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MEAT QUALITY FROM CHAROLAIS BULLS FED DIETS WITH DIFFERENT LEVELS OF CORN SILAGE INCLUSION

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Original scientific paper

SUMMARY

A sample of 6 intensive beef farms was selected according to the feeding plan adopted during the fattening period of Charolais bulls. Two farms did not include any corn silage in the diet (CS0), while corn silage represented 22% of the dietary DM in the second group of 2 farms (CS22), and it raised up to 44% of the dietary DM in the last 2 farms (CS44). Five bulls were randomly selected from each farm to be slaughtered in the same abattoir. Bulls age was similar across treatments but the CS44 bulls had a lower carcass weight (396 kg) than the other two treatments (436 and 446 kg for CS0 and CS22, respectively). Carcass fleshiness (SEUROP) and fatness scores were not affected by the level of corn silage in the diet. Meat quality was evaluated on a joint sample of the m. Longissimus thoracis, excised from the 5th to the 9th rib of each right half carcass 24 h post-mortem, after an ageing period of 10 d vacuum packaged at 4°C. Meat chemical analysis showed no variations in pH, DM, intramuscular fat and protein content due to the different silage inclusion in the diet. Only the cholesterol content was progressively reduced in the meat of bulls fed increasing quantities of corn silage according to a significant negative linear trend. Meat colour, cooking losses and shear force values were not affected by the diet. Therefore, based on these findings there are no substantial arguments against the use of a large amount of corn silage in the fattening diets of Charolais bulls.

Key-words: beef production, Charolais, corn silage, carcass traits, meat quality

INTRODUCTION

Corn silage (CS) appeared to be an interesting feedstuff for beef cattle because of the joint provision of starch and physical effective fiber (Cozzi et al., 2005) and its palatability (Atwood et al., 2001). Nowadays, the adequate management of corn plant at harvest and its proper ensiling allow stockmen to produce a home grown forage, which preserves good quality standards for long periods. The great field yield and the energy content of this roughage increased the number of cattle grown per unit of farm land (Abdelhadi et al., 2005). This justifies the great interest towards the use CS by beef production systems traditionally based on other forage sources, such as grass silage (Browne et al., 2005; Juniper et al., 2005) or hay (Comeford et al., 1992). Even the cost of feeding should benefit from a large inclusion of CS in the beef cattle diets due to a reduced need for other energy and fiber sources generally bought by the farmer from the feed market (Juniper et al., 2005). However, some aspects related to the large use of CS in beef cattle feeding still need some further discussion. One main concern regards the effects on meat quality and colour in particular, since diets rich in forages have shown detrimental effect on this important quality trait (Mandell et al., 1998). The aim of this study was to verify if the inclusion of increasing amounts of CS in diets fed to Charolais bulls have any effects on their carcass traits and meat quality.

MATERIAL AND METHODS

The research considered a sample of 6 beef cattle farms located in the Veneto region which finished Charolais bull imported from France.

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The farms were selected based on the percentage of the total dietary dry matter (DM) provided by the inclusion of CS in the ration fed during the fattening period. Two farms did not use any corn silage (CS0), while this roughage represented 22% of the dietary DM in the second group of 2 farms (CS22), and it raised up to 44% of the dietary DM in the last 2 farms (CS44). In order to describe the feed composition of the diets, five categories of ingredients were considered: corn silage, other forage sources, sugar beet pulps, cereal based concentrates and protein sources (Table 1).

Table 1. Average composition of the experimental diets by main feedstuff categories (% of total DM)

	Diet		
	CS0	CS22	CS44
Corn silage	0	22	44
Other forages	11	7	5
Sugar beet pulps	22	15	0
Cereal based concentrates	53	47	43
Protein sources	14	9	8

Five bulls were randomly selected from each farm by a cattle market expert and they were transferred to the same abattoir for the slaughter. Age and carcass weight data were collected along with the carcass fleshiness and fatness scores given by a trained inspector according to the European grading scheme (OFIVAL, 1984). Twenty-four hours after slaughtering, a joint sample of the m. *Longissimus thoracis* was excised from the 5th to the 9th rib of each right half carcass and vacuum packaged to be stored at 4°C for an ageing period of 8±2 days. After this period, meat pH and colour were measured on samples after exposure to air for 1 hour at 2°C (Boccard *et al.*, 1981). Colour was determined using a CR 100 Chromameter (Minolta Camera, Osaka, Japan) equipped with C illuminant, and colour data were expressed according to the Hunter-Lab system (Boccard et al., 1981). Cooking loss was calculated for a 2.5 cm thick steak by difference in weight before and after a period of 50 min at 75°C water bath. Five cylindrical meat cores 1.25 cm in diameter were then excised from the cooked steak for the instrumental measurement of tenderness using a Warner-Bratzler shear force meter. Uncooked meat samples were freeze-dried and ground to measure DM, crude protein, intramuscular fat and cholesterol content (AOAC, 1990). All data were submitted to GLM procedures of SAS (1990) and the statistical model considered the effects of diet (level of CS inclusion) and farm within diet. The significance of the diet effect was tested by using farm within diet as error term and its 2 degrees of freedom were used to test the significance of linear and quadratic trend for the level of CS inclusion. The minimum threshold for the statistical significance was $P<0.05$.

RESULTS AND DISCUSSION

The average composition of the 3 types of diets based on the main feedstuffs categories (Table 1) showed, as expected, that the inclusion of increasing amounts of CS allowed a progressive reduction of long fiber roughages and energy feedstuffs, either sugar beet pulps or starch sources. A decreasing trend was observed also the protein sources but this was only the consequence of the different choice among protein feedstuffs made by different farms. The slaughter age was similar for all the bulls (Table 2) but those fed the CS44 diet showed the lightest carcass weight. This result approves previous studies in which the administration of finishing diets for beef cattle with a high Forage:Concentrate ratio led to lower final carcass weights (Coombs et al., 1990; O'Sullivan et al., 2003). Based on the feed chemical composition data obtained from the literature (NRC, 2000; INRA, 1988) diets had a similar protein and NDF content and energy density (on DM basis: CP 13 to 14%, NDF 30 to 32%, Unitè Fouragère Viande 0.9 to 1.0 per kg DM).

Table 2. Carcass evaluation of Charolais bulls fed diets with increasing levels of corn silage

		Diet			Significance		SE
		CS0	CS22	CS44	Lin.	Quad.	
Age at slaughter	Months	20.4	19.7	19.7	ns	ns	2.7
Carcass weight	kg	436	446	396	*	ns	30
SEUROP	score†	4.1 ± 0.3	4.1 ± 0.3	4.0 ± 0.0			
Fatness	score‡	2.7 ± 0.5	2.7 ± 0.5	2.5 ± 0.5			

† 1 = poor to 6 = super; ‡ 1 = minimum to 5 = maximum; * P<0.05; ns = not significant

Browne et al. (2004) hypothesized that a negative effect of diets rich in CS on growth performance should be the consequence of a lower voluntary intake induced by the fermentation acid content of the roughage. However results on this topic have often appeared to be contradictory, as reported by Ferret et al. (1997). In this research, the different level of CS inclusion in the diet had no effect on carcass quality as shown by the similar scores given for fleshiness (SEUROP) and fatness by the trained inspector (Table 2). This result was consistent with those of Brennan et al. (1990) who found no differences on main carcass traits feeding diets ranging from low to high corn silage:corn grain ratios. Approving the previous results reported by Cozzi et al., (2005) feeding finishing Limousin bulls a diet in which CS provided 45% of the total DM, meat pH and the colour parameters were not affected by increasing inclusion of this roughage in the diet (Table 3). The ensiling process is likely to lower the carotenoid content of the fresh forage which has been demonstrated to be the key factor to deteriorate meat colour (Knight et al., 1998). Therefore, the previous evidences clearly demonstrate the inconsistency of the hypothesized negative effect of a large dietary inclusion of CS on cattle meat colour.

Table 3. Meat quality traits from Charolais bulls fed diets with increasing levels of corn silage

		Diet			Significance		SE
		CS0	CS22	CS44	Lin.	Quad.	
pH		5.51	5.58	5.57	ns	ns	0.07
Colour:							
Lightness	L	42	40	42	ns	ns	2.6
Redness	A	23	24	24	ns	ns	1.4
Yellowness	B	12	12	12	ns	ns	1.4
Cooking losses	%	28.8	29.8	28.9	ns	ns	3.2
Shear force	kg/cm^2	3.4	3.1	3.4	ns	ns	1.0

ns = not significant.

Consistent with the colour evaluation, meat cooking loss and tenderness (measured as shear force) were similar across dietary treatments (Table 3). Chemical analysis of meat samples showed no effects of CS inclusion on meat DM, intramuscular fat and protein content and these results were in agreement with other studies compared CS diets with various Forage : Concentrate ratios (De Campeneere et al., 2001).

Table 4. Chemical composition of meat from Charolais bulls fed diets with increasing levels of corn silage

		Diet			Significance		SE
		CS0	CS22	CS44	Lin.	Quad.	
Dry matter	%	26.4	26.5	27.3	ns	ns	0.9
Crude protein	% DM	84.7	86.3	89.1	ns	ns	2.6
Intramuscular fat	% DM	11.7	10.3	7.3	ns	ns	2.7
Cholesterol	mg/100g fresh weight	59.5	58.4	52.4	**	*	1.3

**P<0.01; * P<0.05; ns = not significant

Only the cholesterol content was progressively reduced according to a linear trend when CS increased in the diet. A similar result was obtained by Descalzo et al. (2004) comparing grain finishing diet with pasture.

CONCLUSION

Based on these findings, there are no substantial arguments against the use of a large amount of corn silage in the fattening diets of Charolais bulls. No detrimental effects on carcass traits and meat quality were observed even when CS represented 44% of the total DM fed during the finishing period. Therefore, the ultimate decision about the amount of CS included in the diet of beef cattle must be based only on the daily gain over feed cost ratio.

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