EFFECTS OF PROCESSED CORN AND SOYBEAN MEAL ON CARCASS AND MEAT QUALITY CHARACTERISTICS OF BEEF STEERS

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Background

Beef meat quality can be improved by nutrition through its effects on fat deposition (intramuscular fat) and protein turn-over (collagen). However, so far research mostly focused on the effects of different feeding systems (pasture *vs* stable) (Ender et al., 1997; Daly et al., 1999) and diet composition (Mandell et al., 1997; 1998) rather than on the effects of feed processing which enable the supplementation of higher rapidly available energy and amino acids in the rumen and at the intestinal level. Higher energy and protein absorption could benefit beef eating quality (i.e. visual marbling and tenderness), through increased intramuscular fat deposition, and help reduce environmental pollution due to lower nitrogen output. Several studies (Veira et al., 1994: Petit et al., 1994) showed that dietary nitrogen supplementation significantly increases weight gain in steers due to an higher availability of nitrogen at the small intestine level. However, the results concerning its effects on carcass and meat quality are contradictory. Petit et al. (1994) failed to find an effect of protein supplementation on carcass yield and marbling score in meat of beef steers fed silage supplemented with different levels of energy. On the other hand, Mir et al. (1999) reported an increased proportion of steers graded high for carcass yield following supplementation of higher dietary protein levels (17.2 *vs* 15 and 11%) in the finishing phase.

Objectives

The aim of this project was to study the effects of dietary supplements containing coarse *vs* ground corn and soybean meal high in rumen undegradable protein (Soypass™) *vs* conventional soybean meal on carcass and meat quality of beef steers fed iso-energetic diets based on corn silage.

Methods

To determine the effect of corn processing (coarse [CC] or ground [GC]) and soybean meal processing (solvent extracted 48% crude protein [CP] soybean meal [SS] or lignosulfonate treated soybean meal, Soypass™ [SP]) on beef carcass and meat quality, thirty-nine medium-frame crossbred steers were allotted to four iso-energetic feeding treatments during the finishing period: CC + SS (control); CC + SP; GC + SS and GC + SP. Corn silage was offered for ad libitum consumption while processed corn and soybean meal were fed at 7.5 and 0.6 kg/d, respectively. Animal were fed individually twice a day and half of the supplement was added on the top of the silage and mixed by hand. Once achieved the slaughter weight (618 ± 49 kg), all steers were shipped for slaughter. Hot carcass weights (kg) were recorded before overnight chilling. Carcasses were graded using the official grading criteria for determining carcass grade (Agriculture Canada, 1992). Backfat thickness (mm) and the rib-eye area (cm^2) of the *longissimus dorsi* (LD) muscle were measured at the interface between the 13th and 14th rib. Subjective score for marbling was obtained at the same location by using a 10-point scale (USDA, 1981). As for meat quality evaluation, post mortem pH decline in the LD muscle was measured at 2 and 24 h and at six days after slaughter at the 13th-14th rib level. On the sixth day post mortem, the 10th to 14th rib section from the left side of each carcass was removed and trimmed of fat and superficial muscle for the measurement of colour (L*, a*, b*; CR 300 Minolta Chromameter) of the lean after 30 minutes blooming at 4°C and drip loss (%) by calculating the weight (g) losses after 48h storage at 2°C in polystyrene tray overwrapped with an oxygen-permeable film. A steak from the LD was prepared from the 13th-14th rib, vacuum-packed and frozen pending the analysis of Warner-Bratzler shear force (Lloyd Instruments, Warsash, Southampton, UK) and intramuscular fat content (%, Soxtech extraction). Data were analysed according to a 2 x 2 factorial design by using the GLM Procedure of the SAS System (SAS, 1999).

Results and discussion

Although dressing yield (%) was not affected by any of the two feed processing treatments, carcass weight showed a tendency (P=0.08) to be greater for steers fed ground corn (GC) compared to those fed coarse corn (CC) (Table 1). These results are difficult to explain as, differently from the recordings of the growing phase of this study (Ouellet et al., 2002), in the finishing phase no effect of corn processing on daily gain (data not shown) was found. Contrary to the general rule that in cattle the effects of varying energy intake are greatest on the subcutaneous fat depot (Murray et al., 1974; Miller et al., 1987b), steers receiving GC-based diet had a lower (P=0.04) backfat depth at the 13th rib level. However, contrary to Miller et al. (1987a), the change in the backfat thickness did not result in a significant variation in the marbling score of the LD muscle. Decreasing carcass fatness did not correspond to a significant variation in the lean yield (%) and rib-eye area (cm^2). However, the number of carcasses grading "Canada AAA" were greater for steers fed GC than those fed CC (5 *vs* 2). Soybean meal processing which favoured the supply of amino acids at the duodenum did not affect most of the examined carcass quality traits, but it had a certain effect (P=0.07) on marbling score leading to a greater number of carcasses being scored AAA (5 *vs* 2).
Higher water-holding capacity and visual acceptability of beef meat have been associated with increased dietary energy intake through a reduction of muscle glycogen stores (Miller et al., 1987a; den Hertog-Meischke, 1997). Miller et al. (1987b) also reported an increased fat deposition between muscle fibres. In this study, no effect of the higher energy availability, resulting from corn processing, on meat quality was found (Table 2). Likewise, in agreement with Mir et al. (1999), the higher protein/amino acids intake, through soybean processing, did not have any effect on any meat quality trait either. However, contrary to the common opinion about the lack of effect of dietary protein intake on drip loss of the meat, soybean processing seems to have a certain effect (P=0.07) on drip loss (%), which may be due to the greater percent of meat proteins binding water and thus increasing water retention. The effect (P=0.02) of soybean treatment on IMF content must be considered as an effect of the interaction (P=0.01) with corn processing more than that of soybean processing itself.
The results indicate that feed processing improves carcass quality and yield without affecting meat quality.

Table 1. Carcass characteristics of steers fed either coarse or ground corn and either soybean meal or Soypass™

Parameters	Treatment[1]					Significance		
	CC + SS (n=10)	CC + SP (n=10)	GC+ SS (n=10)	GC+ SP (n=9)	SEM	Corn source	Soybean source	Interaction
Carcass weight (kg)	346.5	332.5	359.5	363.0	0.11	**0.08**	0.27	0.20
Dressing yield (%)	57.0	56.4	57.2	56.7	0.52	0.62	0.27	0.98
Lean yield (%)	59.6	60.5	60.8	60.8	0.71	0.29	0.53	0.50
Backfat depth (mm)	7.5	7.4	6.5	6.4	0.50	**0.04**	0.90	0.99
Rib-eye area (cm^2)	91.6	90.8	97.8	91.5	4.13	0.39	0.38	0.49
Marbling score[a]	3.6	4.5	4.4	4.5	0.30	0.14	**0.07**	0.10

[1]Treatment: CC= coarse corn; GC= ground corn; SS= conventional soybean meal; SP: Soypass™
[a]According to a 10-point scale from 1 = devoid to 10= abundant marbling (USDA, 1981)

Table 2. Meat quality traits of steers fed either coarse or ground corn and either soybean meal or Soypass

Parameters	Treatment[1]					Significance		
	CC + SS[1]	CC + SP	GC+ SS	GC+ SP	SEM	Corn source	Soybean source	Interaction
pH_1	6.44	6.58	6.59	6.59	0.12	0.50	0.54	0.53
pH_2	5.37	5.34	5.34	5.38	0.03	0.77	0.98	0.21
pH_6	5.32	5.28	5.30	5.30	0.01	0.80	0.28	0.33
Drip loss (%)	3.35	2.85	3.59	3.03	1.19	0.45	**0.07**	0.91
L*	39.77	40.21	39.17	39.60	0.79	0.60	0.59	0.99
a*	25.33	26.09	25.26	25.30	0.60	0.46	0.49	0.54
b*	13.93	14.18	13.65	13.69	0.36	0.27	0.69	0.76
IMF (%)	1.85	2.84	2.61	2.51	0.20	0.26	**0.02**	**0.01**
Max. shear force (N)	38.4	33.0	37.5	37.6	0.28	0.40	0.26	0.24

[1]Treatment: CC= coarse corn; GC= ground corn; SS= conventional soybean meal; SP: Soypass™

Pertinent literature

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