Effect of *Moringa oleifera* leaves supplementation on Physico-chemical characteristics of goat meat

Moyo B.[1*], Masika P.J.[2], and Muchenje V.[1]
[1]Department of Livestock and Pasture Sciences Faculty of Science and Agriculture, University of Fort Hare, P/Bag X 1314, Alice 5700, South Africa
[2]Agricultural and Rural Development Research Institute Faculty of Science and Agriculture, University of Fort Hare, P/Bag X 1314, Alice 5700, South Africa

***Abstract*— Goat meat (chevon) is an important protein source throughout the world especially in developing countries which improve nutrition for resource-limited farmers. However, quality of meat is affected by nutrition and genotype. The objective of this study was to determine the physico-chemical characteristics and consumer sensory scores of chevon from 24 cross bred Xhosa lop-eared goats supplemented with *Moringa oleifera* leaf meal (MOL). The experimental goats were supplemented with MOL, sunflower seed cake (SC) and grass hay (GH) diets with crude protein value of 23.76, 23.27 and 14.08% respectively. The diet influenced pH (pH_1) and meat colour. Higher pH_1 scored was observed in meat from GH diet and higher (P< 0.05) values for lightness (L*) at 24 hour *post mortem*. The redness (a*) values of meat at 24 hr *post mortem* were higher (P<0.05) in meat from MOL supplemented goats. The yellowness (b*) values of goat meat supplemented with MOL and SC were similar (P>0.05) at 24 hour *post mortem*. Warner Bratzler shear force (WBSF) values of meat from SC (30.09N) and MOL (29.82N) were lower (P< 0.05) than meat from GH diet (32.62N). Meat from goats fed GH diet (29.48%) had higher (P<0.05) cooking losses than MOL (25.37%) and SC (25.57%) fed group. Supplementing crossbred Xhosa lop-eared goats with MOL diet produced chevon with higher physico-chemical characteristics.**

Keywords*— Chevon, cooking loss, *post mortem

I. INTRODUCTION

Chevon is consumed throughout the world and the quality of chevon is affected by diet consumed by goats (Ding et al., 2010) [1]. The physico-chemical characteristics such as meat colour, cooking loss and tenderness depend upon several factors that include intramascular fat, moisture content, protein and the pH meat (Madruga et al., 2008) [2]. Supplementing goats with forage trees has been observed to improve body weight and general health of the goats. Improvement of goat's body weights could have a positive effect on meat physico-chemical characteristics (Oni et al., 2010) [3]. One of such forage trees that are used for supplementing goats is *Moringa oleifera* (Sarwatt et al., 2002) [4].

Moringa oleifera tree, is native of North India with medicinal, therapeutic and nutritional properties and has been introduced to warm regions of the World (Reyes-Sánchez et al., 2006) [5]. These properties could modulate the meat quality (Mielnik et al., 2003)[6]. The plant leaves contains high levels of crude protein (27%) in the leaves (Reyes-Sánchez et al., 2006) [5]. The effect of supplementing with *M. oleifera* on goat meat physico-chemical characteristic has not been studied. Therefore, the objective of the present study was to determine the physico-chemical characteristics of chevon from Xhosa lop-eared goats supplemented with *M. oleifera* leaf meal.

II. MATERIALS AND METHODS

Twenty-four 8 months castrated xhosa lop-eared goats were allocated to three dietary treatments of *M. oleifera* leaf (MOL), sunflower seed cake (SC) or grass hay (GH). All groups were offered of grass hay ad-libitum. The MOL and SC group were offered 200g dried *M. oleifera* leaves and 170g sunflower seed cake per head/day respectively. The goats were kept at the University of Fort Hare farm until slaughter at 10 months of age. At the ends of the feeding trial goats were slaughtered at a commercial Adelaide abattoir using the electric stunning method. Meat analyses was done on the *M. longissimus thoracis et lumborum* (LTL). Carcass pH was measured 1 hour ($pH_{1)}$ and 24 ($pH_{24)}$ hours *postmortem* using a digital pH meter (Crison pH 25 instruments S.A., Alella, Spain). Colour

was also determined after 24 hours postmortem using a Minolta colour guide 45/0 BYK-Gardener GmbH machine to measure the muscle colour (L* = Lightness, a* = Redness and b* = Yellowness).

Blocks of *M. longissimuss thoracis et lumborum* muscle measuring approximately 7x 4cm long were used for determining cooking loss and Warner Bratzler shear force values. The muscle was weighed, placed in a water-tight PVC plastic bag and cooked in a water bath at 85˚C for 45 minutes, until an internal temperature of 70˚C was attained. The samples were cooled and reweighed. Cooking loss (CL) was calculated using the following formula: Cooking loss % = [(weight before cooking – weight after cooking) ÷ weight before cooking] × 100 as described by Ding et al. (2010). After measurement of cooking loss, cooked samples with a cross section of 1x1 cm and at least 3cm long were used to determine meat Warner Bratzler shear force using an Instron Universal Testing Machine (Moddel 3344, Instron Industrial Products, GC, USA). The PROC GLM procedure of SAS (2003) [9] was used to analyse the effect of diet on cooking loss, WB shear force, L*, a*, b* and pH values.

III. RESULTS AND DISCUSSION

As shown in Table 1 goats supplemented with MOL had lowest (P<0.05) pH decline than all other treatments which could be attributed to the antioxidants compounds of *M. oleifera* leaves (Anwar et al., 2007). Antioxidants are reported to reduce the effect of stress and meat colour, as they reduce the rate of lipid oxidation (Anwar et al., 2007). Generally, the supplemented goats (MOL and SC) had lower pH than the GH goats because GH goats were likely to have less glycogen levels than the supplemented ones. The ultimate pH was within the acceptable range (5.6 -5.8) reported for goat carcasses (Mushi et al., 2009). Chevon from goats supplemented with MOL diet had higher redness (a*) values which could be attributed to high levels of dietary iron in MOL diet used. The dietary iron could have influenced the concentration of myoglobin and its chemical state (Priolo et al. 2002) [10].

Higher *L** values were observed in the MOL group compared to the other groups which could be attributed to the increased marbling as a result of supplementation (Ding et al., 2010) [1]. The higher L* values could be due to low pH levels since the pH levels decreases with storage. Meat with higher pHμ usually exhibit lower L* values and have a tendency to yield tougher chevon evidenced by higher WB shear force (Simela, 2005) [11]. Chevon from goats supplemented with MOL showed greater a* and b* values, this could be attributed to the influence of antioxidant compounds. Dietary antioxidant indirectly modifies the chevon colour, probably by decreasing hemoglobin oxidation and activating mechanisms that modify pigment distribution in animal tissues (Simitzis et al., 2008) [12].

Chevon from goats supplemented with MOL and SC had lower values for WB shear force suggesting they were tender than chevon from goats supplemented with the GH diet. The WB shear force values shown in Table 1 are within the normal ranges reported elsewhere (Dhanda et al., 2003[13]; Kadim et al., 2003[14]). Cooking losses shown in Table 1 ranged from 25.37 to 29.48%, which were within the normal range for chevon (Webb et al., 2005[15]; Madruga et al*.,* 2008[2]). Cooking losses were lower in chevon from goats supplemented with a high protein diet, such as MOL and SC. Variation in cooking losses are often linked to differences in cooking time and temperature, ultimate pH and muscle fat content (Madruga et al., 2008[2]; Muchenje et al., 2009[16]).

Table 1 Effect of diet on meat pH, colour, shear force values and cooking loss

Variables	Diets			S.E
	GH	MOL	SC	
Meat pH				
pH_1	6.58^b	6.25^a	6.38^a	0.08
pH_{24}	5.68	5.56	5.59	0.05
$pH_{1\text{-}24h}$	0.9^b	0.69^a	0.79^a	0.16
Colour after 24 h				
L*	40.7^a	44.9^b	43.6^b	0.04
a*	10.5^a	13.1^c	12.5^b	0.2
b*	7.1^a	8.4^b	7.9^b	0.04
Shear force (N)	32.62^b	29.82^a	30.09^a	0.10
Cooking Loss (%)	29.48^b	25.37^a	25.57^a	0.48

^{abc} means with different superscripts in a row are different (p<0.05).

IV. CONCLUSION

It was concluded that supplementing *M. oleifera* meal to cross-bred Xhosa lop eared goats produced chevon of comparable quality to sunflower seed cake with higher physico-chemical characteristics.

ACKNOWLEDGMENT

The authors wish to thank the National Research Foundation of South Africa (NRF) for financial support of this project. The authors are also indebted to the following Departments at the University of Fort Hare:- Agricultural and Rural Development Research Institute (ARDRI), Livestock and Pasture Science and Honeydale Farm.

REFERENCES

1. Ding W, Kou L, Cao B et al (2010) Meat quality parameters of descendants by grading hybridization of Boer goat and Guanzhong Dairy goat. Meat Sci.84: 323-328.
2. Madruga MS, Torres TS, Carvalhọ FF et al. (2008). Meat quality of Moxoto and Canidé goats as affected by two levels of feeding. Meat Sci 80: 1019-1023.
3. Oni AO, Arigbede OM, Oni OO et al. (2010) Effects of feeding levels of dried cassava leaves (*Manihot esculenta*, Crantz) based concentrates with *Panicum maximum* basal on the performance of growing West African Dwarf goats. Livest Sci 129: 24-30.Sarwatt SV, Kapange SS, Kakengi AMV (2002) Substituting sunflower seed-cake with *Moringa oleifera* leaves as a supplement goat feed in Tanzania. Agroforest Syst 56: 241-247.ICoMST at http://www.ICOMST2011.be
4. Reyes-Sánchez N, Spörndly E, Ledin I (2006) Effect of feeding different levels of foliage of *Moringa oleifera* to creole dairy cows on intake, digestibility, milk production and consumption. Livestock Sci 101: 24-31.
5. Mielnik MB, Aaby K, Skrede G (2003) Commercial antioxidants control lipid oxidation in mechanically deboned turkey meat. Meat Sci 65: 1147 – 1155.
6. Anwar F, Sajid L, Muhammad A et al. (2007). *Moringa oleifera*: A Food plant with Multiple Medicinal Uses. Phytother. Res. 21: 17-25.
7. Mushi DE, Safari J, Mtenga LA et al. (2009) Effects of concentrate levels on fattening performance, carcass and meat quality attributes of small East Africa X Norewegian crossbred goats fed low quality grass hay. Livest. Sci. 124:18-155.
8. 9SAS. (2003). In: SAS/STAT Guide to Personal Computers, Version 6, Statistical Analysis System Institute Inc, and Cary, NC
9. Priolo A, Micol D, Agabiel J, Prache S, Dransifield E (2002) Effect of feeding of grass or concentrate feeding systems on lamb carcass and meat quality. Meat Sci 62: 179-185.
10. Simela L (2005) Meat characteristics and acceptability of chevon from South African indigenous goats. PhD Thesis. University of Pretoria, Pretoria, South Africa.
11. Simitzis PE, Deligeorgis SG, Bizelis JA et al. (2008) Effect of dietary oregano oil supplementation on lamb meat characteristics. Meat Sci 79: 217–223.
12. Dhanda JS. Taylor DG, Murray PJ (2003) Part 1. Growth, carcass and meat quality parameters of male goats: effects of genotype and live weight at slaughter. Small Rumin. Res. 50: 57-66.
13. Kadim IT, Mahgoub O, Al-Ajmi DS et al. (2003) An evaluation of the growth, carcass and meat quality characteristics of Omani goat breeds. Meat Sci 66: 203–210.
14. Webb EC, Casey NH, Simela L (2005) Goat meat quality. Small Rumin Res 60: 153-166
15. Muchenje V, Dzama K, Chimonyo M et al. (2009). Relationship between stress responsiveness and meat quality in three cattle breeds. Meat Sci. 81, 653-657.