SEX EFFECTS ON BLOOD STRESS INDICATORS, MUSCLE GLYCOLYTIC POTENTIAL AND MUTTON QUALITY

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Abstract – The objective of this study was to determine sex effects on blood stress indicators, muscle glycolytic potential and mutton quality. Blood samples were collected at exsanguination for measurements of glucose, lactate and cortisol levels. Representative meat samples were collected from the *Muscularis longmissius thoracis et lumborum* for the measurements of glycolytic potential, pH and color co-ordinates. Sex had an effect on blood lactate, cortisol levels, meat pH and colour co-ordinates, but not on muscle glycolytic potential. Ewes had higher levels of blood lactate, cortisol, pH and colour than the rams. High levels of blood stress indicators and meat pH are an indication that the ewes experienced the pre-slaughter period to be more stressful compared to the rams.

Key Words – Glycolysis, muscle metabolites, pre-slaughter stress.

I. INTRODUCTION

During the pre-slaughter period, it is inevitable that sheep will experience some level of stress. Response to pre-slaughter stress differs depending on animal related factors such as sex [1]. Furthermore, sheep are known to be naturally stoic creatures as they do not exhibit obvious signs of distress [2]. Hence most studies on measuring stress responsiveness using blood stress indicators (glucose, lactate and cortisol), glycolytic potential, meat quality and their correlations have been carried out on pigs [3] and cattle [4]. To our knowledge, little or no study has been conducted to determine the sex effects on stress indicators, muscle metabolites, glycolytic potential, meat pH decline and color in sheep. Hence the objective of this study was to determine sex effects on blood stress indicators glycolytic potential and meat quality from sheep slaughtered at a commercial abattoir.

II. MATERIALS AND METHODS

A total of 100 eight-month old lambs consisting of 50 intact rams and 50 non-pregnant ewes were humanely slaughtered in a commercial abattoir. Blood samples were collected during exsanguination for the analysis of plasma glucose and lactate concentrations using a kinetic enzymatic method [5] cortisol enzyme-linked immunoassay (ELISA - ADI- 900-071, Enzo Life Sciences, Farmingdale, NY) kit respectively [6]. Glycolytic potential was calculated as Glycolytic Potential= (2×[glycogen + glucose-6-phosphate]+lactate) [7]. Meat pH was measured using a portable pH meter with a piercing electrode (Crison pH 25, instruments, S.A., Alella, Spain). The meat color variables L*, a*, b* were also measured using a Minolta color-guide machine (45/0 BYK- Gardener GmbH) with a 20 mm diameter, illuminant D65-day light and 10^{o} standard. The data was analysed using the PROC GLM procedure of SAS (version 9.1). All experimental procedures were approved by the University of Fort Hare ethics committee (UFH Ethical clearance number: MUC091SSTE01).

III. RESULTS AND DISCUSSION

Higher levels of blood lactate in ewes were observed and this is an indication that the ewes were more stressed compared to the rams. The high levels of cortisol in ewes may be attributed to differences in sexual glucocorticoid regulation which is responsible for cortisol secretion causing the ewes to be more easily disturbed than the rams. This indicates that male sex hormones (androgens) become suppressive whilst female sex hormones (estrogens) stimulate the HPA axis [8]. Ewes had higher pH levels than the rams at 45 minutes, 3 and 24 hours after slaughter, meaning that the ewes experienced a higher degree of stress than the rams. This implies that less glycogen was available in the muscle to produce lactic acid in order to acidify and lower the pH to the recommended ultimate pH of 5.5 at 24 hours post-mortem [9].The ewes had a lower L* value than the rams and this could be an indication that the ewes were more stressed compared the rams, since stress predisposes meat to become darker in color. Furthermore, the ewes had a

higher value for redness than the rams. Females have been reported to produce a more intense meat color than rams due to their higher alertness during the pre-slaughter period [2,9].

Table 1 : Effect of sex on plasma glucose, lactate, cortisol, glycolytic potential, muscle glycogen, lactate, pH decline and colour from the *Muscularis longmissius thoracis et lumborum* of intact rams and non-pregnant ewes (LSMeans ± standard error of the mean)

	Sex		
Parameters	Rams	Ewes	P value
	n=50	*n*=50	
Plasma glucose (mmol/L)	$4.5^{a} \pm 0.19$	$4.8^{a} \pm 0.19$	0.4033
Plasma lactate (mmol/L)	$5.2^{b} \pm 0.49$	$7.4^{a} \pm 0.49$	0.0016
Plasma cortisol (mm/L)	$179.5^{b} \pm 14.32$	$293.0^{a} \pm 14.32$	0.0001
Glycolytic potential (µmol/g)	$150.16^{a} \pm 1.04$	$138.86^{a} \pm 1.04$	0.57
pH_{45} minutes	$6.4^{b} \pm 0.04$	$7.1^{a} \pm 0.04$	0.0001
pH_{3} hours	$6.1^{b} \pm 0.04$	$6.5^{a} \pm 0.04$	0.0001
pH_{24} hours	$5.9^{b} \pm 0.03$	$6.0^{a} \pm 0.03$	0.0001
L*(Lightness)	$38.1^{a} \pm 0.47$	$36.4^{b} \pm 0.47$	0.0090
a *(Redness)	$12.3^{b} \pm 0.33$	$14.3^{a} \pm 0.33$	0.0001
b *(Yellowness)	$7.0^{b} \pm 0.29$	$8.8^{a} \pm 0.29$	0.0001
H *(Hue angle)	$29.4^{b} \pm 0.73$	$31^{a} \pm 0.73$	0.0431
C *(Chroma)	$14.2^{b} \pm 0.42$	$16.8^{a} \pm 0.42$	0.0001

^{a,b} Means in the same row with different superscripts are significantly different at $P < 0.05$

IV. CONCLUSION

The results from this study have shown that the response of lambs to stress varies depending on sex, where ewes perceived the slaughter procedure more stressful compared to the rams.

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