EFFECT OF FEEDING SYSTEM ON DAILY GAIN OF STEERS, FAT AND CHOLESTEROL CONTENT OF BEEF

V. Schlinder, M. E. Cossu, G. Trinchero, J.J. Grigera Naón, F. Canosa, L. Santa Coloma
Faculty of Agronomy, University of Buenos Aires. Av. San Martín 4453, Buenos Aires (1417), Argentine. AACH (Asociación Argentina de Criadores de Hereford) and JICA (Japan International Cooperation Agency).

Background.

Many health professionals suggest that persons should monitor their intake of cholesterol and total calories to prevent obesity and cardiovascular diseases (LRCP, 1984). The studies linking dietary fat and cholesterol intake with heart diseases have conferred a negative image to red meat for its high content of fat and cholesterol. Over the years there has been a large amount of research done to improve the quality of beef; much work has been done in reducing the fat content to meet consumer demands for leaner meat. However, intramuscular fat levels below 5% may decrease meat quality attributes (juiciness and flavour); at such fat levels, total calories would amount to 120 kcal/100g of lean meat, indicating that it would not be necesary to reduce further the intramuscular fat content (Rogowski, 1978). The production system has to be carefully considered as a key factor affecting nutritional attribuites of meat. Meat from animals grazing pastures is leaner than from those fed on high concentrate diets (Brown *et al.*, 1979, Crouse *et al.*, 1984; Marmer, 1984; García and Casal, 1992).According to Miller *et al.*, 1986 and Eichhorn *et al.*, 1986, cholesterol content of beef is not affected by nutrition. On the other hand, García and Casal (1992) demonstrated that *Longissimus* muscle from grain fed steers had more cholesterol than from grass fed steers. Blood levels of cholesterol - low density lipoproteins would appear to be unaffected by the percentage of fat calories in the diet (Wiseman, 1997). Also, Rhee *et al.* (1982) and Browning *et al.* (1990) determined that the relationship between fat and cholesterol content was not significant as much of the cholesterol is present in structural lipids.

Objective.

To determine the effects of different feeding strategies (grazing, supplementation or fedlot feeding) on daily gain, intramuscular fat and cholesterol concentration of muscle *Longissimus dorsi* from beef steers slaughtered at similar finishing end point.

Methods.

Ninety nine steers of British breeds were alloted at random to one of the following treatments: grazed pasture as unique feed (T1), grazed the same pasture as in T1 and were supplemented with maize grain at 1.5% of liveweight per day on the last 90 days (T2), after grazing the same pasture as in T1 were kept in a feedlot for the last 90 days (T3) and feedlot over all the trial (T4). Steers were slaughtered at a similar finishing point visually assessed by trained abattoir personnel. Slaughter weights and length of the fattening period were respectively: T1= 466 kg (363 days), T2= 468 kg (338 days), T3= 448 kg (300 days) y T4= 354 kg (113 days). Samples of *Longissimus* muscle were obtained at the 9th rib and analyses of ether extract (AOAC, 1984) and cholesterol (colorimetric method using an enzimatic kit ; Boerhinger Mannheim GmbH) were performed. Daily gain (DG), intramuscular fat percentage (IMF) and cholesterol content were analyzed by linear model of GLM from SAS (1997) statistical program. Tukey test with 5% significance was used to compare mean values. Cholesterol regression were also anlysed by GLM regression program (SAS, 1998).

Results and discussion.

All variables studied were significantly influenced by feeding regimen (Table 1).Steers that spent all their fattening stage in feedlot (T4) had DG above one kilogramme,whereas those supplemented (T2) or in feedlot over the last stage of fattening (T3) had similar DG close to 770 g/d, cattle grazing pasture (T1) showed the lowest values (550 g/d; $P<0.01$). These results are coincident with the reviewed literature were is established a positive relation between growth rate and energy intake (Rule *et al.*, 1997; Saiz and Cubbage, 1997) Differences in IMF ($P<0.05$) were highest for T1, intermediate for T2 and T3 and lowest for T4. These results disagree with several studies where is reported thet beef from grazing animals is leaner than from grain fed animals (Brown *et al.*, 1979, Crouse *et al.*, 1984; Marmer, 1984; García and Casal, 1992). In our case, animals from the feedlot were finished and slaughtered earlier than those coming from pastures (113 *vs* 363 days) so an age effect cannot be discarded (Clemens *et al.*,1973). Cholesterol content was somewhat lower than what has been reported by García and Castro Almeyra (1992). Beef from steers in feedlot (T4) had the highest ($P<0.01$) cholesterol content in agreement with García and Casal (1992), who reported that *Longissimus* muscles of grain fed had higher cholesterol level than of forage fed steers.

In Table 2 it can be seen negative, albeit small, relations between cholesterol content and IMF ($R^2=0.09$, $P<0.01$) and cholesterol and growth rate ($R^2=0.07$, $P<0.01$), IMF in particular affects cholesterol content within treatments ($R^2=0.61$). Regression is negative in T1 only (when marbling was higher cholesterol content was lower) but highly positive for T4. Rhee *et al.* (1988) reported a simple correlation coeficient (0.37, $P<0.001$) between fat content and cholesterol content in bovine *Longissimus* muscle, but the low coefficient led the authors to conclude that this correlation would be little significative in practical conditions. In fact, moderate increments in marbling would not bring about relevant variations in cholesterol, taking into account the "b" values and the low IMF in *Longissimus* muscle (mean value 2.6%). According to Kinney Sweeten *et al.* (1990) marbling adipose tissue depots contribute only minute amounts to the total cholesterol present in an ordinary serving of meat. The relation betwen growth rate and cholesterol content was positive in (b=24.4) in the case of steers kept in feedlot (T4) and negative for the rest among which the steepest slope (b= -12.5) was for T1. These results lead to think that increased energy concentration in the feed of confined animals results in increased levels of cholesterol in meat.

Future studies should address the issue if the energy concentration of the feed or the growth rate are determinats *per se* of higher levels of cholesterol in beef of steers reared in pastures.

Conclusions.

Values for growth rate, intramuscular fat percentage and cholesterol content in *Longissimus* muscle were similar for steers fed on

high energy diets for a short period and intermediate between those kept in feedlot during the whole fattening period and those grazing pasture as unique feed.Cholesterol content was positively correlated to intramuscular fat content in *Longissimus* muscle from steers fattened in feedlots.

Pertinent literature.

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Table 1. Effect of feed treatment on daily liveweight gain (kg/d), intramuscular fat (IMF) and cholesterol (mg/100g) content of *Longissimus* muscle

	Treatments				Prob.	MSE
	T1	T2	T3	T4		
Daily gain	0.55±0.12 *A*	0.71±0.13 *B*	0.83±0.23 *B*	1.34±0.23 *C*	P=0.0001	0.153
IMF %	3.24±1.47 *b*	2.75±0.96 *ab*	2.46±0.77 *ab*	1.94±0.53 *a*	P=0.019	1.30
Cholesterol	38.4±4.8 *A*	40.0±3.3 *A*	37.7±3.8 *A*	56.6±7.7 *B*	P=0.0001	4.9

A, B, C= P<0.01; a, b= P<0.05; ns= P>0.05 ; MSE = mean standard error

Table 2. Regression equations of cholesterol content (Y) from IMF and daily gain

	a	b		a	b
%IF (1)	44.30	- 1.50	Daily gain (3)	0.82	- 0.05
%IF (treatment)(2)			Daily gain (treatment)(4)		
- T1	44.88	- 1.08	- T1	45.26	- 12.45
- T2	39.33	0.23	- T2	46.45	- 9.10
- T3	37.71	0.01	- T3	40.35	- 3.13
- T4	51.24	2.01	- T4	23.83	24.39

(1) R^2= 0.09 and P=0.003; (2) R^2= 0.61 and P=0.007; (3) R^2 =0.07 and P=0.07; (4) R^2=0.63 and P=0.0008