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# ORGANIC ACIDS IN THE CONSERVATION OF REFRIGERATED POULTRY CARCASSES

N.N. TERRA, R.V. MELLO and C.R. VALENTE

Department of Technology and Food Science, UFSM, Santa Maria, RS, Brazil

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## INTRODUCTION

The microbial growth on in poultry carcasses is an important factor to industry because it is associated with decrease in quality deterioration, and consequently with economic loss. In addition, Goren *et al.* (1984) indicated poultry was one of the causes of transmission of enteric sicknesses.

Maintenance of the meat quality is dependent on low initial contamination (Smulders, 1986). The use of organic acids has been recommended as a means for increasing the shelf life of poultry carcasses as well as to guarantee the consumer a decrease in pathogenic microorganisms.

Arafa and Chen (1978) noted immersion of poultry portions in ascorbic acid solutions (1% for three minutes) delayed microbial growth and increased the shelf life six to seven days without causing negative effects in the organoleptic characteristics of the boiled meat.

Van der Marel *et al.* (1988), treating poultry carcasses with 1% and 2% lactic acid reduced the contamination by approximately one logarithmic cycle. The effect of lactic acid on microorganisms has also been studied in pork (Snijders, 1985) and in beef (Hamby, 1987).

The purpose of this work was to compare the effects of the use of solutions (ascorbic/lactic acids) on the conservation of refrigerate poultry carcasses.

## MATERIALS AND METHODS

### Treatments

Recently slaughtered poultry carcasses were submitted to the following treatments:

Treatment 1: water immersion for two minutes (control).
Treatment 2: immersion in ascorbic acid solution 1% for three minutes.
Treatment 3: immersion in ascorbic acid solution 1% for five minutes.
Treatment 4: immersion in ascorbic acid 1%, lactic acid 1% for three minutes.

The water and the immersion solutions were at +2°C. Carcasses were wrapped in plastic bags and stored at 5°C for eleven days after the treatment. Experiments were repeated twice.

Microbiological Analyses

A total area of 12cm$^2$ of carcass skin was swabbed immediately after treatment and after 2, 5, 8 and 11 days of storage. Total counts of strict and optional aerobic microorganisms were made in pattern agar (MERCK) incubated at 32°C for 48 hours. Topal counts of coliforms were made using violet red crystal neutral bile agar (DIFCO), incubated at 37°C for 24 hours. Total counts of psychrotrophs were made using patter agar (MERCK), incubated at 7°C for eight days.

Determination of pH

Skin pH of the carcasses was determined in a DIGIMED potentiometer using a glass electrode, simultaneously with the microbiological analyses.

Residual analysis of the acids

Carcasses were washed with 300ml of deionized water and then, portions were taken for determinations.

Ascorbic acid was determined by titration with potassium iodate, using starch as an indicator (Adolfo Lutz Institute, 1988). Lactic acid was determined colorimetrically using iron chloride for colour development (Silva, 1981).

Sensorial Analysis

Together with the microbiological analysis, the carcasses were submitted to the evaluation of a panel composed by seven tasters who graded from zero to nine the attributes of colour, smell, taste and texture. The grades 9 to the carcasses were considered very good, 7-8 good, 5-6 regular, 3-4 unpleasant and 1-2 unacceptable.

For analysis of taste and texture, pieces of poultry thigh were enveloped in aluminum paper and heated during 40 minutes at a temperature of 200°C.

Statistical Analysis

For microbiological data, analysis of variance was calculated considering the entirely casualized design. Duncan's test was used to check the difference between the averages, considering the significance level of 5% (Gomes, 1987).

Sensory data were analyzed by the quadrisquare test of Friedman. The DMS test was used (CAMPOS, 1987) a to check the difference between the averages.

RESULTS AND DISCUSSION

The effects of the treatments on the counts of total coliforms, total aerobics and psychrotrophics is shown in Table 1.

Significative reduction in the level of coliforms were not observed in any of the treatments, despite numerical differences, because of the high coefficient of variation (CV-47%).

The use of ascorbic acid was effective for the control of total aerobics until the 8th storage day, reducing such contamination by approximately one logarithmic cycle. Similar results were found by Arafa and Chen (1987) when they used 1% ascorbic acid for during 3 minutes in pieces of poultry.

Increase in the period during which carcasses were in 1% ascorbic acid solution immersion from three to five minutes

did not result in a significant reduction in the population of aerobics.

Efficiency for control of total aerobics with the combination of ascorbic and lactic acids was monitored until the 8th day. Aerobes were reduced by approximately two logarithmic cycles when compared to control samples and by approximately one logarithmic cycle when compared to the use of 1% of ascorbic acid. Van der Marel *et al.* (1988) treated poultry with 1% lactic acid and reduced the contamination by approximately one logarithmic cycle. However, the greatest reduction obtained is from the combination of ascorbic and lactic acids.

The reduction of psychrotrophs was significant with the use of the acid combination immediately after slaughter. Thereafter, these microorganisms multiplied quickly.

Considering the level of $10UFC/cm^2$ for total aerobes and psychrotrophs as an estimate for the detection of slime and odour characteristic due to deterioration, carcasses treated with acids reached this level in eight to 11 days, while control carcasses reached it in five to eight days.

Tables 2 and 3 show the effect of treatments on the pH and the acid residues left on the skin of carcasses.

Carcasses treated with ascorbic acid resulted in a reduction of pH of approximately 0.5 units immediately after the treatment, which returned to the initial value by the 2nd day. This finding reinforces the results of Arafa and Chen (1978) that the effect of ascorbic acid over the microorganisms present in poultry is not dependent on pH only.

Ascorbic and lactic acid reduced the pH by approximately 1.5 units. However, pH returned to the initial value by the 5th day.

Acid residues found on the skin of carcasses decreased during the storage period in all the treatments.

Increases of the immersion period in ascorbic acid solution did not produce an increase in the concentration of this acid. This finding may constitute a partial answer why the increase in duration of immersion in ascorbic acid solution did not produce an increase its conservation effect. Panellist ratings of colour and odour indicated poultry treated with acids were inappropriate for consumption between the 8th and the 11th day and control poultry reached this point between the 4th and the 8th day (Table 4). Such results confirmed results found in the microbiological analysis.

Lactic and ascorbic acid residues did not influence the taste and texture of cooked carcasses (Table 5).

## CONCLUSIONS

The use of ascorbic acid (1%) for three to five minutes and the use of both ascorbic acid/lactic acid (1% each) after poultry slaughter resulted in a reduction in the microbial population and increased consumption life of these carcasses, without affecting sensory characteristics.

Neither microbiological nor sensory differences were detected when the immersion period during which the carcasses were in the ascorbic acid solution was increased. Nor did the use of the combination of ascorbic and lactic acid provide a significant increase in consumption life of poultry when compared with the use of 1% ascorbic acid alone. Other research must be performed to better the effect of such treatment on total coliforms.

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Table 1. Counting of bacteria under the different treatments during storage +5°C(±1).

| ($log_{10}$CFU/ cm)² | Treatment 1 | Treatment 2 | Treatment 3 | Treatment 4 |
|---|---|---|---|---|
| Total coliforms | | | | |
| day 0 | 1.61a | 1.50a | 1.95a | 1.45a |
| day 2 | 1.70a | 1.00a | 1.60a | 1.18a |
| day 5 | 3.00a | 2.23a | 2.20a | 1.16a |
| day 8 | 4.37a | 2.83a | 2.15a | 1.97a |
| day 11 | 5.24a | 4.57a | 4.50a | 4.06a |
| Total aerobics | | | | |
| day 0 | 3.69ab | 3.52ab | 3.61a | 2.98a |
| day 2 | 4.13a | 3.64a | 3.40a | 2.91a |
| day 5 | 5.65a | 5.18b | 4.46a | 3.11a |
| day 8 | 7.06a | 6.03a | 5.58a | 4.74b |
| day 11 | 7.69ab | 7.95a | 6.58ab | 5.84a |
| Total psychotro-phics | | | | |
| day 0 | 3.28a | 2.97a | 3.91a | 1.90a |
| day 2 | 4.13a | 3.64a | 3.73a | 2.96a |
| day 5 | 5.96a | 5.11ab | 4.90ab | 3.70a |
| day 8 | 7.82a | 7.18a | 6.69a | 6.43a |
| day 11 | 8.38a | 8.48a | 8.32a | 7.77a |

Table 2. Effect of the treatment on the pH of the skin of the carcasses along the storage period.

| | Treatment 1 | Treatment 2 | Treatment 3 | Treatment 4 |
|---|---|---|---|---|
| pH during storage | | | | |
| day 0 | 6.00 | 5.61 | 5.45 | 4.55 |
| day 2 | 6.11 | 5.85 | 6.03 | 5.11 |
| day 5 | 6.38 | 6.35 | 6.15 | 5.77 |
| day 8 | 6.85 | 6.60 | 6.08 | 6.27 |
| day 11 | 6.82 | 6.91` | 7.06 | 6.41 |

Table 3. Residual values * left by the treatments in the carcasses along the storage period.

| Storage (days) | Treatment 2 Ascorbic acid | Treatment 3 Ascorbic acid | Treatment 4 Ascorbic/ lactic acid | |
|---|---|---|---|---|
| 0 | 13.36 | 13.69 | 12.97 | 24.42 |
| 2 | 5.34 | 5.26 | 5.84 | 13.96 |
| 5 | 2.72 | 2.21 | 3.43 | 10.37 |
| 8 | 2.38 | 1.94 | 1.74 | 9.42 |
| 11 | 1.81 | 1.56 | 1.28 | 5.06 |

Table 4. Effect of the treatment in the colour and smell of the carcasses.

| | Storage (days) 0 | 2 | 5 | 8 | 11 |
|---|---|---|---|---|---|
| Colour | | | | | |
| t1 | 8.00a | 7.71a | 7.71a | 1.00b | 1.85a |
| t2 | 7.71a | 8.42a | 8.28a | 7.42a | 4.42a |
| t3 | 7.85a | 8.57a | 8.00a | 6.14ab | 3.14a |
| t4 | 7.00a | 7.42a | 7.14a | 6.57a | 3.14a |
| Smell | | | | | |
| t1 | 7.75a | 8.14a | 6.85a | 1.85b | 1.28a |
| t2 | 7.71a | 8.14a | 8.00a | 6.00ab | 2.57a |
| t3 | 7.71a | 8.42a | 8.14a | 6.28ab | 2.40a |
| t4 | 7.14a | 7.28a | 7.14a | 7.00a | 3.42a |

* In the vertical line, averages with the same letter do not differ significantly.

Table 5. Effect of the treatments in the taste and texture of the carcasses.

| | Storage (days) | | |
|---|---|---|---|
| | 0 | 2 | 5 |
| Taste | | | |
| t1 | 7.85 | 7.71 | 7.14 |
| t2 | 7.71 | 8.14 | 8.00 |
| t3 | 8.00 | 8.42 | 8.00 |
| t4 | 7.00 | 7.28 | 7.24 |
| Texture | | | |
| t1 | 8.00 | 7.71 | 7.14 |
| t2 | 7.81 | 8.14 | 8.71 |
| t3 | 7.85 | 8.28 | 8.42 |
| t4 | 7.71 | 7.71 | 7.28 |