The use of corn silage in diets for beef cattle of different genotype

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ABSTRACT: The study was carried out in a sample of 406 commercial beef farms located in the Po Valley in which corn silage (CS) was included in the diet fed during the finishing period. Each farm was assigned to one class based on the cattle genotype and the results of this partition were the following: Charolaise (35%), Limousine (16%), French Crossbreds (35%) and Dual Purpose breeds (14%). Corn silage represented more than 33% of total dry matter of the diets of Charolaise, French Crossbreds and Dual Purpose cattle while its inclusion was significantly lower in the Limousine class (29.0% of total dietary dry matter). The decision about the amount of CS to be included in the diet has shown to be independent from the silage quality which, however, resulted satisfactory for all classes of cattle genotypes. The analysis of the chemical composition of the diets showed similar results for the four classes and therefore diet formulation seemed not to aim at the fulfilment of the real nutritive requirements of all the animals and of the Dual Purpose class ones in particular.

Key words: Corn silage, Beef cattle genotype, Nutrition, Finishing period.

INTRODUCTION – Beef cattle are reared in the Italian farms under intensive systems with animals kept in closed barns at a high stocking rate. Most of the cattle finished in our fattening units are imported from abroad, France in particular (80%), at an average live weight of 350 kg. The percentage of Italian local breeds is instead very low to represent almost a niche production. The diets for beef cattle are rich in concentrate feedstuffs and starch sources in particular, in order to promote the maximum daily gain. Therefore, most of Italian beef farms are located in the Po Valley where corn is the main grown crop. Corn silage (CS) is a typical ingredient of our beef cattle diets because of its high starch content and the quality of the fibrous portion (Allen *et al.*, 1996). When properly produced and stored, this roughage is easy to handle and it has shown a good palatability for cattle (Atwood *et al.*, 2001). Aim of the present study was to analyze the use of CS in diets fed to beef cattle of different genotypes during the fattening period.

MATERIAL AND METHODS - The study was carried out in a sample of 406 commercial beef farms located in the Po Valley. In all farms CS was included in the fattening diets. The period of data collection lasted from January to July 2005 and only CS harvested in the year 2004 were considered. Each fattening unit housed more than 40 animals with a live weight above 400 kg. The cattle population of the entire farm sample was 233,664 heads and the average number of cattle per farm was 575 ± 849 heads. Each farm was assigned to one of the following 4 classes according to the prevalent genotype: 1) Charolaise; 2) Limousine; 3) French Crossbreds and 4) Dual Purpose breeds. Farms was visited to collect information about the feeding regimen of the animals during the finishing period and representative samples of CS and total mixed ration (TMR) samples were collected for subsequent analysis. Corn silage and TMR samples were analysed for chemical composition and the silage samples were also analyzed for the main fermentative parameters. A physical analysis of the diet samples was carried out by using a mechanical siever equipped with four screens with hole sizes of 19, 13, 8 and 4 mm respectively and a bottom pan. All the experimental data were submitted to analysis of variance within the GLM procedure of SAS (1990). The statistical model considered the effect of the class of cattle genotype and $P<0.05$ was the minimum threshold of statistical significance.

RESULTS AND CONCLUSIONS – The partition of the cattle population according to the four classes of genotype showed the clear prevalence of animals imported from France belonging to French pure breeds (Charolaise

35% and Limousine 16%) or Crossbreds (35%). The Dual Purpose breeds class which included mainly Polish Friesians and Simmental cattle represented only 14% of the total population. Regardless of the genotype class, CS resulted the main ingredient in the composition of the TMR and its average amount of inclusion was 7.8 kg of fresh weight, but there was a wide variation among farms with a SD of 2.45 kg. However, a significant effect of cattle genotype on CS inclusion in diet was observed (Table 1).

Table 1. Total dry matter content of the diets and contribution of corn silage.

	Class of cattle genotype				RMSE
	Charolaise	Limousine	French Crossbreds	Dual Purpose	
Diet dry matter (kg)	8.8^{A}	8.4^{AB}	8.3^{B}	7.5^{C}	1.5
Corn silage:					
kg fresh weight	8.3^{A}	6.8^{B}	8.0^{AB}	7.5^{B}	2.4
% of diet total DM	33.7^{A}	29.0^{B}	34.6^{A}	35.1^{A}	11.3

A,B,C: P<0.05.

Charolaise received the highest amount, Limousine and Dual Purpose the lowest and the French Crossbreds being intermediate. Corn silage represented more than 33% of total TMR dry matter (DM)in the diets of Charolaise, French Crossbreds and Dual Purpose cattle. In the Limousine diets the CS percentage was significantly lower (29.0%) but its DM was not replaced neither by other starch sources nor by fibrous roughages. As regards the forage portion of the TMR, CS was the sole roughage included in the diet only in 2.5% of the dietary samples, while in the most part of them there was an average inclusion of 0.7 kg of long fiber roughages (straw or hay) without any significant effect of class cattle genotype. The decision about the amount of CS to be included in the TMR has shown to be independent from the silage quality since there were no differences across genotype classes for the main chemical constituent and fermentative parameters of the roughage (Table 2). On average the quality of silage samples was satisfactory as indicated by the DM and starch content and by the appropriate fermentative profile with a predominant lactic acid concentration and a modest content of ammonia nitrogen. It is particularly interesting to notice that no statistical differences were observed across the 4 cattle genotype classes for the main chemical components of the TMR (Table 3). This result disagrees with the nutrient requirements for beef cattle available in the literature (INRA, 1988; NRC, 2001) where clear differences among genotypes are reported at least for protein and energy. The lack of any distinction in the feeding management of the different classes has obvious consequences on cattle feeding behaviour. One clear example was the case of the Dual Purpose group which, according to INRA (1988), should be the class gathering cattle breeds with the highest voluntary intake and the lowest energy and protein requirements. If animals of this class are fed a diet exceeding their requirements, like the one reported in Table 3, their feed consumption should be limited by the early stimulation of the satiety centre (Van Soest, 1992) and therefore their total DM intake should be below the expected.

Table 2. Chemical composition and fermentative parameters of corn silage.

	Class of cattle genotype				RMSE
	Charolaise	Limousine	French Crossbreds	Dual Purpose	
Dry matter (%)	35.2	35.2	34.8	34.6	3.8
Crude protein (%DM)	7.6	7.6	7.6	7.6	0.5
Ash (% DM)	4.1	4.1	4.1	4.1	0.4
NDF (% DM)	44.2	43.8	44.2	44.4	2.6
Starch (% DM)	31.1	31.0	31.0	30.7	2.8
pH	3.83^{A}	3.76^{B}	3.83^{A}	3.81^{A}	0.13
Lactic acid (% DM)	4.7	5.3	4.8	5.0	1.2
Acetic acid (% DM)	2.5	2.4	2.5	2.6	0.8
N-NH3 (% of total N)	6.7	6.8	6.7	6.9	1.1

A,B: P<0.05.

This hypothesis is supported by the data of the total DM of the diet reported in Table 1, which may be considered an indirect measure of cattle feed intake. The adoption of a feeding plan which does not take into account the requirements of the different cattle genotypes is likely to impair cattle welfare and the full expression of their growth potential. This type of management strategy should negatively affect farmer profits as well. Consistent with the chemical composition, particle size distribution of the TMR samples did not change according to the different classes of cattle genotype (Table 3). To ensure a satisfactory rumination activity, Sauvant *et al.* (1999) advises that particles longer than 2 mm should represent at least 40% of the total particles of beef cattle diets. Our mechanical siever was not equipped with a 2 mm hole size screen, however less than 12% of the total TMR population had more than 60% of particles which passed through the 4mm screen to were accumulated in the bottom pan.

Table 3. Chemical composition (% DM) and physical properties of the diets.

	Class of cattle genotype				RMSE
	Charolaise	Limousine	French Crossbreds	Dual Purpose	
Chemical composition:					
Dry matter (%)	55.3	57.9	54.9	54.1	7.9
Crude protein (% DM)	13.0	13.0	12.6	12.9	1.1
Ash (% DM)	5.4	5.5	5.4	5.2	0.7
EE (% DM)	3.4	3.4	3.4	3.2	0.7
NDF (% DM)	31.6	31.3	31.9	32.0	3.5
Starch (% DM)	32.2	31.8	32.0	32.1	2.9
Particles distribution (%)					
Particles >19mm	3.5	3.8	3.8	4.0	2.9
Particles >13mm	6.2	5.7	6.2	5.3	3.2
Particles > 8mm	19.5	19.0	20.4	20.3	7.4
Particles > 4mm	22.9	20.9	23.1	23.0	6.9
Bottom pan	48.9	50.6	46.5	47.4	10.5

In conclusion, CS has shown to be an important constituent of beef cattle diets fed during the finishing period in Italian fattening units and the large use of this roughage arises from its good quality. The inclusion of the CS varies according with the class of cattle genotypes but this variation does not reflect the different voluntary intake. One negative outcome of the study was that diet chemical composition has shown to be similar among the different classes of cattle genotypes and therefore it did not aim at the fulfilment of the real nutritive requirements of the animals.

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