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Preservation of Broiler Meat through Citric Acid at Low Temperature in Relation to Organoleptic Microbiological and Biochemical Properties

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Original Research Article

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Abstract: Broiler meat is used as a dietary protein source to the people all over the world for its commercial availability. The present study was carried out to extend the shelf life of broiler meat. Different preservation methods were employed. The meat was preserved in refrigerator at 4 °C temperatures. Citric acid solution was applied to the surface of meat at the concentration of 5 %, 10% and 15 % immediately prior to packaging. To ensure the quality of meat, physicochemical (organoleptic score), biochemical and microbiological parameters were evaluated. The present study showed that concentration of citric acid had significant effects to maintain the quality and extending shelf life of broiler meat in relation with organoleptic score, total bacterial count (TBC), total fungal count (TFC), total coliform count (TCC) and tyrosine value. The organoleptic score was higher in citric acid treated sample than that of control. The study also revealed that, 15 % concentration of citric acid was most effective for extending shelf life and maintaining quality of broiler meat on the basis of organoleptic evaluation, microbiological and chemical analysis. However, further studies are required for the extension of shelf life of broiler meat by using citric acid along with different concentrations of potassium sorbate or other organic acids.
Keywords: Broiler meat, shelf-life extension, citric acid, preservation.

INTRODUCTION

According to Food and Agriculture Organization report published in 2006, Broiler constitutes about 30% of the world's total meat consumption [1]. Broiler and other types of poultry have higher pathogenic and spoilage bacterial counts than most other foods.

However, Broiler meat is contaminated by different types the microorganism, especially by the different types of bacteria and fungi [2]. In addition, Carcass contamination can occur at several points throughout the processing operation of poultry [3]. The shelf life of broiler meat thus depends on the level of its microbial contamination [4]. Therefore, enhancing the keeping quality reducing or killing spoilage causing and food borne pathogenic microorganisms of broiler carcasses are very important objectives of food technologist and microbiologist.

The consumption of broiler meat is found in rural and urban area in Bangladesh and over the world for its cheap rate. Unless cooling is prompt and after slaughter, meat may undergo undesirable changes in appearance and flavor and may support the growth of microorganisms before being processed in some ways for its preservation.

The shelf life of broiler meat can be extended by preservative methods. The chemicals like potassium sorbate, citric acid, sodium propionate, calcium propionate, sodium chloride. Citric acid is used mostly for extending the shelf life of broiler meat because it has no harmful effect on human health [5]. Citric acid has an antimicrobial effect and also a good antioxidant [6, 7]. Tough extensive research on the application of citric acid to control both spoilage and pathogenic organisms in foods of animal origin has been reported [8], to improve the shelf life of broiler meat in the context of Bangladesh acidulent production is crucial.

The application of citric acid has not yet been studied in Bangladesh to extend shelf life of food

especially in meat. In the present investigation the application of citric acid to extend the shelf life of broiler meat was accomplished.

MATERIALS AND METHODS

All the experiments were carried out in the laboratory of Food Technology division, Institute of Food and Radiation Biology, Atomic Energy Research Establishment (AERE), Savar, Dhaka.

Sample collection

Fresh broiler meat used in this study was collected from the local market (named Pollibiddut). Sample was taken in polythene bag with ice and quickly transported (20 minutes) to the laboratory. The samples were washed with tap water followed by drained for few minutes then the muscles were separated from the bone and morphometric study was done. Thereafter the samples were processed for the successive experiments.

Sample preparation

The meat samples were dipped in the concentration of 5, 10 and 15% of citric acid solution for 60 seconds. After dipping the meat was drained for 15 minutes. According to the concentration of citric acid treated meat were packed into pre-sterilized and sealed polythene bag and was stored at 4˚C. The samples without citric acid treatment were selected as control. Determination of moisture content

Moisture of fresh broiler meat was determined by drying a sample at some elevated temperature and reporting the loss of weight in moisture [9].

Determination of ash content

Ash in the fresh broiler meat and meat products is readily determined by incineration either raw or dried sample at 600 ^{0}C for 4-5 hours, depending on the method used. The residue is weighted and reported as ash.

Determination of protein content

Lowry *et al*., [10] method was used to measure the protein content of the sample.

Determination of lipid content

The lipid content was determined using Floch method [7].

Determination of carbohydrate

The Dubois method [16] was used to measure the total carbohydrate content. Organoleptic

Analysis

Sensory evaluation for the detection of freshness or shelf life of the stored meat muscle and consumers acceptance was performed with high degree of reliability by organoleptic evaluation (Figure 2.3). Peryam and pilgrim [11] had developed a useful method for the overall acceptability of food products. Nine point hedonic scales were used for sensory evaluation by the five judges Miyauchi and his co-worker [12].

The hedonic scale was as follows:
9 – Like extremely; 8 – like very much; 7 – like moderately; 6 – like slightly; 5 – Neither like nor dislike; 4 – Dislike slightly; 3 – Dislike moderately; 2 – Dislike very much; 1 – Dislike extremely. In case of organoleptic analysis, the meat was judged into 4 scale (Appearance, Color, Odor, Texture).

Determination of tyrosine

The degree of autolysis and bacterial proteolysis has been assessed in fresh broiler meat by means of tyrosine value. Pearson [13] found that tyrosine value must increase end result of spoilage. Tyrosine value was determined following the method as described by Wood *et al.,* [14].

Estimation of total bacterial count (TBC)

The total bacterial count (TBC) was determined by decimal dilution technique followed by pour plate technique [15].

Estimation of total coliform count (TCC)

The Coliform bacteria changes were estimated by total Coliform count technique following Sharf [15].

Estimation of total fungal count (TFC)

The fungal changes were estimated by total fungal count technique following Sharp [15].

RESULTS AND DISCUSSION

Analytical estimation

Data were taken at an interval of 7 days. After 14 days the broiler meat including control and citric acid treated were begin to spoil. After that it was not possible to carry out the experiment on 21 day and the entire sample were completely spoiled on this day.

Biochemical composition of fresh broiler meat

The biochemical composition showed that moisture was major component of broiler meat and it was 74.45 % (Table 1). Protein is another major component (22.47%). The present study determined the protein content that was 22.47 % (Table 1). The lipid content in fresh broiler meat muscle is about 1.31 %. From the experiment, ash content of fresh broiler meat was found about 0.6%. The carbohydrate is a component which was found about 1.17 %. In the present the biochemical composition included ash moisture, protein, lipid and carbohydrate of fresh broiler meat was investigated (Table 1).

Table-1: Biochemical compositions of fresh chicken broiler meat gm/100 gm sample

Name of component	(%
Moisture	74.45
Ashes	0.6
Protein	22.47
Lipid	1.31
Carbohydrate	1.17

Organoleptic score

Organoleptic score of control and citric acid treated broiler meat sample stored at 4˚C were investigated during the storage on the basis of Hedonic score. At the beginning of the storage period, organoleptic score was comparatively higher both the control and citric acid treated sample. The scores were gradually decreased with the increase of storage period (Figure 1). The organoleptic score in citric acid treated sample were found higher than the control sample. The lowest organoleptic score was found in control sample and the score was 2 on day 14.

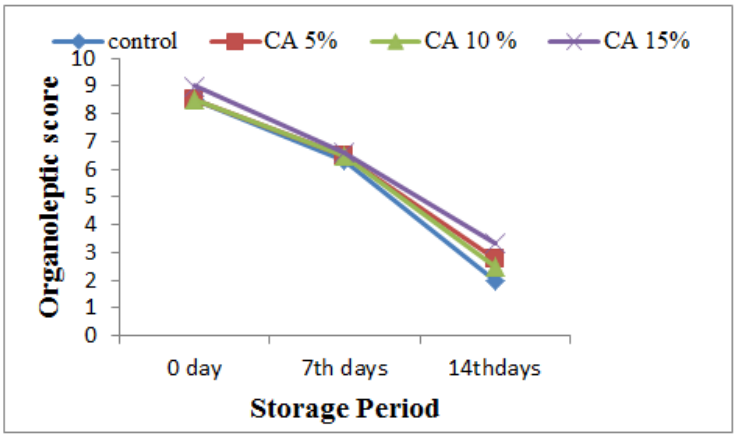

Fig-1: Organoleptic score of control, 5 %, 10 % and 15 % citric acid treated sample during the storage period at 4˚C

Chemical changes of fresh and treated broiler meat during storage

Tyrosine

A gradual change of tyrosine content was found in meat sample during the storage period. The tyrosine content of fresh and citric acid treated broiler meat was found to increase with the increase of storage periods (Figure 2). The tyrosine values of citric acid treated sample were comparatively less than the control sample. The lowest amount of tyrosine value was found on day 0 and the value was 8.280 mg/100 gm sample. The highest amount of the tyrosine value was found on day 14 in control sample and the value was 23.938 mg/100 gm sample (Figure 2). On the other hand the lowest amount of tyrosine values was found on day 14 in 15 % citric acid treated sample.

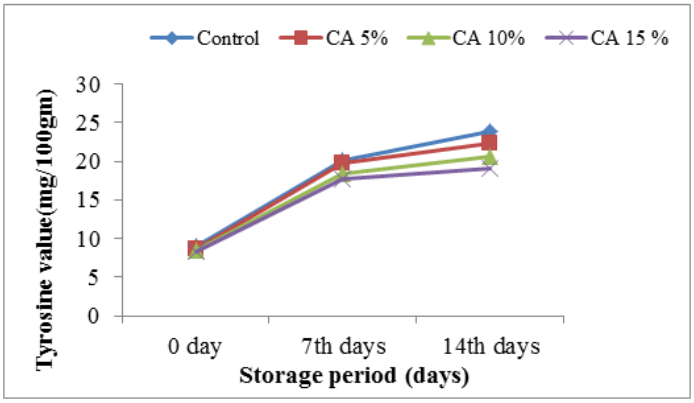

Fig-2: Tyrosine value of controlled, 5%, 10 % and 15 % citric acid treated broiler meat sample during the storage period at 4˚C.

Microbial changes of broiler meat during the storage period

Total bacterial count (TBC)

In control sample the values of total bacterial count were 2.6×10^3 cfu /gm, 3.08×10^4 cfu/gm and 8.4×10^6 cfu/gm on day 0, 7 and 14 during the storage period (Table 2). The result showed increased trends of TBC with storage period. The highest amount of total bacteria was counted from the control sample on day 14 and lowest amount of bacteria was counted from the meat samples which were treated in 15 % citric acid (Table 2).

Table-2: Total bacterial Count (TBC) of fresh and treated broiler meat during storage period

Sample	Total bacterial count (TBC) of chicken meat cfu/gm sample during storage period		
	O day	7 days	14 days
Control	2.6×10^3	3.08×10^4	8.4×10^6
Citric Acid 5 %	0.60×10^2	9.4×10^2	5.44×10^3
Citric Acid 10 %	ND	3.0×10^2	4.8×10^2
Citric Acid 15 %	ND	1.8×10^2	2.44×10^3

Total coliform count (TCC)

In control sample the values of total Coliform count were increased with storage time. Highest amount of the TCC was found in control sample on day 14 but no coliform was observed for 10 % and 15 % citric acid treated sample for whole preservation period (Table 3).

Table-3: Total Coliform Count (TCC) of fresh and treated broiler meat during storage period

Sample	Total Coliform count (TCC) of broiler meat cfu/gm sample during storage period		
	0 day	7 days	14 days
Control	1.24×10^3	5.02×10^3	2.08×10^5
Citric Acid 5 %	ND	1.8×10^2	2.12×10^3
Citric Acid 10 %	ND	ND	ND
Citric Acid 15 %	ND	ND	ND

Total fungal count (TFC)

Total Fungal count was found to increase with storage period. Highest amount of TFC were found on day 14 in control sample and the count were 3.4×10^3 cfu/gm sample (Table 4). There were no TFC on initial day for all citric acid treated samples. On the day 14, the lowest TFC was recorded for 15% treated sample (Table 4).

Table-4: Total Fungal Count (TFC) of fresh and treated broiler meat during storage period

Sample	Total Fungal Count (TFC) of broiler meat cfu/gm sample during storage period		
	0 day	7 days	14 days
Control	6.0×10^1	2.5×10^3	3.4×10^3
Citric Acid 5 %	ND	1.6×10^2	2.8×10^3
Citric Acid 10 %	ND	1.2×10^2	3.6×10^2
Citric Acid 15 %	ND	1.0×10^1	2.0×10^2

According to the La evaluation [16], the acceptable limit of total bacteria is about 1.0×10^6 cfu/ gm sample. According to the statement, only the treated sample showed the acceptable limit of TBC at 4˚C up to 14 day of storage (Table-3.4). The controlled sample showed the acceptable limit up to 7 day at 4˚C storage condition. On day 14 the maximum amount of bacterial colony was found in control sample and lowest amount of bacterial colony was found in 15% citric acid treated sample (Table 4). With the increasing of day the bacterial colony count also increased and highest amount of bacterial colony was found in controlled sample. From the study it was denoted that, the concentration of citric acid has a significant effect on broiler meat sample. So it is clear that the citric acid has an antimicrobial activity that can kill or reduce the pathogenic agent of the meat and meat product.

CONCLUSION

The present study showed that organoleptic evaluation, tyrosine value and microbial count had significant effect to maintain the quality and extending shelf life of broiler meat. It can be concluded that citric acid has significant effect to maintain organoleptic properties of broiler meat. In addition, 15 % concentration of citric acid was most effective to control microbiological and biochemical properties as well. However, further studies are required for the extension of shelf life of broiler meat by using citric acid along with different concentrations of potassium sorbate or other organic acids.

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