THE EFFECTS OF FEEDING BY-PRODUCTS OF SOYBEAN HARVEST ON THE LIPID COMPOSITION AND QUALITY OF BEEF

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Background

Nutrition affects tissue fatty acids in cattle, the w-6:w-3 fatty acids in meat from forage finished cattle is approximately 2 (Enser *et al.*, 2001), well below the recommended level of less than 4 (Holman, 1995). Short term maize grain supplementation in the finishing stage of beef catlle, a common practice in pastoral systems, did not affect fatty acid profile (Grigera Naón *et al.*, 2000). On the other hand, enhanced body fat levels of conjugated linoleic acid (CLA) were found in cattle grazing pastures (French *et al.*, 2000), CLA concentration has also been increased by including extruded full-fat soybeans in feedlot diets (Madron *et al.*, 2002). Full- fat soybeans is an expensive commodity, usually produced for humans, therefore, it becomes relevant to explore the strategic use of by-products of soybean harvest for feeding grazing cattle in the latter stage of fattening. These by-products can have up to 60% cracked soybeans.

Objective

Our objective was to examine the direct and carry-over effects of short term supplementation with by-products of soybean harvest on fatty acid composition and tenderness of meat from steers grazing pastures.

Methods

Forty one , 21 months old Aberdeen Angus steers (initial liveweight 390 ± 28 kg) were randomly allocated to either grazing a mixed temperate pasture, based on white clover and tall fescue (**OP**) (n = 20) or grazing the same pasture daily supplemented with by-products of soybean harvest at 1.1% liveweight (**SP**) (n = 21). After 74 days of supplementation, ten steers were finished and slaughtered, additional feeding was stopped and the remaining eleven animals were fattened on pasture, thus giving treatment **COS** to assess carry-over effect of supplementation. Animals rotationally grazed a 30 hectares field divided in 2.5 hectares paddocks. Slaughter point was in every case visually determined by the same trained abattoir official. Samples of muscle *longissinus dorsi* and muscle *semitendinosus* were kept al - 18^{0}C. 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 cooked samples (water bath heating at 70^{0}C for 50 minutes). Data were analyzed using GLM procedure SAS (1999). Tukey multiple comparison test (SAS) was used to compare treatment means.

Results and discussion

Table 1 contains the ingredients and chemical composition analysis of the by-product of soybean harvest. Average slaughter weight and length of the fattening period for each treatment were respectively **SP** (457 kg, 74 days), **COS** (481 kg, 118 days) and for **OP** (478 kg, 144 days). Differences of fatty acids profiles (**Table 2**) between muscles were minor. Across all treatments, the major fatty acids present were: oleic (37.8%), palmitic (24.8%) and stearic (17.0%). Steers on soybean diets (**SP** and **COS**) had lower oleic acid and higher palmitic acid contents. The proportion of monounsaturated fatty acids decreased with supplementation, whereas the proportion of w-6 acids increased. This resulted in higher values (above 4) of the ratio w-6:w-3 for the supplemented animals (**SP**). Linoleic acid proportion was significantly higher in *m. longissimus* from steers fed the by-product. This acid is an important substrate in rumen biohydrogenation, in theory this would result in increased production of CLA in the rumen, as well as endogenous synthesis of CLA (Madron *et al.*, 2002). We did not measure any increase in CLA due to supplementation, on the contrary CLA content was significant higher in *m. longissimus* of steers on pasture (**OP**) and lowest in those animals slaughtered after 74 days supplementation (**SP**). The apparent discrepancy can find its explanation in the fact that Madron *et al.*, 2002, tested comparatively high concentrate feedlot diets which resulted in overall low CLA content (average 0.71 g/100 g fatty acids) whereas in our case pasture was the main dietary component, CLA content ranged from 0.9 to 1.5 g/100g fatty acid. The interruption of supplementation (**COS**) resulted in intermediate values, between **SP** and **OP**, for proportions of: oleic acid, linoleic acid, CLA, monounsaturated acids and w-6. Shear force was not significantly affected by feeding regimes (**Table 3**).

Conclusions

Supplementation with by-product of soybean harvest brought about a significant lower proportion of CLA and higher ratio w-6:w-3 in *m. longissimus*, with small but significant carry-over effects on the fatty acid profile without affecting tenderness.

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Table 1. Ingredients and chemical composition of by-products of soybean harvest

Ingredient, % DM	
Soybeans	68
Straw and hulls	21
Weed seeds	9
Dust	2
Chemical analysis	
Dry matter %	86.0
Crude protein %	29.8
NDF %	34.5
ADF %	21.3
Ether extract %	9.7
Ash %	9.5

NDF: neutral detergent fibre; ADF: acid detergent fibre

Table 2. Fatty acid composition (%) of muscle lipids

	m. *longissimus dorsi*			/	m. *semitendinosus*			
Treatment	**SP**	**COS**	**OP**	**sd**	**SP**	**COS**	**OP**	**sd**
Fatty acid								
14:0	2.2	2.3	2.4	0.26	2.5	2.3	2.4	0.28
15:0	0.6	0.5	0.6	0.10	0.6	0.5	0.6	0.09
16:0	24.6[a]	25.5[a]	23.8[b]	0.84	25.4[a]	26.1[a]	23.5[b]	1.08
16:1 cis-9	2.3	1.6	3.1	0.58	2.2	2.6	2.7	0.38
17:0	1.1	1.0	1.2	0.13	1.1	1.1	1.1	0.17
18:0	18.1	16.1	16.3	2.02	18.8	17.0	15.8	1.90
18:1 w 9	35.9[a]	38.1[ab]	40.8[b]	2.27	34.4[a]	37.2[ab]	40.4[b]	2.10
18:2 w 6	7.6[a]	5.7[ab]	4.7[b]	1.53	6.9	5.5	4.1	1.86
18:3 w 3	1.3	1.5	1.1	0.36	1.1	1.4	1.5	0.49
CLA*	0.9[a]	1.3[b]	1.5[b]	0.17	1.3	1.3	1.5	0.25
20:5 w 3	0.6	0.7	0.6	0.29	0.6	0.6	0.7	0.3
22:6 w 6	0.1	0.1	0.1	0.05	Lesss than	0.1		
Monounsat.	40.3[a]	42.7[ab]	46.0[b]	2.53	38.7[a]	41.8[ab]	45.1[b]	2.15
Polyunsat.	13.0	11.6	9.6	2.71	12.7	10.9	11.3	3.15
w-6	10.9[a]	7.5[b]	6.7[b]	1.64	9.1	7.3	7.2	1.82
w-3	2.1	2.2	1.7	0.65	1.8	2.1	2.2	0.76
w-6/w-3	5.4[a]	3.4[b]	4.2[ab]	0.83	5.0	3.8	3.5	1.00

a,b, c, means within a row without a common superscript differ ($P < 0.05$)
*CLA cis-9, trans-11

Table 3. Shear force (kg) of muscle *longissimus dorsi* and muscle *semitendinosus*

Treatment	**SP**	**COS**	**OP**	**sd**
m. *longissimus dorsi*	7.4	7.8	7.9	1.90
m. *semitendinosus*	12.0	11.0	10.0	1.96