# FATTY ACID PROFILES OF MEAT OF NGUNI, BONSMARA AND ABERDEEN ANGUS STEERS RAISED ON VELD

V. Muchenje[1,2*], K. Dzama[3], M. Chimonyo[1], J. G. Raats[1], P. E. Strydom[4], A. Hugo[5], and T. Ndlovu[6]

[a*]Department of Livestock and Pasture Science, University Of Fort Hare, P. Bag X1314, Alice 5700, South Africa, Tel: +27 40 602 2059, Fax: +27 40 653 1730, Email: vmuchenje@ufh.ac.za
[b]Department of Agriculture Management, Zimbabwe Open University, Bulawayo Region, P.O. Box 3550, Bulawayo, Zimbabwe
[c]Department of Animal Sciences, Stellenbosch University, P. Bag X1, Matieland 7602, South Africa
[d]Agricultural Research Council, Department Nutrition and Food Science, Private Bag X2, Irene, 0062, South Africa
[e]Department of Microbial Biochemical and Food Biotechnology, University of Free State, P.O. Box 339 Bloemfontein, 9300, South Africa
[f]Department of Biochemistry and Microbiology, University of Fort Hare, P. Bag X1314, Alice, 5700, South Africa

**Keywords**: Monounsaturated fatty acids, natural pasture, Nguni cattle, polyunsaturated fatty acids

## Introduction

Red meat has a relatively high ratio of saturated to unsaturated fatty acids (FA's), which is a risk factor for the development of cardiovascular diseases. The adverse effect of saturated fatty acids (SFA) on the human plasma cholesterol levels makes it imperative to evaluate FA profiles in beef. Polyunsaturated to saturated fatty acids (PUFA/MUFA) and Omega 6 (n-6) to Omega 3 (n-3) ratios, and conjugated linoleic acid (CLA) are important because of their effects on obesity, cardiovascular problems and anticarcinogenic action (Moreno et al., 2006). Fatty acid composition is influenced by diet and genotype due to the underlying differences in gene expression or activities of enzymes involved in FA synthesis, desaturation or chain elongation (Barton et al., 2007). The majority of the available reports on meat quality in Southern Africa are based on established beef breeds, such as the Angus and the Hereford on cultivated pastures and feedlots in the sourveld (Strydom et al., 2000). No studies on FA profiles have been reported in cattle that are grazed communally on veld, without any form of dietary supplementation. In communal grazing cattle from different households are brought together and grazed in areas which are owned by communities with limited and inadequate veld management principles being applied, resulting in overgrazing and loss of weight, specially during the dry season. This may affect FA composition which is closely related to fatness (Zembayashi et al., 1995). Therefore, the objective of this study was to compare FA profiles of Nguni, Bonsmara and Angus steers raised under natural grazing without dietary supplementation.

## Materials and Methods

Fifteen 7-month old weaners each of Nguni, Bonsmara and Angus were raised on sweetveld without any feed supplementation at the University of Fort Hare farm till slaughter at 18 months. Fatty acid profile analyses were done on the *M. longissimus thoracis et lumborum* (LL) sampled a 24 hours after slaughter. Total lipid from muscle sample was quantitatively extracted with chloroform-methanol (2:1 v/v) and the FA analyses were done using gas chromatography. The FA's were expressed as the proportion of each individual FA to the total of all FA's present in the sample. The following FA combinations and ratios were calculated: SFA, MUFA, PUFA, PUFA/SFA ratio and n-6/n-3 ratio. The effect of breed on FA profiles and a correlation procedure between Intramuscular fat (IMF) and FA's were analyzed using GLM procedures of SAS (2000). Significance differences among means were compared using the PDIFF procedure.

## Results and discussion

Except for MUFA and the n-6/n-3 ratio, there were no breed effects ($P > 0.05$) on IMF and levels of most FA's (Table 1). The Angus had the highest MUFA content and lowest n-6/n-3 ratio ($P < 0.05$). The differences in FA composition may be due to different activities of enzymes involved in FA synthesis and modification. Except for MUFA and the n-6/n-3 ratio, there were significant correlations ($P < 0.05$) between IMF and FA levels (Table 2). Breed effects can be explained by differences in the proportion of IMF as the ratio PUFA/SFA decreases with the increasing fat level of beef (Barton et al., 2007).

**Table 1:** Least square means and standard errors of means (in parenthesis) of some and total fatty acid (FA) (as percentage of the total fatty acids identified) and pertinent FA ratios (of the *Longissimus thoracis et lumborum* muscle of Nguni, Bonsmara and Angus steers

| Fatty acid | Breed | | |
|---|---|---|---|
| | Nguni | Bonsmara | Aberdeen Angus |
| N | 15 | 14 | 10 |
| Intramuscular fat (IMF) | 1.14 % (0.079) | 1.05 % (0.082) | 1.24 % (0.097) |
| C18:2c9t11 (Conjugated linoleic acid, CLA) | 0.30 (0.047) | 0.28 (0.048) | 0.39 (0.057) |
| Polyunsaturated fatty acids (PUFA) | 23.09 (1.647) | 22.84 (1.694) | 18.79 (2.004) |
| Monounsaturated fatty acids (MUFA) | 33.05 (0.837)[a] | 33.47 (0.867)[a] | 36.54 (1.025)[b] |
| Saturated fatty acids (SFA) | 43.70 (1.128) | 43.62 (1.177) | 44.49 (1.382) |
| Omega 6 (n-6) | 14.64 (1.024) | 14.57 (1.060) | 11.36 (1.254) |
| Omega 3 (n-3) | 8.46 (0.64) | 8.27 (0.661) | 7.43 (0.782) |
| PUFA: SFA ration | 0.55 (0.049) | 0.54 (0.051) | 0.44 (0.060) |
| n-6/n-3 ratio | 1.75 (0.049)[a] | 1.79 (0.051)[a] | 1.53 (0.060)[b] |

[a,b,c]Means in the same row with different superscripts differ significantly at $P < 0.05$

**Table 2**: Linear relationship (r) between intramuscular fat (IMF) content and some fatty acids and ratios of the *Longissimus thoracis et lumborum* muscle of Nguni, Bonsmara and Angus steers.

| Fatty acid | r (All steers) | r (Nguni) | r (Bonsmara) | r (Angus) |
|---|---|---|---|---|
| C18:2c9t11 (Conjugated linoleic acid, CLA) | 0.67 (***) | 0.62 (*) | 0.56 (*) | 0.81 (**) |
| Polyunsaturated fatty acids (PUFA) | -0.88 (***) | -0.91 (***) | -0.90 (***) | -0.88 (***) |
| Monounsaturated fatty acids (MUFA) | 0.74 (***) | 0.80 (***) | 0.53 (NS) | 0.81 (**) |
| Saturated fatty acids (SFA) | 0.71 (***) | 0.78 (***) | 0.90 (***) | 0.56 (NS) |
| Omega 6 (n-6) | -0.85 (***) | -0.91 (***) | -0.82 (***) | -0.85 (**) |
| Omega 3 (n-3) | -0.88 (***) | -0.90 (***) | -0.94 (***) | -0.90 (***) |
| PUFA:SFA ration | -0.83 (***) | -0.88 (***) | -0.88 (***) | -0.81 (**) |
| n-6/n-3 ratio | 0.11 (NS) | 0.26 (NS) | 0.45 (NS) | 0.16 (NS) |

Significantly correlated at * $P < 0.05$; ** $P < 0.01$; *** $P < 0.001$.

**Conclusions**

It can be concluded that Nguni meat FA's were similar to that of Angus and Bonsmara, although the Angus meat had the highest MUFA content and lowest n-6/n-3 ratio. There were correlations between IMF and most FA's.

**Acknowledgements**

This research was funded by the Kellogg Foundation. The steers were slaughtered at the East London Abattoir, East London, South Africa.

**References**

Barton, L., Marounek, M., Kudrna, V., Bures, D., and Zahradkova, R. (2007). Growth performance and fatty acid profiles of intramuscular and subcutaneous fat from Limousin and Charolais heifers fed extruded linseed, *Meat Science*, doi: 10.1016/j.meatsci.2007.01.005

Hur, S.J., Ye, B. W., Lee, J. L., Ha, Y. L., Park, G. B., and Joo, S. T. (2004). Effects of conjugated linoleic acid on color and lipid oxidation of beef patties during cold storage, *Meat Science*, (66), 771– 775.

Moreno, T., Franco, D., Bispo, E., Perez, N., and Monserrat, L. (2006). Effect of the finishing diets on beef nutritional composition of six commercial muscles. In *Proceedings 52nd International Congress of Meat Science and Technology* (pp. 119 – 120), 13 – 18 August 2006, Dublin, Ireland.

SAS. (2000). *SAS User's Guide: Statistics* (Version 6 Ed.), (SAS Inst. Inc., Cary, NC).

Strydom, P.E., Naude, R. T., Smith, M. F., Scholtz, M. M. and van Wyk. J. B. (2000). Characterisation of indigenous African cattle breeds in relation to meat quality traits, *Meat Science, (*55), 79 -88.

Zembayashi, M., Nishimura, K., Lunt, D. K., and Smith, S. B. (1995). Effect of breed type and sex on the fatty acid composition of subcutaneous and intramuscular lipids of finishing steers and heifers, *Journal of Animal Science, (73)*, 3325-3332.