FATTY ACID COMPOSITION OF LONGISSIMUS MUSCLE OF STEERS FATTENED UNDER DIFFERENT FEEDING REGIMENS

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Background.

Over the last few years there has been a great deal of research done to improve beef quality. Argentina has distinct soil quality and climate which enable beef production under environment friendly conditions. This results in a low cost natural product obtained by also paying due attention to animal welfare. Energy supplementation of grazing cattle is an important strategic tool available to overcome seasonal grass production or to speed up fattening. On the other hand feedlot feeding, in the latter stage of the finishing period, improves feed conversion rate and daily weight gain.

The effect of feeding strategy is particularly relevant to the amount and composition of intramuscular lipids (Kimura, 1997). Several authors have shown lower levels of intramuscular lipids in grazing as opposed to confined cattle, even at a similar finishing degree (Brown *et al.*, 1979; Crouse *et al.*, 1984; Marmer *et al*, 1984). The importance of polyunsaturated fatty acids (PUFA) to human health was perceived in the fifties, later confirmed by considerable evidence about n-3 and n-6 PUFA defficiencies associated with poor health. Contents of n-3 and n-6 PUFA in tissues is dependent on the amounts of these acids in the diet. High dietary amount of one of them results in a lower amount of the other in beef, the optimum ratio n-6/n-3 intake has been suggested to be 4:1 (Holman, 1995). Part of the unsaturated fatty acids in the diet by-pass rumen hydrogenation, they are stored as such in the tissues thus increasing n-3 PUFA and of n-6 PUFA availability in beef of forage fed and grain fed cattle respectively (García and Casal, 1992).

Objective.

To determine the effects of three fattening regimens on fatty acid profile and amount of intramuscular fat of *Longissimus* muscle of steers slaughtered at a similar end-point.

Methods.

Thirty six Hereford steers were alloted at random to one of the following treatments: grazed only pasture (T1), grazed the same pasture as in T1 and were supplemented with maize grain at 1.5% of liveweight per day for 90 days postweaning (T2) and those kept in feedlot, where they received a commercial compound feed over the last 90 days previous to slaughter (T3).

Steers were slaughtered at approximately 450 kg liveweight, at a similar visual finishing point with not les than 5 mm dorsal fat depth measured by ultrasound. Samples of *Longissimus* muscle were obtained at the 9th rib, ether extract was determined following AOAC (1984) procedures and fatty acids were extracted according to Folch *et al.* (1957). Fatty acid profile was analyzed by gas cromatography (Hewlett Packard 5890 Series II) using HP23 (cis/trans FAME) semicapillary column (30 m x 0.53 mm x 0.25 µm) and Helium as carrier gas. Data were subjected to analysis of variance using SAS (1998) procedures for general linear models.

Results and discussion.

Results are given in Table 1, among the saturated fatty acids (SFA) palmitic acid (C16:0) and stearic acid (C18:0) showed the highest concentrations, 30.2% and 13.5% respectively. Oleic acid concentration (C18:1 = 38.8%) prevailed among the monounsaturated fatty acids (MUFA) while linoleic acid (C18:2-n6 = 3.1%) and linolenic acid (C18:3-n3 = 1.25%) were most representatives of PUFA. Similar fatty acid composition of intramuscular adipose tissue was reported by García and Castro Almeyra (1992) and García and Casal (1992), for cattle bred in our country.

Generally speaking, feeding regimen did not affect fatty acid composition, except for C14:O ($P<0.05$) and 18:2-n6 ($P<0.01$). Feedlot steers (T3) showed higher concentration of linoleic acid (4.09% *vs* 2.64 % mean value for T1 and T2), which might be a consequence of the higher concentrations of this acids in lipids of grains compared to leaves, part of them may by-pass rumen hydrogenation and be absorbed as such in the intestines. Meat from grass fed steers (T1 and T2) tended to have higher concentration of C18:3-n3, and a healthier lower -n6/-n3 ratio (2.4 *vs* 3.5; $P< 0.05$) than in T3, which is consistent with García and Casal (1992). Rumsey *et al.* (1972) reported higher concentrations of SFA in the adipose tissue of forage fed steers in comparison to those been fed on highly concentrated diets, García and Casal (1992) did not find significant differences in SFA in *Longissimus* muscle, our data support the latter. The discrepancy with the reviewed literature (Rumsey *et al.*,1972; Marmer *et al.*, 1984; Larick and Turner, 1989; García and Casal, 1992) regards variation in fatty acid concentration in meat due to feeding different diets, may stem from the fact that supplement in T2 was given at weaning and not in the latter stage of fattening, and that steers remained only a short period in feedlot in T3. Feeding regimen did not affect intramuscular fat percentage (IMF), being 3.1% mean value across treatments which makes *Longissimus* muscle a high quality feed for human consumption. In the case of grass fed animals, feeding a high amount of maize grain at the beginning of the fattening stage did not bring about any difference in IMF.

Conclusions.

Keeping steers, in a feedlot, on a diet high in energy for a short period prior to slaughter or supplementing grazing animals at an early stage of fattening, did not affect either fatty acid profile or intramuscular fat content in *Longissimus* muscle.

Pertinent literature.

AOAC 1984. Official Methods of Analysis (14th edition). Association of Official Analytical Chemists, Arlington, VA.
BROWN, H., MELTON, S., RIEMANN, M., BACKUS, W. 1979. Effects of energy intake and feed source on chemical changes and flavor of ground beef during frozen storage. J. Anim. Sci. 48, 338-342.

CROUSE, J., CROSS, H., SEIDEMAN, J. 1984. Effects of a grass or grain diet on the quality of three beef muscles. J.Anim. Sci. 58, 619-625.

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.

GARCIA, P.T., CASTRO ALMEYRA, A. 1992. Lipids in Argentine beef cuts. Proceedings 38th ICoMST, Clermont-Ferrand, France; Vol. 2, pp: 65-68.

GARCIA, P.T., CASAL J.J. 1992. Lipids in Longissimus muscles from grass or grain fed steers. Proc. 38th ICoMST, Clermont-Ferrand, France; Vol. 2, pp: 53-56.

KIMURA, N. 1997. Factors affecting the fatty acid composition of beef carcass fat. Japan Sci. Soc. Press. Tokyo. Pp:157-166.

HOLMAN, R. 1995. Essential fatty acids in health and disease. Actas de la Jornada de Actualización: Las carnes en la nutrición y salud humana. Academia Nacional de Medicina, Buenos Aires, 26 de julio.

LARICK, D.K., TURNER, B.E. 1989. Influence of finishing diet on the phospholipid composition and fatty acid profile of individual phospholipids in lean muscle of beef catle. J. Anim. Sci., 67, pp: 2282 - 2293.

MARMER, W.N., MAXWELL, R.J., WILLIAMS, E.J. 1984. Effects of dietary regimen and tissue site on bovine fatty acid profiles. J. Anim. Sci., 59, pp: 109 - 121.

RUMSEY, T.S., OLTJEN, R.R., BOVARD, K.P., PRIODE, B.M. 1972. Influence of widely diverse finishing regimens and breeding on depot fat composition in beef cattle. J. Anim. Sci., 35, pp:1069 - 1074.

SAS User's Guide: statistics version 6.12, edition 1998. SAS Inst. Inc., Cary, N.C.

Table 1. Effect of feeding regimen on fatty acid composition (% of total fatty acids) and intramuscular fat percentage (IMF) *Longissimus* muscle

	Fatty acids (%)			Probability	MSE
	T1	T2	T3		
C14:0	3.70±0.44	3.74±0.71	3.13±0.51	P=0.04	0.59
C15:0	0.82±0.08	0.78±0.14	0.70±0.15	ns	0.13
C16:0	30.7±1.9	30.0±2.7	30.0±2.4	ns	2.4
C16:1	2.16±0.47	1.92±0.64	1.86±0.54	ns	0.57
C17:0	1.21±0.16	1.19±0.17	1.11±0.17	ns	0.16
C17:1	0.65±0.08	0.65±0.11	0.66±0.08	ns	0.10
C18:0	13.5±2.3	14.2±3.6	12.9±2.3	ns	2.9
C18:1	38.8±2.6	38.7±2.1	38.9±2.5	ns	2.3
C18:2-n6	2.43±0.95	2.84±0.89	4.09±1.01	P=0.001	0.94
C18:3-n3	1.17±0.29	1.14±0.36	1.29±0.44	ns	0.37
n6 / n3	2.08±0.57	2.65±1.12	3.45±1.29	P=0.02	1.05
SFA	49.9±3.1	49.9±3.9	47.9±3.0	ns	3.4
IMF	3.15±2.12	3.88±2.24	2.36±0.76	ns	1.89

T1 = only pasture, T2 = pasture plus cracked maize at weaning, T3 = feedlot, ns = P>0.05, MSE: mean standard error