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Effect of slaughtering in different slaughter houses on some traits of broiler chicken meat during different storage periods under refrigeration and freezing

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Abstract

The aim of this study was to detection the effects of slaughtering on some traits of different slaughterhouses in chicken breast meat, different indicators were measured to determine some traits of the local fresh chicken breast meat during different storage periods under refrigeration and freezing temperature. All tests were made in the post-graduate laboratories of Animal Production Department, College of Agricultural sciences, University of Sulaimani. The physical evaluation of breast meat for each unlicensed and licensed slaughterhouses during 6 days at refrigeration (4±1°C) storage showed a decrease in water holding capacity (WHC) with an increase in drip loss. There were no significant differences ($P \leq 0.05$) in WHC and thawing loss between breast meat for both slaughterhouses. Results also showed a decrease in pH value with storage period increasing, found no significant differences ($P \leq 0.05$) between unlicensed and licensed slaughter houses after 6 days at refrigeration temperature except after 2 days of storage. Freezing experiment showed fluctuation during 90 days with significant difference ($P \leq 0.05$) only after 90 days of storage. Total volatile nitrogen (TVN) mean an increase during 6 days of storage at refrigeration temperature. It ranged from 3.19 to 4.53 mg N/100 gm for unlicensed and from 2.94 to 3.69 mg N/100 gm for licensed with significant difference ($P \leq 0.05$) only at last day of storage and increased in freezing.

Key words: traits of broiler chicken , slaughtering.

تأثير ذبح فروج اللحم في مجازر مختلفة في بعض صفات لحم الصدر خلال التخزين بالتبريد والتجميد

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الخلاصة

لغرض الكشف عن تاثير الذبح بمجازر مختلفة على نوعية لحوم صدر الدجاج، من اجل ذلك، تمت استخدام عدة قياسات لتحديد الصفات الفيزيائية، الكيميائية والبايولوجية للحم صدر الدجاج تحت ظروف الخزن بالتجميد والتبريد بفترات مختلفة والمقارنة مع الحدود المقبولة لكل قياس. اجريت جميع الاختبارات لهذه الدراسة في مختبرات الدراسات العليا، قسم الانتاج الحيواني، كلية العلوم الزراعية، جامعة السليمانية، اقليم كوردستان، العراق. لوحظ من نتائج التقييم الفيزيائي: ان لحم صدر الدجاج، المذبوح بالمجازر المرخصة والغير مرخصة، في التبريد (4 ± 1م°) لمدة 6 يوم لوحظ انخفاض بقابلية حفظ الماء اثناء فترات التخزين مع زيادة السائل الناضح ، اما بالنسبة للتجميد (-18 ± 1م°) اظهرت النتائج ان قابلية حفظ الماء و قابلية الذوبان عدم وجود اختلافات معنوية ($P \geq 0.05$). النتائج اظهرت انخفاض في الاس الهيدروجيني مع زيادة مدة الخزن بالتبريد لكل من لحم صدر الدجاج المذبوح بالمجازر الغير مرخصة و المرخصة مع عدم وجود فروقات معنوية (ما عدا في اليوم الثاني من التخزين)، اما بالنسبة للتجميد، وجد تذبذب بدرجة الحموضة بين عينات لحم الصدر اثناء فترة التخزين، فروقات المعنوية ($P \geq 0.05$) كانت بعد 90 يوم من التخزين بالتجميد. بالنسبة لقيمة النيتروجين الكلي المتطاير، لوحظ ارتفاع في هذة القيمة اثناء التخزين بالتبريد (4 ± 1م°) حيث كانت تتراوح بين 3.19 الى 4.53 مغلم نيتروجين/100 غم من لحم صدر الدجاج الغير مرخص و بين 2.94 الى 3.69 مغلم نيتروجين/100 غم من لحم صدر الدجاج المرخص بعد 6 ايام من الخزن بالتبريد مع وجود فروقات معنوية ($P \geq 0.05$) فقط في اليوم الاخير من التبريد. في حالة التجميد (-18 ± 1م°)، لوحظ ارتفاع هذه القيمة لكلا من لحم صدر الدجاج الغير المرخص و المرخص خلال فترة التجميد.

الكلمات المفتاحية: فروج اللحم ، االمجازر، صفات لحم الصدر.

Introduction

Throughout the world, consumption of poultry meat continues to rise in both developed and developing countries. Poultry is predicted to become the overall meat of choice (Bilgili, 2002). Production of poultry meat and products has increased in generally throughout the world in the last decade. Chicken and poultry products have become popular because their specific sensory attributes and consider white meat is considered healthier compared to red meat (Balamatsia et al., 2006). In most countries, two kinds of poultry slaughtering are used, one is an automated poultry slaughtering process established recently, whereby automated systems are used for scalding, plucking, eviscerating, rinsing, and packaging carcasses. Carcasses are then stored at 4°C or freezing before saling to supermarkets. The second is traditional slaughtering, which is commonly practiced in shops under poor hygienic conditions. Most of poultry slaughtering is done by traditional procedures (Ministry of Farming, 2005). Poultry meat preserved from deterioration using by low temperature, it could be refrigerated for short period, or it can be frozen for several months (FSIS, 1995). The frozen process is an important factor for limiting the microbial growth and decreasing the enzymatic deterioration, it's advised to keep the poultry meat under -18 ºC. Frequent cycling of the refrigeration system through this temperature zone causes large ice crystal growth in muscle cells and excessive purge (water loss) when thawed (Keeton and Osburn, 2001). Shelf life is a most important parameters affecting the quality of chicken meat after its distribution to the market. It is the result of poultry management conditions, distribution, processing and storage conditions both on the market and in consumers' households (Kozacinski *et al*., 2012). Chicken meat is highly perishable and the time that leads to deterioration varies from four to about twelve days after slaughter, even when maintained in a cooling environment (Smolander *et al*., 2004). The aims of this study will be determining effect of slaughtering in different slaughter houses on some traits of broiler chicken meat.

Material and methods

Seventy-two broiler chicken from one source, at same ages and convergent weights (3250-3700 Kg), were divided into two groups. The first group was slaughtered in unlicensed slaughterhouse and then carcasses were cut up and the breast meat were separated, also the second group was slaughtered in licensed slaughterhouse and then carcasses were cut up and the breast meat were separated. All samples were transferred inside a cork chilled box (ice box) to the laboratory. The sensory evaluation was done immediately whenever the samples reached the laboratory. Some tests were made in the post-graduate laboratories of Animal Production Department, Faculty of Agriculture sciences, University of Sulaimani, Kurdistan region, Iraq. The chicken breast meat stored at refrigeration (4°C) and freezing (-18°C) temperature.

Breast meat samples from unlicensed and licensed slaughterhouse were stored in two types (refrigerator and freezer), each type had six replicates and each replicates composed from three chicken breast meat as follows:

- Breast of chicken meat that slaughtered in unlicensed slaughterhouse and stored at refrigeration temperature (4±1°C) for 6 days.
- Breast of chicken meat that slaughtered in unlicensed slaughterhouse and stored at freezing temperature (-18±1°C) for 90 days.
- Breast of chicken meat that slaughtered in licensed slaughterhouse and stored at refrigeration temperature (4±1°C) for 6 days.
- Breast of chicken meat that slaughtered in licensed slaughterhouse and stored at freezing temperature (-18±1°C) for 90 days.

Several tests were carried out on the breast meat samples during 4 months from September to the end of December 2015. The physical tests on breast meat that stored by refrigeration, the parameters were done at days 0, 2, 4 and 6, Meat stored by freezing the parameters were obtained at 0, 15, 30, 60 and 90 days, represent the study outlines for breast meat stored using the two types of storing. Water-holding capacity (WHC) was carried as describe by (Wardlaw *et al*., 1973) modified, Drip loss as described by (Northcutt *et al.*, 1994 and Dirinck *et al.*, 1996), Thawing loss as described by (Nam *et al.*, 2000), pH measurement as

described by (Naveena and Mendiratta, 2001) and Total volatile nitrogen (TVN) as described by (Malle and Poumeyrol, 1989) modified.

Statistical Analysis

The statistical analysis system XLSTAT (2004) program was used to analyse the data obtained study. Factorial Complete Randomized Design (CRD), was used to analysis data, The significance of differences between means of traits were determined using Duncan's multiple range tests under the probability ($P< 0.05$) (Duncan, 1955). Data of all percentages were transformed to arcsine before statistical analysis.

Results and Discussion

Water-holding capacity (WHC).

Water-holding capacity of fresh meat (ability to retain inherent water) is an important property of fresh meat as it affects both the yield and the quality of the final product.

At refrigeration (4±1 ºC) storage, the results in table (1) show highest percentage of WHC in breast meat. It was 46.99 and 45.55 % for unlicensed and licensed slaughterhouses respectively, at zero day (control).

Table1 WHC percentage of breast meat stored on different periods at refrigeration (4±1 ºC).

Slaughterhouses	Storage Periods (days)			
	0	2 nd	4 th	6 th
Unlicensed	46.99 ± 6.83 *a	44.77 ± 7.49 Ab	28.88 ± 4.44 Bc	25.55 ± 1.11 c
Licensed	45.55 ± 1.11 ab	34.44 ± 4.84 Abc	29.99 ± 3.38 Abc	27.77 ± 2.94 bc

***Number in the table represent mean and standard error. Means with different letter significantly differ (P≤ 0.05).**

Results of WHC percentage were decreased ($P\leq0.05$) significantly with increasing storage periods under refrigeration condition, the results for unlicensed slaughterhouse from 0 to 6 days of storage at refrigeration were 46.99 to 25.55%, and for licensed slaughterhouse were 45.55 to 27.77%, respectively. Ali and Zahran (2010) reported that the WHC in chicken carcasses kept under chilled temperature, was decreased during six days of storage. There was a clear tendency for WHC to increase with increasing meat pH values, pH values were increased away from the isoelectric pH of proteins, and WHC increased as well (Honikel *et al*., 1981; Gorge, 2000). At freezing storage (-18±1 ºC), the highest percentage of WHC in breast meat for unlicensed and licensed slaughterhouses were 47.32 and 44.86% at the initial period , and the lowest percentage were 21.88 and 20.66% after 30 days of storage in the breast meat of unlicensed and licensed slaughterhouses respectively (Table 2).

Table 2 WHC percentage of breast meat stored on different periods at freezing (-18±1 ºC).

Slaughterhouses	Storage Period (days)				
	0	15 th	30 th	60 th	90 th
Unlicensed	47.32 ± 6.83 *a	34.41 ± 1.11 bc	21.88 ± 1.30 d	25.55 ± 4.00 cd	41.10 ± 4.00 ab
Licensed	44.86 ± 1.11 ab	35.23 ± 4.00 bc	20.66 ± 1.38 d	27.77 ± 5.88 cd	36.66 ± 1.92 abc

***Number in the table represent mean and standard error. Means with different letter significantly differ ($P\leq 0.05$).**

The results WHC percentage were decreased during storage at freezing temperature until 30 days of storage and then the percentage of WHC was increased to the last days of storage for both breast meat of unlicensed and licensed slaughterhouses. Significant differences ($P\leq0.05$) recorded in WHC of breast meat of both slaughterhouses in day 15th with 30th and day 30th with 90th of storage. Significant differences ($P\leq0.05$) for unlicensed slaughterhouse at zero day with

day 15th, 30th and 60th of both slaughterhouses were recorded, also significant differences ($P \leq 0.05$) recorded for licensed slaughterhouse in day 0 with day 30th and 60th of both slaughterhouses.

The water holding capacity depend on meat pH and the protein composition, if the pH remains high, it leads to the highest water holding capacity of meat after slaughtering (Northcutt, 1999). Cornforth (1994) stated that broiler breast meat with a high pH has a higher water binding capacity than meat with lower pH.

Table 3: Drip loss percentage per day of breast meat stored on different periods at refrigeration (4±1 ºC).

slaughterhouses	Storage Periods (days)				
	2 nd		2 nd		2 nd
Unlicensed	1.87 ± 0.08 *a	Unlicensed	1.87 ± 0.08 *a	Unlicensed	1.87 ± 0.08 *a
licensed	2.24 ± 0.17 a	licensed	2.24 ± 0.17 a	licensed	2.24 ± 0.17 a

Drip loss

Results in table (3) shows that drip loss percentage at refrigeration storage (4±1 ºC). Differences ($P \leq 0.05$) between breast meat of both slaughterhouses were no significant differences within periods. Wojtysiak and Połtowicz (2006), found that drip loss percentage per day in chicken breast meat was increased with decreased in pH value during refrigeration storage. Suwattitanun and Wattanachant (2014) found the drip loss percentage for breast meat stored at refrigeration temperature during 96 hr was 2.46 %. During storage, degradation of protein due to proteolysis would certainly allow water that is expelled from intramyofibrillar spaces to drip production (Huff-Lonergan and Lonergan, 2005). Lesiak *et al*. (1996) who found that longer storage time was induced greater drip loss. Allen *et al*. (1998) showed that the acidic pH (5.8) fillets had a 2.5% increase in drip loss. Drip loss is influenced by decrease pH decline causing the changes within the muscle postmortem on water movement from the interfilamental space into the interfibrillar fluid and from there into the extracellular space (Berri *et al.*, 2001).

Thawing loss

Thawing loss is a test used to determinate the quality of frozen meat; the increase in thawing loss leads to increase in loosing of juice which leads to meat dry and pale (Berry, 1998).

Table 4: Thawing loss percentage of breast meat stored on different periods at freezing (-18±1ºC).

Slaughterhouses	Storage Periods (days)			
	15th	30th	60th	90th
Unlicensed	1.84 ± 0.35 *b	4.58 ± 1.46 ab	5.15 ± 1.83 ab	4.99 ± 1.20 ab
Licensed	2.46 ± 0.49 B	5.42 ± 1.25 ab	7.92 ± 0.47 a	2.56 ± 0.40 b

***Number in the table represent mean and standard error. Means with different letter significantly differ ($P \leq 0.05$).**

The results of thawing loss percentage were fluctuated during storage at freezing condition from 15 to 90 days. There were not significant differences ($P \leq 0.05$) between breast meat of slaughterhouses during storage periods.

Moran and Todd (1994) have mentioned that the increase in storage period of freezing leads to increase in thawing loss. In any case, breast meat from unlicensed and licensed poultry slaughterhouse were unacceptable after 30 and 60 days of freezing storage, by the Iraqi Central Organization for Standardization and quality control, IQS 1179 when identified the frozen chicken thawing loss should not be more than 5% (ICOSQC /IQS 1179, 1987), and that may be affected nutrient value of meat and lead to low moisture and protein content recorded in this mark.

pH Value

pH considered as one of the important quality tests for evaluating meat quality (Fletcher, 1999). The pH of chicken breast meat is determined by how much glycogen is in the breast muscle prior to slaughter. Additionally, the remaining glycogen in the meat is converted to lactic acid after slaughter might consider a significant parameter of changing in pH values of the meat (Debut *et al*., 2003).

Breast meat samples of unlicensed and licensed slaughterhouses stored at refrigeration temperature (4±1 ºC) had higher pH values after slaughtered (day zero) (Fig 1).

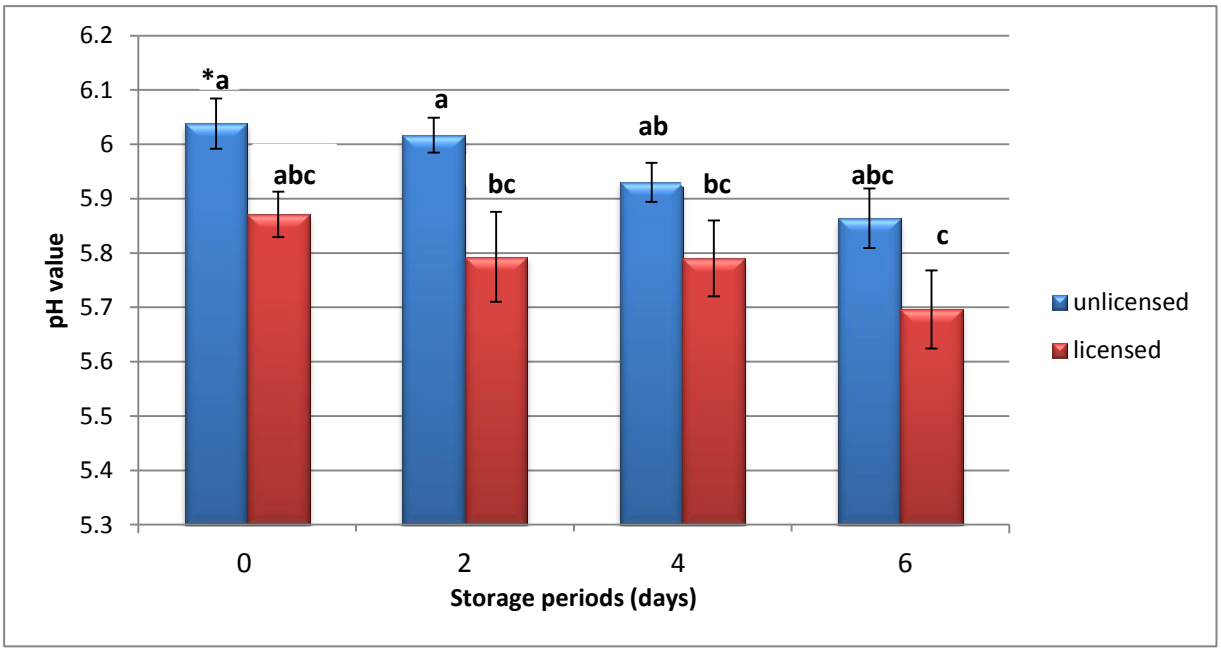

Figure 1: pH values of breast meat under different storage periods (0, 2, 4 and 6 days) at refrigeration (4±1 ºC). Ten grams of meat were added to 50 ml dH_2O in a beaker then the mixture was homogenized and the pH values have measured.

***Represent mean and standard error. Means with different letter significantly differ ($P \leq 0.05$).**

The pH values in breast samples were insignificantly decreased for unlicensed and licensed slaughterhouses during 6 days of storage at refrigeration temperature and that ranged from 6.03 to 5.86 for unlicensed and from 5.87 to 5.69 for licensed. Significant difference ($P \leq 0.05$) was noted between unlicensed and licensed only after 2 days of storage. Breast meat of unlicensed slaughterhouse at day 0 and 2nd day were significantly differ with day 2nd, 4th and 6th of licensed, also at day 4th of unlicensed was significantly compared to day 6th of licensed. The present results were consistent with Wojtysiak and Połtowicz (2006) since they found that pH values in breast meat were decreased during refrigeration storage and those results were 6.54, 6.29, 6.10 and 6.06 during 6 days of storage respectively. Surmei and Usturoi (2012), have found the pH value of chicken breast meat during the 6 days of refrigerated storage immediately after slaughter, the pH value was increased from 6.05 to 6.38, the last day of storage (sixth day). These results in the research was not consistent with results obtained at the present study.

The rate of decrease in pH of the chicken meat was shown to be influenced by behavior at slaughtering and hastening by struggle activity of the birds on the shackle line, especially wing flapping (Berri et al., 2005). At freezing temperature (-18±1 ºC), the results indicated that the higher pH value (6.24) was obtained in breast meat of unlicensed slaughterhouse after 90 days of storage and the lowest pH value was (5.64) after 30 days of storage in breast of licensed slaughterhouse (Fig 2).

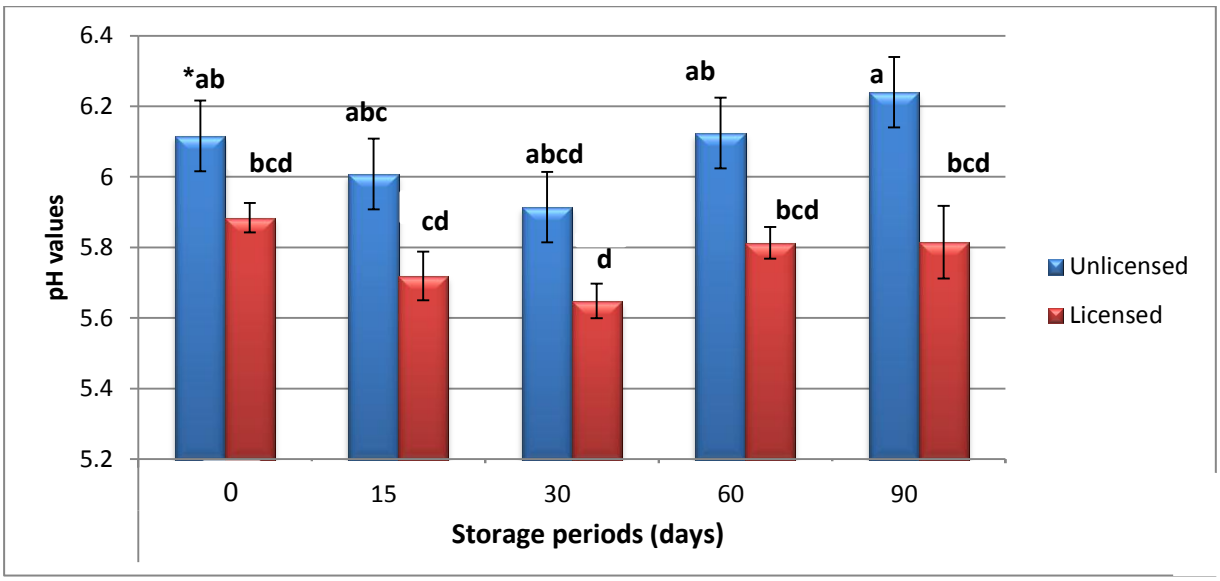

Figure 2: pH values of breast meat under different storage periods (0, 15, 30, 60 and 90 days) at freezing (-18±1 ºC). Ten grams of meat were added to 50 ml dH_2O in a beaker then the mixture was homogenized and the pH values have measured.

***Represent mean and standard error. Means with different letter significantly differ ($P \leq 0.05$).**

The pH values in breast meat for unlicensed and licensed slaughterhouse were fluctuated during 90 days of storage at freezing temperature. Significant difference ($P \leq 0.05$) between breast meat of unlicensed and licensed slaughterhouses at the last day (after 90 days of storage) . After 90 days' storage for unlicensed showed significantly differ with all storage days of licensed slaughterhouse, also at day 0 of unlicensed was significantly differ with day 15th and 30th of licensed. The pH of muscle breast remains high after post mortem (Church, 1998). pH data of our results were coincide with another study that showed fluctuation of pH mean value in chicken breast meat during ninety days of freezing (Kumar *et al.* ,2014). Similar results were reported by Rao and Kowale (1988) with meat during frozen storage for 90 days.

Total volatile nitrogen (TVN)

The TVN is considered as an indicator for any change in meat protein and other nitrogen compounds. Total volatile Nitrogen is related to protein breakdown and its quantity in meat is deemed as an index of the meat spoilage (Ruiz-Capillas and Jimenez-Colmenero, 2005). In the refrigeration storage (4±1 ºC), the results indicated that the TVN value was increased for both unlicensed and licensed slaughterhouses during storage periods (Fig 3). The higher values obtained for unlicensed and licensed slaughterhouse after 6 days of storage were 4.53 and 3.69 mg N/ 100 gm meat, respectively.

The TVN values in breast meat of unlicensed and licensed slaughterhouses were increased during 6 day of storage at refrigeration temperature. These results showed significant difference between slaughterhouses ($P \leq 0.05$) only after 6 days of storage. TVN values in day 6th of unlicensed was differ significantly compared to other storage days (not with day 4th of unlicensed), and day 4th of unlicensed differ significantly with day 0 of both slaughterhouses and also with day 2nd of unlicensed.

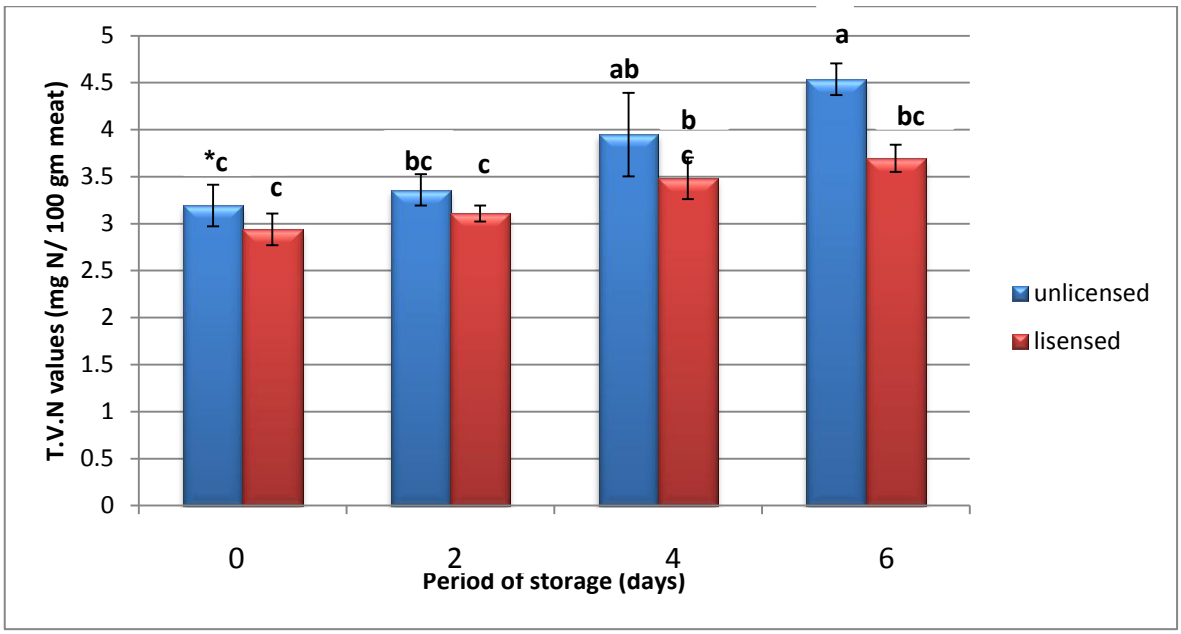

Figure 3: TVN mean values of breast meat under different storage periods (0, 2, 4 and 6 days) at refrigeration (4±1 ºC). Fifty grams of meat was added to 100 ml TCA (7.5%) in a beaker then the mixture was homogenized and then using kjeldahl for detection of T.V.N.

***Represent mean and standard error. Means with different letter significantly differ (*P*≤ 0.05).**

There are many studies have done on different frozen meat in which the TVN had been followed as an indicator for the storage meat sample type. These studies referred to increase in TVN during storage period, depend on different factors such as temperature, storage period and meat type (Rukchon *et al*., 2011). Edris *et al.* (2012) recorded that TVN values in breast meat during refrigeration storage have increased from slaughtering to 8 days' storage, their results were agreed with our results for TVN being as an indicator in breast meat. In the freezing storage (-18±1 ºC), the higher value of TVN in breast meat of unlicensed and licensed slaughterhouse were 5.04 and 4.20 mg N/ 100 gm meat respectively, after 90 days of storage (Fig 4).

The TVN values in samples taken from both unlicensed and licensed slaughterhouse and stored by refrigeration or freezing are acceptable according to Iraqi standardization. The Iraqi Central Organization for Standardization and quality control, IQS 1179, specified the frozen chicken TVN. value not to exceed 20 mg N/ 100g meat (ICOSQC, 1987).

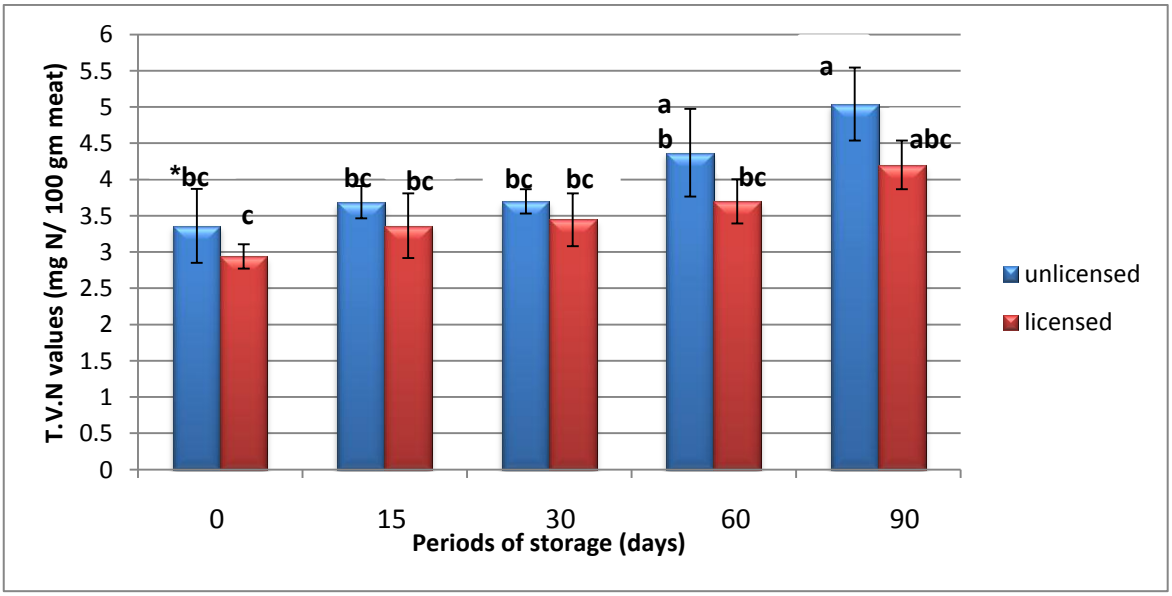

Figure 4: TVN mean values of breast meat under different storage periods (0, 15, 30, 60 and 90 days) at freezing (-18±1 ºC). Fifty grams of meat was added to 100 ml TCA (7.5%) in a beaker then the mixture was homogenized and then using kjeldahl for detection of TVN.

***Represent mean and standard error. Means with different letter significantly differ (*P*≤ 0.05).**

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