

EFFECT OF SLAUGHTERING METHOD ON THE KEEPING QUALITY OF BROILER CHICKENS' MEAT

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ABSTRACT: *An experiment was conducted to study the effect of different slaughtering methods (Islamic traditional Islamic, hanging and electrical stunning). A total of 81 male broiler chickens 42 day of age were selected according to average body weight and randomly divided into 3 groups. The birds were further divided into three replicates and were allotted the completely randomized design. The chickens within each group were weighed and were slaughtered by one of three slaughtering methods (traditional, hanging and stunning). The bled blood of each bird was collected and weighed. The carcass was weighed. Three parts from each carcass were chosen (breast, thigh and wing) to estimate the deterioration level at 3 different times after slaughtering (6 hrs, 48 hrs and 96 hrs). There was a significant difference ($P \leq 0.01$) in bled blood weight with respect to the slaughtering method. Stunning method had the lowest amount (50 gm) while the hanging method had the highest amount (67 gm). There was no significant difference ($P > 0.05$) on the bacterial count due to the slaughtering method at 6 hours postmortem. Nevertheless, the breast had the highest and the thigh had the lowest bacterial count. There was a significant difference ($P \leq 0.01$) on the bacterial count with respect to slaughtering method at 48 hours postmortem, where the electrical stunning method having the highest count (83×10^6) and the Islamic hanging method had the lowest count (55×10^6). At 96 hours, post mortem there was a significant difference ($P \leq 0.01$) on the bacterial count with respect to slaughtering method on the same trend as at 48 hours. The Islamic hanging method seem to be the best one among the three methods, and therefore it is recommend to be used for slaughtering of the broiler chickens.*

Key Word: Slaughtering Method, Keeping Quality, Chickens' Meat

INTRODUCTION

Poultry processing is a complex combination of biology, chemistry, engineering, marketing, and economics. Poultry production and processing involve a series of interrelated steps designed to convert domestic birds into ready-to-cook whole carcasses, cut-up carcass parts, or various forms of deboned meat products (Alan, 2001). During production and management of poultry, ante mortem (pre-slaughter) factors not only exert important effects on muscle

growth, composition, and development, but also determine the state of the animal at slaughter. Meat is a very good source of animal protein that consists of essential amino acid, minerals, vitamins and essential fatty acids (Lawrie, 1991). Meat provides calories from fat, proteins and limited quantities of carbohydrate (Judge, *et al.*, 1990). Lean meat contains from 15 to 20% of protein, which varies inversely with percentage of fat. Lysine, which is an essential amino acid, is constant

between 0.5 and 0.57% and methionine plus cystine between 0.21 and 0.26% (Bender, 1975). It is also one of the few foods which provide complete protein as well as being rich source of such essential nutrients as iron, niacin and vitamin B₁₂ (Lawrie, 1991). The meat of chicken is an excellent source of B-complex vitamins, proteins and many other important minerals like iron and zinc. It generally enhances the meals, makes for satiety and staves off hunger. It is almost completely digestible and high on the nutritional scale. Chicken meat is a good source of nicotinic acid, which helps fighting against cancer. It also have, trace amounts of mineral like selenium, which helps to make the hair strong and healthy. Other important B-complex vitamins like B₆ and its co-ordinate function with nicotinic acid helps to convert the available food sources like carbohydrates, fats and pertains into energy sources and also important to maintain the cardiovascular health.

However, meat on the other hand is a perishable product and is subject to quick deteriorations if it is not handled properly. Food safety and the shelf life aspects of broiler meat are of importance concerns in relation to the microbial growth. The focus is mainly on the absence or control of potentially pathogenic microbes such as salmonella and campylobacter. Commercially spoilage bacteria play an important role in food safety and its shelf life. Microbial aspects of poultry meat can be divided into two major categories, in the live phase of poultry production and during processing of meat and keeping. Forrest *et al.* (1995) defined spoilage as the point at which the meat becomes unfit for human consumption. Ayres (1960) reported that the common spoilage organisms for fresh meat are aerobic bacteria *Pseudomonas* and *Campylobacter* types. Lawrie (1991) reported that many factors affect the growth of meat spoilage microorganism. He added that the most important factors appear to be the availability of nutrients, suitable temperature,

moisture, osmotic pressure of medium, pH and oxidation-reduction potential.

One of the most important factors that affects the level of contamination and enhance the extent of the deterioration is the amount of blood left within the carcass after bleeding. Blood is considered to be an excellent medium for the growth of bacteria due to its high nutritive value, its temperature, pH and relative humidity. The amount of blood bled by the animal depends on the slaughter method used. Blood components, especially haemoglobin, are powerful promoters of lipid oxidation and may decrease the shelf life of meat products (Alvarado *et al.*, 2007).

There are many slaughter methods practiced in the world: these include the Halal (Islamic traditional or hanging) methods and stunning (electrical and CO₂) methods. The Islamic method requires the use of sharp knife, which according to Prophet Muhammad (peace be upon him) relieves the animal of any suffering (Sahih Moslim). Maximum drainage of blood is required. In the Holy Quran blood consumption has been forbidden by Muslims.

Electrical stunning is the most common method of slaughter and is carried out in the large processing plants, and the stunning operation is mechanized to cope with the high through numbers of birds. Different conditions were used for electrical stunning, depending on the region of the world. European electrical stunning conditions in most cases kill the bird by electrocution and cardiac arrest, stopping blood flow to the brain. Thus death occurs by loss of blood supply to the brain (Sams, 2001). He added that this harsher electrical stunning results in higher incidence of hemorrhaging and broken bones. Variation in electrical resistance, as a result of different skull thicknesses can cause ineffective stunning (Alan, 2001).

This experiment was conducted to study the effect of slaughtering methods on the keeping quality of broiler chickens meat. With general objective to determine the suitable slaughtering method that can help in getting the best keeping quality with longer shelf life for the meat of broiler chickens. With specific objectives to evaluate the preservation capability of meat produced by either Islamic traditional or hanging slaughtering methods or electrical stunning method, through bacterial count of minced meat kept for different durations in a refrigerator.

MATERIALS AND METHODS

Experimental Site and birds

This experiment was carried out at the peoples' development company, north Wad Medani City at Wad Elmajzoub area. A total of 81 broiler male chickens (six week of age) of approximately similar body weights (1.9kg) were selected from a broiler flock. The chickens were divided into three groups (27 chickens in each).

Equipments

Equipments used were electrical stunning sky switch mode- power, knives, ice container, digital balance, electrical grader, Petri dishes, pipettes, test tubes (Durham tubes), conical flasks, measuring cylinder and others.

Slaughter methods:

Three slaughter methods were used for slaughtering of the birds.

Traditional Islamic method

In this method the birds were slaughtered according to the Islamic traditions by severing the jugular veins, trachea and the esophagus. This method was performed without stunning. Before slaughtering, the feathers around the neck were removed for thorough blood collection. The birds' legs and wings were grasped with

one hand, and the head was laid on the slaughtering block and then the slaughtering was performed. The neck was held on the flat position until the bleeding was completed. After slaughter the blood of each bird was collected in 15 x 10cm plastic bag.

Hanging Islamic method

The birds were slaughtered in the same way as in previous method. The main difference is in the position of the bird during slaughtering and bleeding. The birds in this method were held on an upside down position and slaughtering was done while hanging. The birds were left on this position until the bleeding was completed. The blood was collected in 15 x 10cm plastic bag.

Electrical stunning method

In this method electrical stunning, using Sky switch mode -power supply 110 volt passing electrical current in a water bath, was done before slaughter. The head of each bird was allowed to come in contact with the electrified water bath for 3-5 seconds until the birds got unconscious. The slaughtering was done while the birds were hanging as in the previous method by severing the jugular veins, trachea and the esophagus. The birds were left on this position until the bleeding was completed. The blood was collected in 15 x 10cm plastic bag.

Feathers removal and carcass preparation:

After slaughtering and blood collection the slaughtered birds were immersed in hot water 140°F for two minutes to help in feathers scalding. Afterwards the feathers were removed mechanically by using a feather picking machine. Pin and immature feathers were removed manually. The birds were then opened for evisceration and removal of internal organs. Then carcasses were cleaned thoroughly and immersed in ice for cooling. Each carcass was divided into two halves right and left. Then the breast, thigh and wing of the left side were removed and

dissected. The soft tissues were collected, ground and was kept in a refrigerator for further microbial analysis.

Sterilization of instruments and media:

Instruments such as loops, spoons were sterilized by direct flaming. Hot air oven (320-338°F) for one hour was used for glass ware such as pipettes, tubes and flask. An autoclave was used for sterilization of media and distilled water; the exposure time was 15-20 minutes at 250°F under pressure of 15 pounds/ inch².

Plate count agar:

This medium was used as a method to determine the total bacterial count. It was obtained in a dehydrated form of 30 grams with pH 7, constituting 9.0 grams yeast extract, 7.0 grams tryptone, 5.0 grams Dextrose and 9.0 grams agar.

Media preparing steps:

The media were prepared according to the manufactures instructions.

The powder was weighed; dissolved in distilled water with heating. Sterilization was done using the autoclave.

Microbiological studies and analysis:

Microbial studies were done by using bacterial viable count using the pour plate method as described by FAO (1992). One ml from each dilution was transferred aseptically by pipette to sterile petri dish. 15-20 ml of melted media nutrient agar. Then it was mixed thoroughly and allowed to solidify, the plates were incubated at 98.6°F for 48 hours. The colonies were counted as colony forming unit /gm as mean value. Five grams from each sample were weighed aseptically in sterile container and then blended with 45 ml sterile distilled water using sterile electric blender for two minutes to get 1/10 dilution. One ml from the first dilution was transferred to 9 ml sterile distilled water to obtain the second dilution. This procedure was repeated to obtain

successive serial dilutions 10^{-1} , 10^{-2} , 10^{-3} ... 10^{-10} , to get 10 dilutions (FAO, 1992).

Data collection:

Blood weight

After slaughtering, the blood from each broiler chicken was collected and weighed using a digital balance.

Bacterial count

The broiler chickens' carcasses parts of the left side (breast, thigh and wing) after being removed and dissected, the soft tissue of each part was prepared for microbial analysis (bacterial count). The bacterial count was done at three different times (6 hours, 48 hours and 96 hours) post-mortem for each part for each slaughter method.

Statistical analysis

Statistical analysis was done using MSTAT. Analysis of variance was done as described by Steel and Torrie (1980). A completely randomized design was used to analyze the data. Duncuns' multiple range tests were used to determine the differences among the treatments means.

RESULTS AND DISCUSSION

The amount of blood collected after slaughtering the broiler chickens using the three different methods (Islamic traditional, hanging and electric stunning methods) were shown in Table (1). There were significant differences ($P < 0.01$) in the weight of bled blood using the different slaughter methods. The electrically stunned group recorded the lowest weight of blood, while that slaughtered by the Islamic hanging method recorded the highest weight of blood bled. It was clear that rendering the birds insensible and the position of birds during exsanguinations affect the level of bleeding. Hanging without stunning lead to more bleeding and this may be attributed to the effect of gravity and the rapid speed of blood flow in the blood vessels before clotting.

Lying on the surface, as done in the traditional slaughter method, reduces the bleeding or the blood removal from the vessels. However, electrical stunning slaughter renders the birds insensible and aggravates the situation resulting in even less bleeding. This may be attributed to the fact that the blood was arrested in the blood vessels, these findings were in accord with Sams (2001) who reported that the electrical stunning stops blood flow leading to cardiac arrest and consequently to death of the bird before slaughter which is prohibited in Islamic foods. Nevertheless, hanging slaughter method resulted in maximum blood drainage from the carcass, which might be attributed to deep sleep experienced by the birds at the time of slaughtering afterward (Iqra Islamic trust, 2010). This bleeding is by far one of the most important factors in Islamic laws in well killing (dhabih) as stated by Prophet Mohammed (peace be upon him) in his saying "Verily Allah has prescribed proficiency in all things. Thus, if you kill, kill well; and if you perform dhabih, perform it well. Let each one of you sharpen his blade and spare suffering, to the animal he slays". (Sahih Muslim). These findings confirm that electrical stunning leads to cardiac arrest and immediate loss of brain function (Humane slaughter association, 2003). Animals and birds stunned prior to slaughtering had classic patterns of trauma and hemorrhage which results in blood clotting leading to more retained blood in the carcass (Iqra Islamic trust, 2010). Cardiac arrest also results in high percentage of death prior to slaughter (17-37%). Bleeding was reduced by almost 25% in stunned birds compared with hanging method. These results are on line with Bilgili (1992) and Fletcher (1993) who noticed that in addition to rendering the bird insensible, the stunned birds reduce wing flapping and muscular contraction.

The bacterial count on the different parts of broiler chickens carcass (breast, thigh and wing) after six hour of exsanguinations were shown in Table (2). The data showed

that there was insignificant difference ($P \geq 0.05$) on bacterial count due to the slaughter method or due to carcass part. This is because the meat is still fresh and the bacterial count although not significant, but the hanging method recording the lowest bacterial count with respect to the method. The increase in the bacterial count may be attributed the readily accessible nutrients available for the bacterial growth, as blood is considered to be the most important medium for bacteria growth. Among the different parts, the breast muscle seemed to have more retained blood, hence more bacterial count, while the thigh tended to have the lowest bacterial count.

Table (3) shows the effect of slaughter method on bacterial count after 48 hours postmortem in some parts of broiler chickens carcass. There were significant differences ($P < 0.05$) among the different slaughter methods with respect to part (Fig. 1, 2 and 3). The thigh had significantly ($P < 0.01$) the highest bacterial count compared to the other two parts (breast and wing), irrespective to the slaughter method, while the wing had the lowest bacterial count. However, the stunning method resulted in significantly ($P < 0.01$) the highest bacterial count, irrespective to part, while the hanging method recorded the lowest bacterial count. These results may be attributed to the residual blood in the different parts. In those parts with high residual blood (stunning method), the bacteria continued to grow as far as there was available nutrients, while for those with low residual blood (hanging method), the bacterial growth rate was checked as the available nutrients were depleted soon. The bacterial count was positively affected by the amount of residual blood left in the carcass. In using the electrical stunning, inefficient or improper bleeding causes more blood to be retained in the carcass. Irrespective to method of slaughtering, the breast had the highest bacterial count (Fig. 1, 2 and 3). However, the electrical stunning method recorded the highest bacterial count which is interrelated

to more retained blood and dead tissue. This high bacterial growth will lesser the shelf life of the meat and may lead to more deterioration of the product. These findings are in line with those of Greory and Wilkins (1989), who stated that electrical stunning has been associated with a higher incidence of carcass damage, such as red wing tips, broken bones, and hemorrhages. It can causes approximately 90% heart fibrillation resulting in inefficient bleeding, severe muscle contractions causing increased hemorrhaging and even death before exsanguinations, which by far will lead to poor carcass and meat quality. Even though electrical stunning can decrease the rate of pH decline early post-mortem, it has been shown to have little effect on breast muscle pH and rigor-values, after the four to six hours post-mortem aging period (Papinaho and Fletcher, 1996; Alvarado *et al.*, 2000). In these study findings, the higher bacterial count suggests lower PH. However, this study can confirm previous studies that shown the traditional method can be used successfully as an alternative to conventional electrical stunning method based on ensuring an irreversible loss of consciousness while not negatively affecting carcass and meat quality (McNeal *et al.*, 2003; McNeal and Fletcher, 2003).

As shown in Table (4), the bacterial count after 96 hours postmortem increased steadily as the time passed. However, there were significant differences ($P \geq 0.05$) among the different slaughter methods. Still the general trend was kept the same, and the carcasses resulted from hanging method tended to have the lowest bacterial count; while those parts of carcasses resulted from stunning method had the highest bacterial count, irrespective to part. However, the gap between the different methods was getting closer. It seemed that the residual blood was depleted as available nutrients as the time passed and the microorganisms resolved to muscular tissues as a source of nutrients.

Irrespective to method of slaughtering, the breast recorded the highest

bacterial count (Fig. 1, 2 and 3), this interpreting more blood arrested in the breast. These findings agree with those of Alvarado *et al.* (2007), who showed that blood content in breast muscle from birds subjected to different slaughter methods can be estimated by measuring the hemoglobin content in aqueous tissue extracts. It was indicated that bleeding removed little blood from the breast muscle. There are only four capillaries surround each muscle fiber (Mathieu-Costello, 1993), which might explain why there is poor blood removal from this muscle after bleeding. After slaughtering, the blood pressure drops rapidly so that there is not enough driving force to empty the numerous capillary beds in this muscle. This resulted in more bacterial growth in the breast, irrespective, to the slaughter method (Figures 1, 2 and 3). This observation has been noted in previous research and indicated that hemoglobin content in the breast muscle of not bled, stunned and bled, electrocuted and bled, decapitated and Halal slaughtered chickens is 0.36, 0.19, 0.22, 0.17, and 0.17 mg/g of soft tissue, respectively (Griffiths *et al.*, 1985). Lipid oxidation is a major cause of quality deterioration in foods, and inefficient and improper bleeding may cause more blood (hemoglobin) to be retained in the breast meat. This was confirmed by Alvarado *et al.* (2007), who showed that blood components, especially hemoglobin, are powerful promoters of lipid oxidation and may decrease the shelf life of meat products. In using traditional slaughtering method, the thigh tended to have the highest bacterial count 96 hours postmortem followed by the breast while the wing had the lowest bacterial count (Fig.1). However, using the hanging slaughtering method, the different parts seemed to be affected similarly at the different times (Fig. 2). However, using electrical stunning slaughtering method, the breast seemed to be the most affected parts after 96 hours postmortem, followed by the thigh (Fig. 3).

CONCLUSIONS

It could be concluded that:

The Islamic hanging slaughtering method resulted in higher level of bleeding compared to Islamic traditional slaughtering and electrical stunning methods.

The Islamic hanging slaughtering method resulted in the best keeping meat quality compared to other methods.

Meat deterioration and hence the bacterial count was affected by the level of bleeding.

The bacterial count increased as the time after exsanguinations increased (at 96 hours was far greater than at 6 hours).

Different carcass parts differ in their susceptibility to microorganisms according to the amount of retained blood in each.

Table (1): Effect of Islamic traditional slaughtering method (ITSM), Islamic hanging slaughtering method (IHSM) and Electric stunning method (ESM) on bled blood weight of broiler chickens (gram)

Parameter	Treatments			S.E.±	C.V.%	P
	ITSM	IHSM	ESM			
Blood Weight	57 b	67 a	50 c	1.53	7.62	***

*** indicates significant differences at $P \leq 0.001$.

Means in row followed by different letter(s) are significantly different at $P = 0.05$, according to Duncan's Multiple Range Test.

Table (2): Effect of Slaughter method on bacterial count after 6 hours on some parts of broiler carcass

Carcass Parts	Treatments			S.E.	C.V.%	P
	T.M.	H.M.	E.S.M.			
Breast	6633 a	6600 a	7600 a	378	17.07	NS
Thigh	6200 a	5467 a	6333 a	380	20.52	NS
Wing	6600 a	5600 a	6833 a	498	25.18	NS

NS indicates not significantly different.

Table (3): Effect of Slaughter method on bacterial count after 48 hours on some parts of broiler carcass (10^6)

Carcass parts	Treatments			S.E.	C.V.%	P
	T.M.	H.M.	S.M.			
Breast	72 b	56 c	82 a	5	15.71	**
Thigh	73 b	55 c	86 a	5	11.57	***
Wing	62 b	54 c	80 a	6	22.91	**

** and *** indicate significant differences at $P \leq 0.01$ and $P \leq 0.001$, respectively.

Means within each row followed by different letter(s) are significantly different at $P = 0.05$, according to Duncan's Multiple Range Test.

Table (4): Effect of Slaughter method on bacterial count after 96 hours on some parts of broiler carcass (10^6)

Carcass parts	Treatments			S.E.	C.V.%	P
	T.M.	H.M.	E.S.			
Breast	507 b	420 c	610 a	42	21.37	*
Thigh	587 a	417 c	537 b	46	25.99	**
Wing	447 c	403 b	480 a	14	10.10	*

* and ** indicate significant differences at $P \leq 0.05$ and $P \leq 0.01$, respectively.

Means in rows followed by different letter(s) are significantly different at $P=0.05$, according to Duncan's Multiple Range Test.

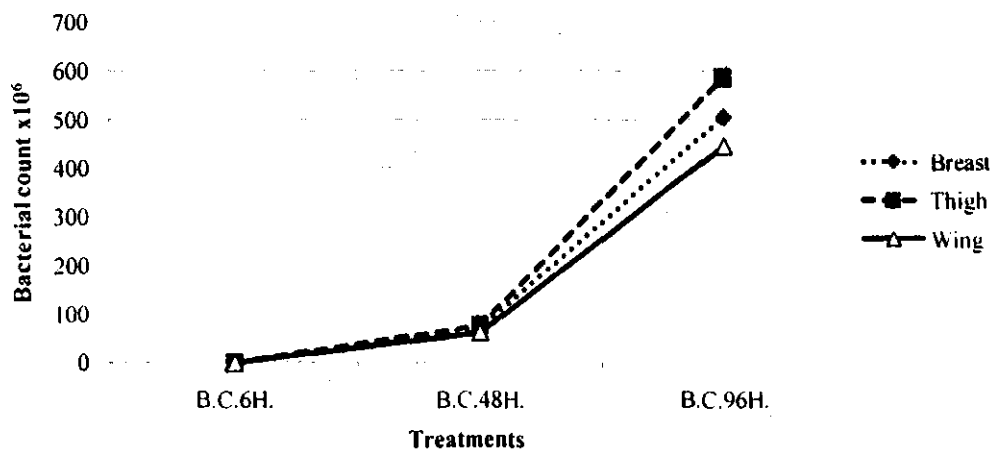


Figure 1. Effect of keeping time on the bacterial count of different carcass parts of broiler chickens slaughtered by Islamic traditional method

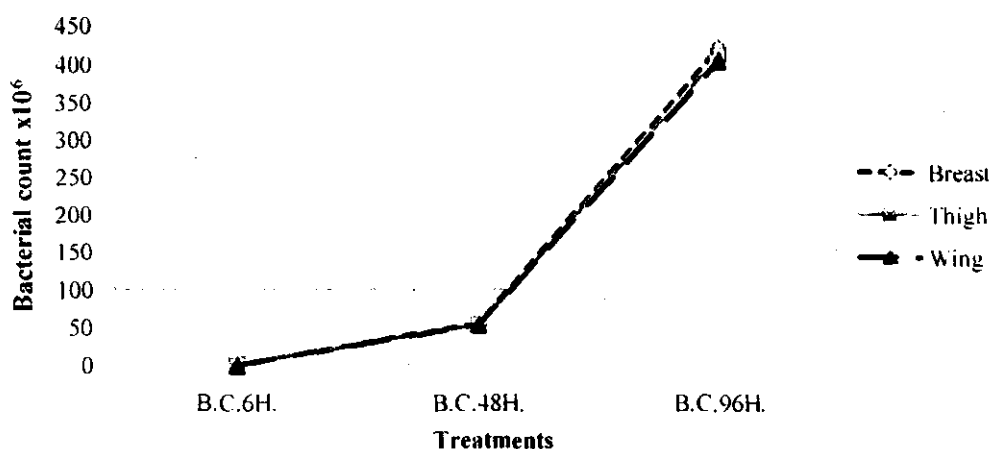


Figure 2. Effect of keeping time on the bacterial count of different carcass parts of broiler chickens slaughtered by Islamic hanging method

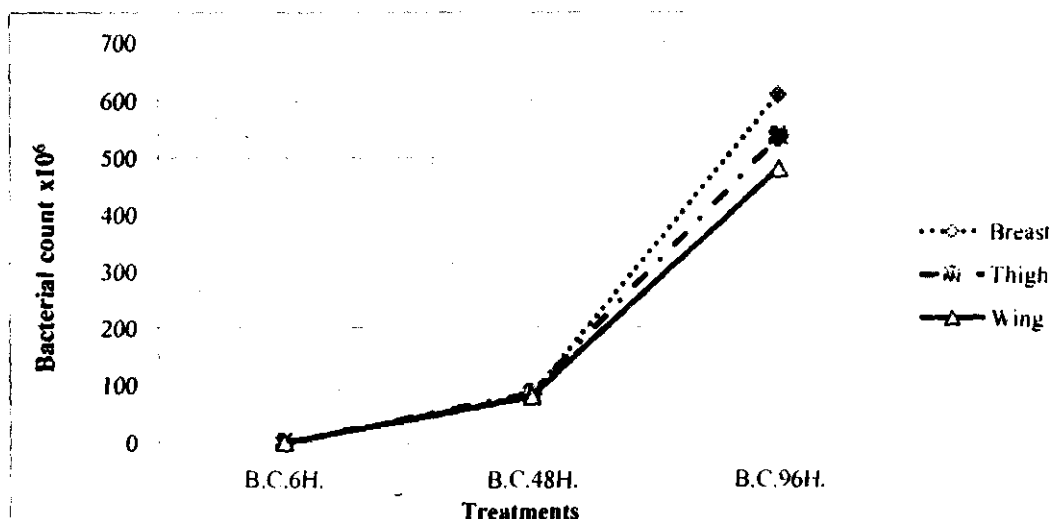


Figure 3. Effect of keeping time on the bacterial count of different carcass parts of broiler chickens slaughtered by electrical stunning method

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الملخص العربي

تأثير طريقة الذبح على جودة لحوم فراخ اللحم

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أجريت تجربة لدراسة تأثير طرق الذبح على جودة لحوم فراخ اللحم (الطريقة الإسلامية المعلقة والإسلامية المستلقاة و الصعق الكهربائي). تم اختيار ٨١ من ذكور فراخ اللحم حسب متوسط أوزانها الحية. وتم توزيعها عشوائياً إلى ثلاث مجموعات. تم نبح كل مجموعة بوحدة من إحدى الطرق الثلاث. تم جمع الدم النازف من كل طائر على حده وتم وزنه. تم اختيار ثلاث أجزاء من كل طائر وهي الصدر والفخذ والجناح لتقدير المحتوى البكتيري فيها في ثلاث فترات زمنية (٦ ساعات و ٤٨ ساعة و ٩٦ ساعة بعد الذبح). أظهرت الدراسة وجود فرق معنوي ($P \geq 0.01$) في كمية الدم النازف بين طرق الذبح الثلاث. أدت طريقة الذبح الإسلامي المعلقة لنزف أكبر كمية من الدم. بينما أدت طريقة الصعق الكهربائي لنزف أقل كمية من الدم. كما أظهرت الدراسة عدم وجود فرق معنوي ($P \geq 0.05$) في عدد المستعمرات البكتيرية بين طرق الذبح الثلاث بعد ٦ ساعات من الذبح. أظهرت الدراسة أن هنالك فرق معنوي ($P \geq 0.01$) في أعداد المستعمرات البكتيرية بين طرق الذبح المختلفة بعد ٤٨ ساعة من الذبح. حيث أدت طريقة الصعق الكهربائي إلى وجود أكبر عدد من المستعمرات بينما أدت طريقة الذبح الإسلامي المعلقة إلى وجود أقل عدد من المستعمرات. أظهرت الدراسة أيضاً وجود فرق معنوي في أعداد المستعمرات البكتيرية بين طرق الذبح الثلاث بعد مرور ٩٦ ساعة بعد الذبح. حيث حافظت الطرق على نفس المنوال مقارنة بالنتائج بعد ٤٨ ساعة. أثبتت الدراسة أن الطريقة الإسلامية المعلقة هي الأفضل. لهذا نوصي باستعمالها لذبح فراخ اللحم.