CONTRIBUTION OF LONG CHAIN N-3 AND N-6 POLYUNSATURATED FATTY ACIDS FROM BEEF ACCORDING TO FEEDING REGIMEN

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Introduction:

Health related concerns about beef is limited to its relatively high concentrations of hypercholesterolemic, saturated fatty acids (SFA), low concentration of hypocholesterolemic polyunsaturated fatty acids (PUFA) and the presence of cholesterol. The recommended intake for humans of n-6 fatty acids is approximately 4 % of dietary energy with a minimum of 1.5% and the intake of n-3 fatty acids should be about 0.75% of dietary energy to avoid essential fatty acid deficiency. There is great evidence that increased consumption of n-3 fatty acids protect from CHD and that excessive consumption of n-6 fatty acids at the expense of n-3 promote CHD and other diseases. Analysis of n-3 PUFA intake, intake recommendations, and health claims often are limited to C18:3 (ALA), C20:5 (EPA) and C22:6 (DHA) and often omit C22:5 (DPA). DPA is an intermediate in the production of DHA from EPA and its contribution in beef lipids is higher than EPA and DHA. The functional and nutrition attributes of DPA are largely unknown but some studies shows that DPA appears to be a primary end point for the synthesis of n-3 PUFA from ALA (Howe, Meyer, Record & Baghurst, 2005).

The objective of this study was to evaluate the effects of animal diet, pasture only, pasture plus 0.7 and 1.0 % of live-weight of grain supplementation and feedlot on the contribution of n-3 and n-6 PUFA of intramuscular lipids from Angus steers.

Materials and methods

Twenty four Angus (A) steers were allotted from 5-7 months old to slaughter weight to the following four treatments of 6 animals each. T1: grazed on pasture (Mainly alfalfa and festuca); T2: supplemented with corn grain (0.7% of live-weight) daily and free access to pasture; T3: supplemented with corn grain (1% of live-weight) daily and free access to pasture and T4: Feedlot (concentrate based in corn, hay alfalfa and soy bean and expeller meal). All steers were conventionally slaughtered in a commercial abattoir at similar degree of finishing. After 24 h at 4°C 6 steaks of *Longissimus dorsi* muscles at the 11 th rib were taken at random from each treatment, carefully dissected and used for chemical analysis. Aliquot samples of 10 g each, trimmed of external fat, were minced carefully, dried and extracted in a Tekator apparatus using hexane as the extraction solvent according to official methods (AOAC, 1992). Aliquot samples of 5 g each were extracted using the Folch, Lees and Stanley (1957) method. Fatty acid methyl esters (FAME) were prepared according with the method of Pariza, Park and Cook (2001) and measured using a Chrompack CP 900 equipment fitted with a flame ionization detector. Separation of FAME was performed on a WCOT fused silice capillary column (CP-Sil 88 100 m x 0.25 mm i.d. coating), using N2 as a carrier gas. The oven temperature was programmed at 70° C for 4 min, increased from 70 to 170°C at a rate of 13°C /min and then increases from to 170° to 200° C at 1°C/min. Individual fatty acids were identified by comparing relative retention times with individual fatty acids standard (PUFA-2 Animal Source. Supelco). Analytic results were expressed as percentages of total fatty acids. On the basis of the content of fat in the muscle and the fatty acid profile the content of fatty acid was calculated in 100 g of meat. Statistical analysis were performed by means of the statistical software SYSTAT version 6.1 1996, SPSS Inc. If there was a significant treatment effect by F-test, the Tukey´studentized range (HSD) was used for follow-up comparisons of treatment means

Table 1. PUFA n-6 and n-3 composition (%) and fatty acid nutritional ratios of LD muscle lipids according to feeding regimen.

Fatty acid	T1	T2	T3	T4	SS
PUFA n-6	4.56b	4.76b	5.23b	5.46a	**
C18:2	2.98b	3.18b	3.49b	5.78a	***
C20:3	0.35	0.33	0.36	0.24	NS
C20:4	0.97	0.93	1.14	0.82	NS
C22:4	0.25	0.32	0.24	0.20	NS
PUFA n-3	3.01a	2.39ab	1.50b	0.83c	***
C18:3	1.39a	0.79b	0.60b	0.17c	***

C20:5	0.41a	0.32ab	0.29b	0.13c	***
C22:5	1.02a	1.00a	0.52b	0.23c	***
C22:6	0.19a	0.28a	0.08b	0.08b	***
n-3+n-6	7.57	7.15	6.73	6.26	NS
n-6/n-3	1.53	2.15	3.80	10.15	**
C18:2/C18:3	2.20c	4.27b	7.24b	26.43a	***
C20:4/C20:5	2.56b	3.52b	4.45b	12.73a	***
C18:2/CLA	4.54 c	7.42bc	8.52b	25.01a	***

Fig 1. n-6 PUFA (mg/100g LD)

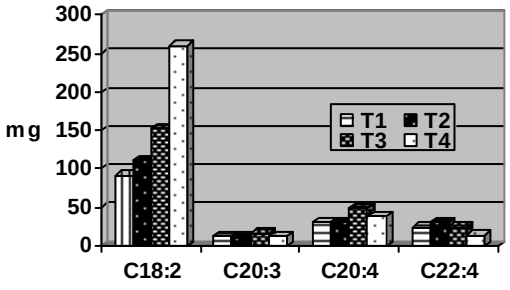
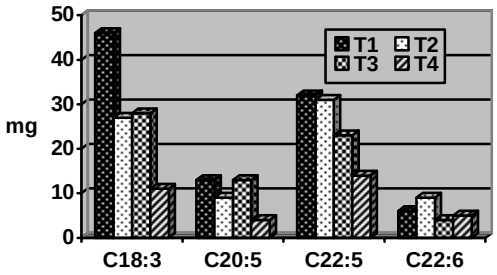


Fig 2. n-3 PUFA (mg/100g LD)



Results and discussion

The fatty acid composition (%) of n-3 and n-6 PUFA in LD *muscle* according to diet is shown in Table 1. Total PUFA n-6 and n-3 was not different but the total n-3 decreased from T1 to T4 and total n-6 increased from T1 to T4. The only n-6 PUFA affected by the diet was C18:2 (5.78; 3.49; 3.18 and 2.98 % for T4, T3, T2 and T1 respectively). All n-3 PUFA decreased linearly as the amounts of grain in the diet increased. C18:3 (1.39, 0.79, 0.60 and 0.17%); 20:5 (0.41, 0.34, 0.27, and 0.05%); 22:5 (0.70, 0.51, 0.49 and 0.30%) and 22:6 (0.19, 0.28, 0.10 and 0.08% for T1, T2, T3 and T4 respectively. The C18:2 n-6/C18:3 n-3 ratio were linearly and significantly ($p<0.001$) affected for the diet (2.20, 4.27, 7.24 and 26.43 for T1, T2, T3 and T4 respectively). The ratios C18:2n-6/C18:3 n-3 and C20:4 n-6 / C20:5 n-3 showed similar patterns and could be used as very good indicators of the ruminant diets. The hyperlipidemic effects of C20:4 n-6 are counteracted by C20:5 n-3 (Scientific Review Committee, 1990. The n-6/n-3 PUFA ratio according to the Department of Health (1994) should be lower than 4 in human diets. It is interesting to notice that EPA an DHA only are formed in significant amounts if the ratio n-6/n-3 is less than 10:1. In Fig 1and 2 are shown the mg of n-6 and n-3 PUFA in 100g /LD. The n-3 fatty acid recommendation is 0.6-1,2% of energy for ALA; up to 10% of this can be provided by EPA or DHA. The evidence base supports a dietary recommendation of 500 mg/day of EPA and DHA for CVD risk reduction. It is interesting to notice that n-3 from fish or fish oil supplements, but not ALA, benefit CVD outcomes in primary and secondary prevention studies (Howe, Meyer, Record, & Baghurst, 2006). The contribution of meat to EPA, DPA and DHA intakes is often ignored when assessing intakes from food records. DPA, the predominant n-3 HPUFA in meats, is an intermediate in the production of DHA and EPA is often omit (Howe, Meyer, Record, & Baghurst, 2006). The limited information available on physiologic effects of DPA suggest that some of is effects may be similar to but quantitatively distinct from EPA and DHA.

Conclusion

Beef is an important dietary source of long chain n-3 PUFA, in which DPA predominates. Grass beef is a practical alternative to increases the contribution of n-3 PUFA. The amounts of n-3 PUFA in muscle tissue phospholipids of lean beef need to be taken in account when determining dietary PUFA intakes, whereas previous estimates of LCn3PUFA have been based on consumption of seafood only.

References

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