59 ^c ±	120
3%AA/120	3.20 ^c ±	120

(aerobic plate counts, 120 sec.)

Mean difference: 1.61 log unit

Table 9. APC values of chicken breast dipped in different levels of acetic acid for 120 sec.

Treatments	APC values	
	1-3%	120
/120	4.81 ^a ±	120
1%AA/120	4.20 ^b ±	120
2%AA/120	3.59 ^c ±	120
3%AA/120	3.20 ^c ±	120

Mean values with different superscripts in the same column are significantly different ($P < 0.05$).

: Table 9 1-3%

150 (aerobic plate counts, APC) 4C 1 2- 3% 150 가 (P < 0.05).

Table 9. APC values of chicken legs dipped in different levels of lactic acid for 150 sec.

Treatments	APC values
	0d
/150	4.00 ± 0.065b
1%LA/150	3.68 ± 0.115b
2%LA/150	3.23 ± 0.035a
3%LA/150	3.12 ± 0.060a

Mean values with different superscripts in the same column are significantly different (P < 0.05).

: Table 10 1-3% 150 4C 1 2- 3% 150 가 (P < 0.05).

Table 10. APC values of chicken legs dipped in different levels of citric acid for 150 sec.

Treatments	APC values
	0d
/150	4.08 ± 0.020a
1%CA/150	3.95 ± 0.115a
2%CA/150	3.73 ± 0.010b
3%CA/150	3.57 ± 0.015b

Mean values with different superscripts in the same column are significantly different (P < 0.05).

Kim (1998) (2 ± 2) 500g (, 가 ,) 4 , 7 4 가 10 4 .

Kim (1998)

가 (P<0.05)

(

2)

(final products)

500g

, 60-150

1-3%

pH, color, TBA

가

가) :

:

(1)

Table 11

1-3%

150

4°C

1

pH

. 1

- 3%

150

가

(P <

0.05).

Table 11. Mean pH values of chicken legs dipped in different levels of acetic acid for 150 sec.

Treatments	pH values
	0 days
/150	6.77 ± 0.057d
1%AA/150	5.98 ± 0.223c
2%AA/150	5.47 ± 0.160b
3%AA/150	5.10 ± 0.048a

Mean values with different superscripts in the same column are significantly different (P < 0.05).

Table 12

1-3%

150

4°C

1

Hunter color I*가

. 1 - 3%

150

가

Table 12. Mean color I* values of chicken legs dipped in different levels of acetic acid for 150 sec.

Treatments	Color-L values
	0d
/150	61.3 ± 1.027a
1%AA/150	64.7 ± 0.670b
2%AA/150	64.7 ± 0.411b
3%AA/150	67.3 ± 0.520c

Mean values with different superscripts in the same column are significantly different (P < 0.05).

Table 13. Mean color a* values of chicken legs dipped in different levels of acetic acid for 150 sec.

Treatments	Color-a values
	0d
/150	15.6 ± 1.552c
1%AA/150	11.7 ± 0.571b
2%AA/150	10.1 ± 0.625a
3%AA/150	10.2 ± 0.200a

Mean values with different superscripts in the same column are significantly different (P < 0.05).

Table 14. Mean color b* values of chicken legs dipped in different levels of acetic acid for 150 sec.

Treatments	Color-b values
	0d
/150	-8.0 ± 0.454a
1%AA/150	-6.1 ± 0.612c
2%AA/150	-6.6 ± 0.508b
3%AA/150	-4.5 ± 0.483d

Mean values with different superscripts in the same column are significantly different (P < 0.05).

different ($P < 0.05$).

a-5) 가

10

가 9 point hedonic scale

5

6-9 , 가

9

1-4 , 가

1

Table 16

1-3%

150

4cC

1

1 - 3%

150

가

(P

< 0.05).

Table 16. Mean odor values of chicken legs dipped in different levels of acetic acid for 150 sec.

Treatments	odor values
	Od
/150	6.75 ± 0.412d
1%AA/150	6.00 ± 0.267c
2%AA/150	5.00 ± 0.000b
3%AA/150	4.75 ± 0.164a

Mean values with different superscripts in the same column are significantly different ($P < 0.05$).

Table 17

1-3%

150

4cC

1

2 - 3%

150

가

(P

< 0.05).

Table 17. Mean appearance values of chicken legs dipped in different levels of acetic acid for 150 sec.

Treatments	appearance values
	Od
/150	6.38 ± 0.263c
1%AA/150	6.50 ± 0.327c
2%AA/150	5.50 ± 0.189b
3%AA/150	4.50 ± 0.189a

Mean values with different superscripts in the same column are significantly

different (P < 0.05).

Table 18
 150 4C 1-3% pH가
 . 1 - 3% 150
 가 (P < 0.05).

Table 18. Mean pH values of chicken legs dipped in different levels of lactic acid for 150 sec.

Treatments	pH values
	0d
/150	6.80 ± 0.100d
1%LA/150	6.35 ± 0.047c
2%LA/150	5.72 ± 0.129b
3%LA/150	5.11 ± 0.129a

Mean values with different superscripts in the same column are significantly different (P < 0.05).

Table 19 1-3% 150
 4C 1 Hunter color I*가
 . 1 - 3% 150 가
 (P > 0.05).

Table 19. Mean color I* values of chicken legs dipped in different levels of lactic acid for 150 sec.

Treatments	Color-L values
	0d
/150	65.1 ± 0.834a
1%LA/150	62.3 ± 0.330a
2%LA/150	63.8 ± 1.235a
3%LA/150	64.0 ± 0.507a

Mean values with different superscripts in the same column are significantly different (P < 0.05).

Table 20 1-3% 150
 4C 1 Hunter color a*가
 . 1 - 3% 150
 가 (P > 0.05).

Table 20. Mean color a* values of chicken legs dipped in different levels of lactic acid for 150 sec.

Treatments	Color-a values
	0d
/150	9.2 ± 0.782a
1%LA/150	10.4 ± 0.496a
2%LA/150	9.0 ± 0.813a
3%LA/150	7.3 ± 0.917a

Mean values with different superscripts in the same column are significantly different (P < 0.05).

Table 21. Mean color b* values of chicken legs dipped in different levels of lactic acid for 150 sec.

Treatments	Color-b values
	0d
/150	-4.5 ± 0.892a
1%LA/150	-3.8 ± 0.391a
2%LA/150	-4.8 ± 0.748a
3%LA/150	-2.4 ± 0.891a

Mean values with different superscripts in the same column are significantly different (P < 0.05).

Table 22. Mean odor values of chicken legs dipped in different levels of lactic acid for 150 sec.

Treatments	odor values
	0d
/150	6.75 ± 0.164cd
1%LA/150	6.25 ± 0.313c
2%LA/150	4.00 ± 0.263a
3%LA/150	5.50 ± 0.189ab

Mean values with different superscripts in the same column are significantly different (P < 0.05).

Table 22. Mean appearance values of chicken legs dipped in different levels of lactic acid for 150 sec. (P > 0.05).

Table 23. Mean appearance values of chicken legs dipped in different levels of lactic acid for 150 sec.

Treatments	appearance values
	0 day
/150	6.25 ± 0.313c
1%LA/150	6.50 ± 0.189cd
2%LA/150	4.63 ± 0.263ab
3%LA/150	4.13 ± 0.125a

Mean values with different superscripts in the same column are significantly different (P < 0.05).

(2)

1) OPP/PE

a)

a-1)

500g, 150 OPP/PE (aerobic plate counts, APC)

Table 24. Mean appearance values of chicken legs dipped in different levels of lactic acid for 150 sec. (P > 0.05)

< 0.05). 16 , 5%
 0 APC가 .

Table 24. APC values of refrigerated (4°C) chicken wings dipped in different levels of acetic acid for 150 sec and packaged in OPP/PE film.

Treatments	APC values				
	0d	4d	8d	12d	16d
/150	3.56 ± 0.080c	4.16 ± 0.075d	5.62 ± 0.335d	6.08 ± 0.18d	7.29 ± 0.035c
1%AA/150	3.65 ± 0.065cd	3.60 ± 0.100c	4.39 ± 0.070c	4.30 ± 0.00c	7.87 ± 0.060c
3%AA/150	3.32 ± 0.040ab	3.02 ± 0.020b	3.02 ± 0.020a	3.06 ± 0.020b	4.39 ± 0.310b
5%AA/150	3.22 ± 0.10a	2.71 ± 0.08a	3.02 ± 0.020a	2.42 ± 0.035a	2.35 ± 0.350a

Mean values with different superscripts in the same column are significantly different (P < 0.05).

: Table 25 1-5%
 150 4°C 1 OPP/PE
 4°C (aerobic plate counts, APC)
 . 3 - 5% 150 가
 (P < 0.05). 16 ,
 APC가 .

Table 25. APC values of refrigerated (4°C) chicken wings dipped in different levels of lactic acid for 150 sec and packaged in OPP/PE film.

Treatments	APC values				
	0d	4d	8d	12d	16d
/150	3.91 ± 0.030b	5.50 ± 0.010c	7.49 ± 0.035c	7.36 ± 0.130cd	7.90 ± 0.035d
1%LA/150	3.48 ± 0.020b	3.62 ± 0.235b	6.64 ± 0.000b	7.16 ± 0.075c	7.77 ± 0.060c
3%LA/150	2.91 ± 0.145a	2.26 ± 0.060a	3.92 ± 0.020a	5.40 ± 0.035b	6.66 ± 0.065b
5%LA/150	2.89 ± 0.150a	2.35 ± 0.050a	4.00 ± 0.000a	4.46 ± 0.005a	6.46 ± 0.025a

Mean values with different superscripts in the same column are significantly different (P < 0.05).

: Table 26 1-5%
 150 4°C 1 OPP/PE
 4°C (aerobic plate counts, APC)
 . 3 - 5% 150
 가 (P < 0.05). 12 .

Table 26. APC values of refrigerated (4°C) chicken wings dipped in different levels of citric acid for 150 sec and packaged in OPP/PE film.

Treatments	APC values				
	0d	4d	8d	12d	16d
/150	3.81 ± 0.050c	4.89 ± 0.190d	5.91 ± 0.080a	6.78 ± 0.220c	7.31 ± 0.200ab
1%CA/150	3.53 ± 0.040c	3.33 ± 0.125c	5.51 ± 0.170a	7.16 ± 0.120cd	8.08 ± 0.000c
3%CA/150	3.13 ± 0.050a	3.25 ± 0.070b	5.15 ± 0.250a	5.50 ± 0.215ab	8.24 ± 0.085cd
5%CA/150	3.09 ± 0.090a	2.55 ± 0.010a	4.47 ± 0.385a	5.44 ± 0.355a	7.17 ± 0.060a

α-mean values with different superscripts in the same column are significantly different (P < 0.05).

3-4 7
 OPP/PE . CO₂,
 MAP MPP packaging 가 , MAP
 (modified atmosphere packaging) CO₂
 가 가 CO₂가 (Gill,
 1996). , MAP CO₂ CO₂ 가
 (*Pseudomonas* spp.) 2
 .
 (*Lactobacillus* spp.) 가 (Gill, 1996 ;
 Molins, 1991).
 . *Pseudomonas* spp.
 .
 (*Clostridium* spp.)
 (Molins, 1991). CO₂ 가
Pseudomonas spp.
 CO₂ , O₂, N₂ MA .
Lactobacillus spp. *Leuconostoc* spp.
Lactococcus spp. *Streptococcus* spp. (Gill, 1996 ; Molins,
 1991).
 b)
 b-1)
 :
 () (final products)

500g , 150 1-5% ,
 OPP/PE
 4°C pH, color, TBA 가 .
 Table 27 1-5% 150
 4°C 1 OPP/PE 4°C
 pH 1 - 5% 150
 (P < 0.05) 8

Table 27. Mean pH values of refrigerated (4°C) chicken wings dipped in different levels of acetic acid for 150 sec and packaged in OPP/PE film.

Treatments	pH values				
	0d	4d	8d	12d	16d
/150	6.94 ± 0.090d	6.93 ± 0.053d	7.96 ± 0.130d	7.75 ± 0.221cd	7.62 ± 0.066b
1%AA/150	5.74 ± 0.061c	6.55 ± 0.115c	6.75 ± 0.037c	7.27 ± 0.211b	7.66 ± 0.268b
3%AA/150	5.34 ± 0.083b	6.45 ± 0.045b	6.39 ± 0.061b	7.57 ± 0.309c	7.61 ± 0.207b
5%AA/150	5.07 ± 0.103a	5.66 ± 0.050a	5.70 ± 0.068a	5.98 ± 0.025a	6.59 ± 0.267a

Mean values with different superscripts in the same column are significantly different (P < 0.05).

, pH,
 가 (,
 1997).
 pH가
 pH 가
 (,
 , 1997).

Table 28 1-5% 150
 4°C 1 OPP/PE 4°C
 Hunter color I*가 1-5% 150
 4

Table 28. Mean color I* values of refrigerated (4°C) chicken wings dipped in

different levels of acetic acid for 150 sec and packaged in OPP/PE film.

Treatments	color-L values				
	0d	4d	8d	12d	16d
/150	60.2 ± 0.730a	66.8 ± 0.82c	61.1 ± 0.738a	64.9 ± 1.201c	60.9 ± 2.293a
1%AA/150	63.5 ± 0.718b	63.6 ± 0.851a	61.0 ± 0.661a	59.9 ± 1.614a	62.8 ± 0.890b
3%AA/150	65.4 ± 1.090c	66.0 ± 0.810b	66.1 ± 0.210b	63.1 ± 0.652b	65.7 ± 0.965c
5%AA/150	66.6 ± 0.71cd	67.9 ± 1.148d	69.6 ± 1.068c	70.4 ± 0.627d	66.1 ± 0.919c

Mean values with different superscripts in the same column are significantly different (P < 0.05).

Table 29
 4C
 Hunter color a*가
 1-5%
 1
 OPP/PE
 1 - 5%
 150
 8
 (P < 0.05)

Table 29. Mean color a* values of refrigerated (4C) chicken wings dipped in different levels of acetic acid for 150 sec and packaged in OPP/PE film.

Treatments	color-a values				
	0d	4d	8d	12d	16d
/150	20.5 ± 1.679d	10.5 ± 0.681d	19.4 ± 2.324c	26.8 ± 0.909a	9.2 ± 0.873b
1%AA/150	14.8 ± 1.054c	8.8 ± 0.505c	16.7 ± 0.918b	10.5 ± 0.695a	9.3 ± 0.970b
3%AA/150	12.8 ± 0.587b	6.8 ± 0.521b	14.2 ± 0.850b	11.2 ± 0.479a	6.7 ± 0.983a
5%AA/150	8.7 ± 1.177a	4.0 ± 0.252a	6.5 ± 0.397a	9.2 ± 0.476a	13.9 ± 0.596c

Mean values with different superscripts in the same column are significantly different (P < 0.05).

Table 30
 4C
 Hunter color b*가
 1-5%
 1
 OPP/PE
 1 - 5%
 150
 (P < 0.05)

Table 30. Mean color b* values of refrigerated (4C) chicken wings dipped in different levels of acetic acid for 150 sec and packaged in OPP/PE film.

Treatments	color-b values				
	0d	4d	8d	12d	16d
/150	-7.7 ± 0.725a	-4.9 ± 0.959a	-7.1 ± 1.249ab	-0.7 ± 1.260a	-0.1 ± 0.737c
1%AA/150	-3.5 ± 1.932c	-4.5 ± 0.588ab	-6.4 ± 0.680bc	0.7 ± 1.224a	-1.6 ± 1.055b
3%AA/150	-5.4 ± 0.695b	-3.8 ± 0.554bc	-7.5 ± 0.845a	-2.0 ± 0.535a	0.8 ± 1.611c
5%AA/150	-3.5 ± 0.579c	-0.9 ± 0.849d	-2.8 ± 0.428d	-0.8 ± 0.398a	-4.5 ± 0.687a

Mean values with different superscripts in the same column are significantly different (P < 0.05).

Table 31. Mean color TBA values of refrigerated (4C) chicken wings dipped in different levels of acetic acid for 150 sec and packaged in OPP/PE film. (P < 0.05)

Treatments	TBA values				
	0d	4d	8d	12d	16d
/150	0.166 ± 0.006a	0.132 ± 0.003a	0.177 ± 0.012b	0.119 ± 0.003a	0.116 ± 0.004a
1%AA/150	0.236 ± 0.009b	0.171 ± 0.008b	0.150 ± 0.002d	0.184 ± 0.004c	0.181 ± 0.005c
3%AA/150	0.264 ± 0.085b	0.244 ± 0.007d	0.178 ± 0.002c	0.227 ± 0.012d	0.242 ± 0.013b
5%AA/150	0.243 ± 0.005b	0.355 ± 0.009c	0.515 ± 0.005a	0.518 ± 0.001b	0.566 ± 0.017b

Mean values with different superscripts in the same column are significantly different (P < 0.05).

Kim (1999) pH, TBA가

Gray (1996) 가

Gill (1996)

Siu Draper (1978)

Issanchou (1996)

(3±1) (1±1) (0±2) 가
 pH TBA가 (500g
 Hunter color a b가
 가 .
 b-3) 가
 10 가 9 point hedonic scale .
 5 6-9 , 가 9
 , 1-4 , 가 1
 . Table 32 1-5%
 150 4C 1 OPP/PE
 4C 가 . 1 - 5% 150
 (P < 0.05) 8

Table 32. Mean odor values of refrigerated (4C) chicken wings dipped in different levels of acetic acid for 150 sec and packaged in OPP/PE film.

Treatments	odor values				
	0d	4d	8d	12d	16d
/150	6.50 ± 0.189d	5.50 ± 0.327d	3.25 ± 0.164a	1.00 ± 0.000a	1.00 ± 0.000a
1%AA/150	5.75 ± 0.164c	5.13 ± 0.295c	4.00 ± 0.378b	1.25 ± 0.164ab	1.50 ± 0.189b
3%AA/150	5.25 ± 0.313b	4.50 ± 0.189b	4.00 ± 0.189c	2.50 ± 0.189c	2.00 ± 0.000c
5%AA/150	3.88 ± 0.227a	4.13 ± 0.350a	3.50 ± 0.189c	3.00 ± 0.00d	2.25 ± 0.164d

Mean values with different superscripts in the same column are significantly different (P < 0.05).

Table 33 1-5% 150
 4C 1 OPP/PE 4C
 가 . 3 - 5% 150
 8

Table 33. Mean appearance values of refrigerated (4C) chicken wings dipped in different levels of acetic acid for 150 sec and packaged in OPP/PE film.

Treatments	appearance values				
	0d	4d	8d	12d	16d
/150	6.50 ± 0.189c	5.63 ± 0.274c	3.50 ± 0.189a	1.38 ± 0.18ab	1.00 ± 0.000a
1%AA/150	6.38 ± 0.183c	5.50 ± 0.189c	4.00 ± 0.267b	1.25 ± 0.164a	1.00 ± 0.000a
3%AA/150	5.88 ± 0.227b	5.13 ± 0.295b	4.75 ± 0.164c	1.38 ± 0.183ab	1.38 ± 0.183b
5%AA/150	4.25 ± 0.164a	4.50 ± 0.116a	4.13 ± 0.227b	3.00 ± 0.000c	2.00 ± 0.000c

Mean values with different superscripts in the same column are significantly different (P < 0.05).

:

b-4)

Table 34	1-5%	150
4C	1	OPP/PE
pH	1 - 5%	150
	(P < 0.05)	, 3-5% 8

Table 34. Mean pH values of refrigerated (4C) chicken wings dipped in different levels of lactic acid for 150 sec and packaged in OPP/PE film.

Treatments	pH values				
	0d	4d	8d	12d	16d
/150	6.90 ± 0.127d	6.67 ± 0.085c	7.47 ± 0.234cd	8.00 ± 0.150d	7.65 ± 0.190c
1%LA/150	5.80 ± 0.065c	6.66 ± 0.111c	7.24 ± 0.218c	7.76 ± 0.189c	7.81 ± 0.157cd
3%LA/150	5.08 ± 0.064b	6.17 ± 0.074b	6.10 ± 0.140ab	7.54 ± 0.291b	7.30 ± 0.342b
5%LA/150	4.78 ± 0.042a	5.95 ± 0.061a	5.93 ± 0.081a	6.44 ± 0.129a	6.49 ± 0.204a

Mean values with different superscripts in the same column are significantly different (P < 0.05).

Table 35	1-5%	150
4C	1	OPP/PE
Hunter color L*가	1 - 5%	150
	(P < 0.05)	, 4

가 .

Table 35. Mean color L* values of refrigerated (4C) chicken wings dipped in different levels of lactic acid for 150 sec and packaged in OPP/PE film.

Treatments	color-L values				
	0d	4d	8d	12d	16d
/150	65.7 ± 1.264d	65.9 ± 1.107a	61.3 ± 0.971a	63.6 ± 0.831b	65.6 ± 0.712a
1%LA/150	62.3 ± 0.566c	68.2 ± 1.103a	62.6 ± 0.662b	63.9 ± 0.701c	65.1 ± 0.955a
3%LA/150	60.3 ± 0.874b	66.9 ± 0.374a	63.4 ± 0.373c	61.4 ± 0.974a	62.7 ± 0.704a
5%LA/150	57.8 ± 0.414a	65.7 ± 0.773a	65.3 ± 0.773d	65.6 ± 0.460d	66.2 ± 1.178a

Mean values with different superscripts in the same column are significantly different (P < 0.05).

Table 36. Mean color a* values of refrigerated (4C) chicken wings dipped in different levels of lactic acid for 150 sec and packaged in OPP/PE film.

Treatments	color-a values				
	0d	4d	8d	12d	16d
/150	14.2 ± 0.958a	9.0 ± 0.468a	19.1 ± 1.500a	23.6 ± 1.140d	5.3 ± 0.348a
1%LA/150	21.9 ± 0.495d	8.5 ± 0.027a	22.7 ± 1.598a	18.1 ± 1.128c	6.0 ± 0.462a
3%LA/150	17.1 ± 1.355c	8.4 ± 0.424a	19.6 ± 1.264a	15.1 ± 0.424ab	6.1 ± 0.480a
5%LA/150	16.6 ± 1.391b	9.2 ± 0.508a	21.2 ± 1.586a	14.6 ± 0.839a	6.8 ± 0.789a

Mean values with different superscripts in the same column are significantly different (P < 0.05).

Table 37. Mean color b* values of refrigerated (4C) chicken wings dipped in different levels of lactic acid for 150 sec and packaged in OPP/PE film.

Treatments	color-b values				
	0d	4d	8d	12d	16d
/150	-5.2 ± 0.806b	-1.1 ± 0.777d	-7.7 ± 1.348a	-4.0 ± 0.918a	4.5 ± 1.493a
1%LA/150	-9.6 ± 1.161a	-2.6 ± 0.824c	-10.1 ± 0.720a	-2.0 ± 1.680a	3.3 ± 1.144a
3%LA/150	-4.6 ± 1.664b	-4.0 ± 0.868ab	-6.2 ± 1.544a	-3.1 ± 0.802a	1.5 ± 2.217a
5%LA/150	-2.6 ± 0.614lc	-4.4 ± 1.001a	-10.7 ± 1.193a	-5.0 ± 0.453a	-1.1 ± 0.760a

Mean values with different superscripts in the same column are significantly different (P < 0.05).

Gill (1996)

oxymyoglobin

Deoxy-oxymyoglobin

metmyoglobin

metmyoglobin

가

Gray (1996)

Newburg Concon (1980) malonaldehyde

Table 38

1-5%

150

4C

1

OPP/PE

4C

TBA가

1 - 5%

150

(P < 0.05)

4

Table 38. Mean TBA values of refrigerated (4C) chicken wings dipped in different levels of lactic acid for 150 sec and packaged in OPP/PE film.

Treatments	TBA values				
	0d	4d	8d	12d	16d
/150	0.136 ± 0.003c	0.114 ± 0.002a	0.113 ± 0.003a	0.132 ± 0.002b	0.120 ± 0.002a
1%LA/150	0.164 ± 0.008d	0.137 ± 0.008b	0.149 ± 0.003b	0.109 ± 0.002a	0.160 ± 0.003b
3%LA/150	0.122 ± 0.001ab	0.207 ± 0.001c	0.386 ± 0.005d	0.211 ± 0.006c	0.218 ± 0.005c
5%LA/150	0.121 ± 0.002a	0.220 ± 0.001d	0.347 ± 0.004c	0.407 ± 0.010d	0.477 ± 0.007d

Mean values with different superscripts in the same column are significantly different (P < 0.05).

5) 가

10

가 9 point hedonic scale

5

6-9 , 가

9

Table 39. Mean odor values of refrigerated (4C) chicken wings dipped in different levels of lactic acid for 150 sec and packaged in OPP/PE film.

Table 39. Mean odor values of refrigerated (4C) chicken wings dipped in different levels of lactic acid for 150 sec and packaged in OPP/PE film.

Treatments	odor values				
	0d	4d	8d	12d	16d
/150	6.50 ± 0.189d	5.75 ± 0.164c	2.00 ± 0.000a	1.00 ± 0.000a	1.00 ± 0.000a
1%LA/150	5.75 ± 0.313tc	5.75 ± 0.164c	3.00 ± 0.378b	1.00 ± 0.000a	1.00 ± 0.000a
3%LA/150	5.50 ± 0.423b	5.00 ± 0.000b	3.50 ± 0.189c	2.25 ± 0.164b	1.50 ± 0.189b
5%LA/150	5.00 ± 0.378a	4.25 ± 0.164a	4.25 ± 0.164d	2.50 ± 0.189tc	1.75 ± 0.313tc

Mean values with different superscripts in the same column are significantly different (P < 0.05).

Table 40. Mean appearance values of refrigerated (4C) chicken wings dipped in different levels of lactic acid for 150 sec and packaged in OPP/PE film.

Table 40. Mean appearance values of refrigerated (4C) chicken wings dipped in different levels of lactic acid for 150 sec and packaged in OPP/PE film.

Treatments	appearance values				
	0d	4d	8d	12d	16d
/150	5.50 ± 0.423a	4.75 ± 0.164c	3.00 ± 0.000b	1.00 ± 0.000a	1.00 ± 0.000a
1%LA/150	5.75 ± 0.313a	5.13 ± 0.125d	2.25 ± 0.164a	1.00 ± 0.000a	1.00 ± 0.000a
3%LA/150	4.75 ± 0.313a	4.00 ± 0.295b	3.00 ± 0.267b	1.88 ± 0.227b	1.00 ± 0.000a
5%LA/150	4.75 ± 0.313a	3.75 ± 0.164a	2.25 ± 0.164a	2.13 ± 0.125tc	1.25 ± 0.164a

Mean values with different superscripts in the same column are significantly different (P < 0.05).

(3)

Table 41. ; nozzle, 60ch, Danfoss; Denmark)

(APC) 3% 1 30
 “ 4 ± 1C (APC)
 3%
 2% 1 30”

Table 41. Microbiological changes on refrigerated (4C) whole chicken after spraying treatment with acetic acid (AA) or lactic acid (IA) for 1.30 sec.

Treatments	CFU/cm ²									
	APC		<i>Salmonella</i> spp.		<i>E. coli</i> 0157		<i>Staphylococcus aureus</i>		<i>E. coli</i>	
	0 d	4d	0 d	4d	0d	4d	0d	4d	0d	4d
/1.30	+++	+++	2a	5a	5a	5a	7a	30a	6a	8a
3%IA/1.30	++	++	0b	0b	0b	0b	2b	25a	3b	5b
3%AA/1.30	++	++	0b	1b	0b	0b	1b	10b	1b	2c

Mean values with different superscripts in the same column are significantly different (P < 0.05). +++ = 70-100 CFU/cm², ++ = 30-50 CFU/cm².

3% 1 30“, 0.82L , 4

3.

2,200

(GRAS) 3% 1 - 1 5 3%

2 5 가

()

('99. 11. - '00. 4.) ('00. 5. - '00. 8.) () ()
 500g) GRAS 0-1% (, ,)
 , , 가 OPP/PE .
 , , 가
 ,
 0-180 (dipping
 method) (spray washing method)
 . (OPP/PE film,)
 가
 .
 (after evisceration) 0-3% , ,
 . 2-3% ,
 10 1.5 atr 150
 (P < .05)
 가 . 0-6%
 60 - 150
 1% 150 가 . 1-3%
 90-150 0.5-1.5 log
 unit 3.0 log unit
 가 . 1-5%
 150 OPP/PE 4C
 1% 12 3-5% 16
 .
 GRAS ,
 가
 1%
 . (dipping method) (spraying method)
 가
 . (%) (, ,)
) ()
 . 1-2% 90

가 . , Hunter color L a 가
3%
. 1-5%
150 OPP/PE 4C
pH Hunter color L가 8 TBA가 16
. 3% 1 30"
(*Salmonella* spp, *E. coli*,
Staphylococcus aureus)
1-3%
4C
(shelf-life)

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3

2 :

2

3

.

4. *Salmonella* spp.

5.

6. HACCP system

4. *Salmonella* spp.

Experimental 4 : *Salmonella* spp. incidence and distribution during subsequent chicken processing steps

Summary

Food borne Diseases caused by *Salmonella* are most commonly traced to poultry products. A study was conducted to determine the presence of *Salmonella* in processing carcasses in a commercial poultry slaughterhouse and to identify microbial hazards in the various steps of processing. The incidence of *Salmonella* was done at six sampling points in a poultry slaughterhouse: (1) Pre-scald, (2) Post-scald, (3) Post-pick, (4) Post-evisceration, (5) Post-water chilling and (6) Final products.

Sample were taken from the plant's slaughter line on eleven different occasions. A total of 235 chicken carcasses was tested, *Salmonella* spp. were isolated from 48 (20.4%) of the 235 chicken tested. *Salmonella* incidence rates decreased to 12.8% in final products. The serotypes isolated from chicken carcasses were *S. mbandaka* (3.7%), *S. typhimurium* (11.1%), *S. muenchen* (46.3%), *S. enteritidis* (5.6%), *S. schwarzengrund* (5.5%), *S. paratyphi* (3.7%) and non typable *Salmonella* (24.7%). It has been suggested that there are many stages in poultry processing where cross-contamination of carcasses may occur. Antimicrobial drug susceptibility tests of *Salmonella* isolated were performed by agar disc diffusion method, using 10 antibiotics as follows : cefotaxime (CTX), ampicillin (AM), gentamicin (GM), ciprofloxacin (CIP), cefhalothin (CF), chloramphenicol (C), nalidixic acid (NA), sulfamethoxazole trimethoprim (SXT), tetracyclin (TE) and kanamycin (K). Most of strains were highly susceptible to CTX, GM, CIP, CF, C, and SXT, whereas highly resistant to TE, moderately resistant to AM, NA, and K.

Key words : *Salmonella*, chicken, poultry slaughterhouse, cross-contamination

가

Salmonellosis

Salmonella 10%

가

Salmonella

(shackles),

Salmonella

Salmonella

Salmonella

가

가

Salncrella

가

Salncrella

Salnonella

1% peptone water zipper bag

(Standard Rinse Method)

50

37

6

pre-incubation zipper bag

1 ml

10 ml

selenite cystine broth

37

24

selenite cystine broth 50μℓ

Salncrella

XIT-4 agar

37

24

48

colony

1. 가 ()
 가 5 50 *Salmonella*
 가 54%가 *Salmonella*
 (1).

1. Incidence of *Salmonella* spp. of broiler chickens from five different farms, as determined on arrival at the processing plant in winter (n = 50)

Farm	No. of samples	No. positive out of 10	% Positive
1	10	7	70%
2	10	5	50%
3	10	3	30%
4	10	4	40%
5	10	8	80%
Total	50	27	54%

50 , *Salmonella* log₁₀ CFU/g
 6.47 ± 0.22 log₁₀ CFU/g가 가
 . 1.5 log₁₀ CFU/g (2).

Table 2. Bacterial counts of broiler chickens entering the processing plant in winter

Location sampled	<i>Salmonella</i> spp. (log ₁₀ CFU/ga)
Feathers	7.12 ± 0.25
Skin	6.47 ± 0.16
Foot	5.82 ± 0.22
Total	3.23 ± 0.25

a Data are the mean CFU ± the standard deviation. Values are the average of 50 chickens.

2. *Salmonella* ()
 가 *Salmonella*
 10 6 (3). *Salmonella* 60 13 (21.6%)
 1.27 ± 0.16 log₁₀ CFU/g .
 가 *Salmonella*

Table 3. Means of bacterial counts, sampling location and number of samples obtained at each processing plant

Sampling location	No. of samples (trial)	<i>Salmonella</i> spp. (log ₁₀ CFU/ga)
Before defeathering	10 (6)	2.19 ± 0.28
After defeathering	10 (6)	1.58 ± 0.24
After eviscerating	10 (6)	1.32 ± 0.17
Before chill	10 (6)	1.24 ± 0.12
After chill	10 (6)	NDb

a Data are the mean CFU ± the standard deviation. IND = none detected

가		<i>Salmonella</i>		<i>Salmonella</i>	
60	5	(4).	<i>Salmonella</i>	<i>Salmonella</i>
		1% peptone water	zipper bag		
(Standard Rinse Method)	50				
.	37	6	pre-incubation	zipper bag	1 ml 10 ml
selenite cystine broth	37	24			selenite
cystine broth 50μl	<i>Salmonella</i>		XIT-4 agar	37	24 48
,	colony		<i>Salmonella</i>		
가	.				

Table 4. Incidence of *Salmonella* spp. in the commercial broiler chickens

Month	No. of samplesa (trial)	<i>Salmonella</i> spp.
November	5 (2)	NDb
December	5 (2)	NDb
January	5 (2)	NDb
February	5 (2)	NDb
March	5 (2)	1c
April	5 (2)	4c

aValues are the average of 60 chickens. IND = none detected. cValues are the numbers of positive samples.

4		<i>Salmonella</i>	
5	.	<i>Salmonella</i>	3
			4

Table 5. Means of bacterial counts of broiler chickens stored at 4 for 3 and 7 days

Storage Time (days)	<i>Salmonella</i> spp.
0	NDa
3	Db
7	Db

ND = none detected. D = detected

Salmonella

가

가

3. 가 ()
 가 5 ()
 50 *Salmonella* 가
 76%가 *Salmonella*
 (. 6).

6. Incidence of *Salmonella* spp. of broiler chickens from five different farms, as determined on arrival at the processing plant in summer (n = 50)

Farm	No. of samples	No. positive out of 10	% Positive
1	10	6	60%
2	10	9	90%
3	10	6	60%
4	10	7	70%
5	10	10	100%
Total	50	38	76%

50 , *Salmonella*
 \log_{10} CFU/g 8.24 ± 0.26
 \log_{10} CFU/g가 가 . $1.3 \log_{10}$ CFU/g
 (7).

Table 7. Bacterial counts of broiler chickens entering the processing plant

Location sampled	<i>Salmonella</i> spp. (log ₁₀ CFU/ga)
Feathers	8.24 ± 0.26
Skin	7.69 ± 0.23
Foot	6.95 ± 0.18
Total	7.63 ± 0.22

a Data are the mean CFU ± the standard deviation. Values are the average of 50 chickens.

4. *Salmonella* ()
가 가
Salmonella 10 6 (8). *Salmonella*
60 21 (35%) 2.28 ± 0.22 log₁₀ CFU/g

Salmonella

Table 8. Means of bacterial counts, sampling location and number of samples obtained at each processing plant in summer

Sampling location	No. of samples (trial)	<i>Salmonella</i> spp. (log ₁₀ CFU/ga)
Before defeathering	10 (6)	3.28 ± 0.32
After defeathering	10 (6)	2.37 ± 0.21
After eviscerating	10 (6)	2.86 ± 0.25
Before chill	10 (6)	1.72 ± 0.18
After chill	10 (6)	1.18 ± 0.13

a Data are the mean CFU ± the standard deviation.

가
가 *Salmonella*
Salmonella 80 11 (9).

Table 9. Incidence of *Salmonella* spp. in the commercial broiler chickens

Month	No. of samplesa (trial)	<i>Salmonella</i> spp.
May	10 (2)	NDb
June	10 (2)	2c
July	10 (2)	3c
August	10 (2)	6c

a Values are the average of 80 chickens. bND = none detected. cValues are the numbers of positive samples

4 30 *Salmonella*
 10 11 . *Salmonella*
 가 가 .

Table 10. Means of bacterial counts of broiler chickens stored at 4 for 3 and 7 days

Storage Time (days)	<i>Salmonella</i> spp.
0	Da
3	Da
7	Da

Da = detected

30 *Salmonella*
 10 . *Salmonella*
 가 가 .

Table 11. Means of bacterial counts of broiler chickens stored at 30 for 3 and 7 days in summer

Storage Time (days)	<i>Salmonella</i> spp.
0	0.90 ± 0.07
3	1.54 ± 0.16
7	1.11 ± 0.12

Salmonella
 .
 ()
Salmonella 가
Salmonella 10 3 (11).
Salmonella .

Table 11. Means of bacterial counts, sampling location and number of samples obtained at each processing plant

Sampling location	No. of samples (trial)	<i>Salmonella</i> spp. (log ₁₀ CFU/ga)
Before defeathering	10 (3)	3.28 ± 0.29
After defeathering	10 (3)	NDb
After eviscerating	10 (3)	1.48 ± 0.22
Before chill	10 (3)	1.13 ± 0.14
After chill	10 (3)	NDb

Data are the mean CFU ± the standard deviation. IND = none detected

5 가 *Salmonella*

54% 76%

Salmonella 50 가

5 가 , 가

Salmonella 가

4 가 *Salmonella*

60

11

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5.

Experimental 5 : Enhancing safety of refrigerated chicken during winter and summer

Summary

Our objective was to evaluate the antimicrobial effects on *Salmonella typhimurium* in refrigerated chicken legs dipped with organic acid. For each treatment, Chicken (average weight of 500 ± 30 g) legs were treated with 0.5-2%(v/v) organic acid and 2.5-10% (w/v) TSP solutions at exposure times of 10 minutes. Controls were sprayed with tap water only at exposure times of 10 minutes. Treated chicken legs were packed in Whirl-pak bags and stored at 4 °C. Samples were appropriately diluted with 1% peptone water and plated on XLT4 agar for *Salmonella typhimurium*. Treatments of 1.0% acetic acid for 10 minutes significantly decreased the growth of *Salmonella typhimurium* for 16 days. Treatments of 2.5-10% (w/v) TSP and 0.5-2%(v/v) acetic acid for 10 minutes significantly reduced the growth of *Salmonella typhimurium* on chicken legs during storage of 12 days compared to controls. However controls treated with tap water rapidly increased the growth of *Salmonella typhimurium* to 2.31 log units for 16 days. No *Salmonella typhimurium* were found in any samples treated with 2.0% acetic acid for 16 days. It was concluded that increasing levels of organic acid by 1.0% exposure times of 10 minutes were an effective preservative for preventing the growth of *Salmonella typhimurium* which could be used to ensure the safety of refrigerated chicken legs. And we can achieve better microbial quality on the poultry meat during processing after using appropriate detergents and sanitizers.

Key words : *Salmonella*, chicken, organic acid, trisodium phosphate,

가 가 가 . 가 , 1981 1993
 44% .
Salmonella spp.
 가 .
 pathogens) . 가
 . 가
 .
 ,
Salmonella spp.
 , , TSP(trisodium phosphate)
 가 ,
 .

1.

1)

Salmonella typhinurium ATCC 13311

. - 70

S. typhinurium

XLT 4 agar

37 , 24

BHI broth

Spectrophotometer(Beckman BUR 650)

가 600nm

105 - 106 CFU/

Ml

2)

가

500g

1

1

(0-4C)

3)

가 : : 가

5cm x 7cm x 3cm

5

(%)

Salmonella typhinurium

105 CFU/ml

4

4

. 1L

105 CFU/ml

Salmonella typhinurium

4

4)

Salmonella typhinurium ATCC 13311

가 : :

가 5cm x 7cm x 3cm

5

3ml (105 CFU/ml)

) *Salmonella typhinurium* ATCC 13311

. 15

25 psi

1.0L

30

30

4C, 100Kg

30

Stonacher bag

100ml

0.1%(w/v)

peptone water(Difco)

1

shaking

. *Salmonella*

10c-10-4

pH 7.0

,

5ml

double-strength buffer peptone water (BPW, Difco)가

37C, 20

1ml

9ml

tetrathionate-hajina broth(Difco)

43C, 27 . Brilliant green sulfa(BGS) agar(Difco),
Modified lysine iron agar(Difco), Xylose lysine tergitol 4 (XLT4) 37C, 24
Log(CFU/ml)

2.

가 , , , ,

,

. 3 HACCP system

1. *Salmonella typhimurium* 105 CFU/ml 4
Salmonella typhimurium 1 ()
2 () . APC GNC 가 *Salmonella*
Salmonella 가 .
가 가 가 . 0.5%
4 ()
Salmonella 4 .
Salmonella typhimurium .
5 , 10 *Salmonella typhimurium* 105 CFU/ml
4 *Salmonella typhimurium* 3(
) 4() . 5 , 10
가 *Salmonella* .
Salmonella
가 . 가 가
가 . 1.0% 2.0%
Salmonella 4 .
Salmonella typhimurium 가 .

Table 1. Mean of *Salmonella typhimurium* counts of chicken treated with acetic acid (AA) for 10 min during storage at laboratory refrigerator (4C).

Treatments	Log ₁₀ CFU/ga				
	0day	4days	8days	12days	16days
0.5%AA/10min	3.30 ± 0.51a	NDb	ND	ND	ND
1.0%AA/10min	ND	ND	ND	ND	ND
1.5%AA/10min	ND	ND	ND	ND	ND
2.0%AA/10min	ND	ND	ND	ND	ND
Control	5.78 ± 0.37	6.50 ± 0.29	5.51 ± 0.16	4.60 ± 0.40	ND

aMeans of 3 replications (Mean ±: standard error). bND = none detected

Table 2. Mean of *Salmonella typhimurium* counts of chicken treated with acetic acid (AA) for 10 min during storage at commercial refrigerator (4C).

Treatments	Log ₁₀ CFU/ga				
	0day	4days	8days	12days	16days
0.5%AA/10min	3.39 ± 0.48 ^a	ND ^b	ND	ND	ND
1.0%AA/10min	ND	ND	ND	ND	ND
1.5%AA/10min	ND	ND	ND	ND	ND
2.0%AA/10min	ND	ND	ND	ND	ND
Control	5.78 ± 0.37	5.93 ± 0.45	6.55 ± 0.39	4.70 ± 0.29	ND

^aMeans of 3 replications (Mean ±: standard error). ^bND = none detected

Table 3. Mean of *Salmonella typhimurium* counts of chicken treated with lactic acid (LA) for 5 min during storage at laboratory refrigerator (4°C).

Treatments	Log ₁₀ CFU/ga				
	0day	4days	8days	12days	16days
1.0%LA/5min	2.31 ± 0.48	ND	ND	ND	ND
2.0%LA/5min	1.54 ± 0.32	ND	ND	ND	ND
3.0%LA/5min	ND	ND	ND	ND	ND
Control	3.50 ± 0.33	3.27 ± 0.23	2.09 ± 0.24	ND	ND

^aMeans of 3 replications (Mean ±: standard error). ^bND = none detected

Treatments	TSP(trisodium phosphate)		<i>Salmonella typhimurium</i>		105 CFU/ml
	4	6	TSP	<i>Salmonella typhimurium</i>	
가	가	가	가	가	5
가	가	가	가	가	2.5% TSP
가	가	가	가	가	4
가	가	가	가	가	가

Table 4. Mean of *Salmonella typhimurium* counts of chicken treated with lactic acid (LA) for 10 min during storage at commercial refrigerator (4°C).

Treatments	Log ₁₀ CFU/ga				
	0day	4days	8days	12days	16days
1.0%LA/10min	2.31 ± 0.48	ND	ND	ND	ND
2.0%LA/10min	ND	ND	ND	ND	ND
3.0%LA/10min	ND	ND	ND	ND	ND
Control	2.09 ± 0.37	3.20 ± 0.39	3.50 ± 0.56	ND	ND

^aMeans of 3 replications (Mean ±: standard error). ^bND = none detected

Table 5. Mean of *Salmonella typhimurium* counts of chicken treated with trisodium phosphate (TSP) for 10min during storage at laboratory refrigerator (4°C).

Treatment	Log ₁₀ CFU/ga				
	0day	4days	8days	12days	16days
2.5% TSP/10min	3.92 ± 0.37a	NDb	ND	ND	ND
5.0% TSP/10min	ND	ND	ND	ND	ND
7.5% TSP/10min	ND	ND	ND	ND	ND
10% TSP/10min	ND	ND	ND	ND	ND
Control	3.05 ± 0.14	3.30 ± 0.26	3.23 ± 0.12	ND	ND

aMeans of 3 replications (Mean ±: standard error). hND = none detected

가 (,)
Salmonella
 (7). 10 *Salmonella*
typhimurium *Salmonella typhimurium*
 . TSP(1% 5%) 10
Salmonella typhimurium
Salmonella typhimurium 가 .
 TSP *Salmonella typhimurium* .

Table 6. Mean of *Salmonella typhimurium* counts of chicken treated with TSP for 10 min. during storage at commercial refrigerator (4C).

Treatments	Log ₁₀ CFU/ga				
	0day	4days	8days	12days	16days
2.5% TSP/10min	1.73 ± 0.10a	NDb	ND	ND	ND
5.0% TSP/10min	ND	ND	ND	ND	ND
7.5% TSP/10min	ND	ND	ND	ND	ND
10% TSP/10min	ND	ND	ND	ND	ND
Control	3.61 ± 0.42	4.26 ± 0.56	4.18 ± 0.32	3.57 ± 0.41	ND

aMeans of 3 replications (Mean ±: standard error). hND = none detected

Table 7. Mean of *Salmonella typhimurium* counts of chicken treated with acetic acid (AA) and trisodium phosphate (TSP) for 10 min. during storage at 4C.

Treatments	Log ₁₀ CFU/ga		
	After defeathering	After eviscerating	After chilling
1% AA/10min	NDb	ND	ND
1% TSP/10min	3.03 ± 0.37	5.72 ± 0.19	4.60 ± 0.73
5% TSP/10min	4.78 ± 0.62	4.83 ± 0.49	5.72 ± 0.19
Control	4.98 ± 0.47	5.15 ± 0.56	4.30 ± 0.46

aMeans of 3 replications (Mean ±: standard error). hND = none detected

2.

가 2000 HACCP system HACCP system
 '99 1

1) HACCP

- 11
 -

2)

-

3)

-

-

Salmonella spp., *Listeria* spp., *Staphylococcus aureus* 3가

-

(3)

TSP (4C), (1 ± 2C)
Salmonella typhinurium 1%
 가 1% 10
S. typhinurium 2%
 10 4C 3% 5
S. typhinurium TSP 5% 10
 1% 1-5% TSP 10 1%
 가 1%

S. typhinurium 가

(2) :

(1)

(*Salmonella* spp.)

1

500g

()

5

1

(30 x 5 x 10)

(4C, 10C),

Salmonella

Salmonella typhinurium

ATCC 13311

가 :

가 5cm x 7cm x 3cm

5

3ml (105 CFU/ml)

) *Salmonella typhinurium* ATCC

13311

15

25 psi

1.0L

30

30 4C, 100Kg 30
 Stomacher bag 100ml 0.1%(w/v) peptone water(Difco) 1
 shaking . *Salmonella*
 10c-10-4 pH 7.0 , 5ml double-strength buffer peptone
 water (BPV, Difco)가 37C, 20 1ml
 9ml tetrathionate-hajina broth(Difco) 43C, 27 .
 Brilliant green sulfa(BGS) agar(Difco), Modified lysine iron agar(Difco), Xylose
 lysine tergitol 4 (XLT4) 37C, 24
 Log₁₀(CFU/ml)
 , , , , , , , ,
 Topax-66, -64,
 P3-oxonia active .
 2)
 1) *Salmonella* 가
Salmonella 가
 10 *Salmonella typhinurium* 105 CFU/ml
 4 *Salmonella typhinurium*
 8 . 4.72 log CFU/g , 4, 8, 12, 16
 1.08, 1.06, 1.08, 2.41 log unit . 1%
Salmonella 8
Salmonella . 1% 4
Salmonella 4
Salmonella 0.91 log unit . 1% 4
Salmonella 8
Salmonella .
Salmonella typhinurium .

Table 8. Mean of *Salmonella typhinurium* counts of chicken treated with organic acid for 10 min. during storage at 4C.

Treatment	<i>Salmonella</i> spp. counts(log ₁₀ CFU/g) a				
	0 day	4 days	8 days	12 days	16 days
Control	4.72 ± 0.11	3.64 ± 0.12	3.66 ± 0.09	3.64 ± 0.12	2.31 ± 0.22
1% Acetic acid	ND ^b	ND	ND	4.65 ± 0.02	2.57 ± 0.35
1% Lactic acid	ND	2.73 ± 0.91	2.30 ± 0.18	4.07 ± 0.60	2.15 ± 0.67
1% Citric acid	ND	ND	ND	2.52 ± 0.25	ND

aMeans of 3 replications (Mean ±: standard error). bND = none detected

	10	<i>Salmonella typhimurium</i> 105 CFU/ml	
2		<i>Salmonella typhimurium</i>	
	9		3.94
log CFU/g	4	2.65 log CFU/g	1.30 log CFU/g
3.63 log CFU/g	가	12, 16	0.77 log CFU/g, 0.78 log CFU/g
		<i>Salmonella</i>	
	4	<i>Salmonella</i>	

Table 9. Mean of *Salmonella typhimurium* counts of chicken treated with organic acid for 10 min. during storage at 2°C.

Treatment	<i>Salmonella</i> spp. counts(log ₁₀ CFU/g) a				
	0 day	4 days	8 days	12 days	16 days
Control	3.94 ± 0.24	2.65 ± 0.02	3.63 ± 0.13	3.17 ± 0.12	3.18 ± 0.40
1% Acetic acid	NDb	ND	3.52 ± 0.15	2.94 ± 0.26	3.01 ± 0.27
1% Lactic acid	ND	ND	3.23 ± 0.24	3.41 ± 0.42	ND
1% Citric acid	ND	ND	3.38 ± 0.39	3.48 ± 0.44	2.92 ± 0.27

aMeans of 3 replications (Mean ±: standard error). ND = none detected

	10	<i>Salmonella typhimurium</i> 105 CFU/ml	
	10	<i>Salmonella typhimurium</i>	
	10		4 2.42
log CFU/g	8, 12	0.62 log CFU/g, 0.72 log CFU/g,	16 1.35 log
CFU/g	가		
		<i>Salmonella</i> 4	
	<i>Salmonella</i>		<i>Salmonella</i>
	가	가	8
	12	3.42 log CFU/g	

Table 10. Mean of *Salmonella typhimurium* counts of chicken treated with organic acid for 10 min. during storage at 10°C.

Treatment	<i>Salmonella</i> spp. counts(log ₁₀ CFU/g) a				
	0 day	4 days	8 days	12 days	16 days
Control	4.23 ± 0.59	2.42 ± 0.17	3.04 ± 0.23	3.06 ± 0.28	3.87 ± 0.64
1% Acetic acid	NDb	ND	1.53 ± 0.31	2.26 ± 0.26	3.25 ± 0.39
1% Lactic acid	ND	ND	ND	3.42 ± 0.38	2.45 ± 0.27
1% Citric acid	ND	ND	2.62 ± 0.10	3.58 ± 0.29	2.63 ± 0.32

aMeans of 3 replications (Mean ±: standard error). ND = none detected

	phosphate 10	<i>Salmonella typhimurium</i> 105 CFU/ml	
4	phosphate	<i>Salmonella typhimurium</i>	
11	5% TSP(trisodium phosphate)		16
	5% SPP(sodium pyrophosphate)		
	16		5% STPP(sodium

tripolyphosphate) 4
 8 12 *Salmonella* 0.78
 log unit 16 0.26 log unit
 phosphate 가 *Salmonella typhinurium*

Table 11. Mean of *Salmonella typhinurium* counts of chicken treated with phosphate for 10 min. during storage at 4°C.

Treatment	<i>Salmonella</i> spp. counts(log ₁₀ CFU/g) a				
	0 day	4 days	8 days	12 days	16 days
Control	3.23 ± 1.48	3.51 ± 0.96	3.30 ± 1.73	2.30 ± 1.23	1.56 ± 0.82
5% TSP	ND ^b	ND	ND	ND	ND
5% SPP	ND	ND	ND	ND	ND
5% STPP	ND	ND	ND	1.52 ± 0.26	1.30 ± 0.35

aMeans of 3 replications (Mean ±: standard error). bND = none detected

phosphate 10 *Salmonella typhinurium* 105 CFU/ml
 2 phosphate *Salmonella typhinurium*
 12 5% TSP(trisodium phosphate)
 16 5% SPP(sodium pyrophosphate)
 16 5% STPP(sodium
 tripolyphosphate) 2
 12 16 *Salmonella* 1.65
 log unit 2°C. phosphate
 가 *Salmonella typhinurium*

Table 12. Mean of *Salmonella typhinurium* counts of chicken treated with phosphate for 10 min. during storage at 2°C.

Treatment	<i>Salmonella</i> spp. counts(log ₁₀ CFU/g) a				
	0 day	4 days	8 days	12 days	16 days
Control	2.30 ± 0.34	3.18 ± 0.73	3.18 ± 1.28	4.00 ± 1.52	4.35 ± 2.36
5% TSP	ND ^b	ND	ND	ND	ND
5% SPP	ND	ND	ND	ND	ND
5% STPP	ND	ND	ND	ND	2.70 ± 0.35

aMeans of 3 replications (Mean ±: standard error). bND = none detected

phosphate 10 *Salmonella typhinurium* 105 CFU/ml
 2 phosphate *Salmonella typhinurium*
 13 5% TSP(trisodium phosphate)
 16 5% SPP(sodium pyrophosphate) 5%
 STPP(sodium tripolyphosphate) 2
 12 16 *Salmonella*
 2.34 log unit, 1.51 log unit 10°C.
 phosphate 가 *Salmonella typhinurium*

Table 13. Mean of *Salmonella typhimurium* counts of chicken treated with phosphate for 10 min during storage at 10C.

Treatment	<i>Salmonella</i> spp. counts(log10 CFU/g) a				
	0 day	4 days	8 days	12 days	16 days
Control	2.70 ± 0.38	3.54 ± 1.29	3.48 ± 1.36	3.90 ± 1.85	5.04 ± 0.25
5% TSP	NDb	ND	ND	ND	ND
5% SPP	ND	ND	ND	ND	2.70 ± 0.48
5% STPP	ND	ND	ND	ND	3.53 ± 0.19

aMeans of 3 replications (Mean ±: standard error). bND = none detected

500g		<i>Salmonella</i>		가	
50g	40,000L	1% (v/v)	Whirl-Pak sample bag	4C	1.0atm
30	1n				2
	40,000L	1.0 atm	30	1n	
	2			4C	
(1%)	1.5 atm	30		4C	16
		2-14	1%	1.0 atm	30
4	8				가
		<i>Salmonella</i> spp. 가		12	<i>Salmonella</i> spp. 가
	16				

Table 14. Mean of *Salmonella* spp. counts of chicken legs treated with 1% organic acid for 30 sec at 1.0 atm during storage at 4C.

Treatment	<i>Salmonella</i> spp. counts(log10 CFU/g) a				
	0 day	4 days	8 days	12 days	16 days
Control	NDb	4.88 ± 1.62	3.94 ± 1.27	3.35 ± 1.56	ND
1% Acetic acid	ND	ND	ND	3.96 ± 0.52	ND
1% Lactic acid	ND	ND	ND	3.91 ± 0.09	ND
1% Citric acid	ND	ND	ND	2.88 ± 0.54	ND

aMeans of 3 replications (Mean ±: standard error). bND = none detected

(1%)	1.5 atm	30		2C	16
<i>Salmonella</i> spp.			2-15	1%	1.0 atm
30					
가		<i>Salmonella</i> spp. 가			
	12	<i>Salmonella</i> spp. 가			

Table 15. Mean of *Salmonella* spp. counts of chicken legs treated with 1% organic acid for 30 sec at 1.0 atm during storage at 2C.

Treatment	<i>Salmonella</i> spp. counts(log10 CFU/g) a				
	0 day	4 days	8 days	12 days	16 days
Control	NDb	4.75 ± 1.28	2.45 ± 1.83	2.95 ± 0.33	5.53 ± 2.37
1% Acetic acid	ND	ND	ND	ND	ND
1% Lactic acid	ND	ND	ND	ND	ND
1% Citric acid	ND	ND	ND	3.42 ± 1.26	ND

aMeans of 3 replications (Mean ±: standard error). IND = none detected

(%) 1.5 atr 30 10cC 16
Salmonella spp. Table 2-16 . 1% 1.0 atm
 30
 가 *Salmonella* spp. 가
 12 *Salmonella* spp. 가

Table 16. Mean of *Salmonella* spp. counts of chicken legs treated with 1% organic acid for 30 sec at 1.0 atm during storage at 10cC.

Treatment	<i>Salmonella</i> spp. counts(log10 CFU/g) a				
	0 day	4 days	8 days	12 days	16 days
Control	NDb	ND	ND	3.23 ± 1.46	1.30 ± 0.37
1% Acetic acid	ND	ND	ND	ND	ND
1% Lactic acid	ND	ND	ND	1.51 ± 1.63	ND
1% Citric acid	ND	ND	ND	ND	ND

aMeans of 3 replications (Mean ±: standard error). IND = none detected

0.5Kg
 40,000L 2.5%, 5% 7.5% (v/v) TSP (trisodium phosphate)
 1.0atm 30 1n
 2 , Whirl-Pak sample bag 4C
 40,000L 1.0 atr
 30 1n 2
 4C
 TSP 1.0 atr 30 4C 16 *Salmonella* spp.
 Table 17
Salmonella 30 1.0 atr
 TSP *Salmonella* 4C 4
 2.5% TSP 5% 7.5% TSP

Table 17. Mean of *Salmonella typhimurium* counts of chicken treated with trisodium phosphate for 10 min. during storage at 4cC.

Treatment	<i>Salmonella</i> spp. counts(log ₁₀ CFU/g) a				
	0 day	4 days	8 days	12 days	16 days
Control	0.91 ± 0.66	1.9 ± 1.7	3.18 ± 1.73	4.48 ± 2.67	0.12 ± 0.03
2.5% TSP	0.02 ± 0.01	NDb	0.06 ± 0.06	3.52 ± 0.34	5.14 ± 0.07
5% TSP	0.06 ± 0.02	ND	0.18 ± 0.18	0.29 ± 0.14	ND
7.5%TSP	0.21 ± 0.39	ND	1.40 ± 0.98	1.35 ± 0.59	0.38 ± 0.22

aMeans of 3 replications (Mean ±: standard error). IND = none detected

TSP 1.0 atrn 30	2cC 16	<i>Salmonella</i>
spp.	18 4cC	
<i>Salmonella</i>	TSP 1.0 atrn 30	
<i>Salmonella</i>	5% 7.5% TSP	4cC 4
	5% TSP가	
TSP 1.0 atrn 30	10cC 16	<i>Salmonella</i>
spp.	2-20 4cC	
<i>Salmonella</i>	TSP 1.0 atrn 30	4
<i>Salmonella</i>		<i>Salmonella</i>

Table 18. Mean of *Salmonella typhimurium* counts of chicken treated with trisodium phosphate for 10 min. during storage at 2°C.

Treatment	<i>Salmonella</i> spp. counts(log ₁₀ CFU/g) a				
	0 day	4 days	8 days	12 days	16 days
Control	0.94 ± 0.67	2.54 ± 0.26	5.35 ± 0.05	3.44 ± 1.24	5.38 ± 2.58
2.5% TSP	0.02 ± 0.01	0.50 ± 0.18	0.36 ± 0.06	0.99 ± 0.01	1.32 ± 0.52
5% TSP	0.06 ± 0.02	NDb	0.24 ± 0.13	1.25 ± 1.34	ND
7.5%TSP	0.55 ± 0.51	ND	2.00 ± 1.60	2.50 ± 2.07	ND

aMeans of 3 replications (Mean ±: standard error). IND = none detected

Table 19. Mean of *Salmonella typhimurium* counts of chicken treated with trisodium phosphate for 10 min. during storage at 10°C.

Treatment	<i>Salmonella</i> spp. counts(log ₁₀ CFU/g) a				
	0 day	4 days	8 days	12 days	16 days
Control	0.91 ± 0.66	4.59 ± 4.01	3.27 ± 0.59	2.86 ± 1.12	0.68 ± 0.23
2.5% TSP	NDb	ND	1.59 ± 1.01	0.13 ± 0.07	ND
5% TSP	ND	ND	1.35 ± 0.75	1.32 ± 1.03	ND
7.5%TSP	ND	ND	1.00 ± 0.58	1.47 ± 1.08	ND

aMeans of 3 replications (Mean ±: standard error). IND = none detected

가	<i>Salmonella</i> spp.
5 3 , Topax-66,	-64, P3-oxonia active
<i>Salmonella</i> spp.	(20). <i>Salmonella</i> spp.
<i>Salmonella</i> spp.가	Topax-66,

-64, P3-oxonia active

Salmonella

가 *Salmonella* spp.

가

가

Table 20. Means of bacterial counts, sampling location and number of samples obtained at each processing plant

Sampling location	No. of samples (trial)	<i>Salmonella</i> spp. counts (log ₁₀ CFU/g) ^a	
		Before cleaning and sanitation	After cleaning and sanitation
Before defeathering	5 (3)	2.25 ± 0.16	2.48 ± 0.22
After defeathering	5 (3)	0.62 ± 0.13	0.28 ± 0.28
After eviscerating	5 (3)	1.28 ± 0.19	0.47 ± 0.21
Before chill	5 (3)	0.26 ± 0.24	ND ^b
After chill	5 (3)	0.06 ± 0.02	ND

^a Data are the mean CFU ± the standard deviation. ^bND = none detected

, TSP (1.5atn, 30 , 1m)
 (4-10C), (2C) *Salmonella typhimurium*
 1% 가 . 1% 10
 105 CFU/ml *S. typhimurium*
 8 *S. typhimurium* .
 10C 4 *S. typhimurium* .
 5% 10 105 CFU/ml *S. typhimurium*
 8 *S.*
typhimurium . (Topax-66, -64,
 P3-oxonia active) *Salmonella* arbs .
 1% 5% TSP, SPP, TSPP
S. typhimurium 가 .

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6.

HACCP system

Experimental 6 : Evaluation of HACCP system and safety of refrigerated chicken

Summary

There was a limited reported on the effectiveness of spray-washing for decontamination of chicken legs treated with organic acid. Our objective was to evaluate the antimicrobial effects on *Salmonella typhimurium* in refrigerated chicken legs rinsed and dipped with organic acid. For each treatment, Chicken (average weight of 500 ± 30 g) legs were sprayed with 1-3% organic acid at 1.0 atm for 10 seconds. Controls were sprayed with tap water only at 1.0 atm for 10 seconds. Treated chicken legs were packed in Whirl-pak bags and stored at 4 °C. Samples were appropriately diluted with 1% peptone water and plated on XLT4 agar for *Salmonella typhimurium*. Treatments of 1-2% organic acid at 1.0 atm for 10 sec significantly decreased the growth of *Salmonella typhimurium*. However controls treated with tap water rapidly increased the growth of *Salmonella typhimurium* to 5.02 log units. No *Salmonella typhimurium* were found in any samples treated with 3.0% organic acid. Chicken (average weight of 500 ± 30 g) legs were treated with 1-5%(v/v) organic acid solutions at exposure times of 150 seconds. Treatments of 1-5%(v/v) acetic acid for 150 seconds significantly reduced the growth of *Salmonella typhimurium* on chicken legs during storage of 16 days compared to controls. And to reduce microbial contamination of poultry meat during processing, we established a Hazard Analysis critical control points (HACCP) model which includes critical limits for each CCP, monitoring procedures and corrective actions. It is expected that microbial quality will be improved with the implementation of the HACCP plan.

Key words : *Salmonella*, chicken, organic acid, HACCP

Salmonella spp.

HACCP system

가

Salmonella

Salmonella

가

4.8%,

24.5%

(Pivnick

),

가

(500g)

(0-4°C)

Salmonella

HACCP system

Salmonella spp.

Salmonella spp.

Salmonella spp.

(HACCP)

(CCP)

1.

(*Salmonella* spp.)

1
500g 1,000
5 1 (30 x
5 x 10)
(Final Processing) (%)
Salmonella 가 5
10 (60 x 5 x 10) (%)
OPP/PE
20
OPP/PE (4C),
(30C),
1
HACCP

2.

500g ()
HACCP system

3.

Salmonella typhinurium ATCC 14028

American Type Culture Collection (ATCC)

가 : : 가 5cm x 7cm x 3cm 5 3ml (10⁸-10⁴ CFU/ml)
) *Salmonella typhinurium* ATCC14028
15 25 psi
1.0L 30 30
4C, 100Kg 30 Stonacher bag 100ml
0.1%(w/v) peptone water(Difco) 1 shaking

4.

1

Topax-66

Salmonella

3

HACCP system

5.

Salmonella

10⁻⁶-10⁻⁴ pH 7.0

, 5ml

double-strength buffer peptone water (BPW, Difco)가

37°C, 20

1ml

9ml

tetrathionate-hajina

broth(Difco)

43°C, 27

Brilliant green

sulfa(BGS) agar(Difco), Modified lysine iron agar(Difco), Xylose lysine tergitol 4

(XLT4)

37°C, 24

Log₁₀CFU/ml

6.

Salmonella

(0-4°C)

(30°C)

OPP/PE

0-3%

2-5L

0-120

0-24

Salmonella

7.

Salmonella

500g

20

OPP/PE

Salmonella

가

OPP/PE

8. HACCP System

HACCP . Hazard analysis 가
, ,
가,
가 .
, ,
, 가 가
, 가
,
. Critical control point
,
가 , ,
가 가 .

9.

SAS program

1. *Salmonella* spp.

Sampling point	No. of positive samples	percentage of positive samples
Pre - scald(at bleed line)	7 / 41	17.1%
Post - scald	6 / 39	15.4%
Post - pick	12 / 40	30%
Post - evisceration	10 / 39	25.6%
Post-water chilling	8 / 37	21.6%
Final product	5 / 39	12.8%
Total	48 / 235	20.4%

2. *Salmonella*

Salmonella spp. 2 가
S. nuerchen .
S. typhimurium 6 (11.1%)가
S. schwarzengrund S.
S. nontevideo S. petahikve
Salmonella spp. 가 13
(*Salmonella* ; Non Typable
Salmonella, NIS).

Table 1. *Salmonella* spp. incidence for broiler carcasses from six sampling points in a commercial processing plant

Sampling point	No. of positive samples / percentage of positive samples
Pre - scald(at bleed line)	7 / 41 17.1
Post - scald	6 / 39 15.4
Post - pick	12 / 40 30.0
Post - evisceration	10 / 39 25.6
Post-water chilling	8 / 37 21.6
Final product	5 / 39 12.8
Total	48 / 235 20.4

Table 2. Serotypes of *Salmonella* isolated for broiler carcasses from six sampling

points in a commercial processing plant

Serotype	No. of strains (%)	Antigenic formula			
		Group	O antigen	H antigen	
				Phase1	Phase2
<i>S. nuenchen</i>	25 (46.3)	C2	6, 8	d	1, 2
<i>S. nantevidaeo</i>	2 (3.7)	C1	6, 7	g, n, s	-
<i>S. schwarzengrund</i>	3 (5.6)	B	4, 12	d	1, 7
<i>S. petahikve</i>	2 (3.7)	E4	1, 3, 9	f, g, t	1, 7
<i>S. typhinurium</i>	6 (11.1)	B	4, 12	i	1, 2
<i>S. essen</i>	3 (5.6)	B	4, 12	g, m	-
NIS	13 (23.1)	E4	na	n	n

a not determined

3. *Salmonella*

Salmonella 4 .

가 . *S. nuenchen*

가 *S. nuenchen* NIS *S. nantevidaeo*가 . *S. nuenchen*가

. 2 *Salmonella*

. *S. schwarzengrund*, *S. petahikve*, *S. essen*, *S. typhinurium* NIS

. NIS가

S. typhinurium . NIS *S. nuenchen*

S. nuenchen *S. nantevidaeo* NIS가

S. nuenchen NIS

S. nuenchen .

. *S. essen* NIS

S. nuenchen .

Table 3. Incidence of *Salmonella* serotypes for broiler carcasses from six sampling points in a commercial processing plant

Sampling point	Occasion of sampling										
	1	2	3	4	5	6	7	8	9	10	11
pre-scald	Mu			Nts	Nts	Mu		Mu		Es	
post-scald	Mu				Mu	Mu Nts				Nts	Mu
post-pick	Mu		Nts Sc Pe	Ty		Mu	Mu Nts				Es
post-evisceration	Mu	Mu Na	Mu Nts Pe	Ty		Mo					
post-water chilling	Mu	Mu Mo	Nts Es	Ty		Mu					
final product	Mu	Mu Mo	Nts Sc Ty	Ty							

Symbols; Mu, *S. nuenchen* ; Mo, *S. ncrtevideo* ; Ty, *S. typhinurium* ; Es, *S. essen*
 Sc, *S. schwarzengrund* ; Pe, *S. petahikve* ; Nts, Non Typable *Salmonella*

4.

	10		
150		<i>Salmonella typhinurium</i>	105 CFU/ml
<i>Salmonella typhinurium</i>			4 - 6 . 3% 10
		<i>Salmonella</i>	. 3%
10	150		<i>Salmonella typhinurium</i>

Table 4. Mean of *Salmonella typhinurium* counts of chicken after spraying treatments with different levels of acetic acid for 10 seconds.

Spraying treatment	Dipping treatment for 150 seconds	
	2% Acetic acid	3% Acetic acid
control	5.02 ± 0.19a	5.02 ± 0.19
1% Acetic acid	4.40 ± 0.15	3.34 ± 0.12
2% Acetic acid	3.26 ± 0.08	1.90 ± 0.11
3% Acetic acid	NDb	ND

aMeans of 3 replications (Mean ±: standard error). IND = none detected

Table 5. Mean of *Salmonella typhinurium* counts of chicken after spraying treatments with different levels of lactic acid for 10 seconds.

Spraying treatment	Dipping treatment for 150 seconds	
	2% Lactic acid	3% Lactic acid
control	5.02 ± 0.19a	5.02 ± 0.19
1% Lactic acid	3.64 ± 0.21	3.11 ± 0.17
2% Lactic acid	2.78 ± 0.13	2.30 ± 0.07
3% Lactic acid	NDb	ND

aMeans of 3 replications (Mean ±: standard error). IND = none detected

Table 6. Mean of *Salmonella typhimurium* counts of chicken after spraying treatments with different levels of citric acid for 10 seconds.

Spraying treatment	Dipping treatment for 150 seconds	
	2% citric acid	3% citric acid
control	5.02 ± 0.19	5.02 ± 0.19
1% citric acid	4.85 ± 0.22	3.72 ± 0.18
2% citric acid	4.72 ± 0.16	3.34 ± 0.21
3% citric acid	NDb	ND

aMeans of 3 replications (Mean ±: standard error). IND = none detected

<i>Salmonella typhimurium</i>	Dipping treatment for 150 seconds		<i>Salmonella typhimurium</i>
	90	150	
105 CFU/ml	150	150	<i>Salmonella typhimurium</i>
7 - 9	3%	3%	<i>Salmonella typhimurium</i>

Table 7. Mean of *Salmonella typhimurium* counts of chicken after dipping treatments with different levels of acetic acid.

Treatments	Dipping treatment time (seconds)	
	90	150
control	4.70 ± 0.24a	4.70 ± 0.34
1% Acetic acid	4.48 ± 0.32	3.62 ± 0.27
2% Acetic acid	4.34 ± 0.28	3.34 ± 0.19
3% Acetic acid	NDb	ND

aMeans of 3 replications (Mean ±: standard error). IND = none detected

Table 8. Mean of *Salmonella typhimurium* counts of chicken after dipping treatments with different levels of lactic acid.

Treatments	Dipping treatments for 150 seconds
control	4.64 ± 0.33a
1% Lactic acid	3.38 ± 0.21
2% Lactic acid	3.15 ± 0.26
3% Lactic acid	NDb

aMeans of 3 replications (Mean ±: standard error). IND = none detected

Table 9. Mean of *Salmonella typhimurium* counts of chicken after spraying treatments with different levels of citric acid for 10 seconds.

Treatments	Dipping treatments for 150 seconds
control	4.54 ± 0.28
1% citric acid	4.52 ± 0.42
2% citric acid	4.45 ± 0.21
3% citric acid	NDb

aMeans of 3 replications (Mean ±: standard error). IND = none detected

	150	OPP/PE
<i>Salmonella typhimurium</i> 105 CFU/ml	4	
<i>Salmonella typhimurium</i>	10 - 12	150
<i>Salmonella</i>		
<i>Salmonella</i>		
가	.	가 가
. 1.0%	3.0%	
<i>Salmonella</i>	4	.
<i>Salmonella typhimurium</i>		가

Table 10. Mean of *Salmonella typhimurium* counts of chicken after dipping treatments with different levels of acetic acid for 150 seconds during storage at laboratory refrigerator (4°C).

Treatment	<i>Salmonella typhimurium</i> counts (log ₁₀ CFU/g) a				
	0day	4days	8days	12days	16days
Control	4.82 ± 0.26a	3.50 ± 0.14	3.52 ± 0.14	4.28 ± 0.05	3.30 ± 0.29
1% acetic acid	4.69 ± 0.26	4.53 ± 0.14	4.28 ± 0.17	4.03 ± 0.19	3.66 ± 0.14
3% acetic acid	4.38 ± 0.13	ND	ND	ND	ND
5% acetic acid	NDb	ND	ND	ND	ND

aMeans of 3 replications (Mean ±: standard error). IND = none detected

Table 11. Mean of *Salmonella typhimurium* counts of chicken after dipping treatments with different levels of lactic acid for 150 seconds during storage at laboratory refrigerator (4°C).

Treatment	<i>Salmonella typhimurium</i> counts (log ₁₀ CFU/g) a				
	0day	4days	8days	12days	16days
Control	4.01 ± 0.18a	3.2 ± 0.20	3.1 ± 0.15	3.7 ± 0.05	ND
1% lactic acid	3.80 ± 0.16	3.52 ± 0.05	ND	ND	ND
3% lactic acid	3.52 ± 0.27	ND	ND	ND	ND
5% lactic acid	NDb	ND	ND	ND	ND

aMeans of 3 replications (Mean ±: standard error). IND = none detected

Topax-66, -64, P3-oxonia active
Salmonella spp.
 (13). Topax-66, -64, P3-oxonia active
 가 *Salmonella*
 가

Table 12. Mean of *Salmonella typhimurium* counts of chicken after dipping treatments with different levels of citric acid for 150 seconds during storage at laboratory refrigerator (4C).

Treatment	<i>Salmonella typhimurium</i> counts(log ₁₀ CFU/g) a				
	0day	4days	8days	12days	16days
Control	4.54 ± 0.32a	3.50 ± 0.14	3.52 ± 0.14	4.28 ± 0.05	3.30 ± 0.18
1% citric acid	4.52 ± 0.27	ND ^b	ND	ND	ND
3% citric acid	4.45 ± 0.23	ND	ND	ND	ND
5% citric acid	ND	ND	ND	ND	ND

aMeans of 3 replications (Mean ±: standard error).
 bND = none detected

Table 13. Means of bacterial counts, sampling location and number of samples obtained at each processing plant

Sampling location	No. of samples (trial)	Bacterial counts(log ₁₀ CFU/g) a	
		Before cleaning and sanitation	After cleaning and sanitation
Before defeathering	5 (3)	6.23 ± 1.64	5.48 ± 1.26
After defeathering	5 (3)	5.32 ± 1.47	4.28 ± 1.59
After eviscerating	5 (3)	5.28 ± 1.19	3.48 ± 1.21
Before chill	5 (3)	4.26 ± 1.42	3.35 ± 1.57
After chill	5 (3)	4.16 ± 1.02	2.47 ± 0.54

a Data are the mean CFU ± the standard deviation.

()

HACCP system

Table 13. HACCP programs for Fine Korea Co.

	1. , 2. 3. () 4.	1. : 83 , 2. 10% 3. 4. 10%	1. : - , : - : $1.0 \times 10^3 / \text{cm}^2$ 2. - : $1.0 \times 10^2 / \text{cm}^2$
	1.	1. 10%	
	1. , 2. 3.	1. : , : 15 2. zero 3.	2. : $1.0 \times 10^2 / \text{cm}^2$
	1. () 2. 3. 4. 5.	1. : 1 2. : 1 3. 4. 5.	1. : $1.0 \times 10^5 / \text{cm}^2$ 2. : $1.0 \times 10^3 / \text{cm}^2$
	1. 2. finger 3. finger 4.	1. 2. . 20% 3. 4. 10%	1. : $1.0 \times 10 / \text{cm}^2$ 2. : $1.0 \times 10^3 / \text{cm}^2$
	1. 2. 3. 4. 5. ,	1. 2. 3. 10% 4. 1.5 atn 5. 20%	1. , , - : $1.0 \times 10^2 / \text{cm}^2$ 2. : $1.0 \times 10 / \text{cm}^2$ 3. - : $1.0 \times 10^2 / \text{cm}^2$

continued

Table 13. continued

	<p>1. air chilling 2. chilling water 3. 4.</p>	<p>1. 4 2. 4 3. 1 2 4. 10</p>	<p>- : $1.0 \times 10^3 / \text{cm}^2$</p>
	<p>1. 2. 3.</p>	<p>1. 2. 3.</p>	
	<p>1. 2. 3.</p>	<p>1. 2. 3. 10%</p>	
		<p>: 5 : -18</p>	
		<p>1 1</p>	

Salmonella

spp. '99. 11-

'00. 4 .

HACCP system 가

Salmonella *Salmonella*

가 500g

2 (0-4C)

Salmonella . ,

Topax-66, -64

HACCP system

235

Salmonella spp. *Salmonella* spp. 235 48 가 20.4%

Salmonella spp. 1 .

bleed knife 41 7 17.1%

39 6 15.4%

40 12 30%

39 10 25.6%

37 8

21.6%

39 5 (12.8%) 가

Salmonella spp. 25 가 47.2%

S. nuenchen . *S. typhimurium*

6 (11.1%)가 *S. schwarzengrund* *S. enterica* 3 5.6%

가 *S. mbandaka* *S. typhimurium*가 2 가 3.7%

Salmonella spp. 가 13

(*Salmonella* ; Non Typhable *Salmonella*, NIS) . ,

Topax-66, -64, P3-oxonia active

Salmonella spp. . Topax-66,

-64, P3-oxonia active

가 *Salmonella* .

가
(CCP) 4 , 1 , 3 , 5
, 4 , 5 , 4 , 3 , 3 ,
,
()
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1.

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가. 가 ().

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