Effects of diet and time on feed on phospholipid fatty acid composition and beef meat flavour

M.M. Campo [1], M. Enser [1], A. Gondou [2], J.S. Elmore [2], D.S. Mottram [2], G.R. Nute [1], N.D. Scollan [3] and J.D. Wood [1]
[1] *Division of Food Animal Science, University of Bristol, Langford, Bristol BS40 5DU, UK*
2 School of Food Biosciences, University of Reading, Whiteknights, Reading RG6 6AP, UK
3 Institute of Grassland and Environmental Research, Plas Gogerddan, Aberystwyth SY23 3EB, UK

Introduction The polyunsaturated fatty acids (PUFA) of the intramuscular phospholipids are the most significant lipids in the development of cooked beef flavour (Mottram and Edwards, 1983). In lamb, differences in n-6 and n-3 fatty acid composition have been shown to be a major factor influencing consumer perception and acceptability (Sañudo *et al*, 2000). Altering meat PUFA, especially n-3 fatty acids, to improve its value in human nutrition (COMA, 1994) may have effects on flavour and acceptability. The aim of this work was to evaluate differences in flavour perception when intramuscular fatty acid composition is changed in beef meat.

Material and methods Twenty eight Charolais cross steers, initial live weight 548 kg, were fed for 60 or 90 days before slaughter a diet containing 125 g/kg whole linseed (n-3 source) or 280 g/kg full fat soya (n-6 source). At 48 h post mortem, the loin joint was dissected and 2-cm thick steaks of m. *longissimus* were obtained, frozen immediately and kept at –20 ^{o}C for fatty acid analysis (GC) of the phospholipid fraction and for flavour volatile analysis. The rest of the joint was conditioned for 10 days prior to being vacuum packaged and frozen to await sensory analysis. After thawing at 4 ^{o}C for 24 h, 2-cm thick chops were prepared and grilled at 160 ^{o}C to an internal temperature of 74 ^{o}C. A 10-member trained taste panel assessed beef flavour intensity on a 0-100 line scale. Dissected muscle was grilled and 5g transferred into a conical flask kept at 60 ^{o}C and swept with nitrogen at 40ml per min for 60 minutes to transfer volatiles onto a Tenax trap. Volatiles were analysed by gas chromatography/mass spectrometry. Analysis of variance was applied to the 2x2 factorial analysis design by GLM procedures of the SAS package.

Results Phospholipid fatty acid composition was influenced by diet with most differences occurring by 60 days (Table 1). Linseed fed animals contained more n-3 fatty acids and soya fed animals had a higher content of n-6 fatty acids, although differences in length of feeding were significant only for n-6 fatty acids ($p<0.05$). However, no significant differences were found in beef flavour intensity between linseed and soya fed animals or between periods on feed. There were few correlations with flavour compounds. Only the correlation between the content of total n-3 fatty acids and the proportion of sulphur-containing flavour compounds ($r=0.54$, $p<0.05$) was significant, possibly due to the higher instability of n-3 *versus* n-6 fatty acids providing appropriate precursors. Only alcohols among the group of volatile compounds showed significant differences between diets ($p<0.01$) and times on feed ($p<0.05$), but with a significant interaction between both effects ($p<0.001$) since with soya fed animals these decreased with time on feed while for linseed fed animals they increased.

Table 1. *Polyunsaturated n-3 and n-6 fatty acid composition of m.*longissimus *phospholipids (mg/100g muscle), sensory beef flavour score (0-100 scale) and the proportion (x100) of headspace volatiles in beef from steers fed linseed or soya for two times on feed (ToF, 60 and 90 days).*

	n	Linseed		Soya		sed	Significance		
		60 d	90 d	60 d	90 d		Diet	ToF	D*T
n-3 fatty acids	*7*	65.90	72.62	45.74	39.46	1.28	***	n.s.	**
n-6 fatty acids	*7*	96.42	107.04	139.65	154.10	2.95	***	*	n.s.
Beef flavour	*7*	24.0	27.6	26.7	22.0	2.86	n.s.	n.s.	*
Alcohols	*5*	2.69	5.18	3.11	2.63	0.21	**	*	***
Aldehydes	*5*	48.34	53.52	49.34	58.88	2.14	n.s.	n.s.	n.s.
Ketones	*5*	20.92	18.17	19.93	19.17	1.87	n.s.	n.s.	n.s.
N-containing	*5*	1.06	1.16	1.18	1.65	0.35	n.s.	n.s.	n.s.
S-containing	*5*	13.43	8.73	11.91	5.29	4.22	n.s.	n.s.	n.s.

n = number of animals per group; n.s.= no significant; * = $p<0.05$; ** = $p<0.01$; *** = $p<0.001$

Conclusion It is possible to produce a healthier beef meat high in n-3 fatty acids without significant changes in flavour assessed by a trained taste panel. Although n-3 polyunsaturated fatty acids are more susceptible to lipid oxidation than the n-6 PUFA, the higher total PUFA content (n-3 + n-6) in soya could explain the lack of significant diet effects. However, further studies should be done to understand the complexity of the chemistry of flavour and the multiple interactions of all meat components, including lipids, sugars and amino acids.

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