QUALITY OF MEAT FROM STEERS OF TWO DIFFERENT FRAME SIZES GRAZING HIGH QUALITY PASTURES SUPPLEMENTED WITH HIGH MOISTURE MAIZE GRAIN OR WHOLE PLANT MAIZE SILAGE

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Background

Beef produced from grazing cattle results in higher levels of unsaturated fatty acids (Miller, *et al.,* 1987 and García and Casal, 1992), lower n-6:n-3 fatty acids (Enser, *et al.* 2001) and higher levels of conjugated linoleic acid (CLA) in body fat (French, *et al.* 2000) as opposed to meat from animals fattened in high concentrate diets. However, short term supplementation with maize grain or soybean harvest by-products in the finishing stage did not affect fatty acid profile (Grigera Naón, *et al.*, 2000 and Grigera Naón, *et al.*, 2003).; longer supplementation periods may be necessary to overcome seasonal grass production , thus the widespread use of other supplements such as high moisture maize grain and maize silage (Abdelhadi, 2000), which in turn may affect meat quality. Frame size of animals can have decisive bearings on the length of the fattening stage (Di Marco, 1998) and on some aspects of quality such as tenderness and cooking loss (Muir *et al.*, 1998 and Camfield *et al.* 1999).

Objectives

The objective was to evaluate the effect of type of energy fall-winter supplementation with high moisture maize grain or whole plant maize silage on meat qualitiy of Aberdeen Angus steers with contrasting mature body weight.

Materials and methods

Over 177 days, covering autumn and winter, 32 male calves of six months of age, grazing pastures were assigned to the following treatments: LM, animals of low (L) mature body weight supplemented with high moisture maize grain (M); LS, animals of low (L) mature body weight supplemented with whole plant maize silage (S); HM , high (H) mature body weight animals supplemented with high moisture maize grain (M) and HS, high (H) mature body weight animals supplemented with whole plant maize silage (S). Individuals were weighed every 21 days and fat depth between ribs 12th and 13th was measured by ultrasound using a 3.5 MHz trasductor. At the end of the experiment, eight animals from each treatment were slaughtered. Colour was assessed on the *Longissimus* muscle exposed between the 12th and 13th rib, blooming time was 60 minutes (Wulf and Wise, 1999), readings were taken in L* a* b* colour space, using a Minolta CR-300 (Minolta Co. Ltd., Japan) colorimeter. A Testo 230 pH-meter with a puncture type combination electrode (Testo GmbH & Co., Germany) was used to measure muscle ultimate pH (pHu). Fatty acids were extracted according to Folch *et al.* (1957) and analyzed as methyl esters by gas cromatography. Tenderness was measured with an Instron 4442 Universal Testing Machine (Canton, MA, USA) with a Warner-Bratzler shearing attachment on samples cooked in a water bath at 70 °C for 50 minutes. Data were analyzed using GLM procedure SAS (SAS Inst. Inc., Cary N.C.).

Results and discussion

Animal performance data is shown in Table 1, H calves had higher ($P < 0.01$) initial liveweight as expected. Initial fat depth was the same accross treatments. At the end of the trial L steers had a deeper ($P< 0.01$)

subcutaneous fat layer, lower liveweight gain (P < 0.01) and were lighter (P < 0.01) than H reflecting that smaller animals were more mature. Steers on M gained more (P < 0.01) in autumn than those supplemented with S.

Among treatments , the proportion of ether extract (EE), saturated fatty acids (SFA), polyunsaturated fatty acids (PUFA), n-6 fatty acids, n-3 fatty acids and the ratio between the latter two (Table 2) in meat was similar (P > 0.1). The n-6: n:3 ratio was below 4:1, therefore considered healthy for human beings (Holman, 1995). Concentration of monounsaturated fatty acids (MUFA) was higher in L steers, in accordance to their higher degree of fatness. Animal size influenced the proportion of conjugated linoleic acid (CLA) for LS and LM was 1.08 g/100 g and 0.82 g/100 g respectively (P< 0.05), whereas for HS was 0.93 g/100 g and 1.06 g/100g for HM (P > 0.10). In smaller animals the effect of the different feeding regime became apparent, the rich forage diet enhanced CLA body fat levels as reported elesewhere (French *et al.,* 2000 and Grigera Naón *et al,*., 2003). In case of larger steers this difference was not detected, which can be associated with the fact that they were thinner animals. Ultimate pH (Table 3) was higher for H (P < 0.05) than for L and similar for both supplements. There was a significant (P< 0.05) interaction between animal size and diet for a* and b*, LM showed higher values in comparison to LS, both parameters were similar for large frame steers. Grigera Naón *et al*. (2001), reported that a* and b* were affected when maize grain was fed to grazing steers. Tenderness was not affected neither by type of animal nor by the supplement fed. However, there was a trend for those animals on S to produce somewhat more tender meat. Cooking loss was higher in H as compared to L (P< 0.05), Camfield *et al.* (1999), reported comparable results from three muscles of steers differing in frame size. Such higher cooking loss was recorded in spite of higher pHu in H (P< 0.05), but such value (pHu = 5.8) can seldom affect juiciness (Lawrie, 1998). Cooking losses were similar (P> 0.1), when comparisons were made between supplements, Geay *et al.* (2000) consider that juiciness cannot be modified by feeding regimes.

Conclusions

During the supplementation period, meat from large animals showed lower MUFA and higher pHu than meat from smaller animals; supplements had some effect on CLA concentration and colour parameters a* and b* in small frame steers.

References

- Abdelhadi, L.O., Santini, F.J. , Cangiano, C.A.. and G.A. Gagliostro, C.A.. 2000. Effects of corn silage or high moisture corn supplementation on ruminal pH and pasture digestion in beef heifers grazing high quality pastures. J. Anim. Sci. Suppl. 1. pp 270.

- Camfield, P., Brown, H., Johnson, Z., Lewis, P., Rakes, L., Brown, C. and Oxford, E. 1999. Effect of growth type on tenderness and chemical composition of beef from pasture or feedlot developed steers. Arkansas Animal Research Science-Research series 464. pp 69-82.

- Di Marco, O. 1998. Crecimiento de bovinos para carne. Edited by Oscar Di Marco, Balcarce, Argentina. 235 pages.

- Enser, M., Scollan, N., Suresh Gulati, Richardson, I., Nute, G. and Wood, J. 2001. The effcts of ruminally-protected dietary lipids on the lipid composition and quality of beef muscle. Proceedings 47th International Congress of Meat Science and Technology. pp 186-187. Cracow, Poland.

- French P., C. Stanton, F. Lawless, E. G. O'Riordan, F.J. Monahan, P. J. Caffrey, and A.P. Moloney. 2000. Fatty acid composition, including conjugated linoleic acid, of intramuscular fat from steers offered grazed grass, grass silage, or concentrate-based diets. J. Anim. Sci. 78:2849-2855.

- Folch, J., M. Lees and S.G.H. Sloane.1957. A simple method for the isolation and purification of total lipids from animal tissues. J. Biol. Chem. 226:497-509.

- García, P.T. and Casal, J.J. 1992 Lipids in Lomgissimus muscle in Argentine beef cuts. Proceedings 38th International Congress of Meat Science and Technology, Clermont-Ferrand, France. 2:53-56.

- Grigera Naón, J.J., Schor, A., Cossu, M. E., Trinchero, G. and Parra, V. 2000. Influence of strategic maize grain supplementation on cholesterol and fatty acids of Longissimus and Semitendinosus muscles of beef steers at grazing. Proceedings of 46th International Congress of Meat Science and Technology. 1: 156-157.

- Grigera Naón, J.J., Schor, A., Cossu, M. E., Quiroga, E. and Parra, V. 2001. Effect of strategic maize supplementation on colour and pH of Longissimus and Semitendinosus muscles of beef steers. Proceedings of the 47th International Congress of Meat Science and Technology. 1: 192-193. Cracow, Poland.

- Grigera Naón, J.J., Schor, A., Cossu, M. E., Schindler de Avila, V. and Panella, F. 2003. The effects of feeding by-products of soybean harvest on the lipid composition and quality of beef. Proceedings of the 49th International Congress of Meat Science and Technology, pp 133-134. Campinhas, Brazil

- Geay, Y., D. Bauchart, J.F. Hocquett and J. Culioli. 2001. Effect of nutritional factors on biochemical, structural and metabolic characteristics of muscules in ruminants, consequences on dietetic value and sensorial qualities of meat. Reprod. Nut. Dev. 41:1-26.

- Holman, R. 1995. Essential fatty acids in health and disease. Actas de las Jornadas de Actualización: Las carnes en la nutrición y salud humana. Academia Nacional de Medicina, Buenos Aires, Argentina.

- Lawrie, R. A. 1998. Meat Science, 6th edition. Woodhead Publishing Ltd., Cambridge England, 336 pages.

- Miller, G.R., Field, R. A., Medeiros, M. and Nelms, G. E. 1987. Lipids characteristics in fresh and broiled loin and round steaks from concentrate fed and pasture grazed steers. J. Food. Qual. 9:311-319.

- Muir P. D., J. M. Deaker and M. D. Bown. 2000. Effects of forage- and grain-based feeding systems on beef quality: A review. New Zealand Journal of Agricultural Research, Vol. 41: 623-635.

- Wulf D.M and J.W. Wise. 1999. Measuring muscle color on beef carcasses using the L*a*b* color space. J. Anim. Sci. 77:2418-2427.

Table 1. Animal performance

	Factors					Contrasts, *P* <		
Variable	H	L	M	S	se	H vs.L	M vs. S	B*D
Initial liveweight, kg	185	153	171	166	6.4	<0.01	0.47	0.21
Final liveweight, kg	296.1	260.1	283.9	272.3	7.8	<0.01	0.15	0.23
Daily gain , g/d								
-Autumn	356	426	457	325	43	0.10	<0.01	0.64
-Winter	1103	924	1016	1011	36	<0.01	0.86	0.88
Initial fat depth, mm	2,2	2,2	2,2	2,2	0,11	0,71	0,97	0,21
Final fat depth, mm	2.88	4.46	4.01	3.34	0.47	<0.01	0.03	0.34

Table 2. Ether extract and fatty acid composition (%) of muscle lipids

	Factors					Contrasts, *P* <		
Variable	H	L	M	S	se	H vs.L	M vs. S	B*D
CLA	0.99	0.95	0.94	1.00	0.08	0.55	0.38	0.02
EE, %*	8.12	8.70	8.02	8.79	1.08	0.58	0.46	0.25
SFA	50.0	45.9	48.0	47.9	2.41	0.07	0.98	0.98
MUFA	41.6	47.9	43.7	44.7	1.59	<0.01	0.56	0..30
PUFA	8..34	7..34	8.27	7.41	1.18	0.34	0.41	0.13
n-3	1.96	1.62	2.03	1.55	0.40	0.34	0.18	0.06
n-6	5.31	4.63	5.19	4.76	0.36	0.52	0.58	0.12
Ratio n-6:n-3	3.36	3.27	2.99	3.64	0.52	0.85	0.21	0.39

* on a dry matter basis

Table 3. Cooking loss, pH, colour and tenderness

	Factors					Contrasts, *P* <		
Variable	H	L	M	S	se	H vs.L	M vs. S	B*D
Cooking loss, g/g	0.17	0.14	0.16	0.14	0.01	0.04	0.12	0.43
pH	5.80	5.64	5.66	5.77	0.08	0.04	0.14	0.15
a*	18.6	20.2	20.3	18.5	1.55	0.27	0.22	0.04
b*	6.65	7.00	7.27	6.39	0.55	0.53	0.13	0.03
L	36.0	36.6	36.8	35.8	1.1	0.55	0.36	0.20
Shear force, kg	6.79	6.65	7.30	6.14	0.59	0.82	0.07	0.58