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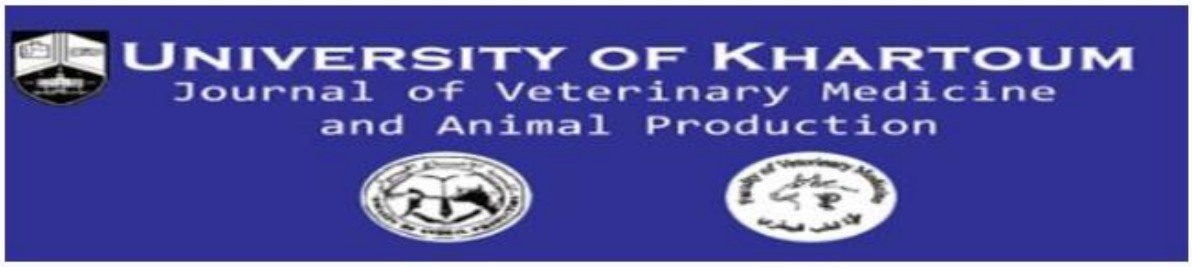

Effects of Different Stunning Voltages and Season on Broiler Carcass Defects and Condemnation in Slaughterhouses in Khartoum State

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Abstract

The aim of this study was to provide information on the influence of stunning voltage on broiler carcass quality and to investigate the effect of year season (winter, summer and autumn) on the percentage of causes of carcasses condemnation in nine poultry slaughterhouses located in Khartoum state. The data were collected by the Veterinary Inspection Services of the Ministry of Agriculture and Animal Rescores and Irrigation, in 2016. The commercial poultry slaughterhouses use different stunning voltages. According to the stunning voltage used the treatments were divided into three groups, Group 1: 25mA, Group 2: 35mA and Group3: 45mA. The influence of electrical stunning voltage on apparent carcasses defects (breast muscle hemorrhage, red wing tips, broken bone, and bleeding) was studied. Also the effect of year season on causes of carcasses condemnation was recorded. Complete randomized design with factorial arrangement was used, each treatment group was replicated 3 times. The collected data were subjected to analysis of variance (ANOVA). The results revealed that high stunning voltage at 45 mA significantly ($P \leq 0.05$) reduced the breast muscle hemorrhages, red wing tips, bleeding and resulted in a better carcass quality compared to other applied voltages (25mA, and 35mA). The different seasons were found to have significant ($P \leq 0.05$) effects on percentage of causes carcasses condemnations. The percentage of carcass condemned with breast muscle hemorrhage and red wing tips were significantly ($P \leq 0.05$) lower in winter compared to summer and autumn. The incidence of condemned carcasses was significantly ($P \leq 0.05$) high (0.50%) in summer and autumn (0.45%) while significantly ($P \leq 0.05$) lower percentage values were recorded in winter (0.13%). The study concluded that carcasses defects were reduced when (45mA) stunning voltage versus 25- 35mA was used and the lowest percentage of carcasses condemned were observed during winter season. The usage of high stunning voltage is recommended for better carcass quality.

Keywords: Electrical stunning, carcass quality, year season, percentage of condemnation broiler

الخلاصة

أُجريت هذه الدراسة لمعرفة تاثير إستخدام الصعق الكهربائي على جودة ذبائح الفراخ وبحث تاثير الفصل السنوي (الشتاء والصيف والخريف) علي نسبة اسباب الاعدامات في تسع مجازر بولاية الخرطوم. تم جمع المعلومات بواسطة خدمة الفحص والتفتيش البيطري بوزارة الزراعة والثروة الحيوانية والري ولاية الخرطوم في 2016. مجازر الدواجن التجارية تستخدم قوة صعق مختلفة بناء على ذلك قسمت المعاملات الى ثلاثة مجموعات: المجموعة1 تستخدم تيار كهرباي بقوة 25 ملى أمبير، المجموعة 2 تستخدم تيار كهربائي بقوة 35 ملى أمبير والمجموعة 3 تستخدم تيار كهربائي بقوة 45 ملى أمبير. تمت دراسة التاثير الناتج من إستخدام الصعق الكهربائي على العيوب الظاهرية للذبيحة (احمرار مناطق الريش في الجناح، البقع الدموية في منطقة الصدر، العظام المكسورة، الادماء). وتم رصد تاثيرفصول السنة علي نسبة اسباب الاعدامات.استخدم تصميم التجربة كامل العشوائية،كل معاملة تم تكرارها ثلاث مرات.أظهرت النتائج أن قوة الصعق المرتفع بمستوى45 ملى أمبير أدى الى خفض العيوب الظاهرية للذبيحة مثل البقع الدموية في منطقة الصدر و احمرار مناطق الريش في الجناح، العظام المكسورة والادماء مما أدى الى تحسن جودة الذبائح ، مقارنة بالصعق بمستوى25 ملى أمبير و 35 ملى أمبير. أظهرت النتائج أن فصول السنة المختلفة أثرت معنويا ($P \leq 0.05$) علىاسباباالاعدامات للذبائح. كانت نسبة الاعدامات نتيجة للبقع الدموية في منطقة الصدر و احمرار مناطق الريش في الجناح اقل ($P \leq 0.05$) فى الشتاء مقارنة بالصيف والخريف. فصل الصيف أدى الى زيادة حالات الاعدام التى سجلت0.5%، الخريف 0.45 % ، بينما النسبة في الشتاء كانت معنويا($P \leq 0.05$) اقل (0.13%). أيضا قلت العيوب الظاهرية للذبائح (البقع الدموية في منطقة الصدر، احمرار مناطق الريش في الجناح، سوء الادماء، العظام المكسورة، صغر الحجم ، الهزال) خلال فصل الشتاء وتحسن جودة الذبائح .خلصت الدراسة أن إستخدام قوة صعق عالية أدت الى تقليل نسبة العيوب الظاهرية للذبائح كما أن نسبة الاعدامات في فصل الشتاء كانت اقل. توصى الدراسة باستخدام قوة صعق عالية لتحقيق جودة ذبائح افضل.

الكلمات المفتاحية: الصعق الكهربائي,جودة الذبائح, فصل السنة، نسبة الاعدامات، فراخ اللحم

Introduction

A sequence of processing is carried out in the poultry slaughter houses to produce high quality carcasses to the market to meet the consumer preference. The most important steps in poultry processing in order to reduce quality defects are the electrical stunning, severing neck blood vessels and bleed out. Electrical stunning reduces the struggle and convulsions during slaughter and subsequently reduce carcass damage associated with these convulsions. Electrical water-bath stunning is the most common method of immobilizing birds for easier killing in commercial poultry processing plants (Savenije *et al.,* 2002). Nevertheless, it is thought that electrical stunning is a cause of many forms of downgrading carcasses. In particular, it is believed that using high voltages in a water-bath stunner can lead to poor bleeding. Inadequately bled birds can be condemned because of excessive blood in the carcass (Fletcher, 1993). Carcass quality defects which have been reported with electrical stunning leading to downgrading carcasses occur when the applied current is either too low or too high (Dickens and Lyon, 1993). Gaseous stunning is also used and one of its major advantages that the birds could be stunned during transport reducing handling stress associated with uncrating and shackling (Sparrey and Kettlewell,1994).

Numerous studies revealed that muscle tissue haemorrhages can be caused by pre-slaughter electrical stunning (Hillebrand *et al.,* 1996; Kranen *et al.,* 1998). High-voltage (ca. 120 mA) electrical stunning has been associated with a higher incidence of carcass damage, such as red wingtips, broken bones, and hemorrhages (Gregory and Wilkins, 1989). High-voltage method is usually favored in the EU because it lowers the risk of birds regaining consciousness during the slaughter process (Alvarado et al., 2007).

Low-voltage electrical stunning has been shown to affect early blood loss negatively but does not affect total blood loss after the 90- to 120-s exsanguinations period

(Gregory, 1993; Papinaho and Fletcher, 1995).

Breast meat color during processing as well as at the retail level, depending on the flock, type of birds processing factors and seasonality (Owens *et al.,* 2000; Woelfel *et al.,* 2002; Petracci *et al.,* 2004; Bianchi *et al.,* 2006). The Genetics of the birds also has been reported as a relevant factor for determining quality characteristics of the meat (Berri *et al.,* 2001; Debut *et al*., 2003). Some factors other than biological variations have been considered to affect poultry meat quality. The environmental conditions during transport and holding of the birds have been shown to affect processing yield and meat quality (Petracci *et al.,* 2001; Bianchi *et al.,* 2004). During summer months, high ante mortem temperatures can affect muscle acidification, or rigor development, and subsequent meat quality via adrenal or other physiological responses or simply by fatigue of the birds (Lambooij, 1999). Hence, the different commercial broiler companies in Khartoum state used different stunning voltages according to their program. This study was raised to assess the effect of both different stunning voltages used in commercial poultry slaughter houses on carcass defects and the effect of year seasons on percentage of carcass condemnation.

Material and methods

Study area

The aim of this research was to detect the influence of different stunning voltages on poultry carcasses defects and the effect of year season on causes of condemnation.

This study was conducted in Khartoum State (Khartoum, Omdurman, East Nile). The data was collected from different commercial poultry slaughter houses located in these three areas.

Data collection

Through a field survey, nine slaughterhouses located in the Khartoum State in Sudan were selected.

The data collection based on official post-mortem inspection records of broiler carcass condemnations, which collected by the veterinary inspection services of the Khartoum state Ministry of Agriculture and Animal Resources and Irrigation. The data were obtained daily by the inspection staff. Birds were subjected to internal and external examination including examination of viscera. The condemned carcasses were classified according to the type of defects. Data from broiler flocks were recorded daily from January to October2016.

Experimental birds

Experimental birds were reared in closed house. The birds were subjected to 6–12hrs of feed withdrawal period prior to slaughter. Birds were transported from the farm to the slaughter house in crates. There were 12 birds per crate and approximately 1500 birds per vehicle. The duration of transportation from the farms to slaughterhouses was 30 minutes. The crates were manually unloaded onto a gravity roller conveyor, which transported the filled crates to the hanging area where they were hanged manually in shackles on the moving overhead defeathering conveyor.

Experimental design

The data was collected from nine different slaughter houses in Khartoum State. They were divided into three groups according to the voltage use for stunning. It was found that different slaughterhouses used different electric stunning voltage. The birds were divided to three groups according to the stunning voltage used (25mA, 35mA, 45mA). The number of birds examined under different stunning voltage 25, 35 and 45mA were 821,486,000; 782,260,000; 821,486,000, respectively. The effect of the

different stunning voltage on the carcass defects was recorded.

The influence of three seasons winter (December to March)**,** summer (April to July)**,** Autumn (August to October) on the percentage of causes of carcasses condemnation was also recorded. The number of birds examined during three season summer, winter and autumn were 919,390,000; 137,905,000; 118,062,300, respectively. The main carcass defects in these slaughter houses which were considered by the veterinary inspector were, emaciation, bleeding, broken bone; breast muscle hemorrhage and red wings tips.

Statistical analysis

The data collected were subjected to analysis of variance (ANOVA) using SPSS (2001) software. Means were separated using Duncan's Multiple Range Test.

Results

The effect of the different stunning voltage on the carcass defects was illustrated in Table1.It was clearly observed that broilers subjected to electrical stunning voltage with 45mA exhibited the lowest value of total condemned birds. The percentage of broken bone as affected by stunning voltage was significantly ($p \leq 0.05$) higher in the groups stunned with 45 and 25 mA compared to 35mA**.**The other carcass defects recorded including (bleeding and redwing tips and breast muscle hemorrhage had significant ($p \leq 0.05$) low value in the group which stunned by 45mA. Versus the higher percentage values of breast muscle hemorrhage and red wing tips that observed with the current voltage value of 25 mA followed by 35mA. On the other hand, the bleeding % values was high in group stunned with35 mA followed by 25 mA

Table 1: Effect of stunning voltage on broiler carcass defects (%)

Parameters	**Treatments (Mean ± SE)**		
	45mA	**35mA**	**25mA**
Total condemned	$0.27^{b}{}_{\pm}.013$	$0.47^{a}\pm.013$	$0.46^{a}\pm.013$
Broken bones	$10.57^{a}\pm0.64$	$6.26^{b}\pm0.64$	$8.95^{a}\pm0.64$
Breast hemorrhage	$1.86^{c}\pm0.76$	$17.34^{b}\pm0.77$	$24.19^{a}\pm0.76$
Red wing tips	$1.71^{c}\pm0.64$	$13.83^{b}\pm0.65$	$17.92^{a}\pm0.64$
Bleeding	$14.1b8^{c}\pm0.74$	$20.38^{a}\pm0.75$	$16.74^{b}\pm0.74$

$^{a-c}$ meansin the same row with different subscript differ significantly ($p \leq 0.05$)
mA: milliamp SE: Standard Errors

Table 2 illustrated the seasonal effect on the percentage of causes of carcasses condemnation. It was noted that the total number of condemned birds were significantly ($P \leq 0.05$) higher during the summer followed by autumn while the lowest values were observed during winter. The results showed that the percentages of carcasses condemned with small size and emaciation were significantly ($P \leq 0.05$) higher in summer while the lowest values were recorded in winter. The results revealed that significantly ($P \leq 0.05$) high percentage of condemnations due to carcasses with wound and breast heamrorhages were recorded during autumn

and summer whereas the lowest percentage values were observed during winter.

No significant (P>0.05) seasonal difference was observed in condemnation% with broken bone defect. The greatest percentage of condemnation (P≤0.05) with red wing tips were recorded in autumn followed by summer whereas the lowest was observed during winter. It was observed that significantly(P≤0.05) high percentage of condemnation carcasses with bleeding was recorded in summer followed by winter and the lowest percentage values was observed in autumn.

Table 2: Effect of different seasons on causes of carcasses condemnation in broilers. (%)

Parameters	Treatments		
	Summer	Autumn	winter
Total condemned	0.51^{a}±0.12	0.46^{b}±0.12	0.14^{c}±0.7
Small size	27.35^{a}±1.00	20.13^{b}±0.83	19.45^{b}±0.80
Emaciation	25.58^{a}±0.804	15.95^{b}±0.664	15.82^{b}±0.65
Wounds	9.42^{a}±/0.63	9.91^{a}±0.66	5.28^{b}±0.80
Broken Bone	8.83±0.587	8.18±0.604	8.83±0.73
Breast hemorrhage	17.17^{a}±0.69	17.38^{a}±0.72	5.89^{b}±0.87
Red wing tips	11.66^{b}±0.58	14.64^{a}±0.60	5.17^{c}±0.73
Bleeding	22.16^{a}±0.84	14.13^{c}±0.69	16.64^{b}±0.68

$^{a-c}$ means in the same row with different subscript different significantly (p≤0.05)
mA: milliamp SE: Standard Errors

Discussion

The commercial poultry slaughter house attempts to apply stunning of birds before slaughter as a common technique during the process of slaughter. This method of stunning is commonly used in order to increase the meat quality. The different stunning voltages used were (45mA, 35mA, 25mA) and their effects on the carcass defects was studied. It was found that increased electrical stunning voltage to 45mA versus 25 – 35mA will decrease the incidence of breast muscle hemorrhages. The results of the current study disagree with Gregory and Wilkins (1989) who found that an increase of breast muscle hemorrhages in broilers stunned with electrical currents higher than130mA or with Hillebrand *et al*. (1996) who stunned with 100 mA found similar effects. The different results can be attributed to the difference in the voltage used. In the current study the voltage used did not exceed 45mA. Raj *et al*. (1992) observed that tetanic convulsions that occurred during electrical stunning had a detrimental effect on breast muscle. Super contractions during electrical stunning rupture blood vessels, causing a high incidence of breast muscle hemorrhages (Hillebrand *et al*., 1996).

Lyon and Lyon (1986) found that 80 to 90% of the cases were suspect surface spots due to blood vessel damage. In this study, it was observed that the bleed out was affected by stunning voltage used (25mA, 35mA, 45mA). It was clear that bleeding % decreased when the electrical stunning voltage was increased to 45mA. This

result agreed with report of Veerkamp and de Vries, (1983), A high voltage level has been associated with a lower bleeding.

The proportion of broken bone in condemned birds as affected by stunning voltage was high in the groups stunned with 45mA and 25 mA compared to 35mA.The increased broken bones with45mA electrical current agrees with Gregory and Wilkins (1990) who noticed the occurrence of broken wish bones increases with higher voltage levels. However, the obtained results differ from Walther (1991) reported that stunning related to carcass damage such as broken bones could be reduced if the stunner voltage was lowered.

The occurrence of red wing tips caused by different stunning techniques shows low value in the group stunned by 45mA versus high value with the current voltage value of 25mA followed by 35mA.The occurrence of red wing tips was reduced when the current increases, these results disagree with the previous study which indicate that as the stunning voltage increased the incidence of red wing tips and red tail is increased (Veerkamp and de Varies, 1983). Similar results were noted by the study of Gregory and Wilkins (1989) who found that, the incidence of red wing tips increases when the electrical stunning was applied.

The results of this study revealed that stunning at 45mA seems to be more beneficial in decreasing breast muscle hemorrhages, red wing tips% value, and results in improved carcass quality compared to other applied voltages 25mA, 35mA. This result disagreed with results of Heath (1984); Gregory and Wotton, (1986); and Lambooij, (1993) who recommended, higher electrical stunning that causes heart failure/immediate death which had been considered as a suitable solution to the problem of animal welfare and humane treatment of food animals during slaughter. The disagreement is based on the indications, that have shown high electrical stunning voltage adversely affects meat quality and carcass appearance, lengthens the bleeding time, increases the risk of broken bones and contamination on the birds and causes difficulties in plucking due to the onset of rigor mortis after an excessively long bleeding time.

These results indicate that the use of 45mA voltage could be used without any detectable adverse effects on the above mentioned characteristics. Regarding the season effect, low carcass defects observed during winter, which indicate that birds affected positively by the low environmental temperature, that expected to alleviate stress before slaughter and thus gives better results in carcass quality and hence lower percentage of condemnation. It was found that during the summer months, heat stress and excitement just prior to slaughter can affect the postmortem metabolism of muscle and subsequent meat quality characteristics such as color, WHC, and texture Lambooij, (1999). The incidence of pale meat is greater during summer (Petracci *et al*., 2004). Bianchi, *et al.* (2007) found that during summer, broiler breast meat undergoes a depression of its functionality and quality. other studies conducted on broiler chickens (Wilkins *et al*., 2000 and Woelfel *et al*., 2002) did not outline clear effects of the season on meat color.

Conclusion

It can be concluded that the season of the year can affect carcass defects that resulted in lowering percentage of condemnation. Stunning voltage at 45mAand winter season seem to be more beneficial in lowering breast muscle hemorrhages, red wing tips, bleeding %values, and consequently better carcass quality compared to other applied voltages (25mA, 35mA) or year season.

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