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# USE OF DIFFERENT TRANSPORT METHODS OF PROPIONIC ACID TREATED BROILER CARCASSES AND ITS IMPACT ON SOME MICROBIAL PROPERTIES

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**ABSTRACT**

Different transport methods of propionic acid- treated broiler carcasses and its impact on some microbial properties were adopted in this study. The experiment was conducted for a period commencing on 09/10/2019 and ending on 09/12/2020, at the poultry farm located at the Animal Production Department, College of Agriculture, Basra University. In this experiment, (42) broiler chicken carcasses with an average preliminary weight of (1400 gm ± 50 gm). Carcasses were supplied by the slaughterhouse, and were made cuts. The breast cut was placed in two containers; the first includes propionic acid at a concentration of (1%), and the second containers includes a concentration of (2%). The two meat cuts were sunk in propionic acid for (5) hours, and were partitioned into (7) treatments. Then, meat cuts, according to treatments (T0, T1, T2), had been transported by a convertible carry truck, (T3, T4) transported by a refrigerated truck, and (T5, T6) transported using a plastic bags, mad of polyethylene, containing crushed ice. Transport process lasted for (2) hours, At the laboratory, it was under a cool storage at +4$C^{O}$ for (0, 3, 6, 9) days. Results revealed that (T3, T4) accomplished a significant decrease ($p>0.05$) in the number of total bacteria in the breast meat cut in comparison with the rest of the treatments and Control Treatment, while treatments (T3, T4, T5, T6) made a significant decrease ($p>0.05$) of Psychrophilic Bacteria compared to the rest of breast meat cuts' treatments. Treatments received propionic acid recorded less number of bacteria (E. Coli) when compared to the Control Treatment of the breast meat cut respectively. Propionic Acid works on limiting the growth of bacteria and maintaining quality of refrigerated and transported meat following different transport methods for longer storage periods.

***Keywords:*** Propionic, Bacteria Transport Methods.

## Introduction

Poultry industry has witnessed a wide range of interest. Researchers and breeders of poultry have paid a significant interest in development of this sector due to the speedy growth and high efficiency in transferring feed into protein (Maranqoni *et al.*, 2015). This development has faced some obstacles resulting from bad transport and storage which in turn cause heat stress, then causing tremendous economic losses in the industry of poultry (Hirakawa *et al*., 2020). The new studies and researches have focused on finding out solutions and substitutes that could address these obstacles through the use of natural additions to the poultry feeds instead of industrial ones. Such feeds play a crucial role in the enhancement of productive and immune performance of birds along with its capability to curb activity and effectiveness of free roots (Dominguez *et al.,* 2020), (Meleudez- Martinez, 2019).

Propionic acid is an organic chemical compound with the formula ($C_3H_6O_2$), which can be written as ($CH_3$ $CH_2$ COOH). The compound exists in the form of an oily, colorless liquid, and belongs to the group of carboxylic acids. Also, it is called propionic acid, while its salts are called propionate. This compound has an anti-bacterial activity, and could play a significant role in reducing the pathogen in poultry meat (Adil *et al*., 2010), (Hosseinnezhad *et al*., 2018).

In the nearest future, propionic acid has tangible applications in poultry industry due to its reliable effectiveness in the fight against pathogenic microbes a bit more than other organic acids such as acetic acid or lactic acid. So far, not much research has been done on the effectiveness of propionic acid against disease-causing bacteria on poultry carcasses (Al-Kassi and Mohssen, 2011).

Therefore, much attention has shifted to the use of organic acids, which are a type of short chain fatty acids, as an effective and safe alternative to antibiotics used for the purpose of activating growth and fighting many bacterial diseases. It is worth mentioning that organic acids naturally exist as a natural component in some plant and animal tissues (Rao *et al*., 2004) and (Hanna, 2012).

The study in hand has aimed at evaluating effectiveness of different concentrations of Propionic Acid and its effect on the microbial growth of the refrigerated broiler carcass meat cuts.

## Materials and Methods

The experiment was conducted for a period from 09/10/2019 to 09/01/2020 in the poultry field located at the Animal Production Department, College of Agriculture, Basra University. In this experiment, (42) broiler carcasses were selected, with an average preliminary weight of (1400 gm ± 50 gm). Carcasses were supplied by the slaughter, and were made meat cuts. The breast cut was placed in two containers; the first includes propionic acid at a concentration of (1%), and the second containers includes a concentration of (2%). The meat cuts deliberately were sunk in Propionic Acid for (5) hours, and were divided to (7) Treatments, as follows:

T0/Control: Transport meat cuts, not refrigerated, not dipped in Propionic Acid.

T1: Transport meat cuts, not refrigerated, dipped in Propionic Acid at a concentration of 1%.

T2: Transport meat cuts, not refrigerated, dipped in Propionic Acid at a concentration of 2%.

T3: Meat cuts transported adopting dry refrigeration, dipped in Propionic Acid at a concentration of 1%.

T4: Meat cuts transported adopting dry refrigeration, dipped in Propionic Acid at a concentration of 1%.

T5: Transport meat cuts dipped in Propionic Acid using crushed ice at a concentration of 1%.

T6: Transport meat cuts dipped in Propionic Acid using crushed ice at a concentration of 2%.

Then, meat cuts, according to treatments (T0, T1, T2), had been transported by a convertible carry truck, (T3, T4) transported by a refrigerated truck, and (T5, T6) transported using a plastic bags, mad of polyethylene, containing crushed ice. Transport process lasted for (2) hours, At the laboratory, it was under a refrigeration storage at +4ºC for (0, 3, 6, 9) days. Next, numbers of bacteria were calculated as follows:

### 1. Total Bacteria Numbers

Counting colonies in the culture plates was adopted. The number of growing colonies in the culture media represents the number of bacterial cells. This number depends on percentage of dilution process adopted. Normally, a series of dilution processes is used in the dilution process.

### 2. Psychrophilic Bacteria Numbers

The number of psychrophilic Bacteria is counted through, after a culture medium getting solid, placing plates in the refrigerator at a temperature of (4-5) ºC for (10) days. Psychrophilic Bacteria is counted using SPSS, 2015).

### 3. E. Coli Bacteria Numbers

The culture medium (Macconkey Agar) is used. Following a culture medium becomes hardened, it is placed in an incubator for (48) hours, then numbers of *E. coli* bacteria is calculated according to (SPSS, 2006) and (SPSS, 2015).

### 4. Statistical Analysis

Statistically, data was analyzed using the readymade statistical program (SPSS, 2015). Results were compared adopting reduced lower significant difference (R.L.S.D.) at a probability level ($p>0.05$) (Al-Rawi & Khalafallah, 2000).

$Yij=u+Ti+eij$

Yij = observation value j in the treatment i

U= formula average mean

Ti= impact of treatment (i=1-6)

eij= value of experimental error related to observation

## Results and Discussion

### 1. Impact of Methods of Transport and Concentration of Propionic Acid on the Total Number of Bacteria of Broiler Breast Cuts

Figure (1) shows the impact of methods of transport and concentration of Propionic Acid on the total number of bacteria of broiler breast cuts. A significant decrease was seen ($p>0.05$) in the number of total bacteria for the Control Treatment and the rest of treatments relying on storage periods for a breast meat cut. Treatments received Propionic Acid recorded less numbers of bacteria compared to the Control Treatment. As figure above showed, there was a significant decrease ($p>0.05$) in the total numbers of bacteria in favor of (T3 & T4), where the numbers of bacteria were (4.10 & 4.18) respectively, which was not in a significant difference with (T5 & T6) compared to Control Treatment (T0), which was not in a significant difference with (T1 & T2). It reached (4.11) logarithmic turns/gm of meat followed by (T5 & T6), where they reached at (2.30 & 2.50) respectively at nine storage days.

Results were consistent with the Iraqi Standard Specifications of the Central Organization for Standardization and Quality Control as to acceptability of meat and its products (Central Organization for Standardization and Quality Control (2000) stipulates that the total number of the aerobic bacteria shall be within CFU10(7)/ KM. An estimation for the total numbers of bacteria is considered a good indicator for meat quality and a method of consumption (Nayef, 2019).

A notable decrease in the numbers of total bacteria may be attributed to a transport method used and the concentration of Propionic Acid. It is refrigeration that curbs the activity of bacteria while the acid works on belittling the number of bacteria to being effective in analyzing meat fats as a result of the high temperature of meat. These fats contain bioactive compounds within its chemical components that It has biological effects including anti-microbiotic properties. Besides, it has an effect to rise the sensitivity of phospholipids belayed of the bacterial cell membrane, causing an increase in permeability, and bringing about a damage to cellular components and their enzymatic reactions (Fratianni *et al*., 2010) and (al-Asadi *et al*., 2018).

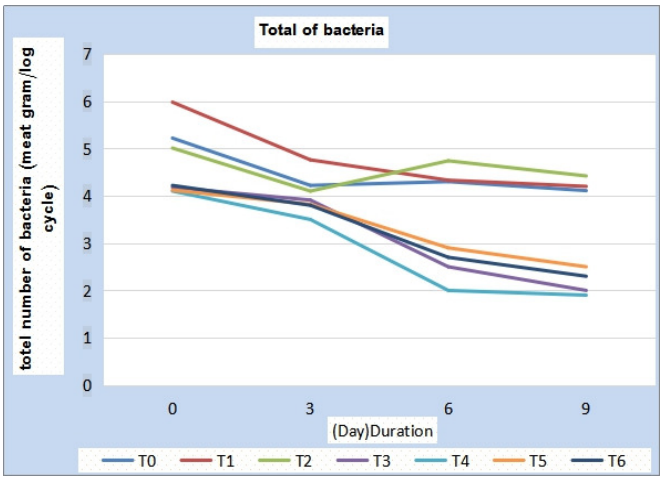


**Fig. 1 :** The effect of transport methods and the concentration of propionic acid on the total number of bacteria on the breast cut in frozen broilers T0

T0/Control: Transport meat cuts, not refrigerated, not dipped in Propionic Acid

T1: Transport meat cuts, not refrigerated, dipped in Propionic Acid at a concentration of 1%.

T2: Transport meat cuts, not refrigerated, dipped in Propionic Acid at a concentration of 2%.

T3: Meat cuts transported adopting dry refrigeration, dipped in Propionic Acid at a concentration of 1%.

T4: Meat cuts transported adopting dry refrigeration, dipped in Propionic Acid at a concentration of 1%.

T5: Transport meat cuts dipped in Propionic Acid using crushed ice at a concentration of 1%.

T6: Transport meat cuts dipped in Propionic Acid using crushed ice at a concentration of 2%.

## 2. Impact of Methods of Transport and Concentration of Propionic Acid on the Total Number of Psychrophilic Bacteria of Broiler Breast Cuts

Figure (**2**) shows the impact of methods of transport and concentration of Propionic Acid on the total number of psychrophiles of broiler breast cuts. A significant decrease was seen ($p>0.05$) in the number of total bacteria for the Control Treatment (T0) and the rest of treatments (T1, T2, T3, T4, T5, T6) relying on the age of Storage periods for a breast meat cut. Treatments received Propionic Acid recorded less numbers of bacteria compared to the Control Treatment (T0). As figure above indicated, there was a significant decrease ($p>0.05$) in the total numbers of psychrophiles bacteria in favor of (T5 & T6), where the numbers of bacteria were (4.88 & 5.01) respectively, which was not in a significant difference with (T4 & T5) compared to Control Treatment (T0), which was not in a significate difference with (T1 & T2). It reached (6.22) logarithmic turns/gm meat at a one-day storage period, and no significant differences were found at a storage period of (3) days among treatments despite appearance of arithmetical difference. Significant differences were clear among treatments at a 6-day storage period where treatments (T3, T4, T5, T6), outperformed significantly ($p>0.05$) the rest of treatments. Whereas, treatments (T3, T4, T5, T6) made a significant decrease ($p>0.05$) compared to other treatments reaching at (1.90, 2.00, 1.60, 1.93) respectively compared to the Control Treatment, which made it at (4.90) logarithmic turns meat followed by the two treatments (T1, T2), reaching at (3.90, 4.00) respectively at a 9-day storage period.

Results were consistent with the Iraqi Standard Specifications of the Central Organization for Standardization and Quality Control as to acceptability of meat and its products (Central Organization for Standardization and Quality Control (2000) stipulates that the total number of the aerobic bacteria shall be within CFU10(7)/KM. An estimation for the total numbers of bacteria is considered a good indicator for meat quality and a method of consumption (Nayef, 2019).

A decrease in the numbers of total psychrophiles bacteria may be attributed to a transport method used and the concentration of Propionic Acid. It is refrigeration that curbs the activity of psychrophiles bacteria while the acid works on belittling the number of bacteria to being effective in analyzing meat fats as a result of the high temperature of meat. These fats contain bioactive compounds within its chemical components that It has biological effects including anti-microbiotic properties. Besides, it has an effect to rise the sensitivity of phospholipids belayed of the bacterial cell membrane, causing an increase in permeability, and bringing about a damage to cellular components and their enzymatic reactions (Fradiani *et al*., 2010) and (Zhang, 2018).

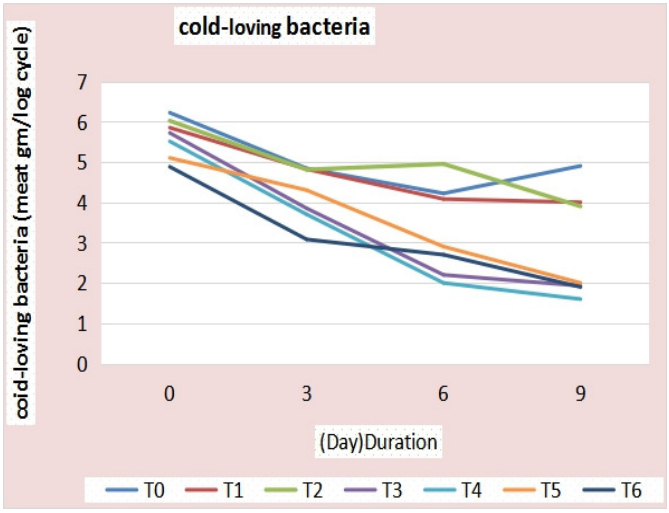


**Fig. 2 :** The effect of transport methods and the concentration of propionic acid in the number of cold-loving bacteria on the breast cut of chickens stored in refrigerated

T0/Control: Transport meat cuts, not refrigerated, not dipped in Propionic Acid

T1: Transport meat cuts, not refrigerated, dipped in Propionic Acid at a concentration of 1%.

T2: Transport meat cuts, not refrigerated, dipped in Propionic Acid at a concentration of 2%.

T3: Meat cuts transported adopting dry refrigeration, dipped in Propionic Acid at a concentration of 1%.

T4: Meat cuts transported adopting dry refrigeration, dipped in Propionic Acid at a concentration of 1%.

T5: Transport meat cuts dipped in Propionic Acid using crushed ice at a concentration of 1%.

T6: Transport meat cuts dipped in Propionic Acid using crushed ice at a concentration of 2%.

### 3. Impact of Methods of Transport and Concentration of Propionic Acid on the Total Number of (E. Coli) Bacteria of Refrigerated-Broiler Breast Cuts

Figure (3) refers to the impact of methods of transport and concentration of Propionic Acid on the total number of *E. coli* bacteria of broiler breast cuts. A significant decrease was not observed ($p>0.05$) in the number of total *E. coli* bacteria for the Control Treatment and the rest of treatments (T1, T2, T3, T4, T5, T6) relying on storage period of one day for a breast meat cut. Treatments received Propionic Acid recorded less numbers of *E. coli* bacteria compared to the Control Treatment. As figure above disclosed, there was a significant decrease ($p<0.05$) in the total numbers of *E. coli* bacteria in favor of (T3, T4, T5, T6), where the numbers of E. Coli bacteria were (3.70, 3.60, 4.90, 4.19) respectively compared to the Control Treatment T0, which was not in a significant difference with (T1 & T2) compared to Control Treatment (T0), which was not in a significant difference with (T1 & T2). It reached (5.10) logarithmic turns/gm of meat at a 6-day storage period. What was found is significant differences among treatments ($p<0.05$) at a 9-day storage period, where the two treatments (T3, T4) outperformed the rest of treatments as to the decrease of the numbers of E. Coli bacteria of a breast meat cut making (2.00, 2.03) respectively, compared to the Control Treatment reaching at (4.90) logarithmic turns/gm of meat. Results were consistent with the Iraqi Standard Specifications of the Central Organization for Standardization and Quality Control as to acceptability of meat and its products (Central Organization for Standardization and Quality Control (2000) stipulates that the total number of the air bacteria shall be within CFU10(7)/KM. An estimation for the total numbers of bacteria is considered a good indicator for meat quality and a method of consumption (Nayef, 2019). A decrease in the numbers of total psychrophiles bacteria may be attributed to a transport method used and the concentration of Propionic Acid. It is refrigeration that curbs the activity of bacteria while the acid works on belittling the number of bacteria to being effective in analyzing meat fats as a result of the high temperature of meat. These fats contain bioactive compounds within its chemical components that It has biological effects including anti-microbiotic properties. Besides, it has an effect to rise the sensitivity of phospholipids belayed of the bacterial cell membrane, causing an increase in permeability, and bringing about a damage to cellular components and their enzymatic reactions (Fradiani *et al*., 2010) and (Annamaria *et al*., 2009).

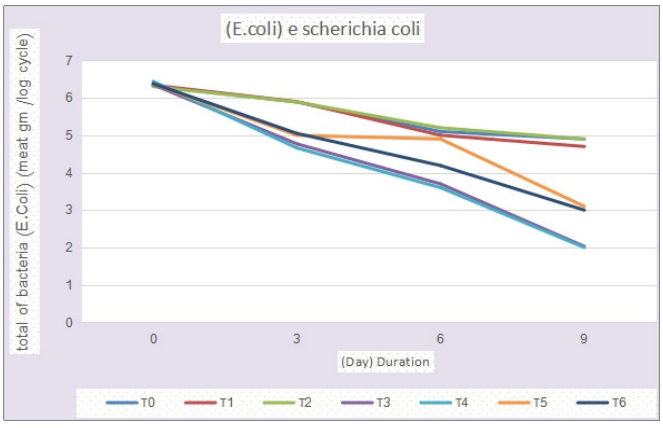


**Fig. 3 :** The effect of transport methods and the concentration of propionic acid on the preparation of *E. coli* bacteria for cold-stored broiler breasts

T0/Control: Transport meat cuts, not refrigerated, not dipped in Propionic Acid

T1: Transport meat cuts, not refrigerated, dipped in Propionic Acid at a concentration of 1%.

T2: Transport meat cuts, not refrigerated, dipped in Propionic Acid at a concentration of 2%.

T3: Meat cuts transported adopting dry refrigeration, dipped in Propionic Acid at a concentration of 1%.

T4: Meat cuts transported adopting dry refrigeration, dipped in Propionic Acid at a concentration of 1%.

T5: Transport meat cuts dipped in Propionic Acid using crushed ice at a concentration of 1%.

T6: Transport meat cuts dipped in Propionic Acid using crushed ice at a concentration of 2%.

## Conclusions

- The dry refrigerated transport method along with an addition of a concentration of 2% propionic acid has reduced the numbers of bacteria causing meat spoilage.
- The use of propionic acid in reducing the growth of bacteria and maintaining the quality of chilled and transported meat by different means of transport for longer storage periods by adding Propionic Acid as a natural preservative

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