

Influence of ethnic group, feeding plan and ageing on colour, water holding capacity and Warner-Bratzler shear of veal calves

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Abstract

Thirty-two male calves, 16 Friesian (F) and 16 Crossbred (C), were fed on milk replacer and maize silage; in addition they received 65 kg/calf (T1; 8F+8C) or 100 kg/calf (T2; 8F+8C) of maize grain. The average age and weight of the animals at slaughter were 6 months and 276 kg. Four samples of *longissimus thoracis et lumborum* from each animal were aged 5, 7, 8, 10 days (d5, d7, d8, d10), and analysed for colour (L*, a*, b*), drip and cooking losses and Warner-Bratzler shear (WBs). Data were analysed by ANOVA, considering ethnic group, feeding plan and ageing as factors. The ethnic group affected drip losses (F: 3.62%; C: 3.08%) and WBs (F: 37.67 N; C: 29.53 N), while the feeding plan affected only drip losses (T1: 3.09%; T2: 2.61%). A significant interaction was observed between ethnic group and feeding plan for L* and a*: FT1 group had L* lower than FT2 (54.58 vs 57.01; P<0.01), while Crossbred showed the contrary (56.66 vs 54.71). The lowest redness was observed in FT2 group (17.32; P<0.01). Ageing significantly increased drip (d5: 2.25%; d10: 3.40%) and cooking losses (d5: 16.96%; d10: 18.20%) and decreased WBs (d5: 39.73 N; d10: 30.02 N).

Introduction

Veal calves production is a very important sector of animal husbandry. In Italy veal calves represent about 13% of the total production and the annual per capita consumption is 4 kg, which represents about the 20% of total beef intake (Cozzi, 2007).

Traditionally, veal is highly appreciated by the consumer for its pale colour and tenderness, as a result of the liquid diet, based on low-iron milk replacers, and the early age at slaughtering. The absence of solid feed, in the traditional feeding system, has a negative effect on animal welfare because it limits the physiological development of the forestomachs and calves cannot express their natural condition of ruminants. In order to improve animal welfare, the directive 97/2/EC (UE Council, 1997) stated that calves must be provided with a minimum daily amount of fibrous feed. Since solid feed supplementation with cereal or roughage could affect meat quality, the main goal in the veal calf production chain is now to improve veal calf welfare, at the same time producing a meat quality in conformity with market demands.

The aim of this study was to evaluate the effects of ethnic group, feeding plan and ageing on physical characteristics of veal.

Materials and methods

Thirty-two male calves, 16 Friesian (F) and 16 Crossbred (C) of unknown genealogy, were used in the study. The calves, reared in the same farm, were housed in eight collective pens of four calves each, with 1.8 m²/calf of space allowance, and assigned to two feeding plans (T1 group: 8F+8C; T2 group: 8F+8C). All the calves were fed with commercial milk replacers based on sprayed skimmed milk powder (350 kg/calf) and maize silage (50 kg/calf), according to a standard feeding program. In addition, calves of T1 group and T2 group received an individual amount of 65 kg and 100 kg of maize grain, respectively. The average starting age was 19 days and the length of the trial was 178 days.

After slaughtering, four samples of *longissimus thoracis et lumborum* (8th T.V.- 1st L.V.) were taken from each animal, weighed, vacuum packaged and aged at 3°C for 5, 7, 8, 10 days (d5, d7, d8, d10).

After each ageing period, the samples were weighed again to determine drip losses (DL) according to Lundström & Malmfors (1985), then sliced into steaks 4 cm thick and analysed for colour, cooking losses (CL) and Warner-Bratzler shear force (WBs). Lightness (L*), redness (a*) and yellowness (b*) colour parameters (CIE, 1976) were measured with a Minolta CR 331 C Colorimeter, using C illuminant (Boccard *et al.*, 1981). Cooking losses were determined on steaks sealed in a polyethylene bag, cooked in a water bath until an internal temperature of 70°C (Barton-Gade *et al.*, 1994). Shear force (N) was measured on cylindrical cores 1.25 cm in diameter removed parallel to the longitudinal orientation of muscle fibers and obtained from the steaks previously employed for cooking losses. A Warner-Bratzler shear device attached to the INSTRON 5543 was used, with a crosshead speed set at 200 mm/min (AMSA, 1995).

Data were analysed by ANOVA (SPSS, 1997), considering ethnic group, feeding plan and ageing as factors.

Results and discussion

The results of the colour parameters are reported in Table 1 and 2. A significant interaction was observed between ethnic group and feeding plan for lightness and redness. In fact Friesian calves fed on T1 diet had lower L* than Friesian fed on T2 diet (54.58 vs 57.01; $P<0.01$), while Crossbred showed the contrary (56.66 vs 54.71; $P<0.01$). FT2 group showed the lowest redness value (17.32; $P<0.01$). Therefore FT1 and CT2 groups produced meat darker and redder than FT2 and CT1 groups. In a previous work on the same animals, Dal Molin *et al.* (2006) found that FT1 and CT2 groups had a higher haem iron content, which could explain the present results.

Table 1. Effect of ethnic group and feeding plan on veal colour

	Lightness, L*			Redness, a*			Yellowness, b*		
	F	C	mean	F	C	mean	F	C	mean
Feeding plan T1	54.58 ^A	56.66 ^B	55.62	19.13 ^B	18.45 ^B	18.79	8.04	7.90	7.97
Feeding plan T2	57.01 ^B	54.71 ^A	55.86	17.32 ^A	18.95 ^B	18.14	7.49	7.82	7.65
Mean	55.80	55.69		18.23	18.70		7.76	7.86	

Means with different letters differ significantly ($P<0.01$)

Table 2. Effect of ageing on veal colour

	Ageing (d)			
	5	7	8	10
Lightness, L*	55.52	55.37	56.04	56.03
Redness, a*	18.25	18.47	18.46	18.68
Yellowness, b*	7.46	7.89	7.83	8.06

The results for drip and cooking losses and Warner-Bratzler shear are reported in Table 3. All the considered factors affected drip losses. Friesian had higher drip losses in comparison with Crossbred (3.62% vs 3.08%; $P<0.05$) and a higher amount of maize grain in the diet (T2) reduced drip losses (2.61% vs 3.09%; $P<0.05$).

Ageing induced an increase of the drip losses, with significant differences for d5 (2.25%) in comparison with d8 (3.12%) and d10 (3.40%) and between d7 (2.65%) and d10. The drip losses increase was about 39% between d5 and d8 and 9% between d8 and d10.

Cooking losses were not influenced by the maize grain supplementation as already reported by Xiccato *et al.* (2002). Ageing induced an increase in cooking losses at d10 in comparison with d5 and d7 (18.20% vs 16.96% and 16.68%; $P<0.05$).

Both ethnic group and ageing affected shear force. In fact the mean value of Friesian was higher than that of Crossbred (37.67 vs 29.53 N; $P<0.05$). As regards ageing, WBs resulted lower at d8 and d10 in comparison with d5 (30.71 and 30.02 N vs 39.73 N; $P<0.05$). In particular the decrease was about 23% between d5 and d8 and only 2% between d8 and d10. On the contrary and in agreement with Xiccato *et al.* (2002), maize grain supplementation did not affect shear force.

Table 3. Effect of ethnic group, feeding plan and ageing on water holding capacity and shear force

	Ethnic group			Feeding plan		Ageing (d)		
	F	C	T1	T2	5	7	8	10
Drip losses, (%)	3.62 ^b	3.08 ^a	3.09 ^b	2.61 ^a	2.25 ^a	2.65 ^{ab}	3.12 ^{bc}	3.40 ^c
Cooking losses, (%)	17.51	17.05	17.26	17.34	16.96 ^a	16.68 ^a	17.36 ^{ab}	18.20 ^b
Warner-Bratzler, (N)	37.67 ^b	29.53 ^a	31.88	35.32	39.73 ^b	34.04 ^{ab}	30.71 ^a	30.02 ^a

Means with different letters differ significantly ($P<0.05$)

Conclusions

The results obtained in this study showed that all the considered factors influenced the physical characteristics of veal in different ways.

As regards colour, the importance of the feeding plan choice in relation to the ethnic group must be stressed. In fact a higher amount of maize grain in the diet allowed Friesian to produce, lighter and less red veal, and so paler, while the same amount of maize grain worsened the lightness of the Crossbred.

Crossbred provided more tender meat and lower drip losses. A higher amount of maize grain in the diet (T2) was advantageous because of reduced drip losses.

Finally, ageing until day 8 worsened water holding capacity, but improved tenderness.

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