

CARCASS HEMORRHAGES AND PHYSICOCHEMICAL PROPERTIES OF *LONGISSIMUS* MUSCLE IN GOATS SUBJECTED TO VARIOUS TYPES OF ELECTRICAL STUNNING

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Abstract – The study examined carcass hemorrhage and meat quality in goats subjected to different methods of pre-slaughter electrical stunning or slaughtered without stunning. Twenty-four Boer crossbred bucks were randomly assigned to low frequency head-only pre-slaughter electrical stunning (LFHO; 50 Hz), high frequency head-to-back (HFHB; 850 Hz) pre-slaughter electrical stunning and slaughter without stunning (SWS). Meat quality traits did not differ among the treatments. Incidences of carcass hemorrhage were higher ($p < 0.05$) in LFHO and HFHB than SWS. However, HFHB had lower incidences of ($p < 0.05$) hemorrhage than LFHO. Electrical stunning prior slaughter increased carcass hemorrhages and but did not affect other meat quality traits in goats.

Key Words – electrical current frequency, meat quality, slaughter.

I. INTRODUCTION

The welfare of animals during slaughter is protected by the 1958 Humane Slaughter Act. Section of this act make it compulsory for animals to be stunned before exsanguination but gives exemption for religious slaughter. Several stunning methods have been described for slaughtering ruminants, for instance, mechanical, electrical and gas stunning [1]. However, electrical stunning is the most widely used stunning method for sheep and goats. The adverse effects on carcass and meat quality commonly observed following the application of the conventional electrical stunning methods (the use of low frequency) have resulted in the development of high frequency electrical stunning system. High frequency electrical stunning minimizes muscle activity associated with convulsions and the incidence of carcass hemorrhages and blood spots [2]. However, this claim is yet to be validated through a comprehensive scientific study. Thus, this study determined the effects of different methods of pre-slaughter electrical stunning [low frequency head-only (LFHO) and high frequency head-to-back (HFHB) electrical stunning] and slaughter without stunning (SWS) on carcass and meat quality in goats.

II. MATERIALS AND METHODS

Twenty four Boer crossbred bucks (8-10 months old; average body weight of 29.96 ± 1.59 kg) were purchased from a commercial goat farm. Goats were assigned into three groups of 8 animals, each based on the type of stunning method. Animals in the control group were slaughtered without stunning (SWS) in accordance with the procedures outlined in the MS1500:2009 [3]. Animals in the other 2 groups were electrically stunned using different techniques [low frequency head-only (LFHO; 1.0 A, 50 Hz for 3.0 s) and high frequency head-to-back (HFHB; 1.0 A, 850 Hz for 3.0 s)]. The stunning procedure was carried out using electrical stunning transformer type CS-1 system (Karl Schermer, Germany) which was linked either with double-electrode scissor-type dry stunning tongs (Z3, Karl Schermer, Ettlingen, Germany) or triple-electrode tongs (2A Handset, Kentmaster, Hartlebury, United Kingdom) for the application of LFHO and HFHB, respectively. Following stunning, all 24 animals were slaughtered by cutting the throat, severing both carotid arteries and jugular veins in order to drain excess blood from the carcass.

After evisceration and carcass dressing, about 20 g of muscle chops from the right *Longissimus lumborum* (LL) muscle were collected, labeled, vacuum packaged, stored in a chiller (4°C) and assigned for drip loss determination. The left LL muscle was dissected out at 2 specific periods, that is, 1 and 7 days postmortem, vacuum packed and transferred to a -80°C freezer until subsequent analyses (pH, glycogen, color, shear force and cooking loss) as described by Nakyinsige *et al.* [1]. Carcass evaluation was carried out following the method of Velarde *et al.* [4]. The carcasses were subjected to visual examination in order to determine the incidences of blood splash and speckle. Data analysis was performed using the GLM procedure of Statistical Analysis System package (SAS) Version 9.2 software and statistical significance was set at $p < 0.05$. A Duncan multiple range test was used to separate means.

III. RESULTS AND DISCUSSION

The results of meat physicochemical characteristics obtained from goats subjected to different stunning methods are as presented in Table 1. All physicochemical traits except cooking loss did not differ among the treatments. Higher cooking loss was observed ($p < 0.05$) in LFHO and HFHB groups compared to SWS at 7 d postmortem (Table 1). These findings are in agreement with those of Velarde et al. [4] and Lokman et al. [5] who documented no differences in meat physicochemical properties between non-stunned and electrically stunned sheep and goats, respectively.

Table 1 Differences in physicochemical properties of LL muscle in goats subjected to different stunning methods

Parameter	Aging (days postmortem)	Treatment			SEM
		SWS	LFHO	HFHB	
Glycogen (mg/g meat)	1	0.95	0.87	0.93	0.03
	7	0.53	0.53	0.51	0.01
pH (unit)	1	5.94	5.96	5.95	0.02
	7	5.93	5.94	5.94	0.01
Drip loss (%)	1	0.85	1.05	0.96	0.02
	7	2.92	3.24	3.11	0.08
Cooking loss (%)	1	29.61	29.97	29.19	0.31
	7	23.96 ^b	27.84 ^a	27.26 ^a	0.39
Shear force (kg)	1	1.70	1.67	1.61	0.02
	7	1.56	1.48	1.51	0.03

The differences in incidences of blood splash and speckle among the pre-slaughter stunning groups are as presented in Table 2. The non-stunned goats (SWS) had lower ($p < 0.05$) incidence of hemorrhages than those from the LFHO and HFHB groups. Carcasses from the HFHB animals presented lower hemorrhages ($p < 0.05$) than those from the LFHO group. This suggests that the use of low frequency electrical currents could have induced a higher intensity of muscle contraction through the tonic phase and an increase in blood pressure with ruptured vessels leading to the presence of hemorrhages in the three cuts of each muscle examined. However, high frequency electrical stunning can create the spinal inhibition of the seizure movement which produce a less severe muscular spasm at the beginning of the current flow [2].

Table 2 Differences in scores of hemorrhages in carcasses of goats subjected to different stunning methods

Parameter	Treatment			SEM
	SWS	LFHO	HFHB	
Speckles	0.07 ^c	2.10 ^a	0.87 ^b	0.01
Blood splash	0.17 ^c	2.12 ^a	0.73 ^b	0.01
Haematomas	absent	absent	Absent	-

IV. CONCLUSION

The present findings indicate that the physicochemical properties of meat from goats slaughtered without stunning are comparable to those subjected to pre slaughter electrical stunning. Carcasses from both electrical stunning methods presented higher incidence of hemorrhages ($p < 0.05$) than those slaughtered without stunning. However, in comparison with the LFHO method, the application of HFHB pre-slaughter electrical stunning has significantly reduced the incidence of carcass hemorrhages.

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