EFFECT OF BREED- AND SEX-TYPE ON MEAT TENDENESS AND COLOUR OF GOAT M. LONGISSIMUS LUMBORUM

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Abstract – Forty weaner male Boer goats (BG) and South African Indigenous Veld goats (IVG) (n=20/breed; 10 intact and 10 castrated) were raised at ARC-API on a diet that is largely "Ram Lamb and Ewe" pellets (Meadow Feeds -13) lucerne, hay and natural grass to a live weight of between 30 and 35 kg. Meat quality characteristics (pH, colour, tenderness and water holding capacity) were evaluated on *m. longissimus thoracis et lumborum (LTL)* of castrated and intact Boer Goat and Indigenous Veld Goat rams (n=40). pH was measured at 24 hours *post mortem*. Warner Bratzler shear force (WBSF), water holding capacity (WHC) and colour (CIE L*, a*, b* Chroma and hue) were measured on 24 hours and 4 days *post mortem* samples. No breed-type effects were noticed but the results show that sex-type had an ageing interaction effect (P < 0.05) on WHC and WBSF, with castrates having a small advantage in terms of juiciness and tenderness. Castration showed an effect on meat redness, a* (P>0.05) but no effect on L*, b* Chroma and hue. Ageing had an advantageous effect on L*, b* Chroma and hue angle on all LTL samples.

Key Words – Boar Goat, Castrated or intact rams, Chevon tenderness, Chevon colour, Southern African Indigenous Veld Goats.

I. INTRODUCTION

The acceptability of goat meat in South Africa is relatively low because of traditional conceptions of off smells, off flavours and expected toughness. Perceptions also exist that Indigenous Veld Goat (IGV) produce tougher meat than Boer Goat (BG) specially bred to be a meat producing breed. It is now discovered that the Indigenous Eco-types of Southern Africa can also produce good meat products if good farming and rearing practices are followed. Except for the advantage to preserve the indigenous breeds for the future generations, these breeds are well adapted to the harsh climate conditions in Southern Africa and are hardy with minimum need for veterinary intervention. Production and slaughter procedures should be adapted to suit the characteristics such as the low glycolitic potential and low carcass fat of goat carcasses. There is therefore a need to optimise the pre- and post-slaughter procedures in order to optimise the chevon (goat meat) visual and eating quality. Development of the market for chevon in South Africa would offer more diversity of species for red meat producers and especially benefit emerging farmers who produce over 90% of the goats in South Africa. There are good indications that goats can yield chevon of acceptable quality to consumers, provided that animals of an appropriate age and sex group are slaughtered, handled and fed well during production and slaughter so as to minimise stress and prevent cold shortening [1].

The aim of this study is to evaluate meat tenderness and colour of chevon from *m. longissimus thoracis et lumborum* (LTL) of electrical stimulated carcasses of the two breed types; BG and IVG from castrated and intact male goats.

II. MATERIALS AND METHODS

Forty weaner male Boer goats (BG) and Southern African Indigenous Veld goats i.e large frame Eastern Cape lobb ear and Northern Cape speckled (IVG) (n=20/breed; 10 intact and 10 castrated) were raised at ARC-API on a diet that is largely "Ram Lamb and Ewe" pellets (Meadow Feeds -13) lucerne, hay and natural grass to a live weight of between 30 and 35 kg. Water was provided ad libitum. On reaching the target weight, the goats were transported to the abattoir of ARC-API, Irene on the day of slaughter. Stress were kept at minimum during transportation. The carcasses were subjected to the following slaughter procedures: directly after exangunation electrical stimulate for 20 seconds (220 V, at 9.5 pulses /sec) then after dressing placed in a chiller at 4 °C within 60 minutes of stunning. Post-slaughter the following samples /data were collected /recorded: Warm carcass weight (1 hour *post mortem*) and cold carcass weight (24 hour *post mortem*) were measured. The carcass pH and temperature were measured at 24 hours *post mortem* after which LTL were dissected from both sides (24 hours and 4 days *post mortem*).

Minolta colour, and water holding capacity (WHC) were taken from each muscle on the thicker end of the muscle. WHC samples were dissected from this sample after colour measurements were taken after 1 hour of blooming. WHC is measured.

One sample for tenderness analyses (as measured mechanically by Warner Bratzler shear force (WBSF)) was collected from the thick middle part of the muscle (left LT– 1 day *post mortem* and on the right LT – 4 days *post mortem*) and stored in a freezer at -20 °C until the analyses were performed. Carcass measurements, pH and temperature, colour, WHC, were collected.

Water holding capacity was determined by calculating the ratio of meat area and liquid area after pressing a 400-600 mg fresh meat sample (24 hours) on a filter paper (Whatman 4) sandwiched between two Perspex plates, and pressed at a constant pressure for 1 min [2]. The areas were measured by means of a Video Image Analyser (Kontron, Germany).

Meat colour was measured on LT sample for each ageing period with a Minolta meter [3] at 3 different places after blooming the meat for about 1 hour. The meat colour were obtained as three components; luminance or lightness, L* (dark to light), and two chromatic components; a* (green to red) and b* (blue to yellow) values (CIE colour model) [4]. Chroma (intensity of the red colour /saturation index) (S) = $(a^2+b^2)1/2$) and hue angle, defined as $\tan^{-1}(a/b)$ that describes the fundamental colour of a substance [5] were calculated.

The LTL samples were cooked by the Sensory Unit of the ARC-API on Irene. A day before the muscles were cooked the vacuum sealed frozen LTL samples were placed on a trolley in a cold room of 4 °C to though for 24 hours. The whole cut were prepared according to an oven-broiling method (dry heat cooking) using direct radiant heat [6]: An electric oven was set on "broil" 10 minutes prior to preparation (200 °C). The samples were placed on an oven pan on a rack to allow meat juices to drain during cooking and placed in the pre-heated oven 9 cm below the heat source. Cooking losses (thawing loss, drip loss, evaporation loss) were measured as part of the standard procedure (not reported here). The muscles were cooked to an internal temperature of ±50 °C, then turned and finished to 70 °C. The muscles were cooled down at room temperature for at least 2 to 3 hours before shear force measurement.

Six cylindrical samples (12.5 mm core diameter) of each sample was cored once parallel to the grain of the meat, and sheared perpendicular to the fibre direction using a Warner Bratzler shear device mounted on an Instron Universal Testing Machine (Model 4301). The shear force was determined using 200 mm/min crosshead speed [6] recommends 200 to 250 mm/min crosshead speeds, with a 1 kN load cell. Each sample was shear once in the centre to avoid the hardening that occurs during cooking toward the outside of the sample. The reported value in kg represented the average peak force measurement.

The data were subjected to analysis of variance for a split plot design [7] with the two goat breeds (BG and IVG) as whole plots and the two ageing periods (1 day, and 4 days post mortem) as subplots. Means for the interactions between subplot and whole-plot were separated using Fisher's protected t-test least significant difference (LSD) at the 5% level of probability [8].

III. RESULTS AND DISCUSSION

In this paper we are reporting on the effect of breed-type, and sex-type effects on chevon WHC, WBSF, and colour, of Boer Goat and South African Indigenous Veld Goats. Electrical stimulation improves goat meat tenderness and colour [9, 10, 11], therefore we chose to electrical stimulate all the carcasses in this study. Under the experimental conditions of this study no breed differences were found between the two breed-types for WHC, WBSF, and colour. Significant differences were found between castrated and non-castrated / intact ram meat and its interactions with ageing. Table 1 represents the typical goat carcass characteristics of the experimental animals. The intact ram carcasses seemed to have on average a lower pH_u than that of carcasses of castrated animals. Live-, warm- and cold carcass weights were similar.

Table 1. Goat carcass characteristics

	Sex-type	
	Castrate	Intact
Carcass side mass (kg)		
Live	34.45	35.71
Warm	15.94	16.04
Cold	15.33	15.55
Dressing %	44.4	43.4
pH_u	5.69	5.52
T_u (°C)	10.88	11.42

The effect of castration or not on the WHC and WBSF of LTL was presented in Table 2. LTL of castrated goat carcasses had a higher WHC at 4 d pm than that of the intact goat carcasses. This could result into a juicier meat product.

Table 2. Effect of sex-type on water holding capacity and Warner Bratzeler shear force of ageing goat *m. longissimus thoracis et lumborum* (LTL).

		Sex-type		
	Ageing	Castrate	Intact	P-valu
		Mean±Standard Deviation		
WHC[1]	1 d pm[3]	0.378 ± 0.036[b]	0.397 ± 0.033[b]	0.0054
	4 d pm	0.433 ± 0.073[a]	0.383 ± 0.049[b]	
WBSF[2] (Kg)	1 d pm	6.526 ± 1.799[a]	5.562 ± 1.425[b]	0.0181
	4 d pm	4.525 ± 1.785[c]	4.908 ± 1.306[bc]	

Means within a row and column, with different superscripts [a,,b,c] are different at P <0.05
[1] Water holding capacity
[2] Warner Bratzler shear force
[3] d pm = days *post mortem*

Although the WBSF of castrated LTL seem to be significantly more tough than that of intact LTL at 1 day *post mortem*, it became more tender at 4 days *post mortem* than that of the intact LTL. This indicates towards a more effective proteolytic degradation during ageing. Electrical stimulation accelerated the rate of *post mortem* glycolysis allowing carcasses to be rapidly chilled without the risk of cold shortening.

The effect of sex-type and ageing on goat meat colour are presented in Table 3.

Table 3. Effect of sex-type and ageing on goat meat colour

Colour parameters	Sex-type		
	Castrate	Intact	P-value
	Mean ± Standard Deviation		
a*	10.63 ± 1.32[a]	9.78 ± 1.16[b]	0.0225
	Ageing		
	1 d pm[1]	4 d pm [1]	
	Mean ± Standard Deviation		
L*	34.71 ± 2.65	35.56 ± 2.87	0.0653
b*	11.38 ± 1.46[b]	12.69 ± 0.85[a]	<0.0001
Chroma	15.31 ± 1.54[b]	16.35 ± 1.13[a]	0.0002
Hue angle	48.31 ± 4.82[b]	51.28 ± 3.77[a]	<0.0001

Means within a row, with different superscripts [a,b] are different at P <0.05
[1] d pm = days *post mortem*

The redness a* measured on LTL of castrated goat carcasses were significantly higher than that of intact carcasses. No differences were found in the L*, and b* attributes. All goat LTL showed ageing effects ($P < 0.05$) on L*, b* and calculated Chroma and Hue angle, but not a*. This means that the intensity of the chevon meat colour increase with ageing and should become more acceptable with ageing up to 4 days *post mortem*.

Goats whether Boer or indigenous goats can be very temperamental in terms of adaptability in a "feedlot" or closed kraal system and resulting growth rate. Some animals are more dominant and competition for food is a problem resulting in some animals growing quicker than others. These characteristics are not breed specific.

IV. CONCLUSIONS

Castrated rams might give juicier meat product than that of intact rams, but concerning tenderness and meat colour the differences were not significant under these specific rearing conditions. Goats seem to be very temperamental and prone to stress and can explain the tougher meat outcome in this study although it was acceptable after 4 days *post mortem*. Efforts must be made to develop rearing and slaughter conditions to alleviate stress in goats. Colour improved in goat meat as a result of ageing, but not much breed and sex-type differences were observed.

The term “indigenous goats” is very broad and one needs to define the animal groups more scientifically. What are we talking about? Are we working with Boer goat crosses or do we try to work with better defined breeds such as larger frame Northern Cape Speckled goats or Eastern Cape lob ear? Or a mixture of these two? The question will probably not be which breed is the best, but rather which conditions will be the best for goats to grow optimally and with less stress and starting with a good quality animal in the first place – not deprived from birth.

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