DIET AND AGEING EFFECT ON INSTRUMENTAL AND SENSORY CHARACTERISTICS OF MEAT FROM PODOLIAN YOUNG BULLS

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Background

Meat quality largely depends on organoleptic properties such as colour, texture, flavour and juiciness which are related to production (breed, age, sex, diet) and technological (refrigereration or ageing time) factors.
Some studies (Bidner et al. 1985; Fortin et al. 1985; O'Sullivan et al. 2003) found no effect of different forage to concentrate ratio supplementations on meat quality. Ageing produces changes in meat characteristics (Zamora et al., 1996, Ruiz de Huidobro et al. 2003), influencing the final perception of the product. Tenderness has been considered the most important meat quality characteristic for consumers (Risvick 1994). It is well known that throughout ageing muscles undergo a series of physical and biochemical changes which are responsible of their conversion to meat. Particularly these modifications concern the Z-disk weakening and the myofibrilis degradation which are highly related to meat tenderness (Koohmaraie, 1994). Both instrumental and sensorial trials have been commonly used for assessing it.

Objectives

The present study aims to assess the effect of different ageing periods and diet supplementation on physicochemical and sensory properties of meat from Podolian young bulls. Such information is at present deficient in literature and has the potential to improve meat quality, primarily tenderness, and so to satisfy consumer desires.

Materials and methods

Experimental design

The experimental animals were twenty organically farmed Podolian young bulls, reared at pasture and divided into two groups of 10 each according to hay to concentrate ratio. In the high concentrate (HC) group the forage to concentrate ratio was 60 to 40 while in the low concentrate (LC) group was 70 to 30. The dry matter chemical composition of supplementation was determined by standard procedures (AOAC, 1990). On average, oats hay used as forage contained 6-7% crude protein, 27-34 % crude fibre, 62-63% NDF, and 0.5 MFU/kg, while the d.m. chemical composition of durum wheat flour shorts as concentrate was 17% crude protein, 7% crude fibre, 27% NDF and 0.95 MFU/kg. Animals were slaughtered at 16-18 months of age. Mean slaughter weight was 378±14.8 kg. The carcasses were assessed for conformation and fatness according to the SEUROP-system (UE n.1208/1981 and UE n.1026/1991). Dressed carcasses were weighed and split into two sides within 1 h *post mortem*, chilled for 48 h at 1-3°C. Dressing percentage (DP) was calculated as carcass weight to slaughter weight ratio x 100. After 48 h post mortem, each side was divided in hind and fore quarters and each quarter was dissected into different anatomical regions. The pH was measured at 1 and 24 h *post mortem* on *Longissimus dorsi* (LD), using a portable pH-meter (Hanna, HI 9025) and a combined glass electrode. The LD muscle was removed from the left and right carcass side and aged in vacuum-packaging at 4°C until 15 and 21 days *post mortem* respectively.

Meat quality

Colour parameters (lightness-L*, redness-a* and yellowness-b*) were measured according to the CIE system (CIE, 1986) using a Minolta Chromameter CR 200. Chroma (C) and hue-angle (H) were calculated according to Liu et al. (1996).
Two 1 cm wide cores were removed from each muscle parallel to the muscle fibre and placed as raw samples in the Warner-Bratzler Shear attachment, which was attached to the model 1140 Instron texture machine. The sensory analysis (flavour and tenderness) was performed by a trained eight-member panel on steaks grilled to an internal temperatue of 75°C. The values were normalised standardising each assessor by his standard deviation according to Cifuni et al., (2004).

Data were subjected to an analysis of variance, using the GLM procedure of the SAS statistical software (1999). Individual animal variation within different supplementation and muscle was used as the error term. When significant effects were found the Student t-test was used to locate significant differences between means.

Results and discussion

Podolian young bulls produced carcass of 198±9.55 kg with an average carcass yield of 52.4±0.78%. Carcass conformation of both groups was classified as good, R according to the SEUROP system, while fattening condition received a score of 2+ and 2- for the HC and the LC groups, respectively.There was a significant decrease in pH during the 24 hours post mortem. Values vary from 6.5±0.07 at 1 hours post mortem to 5.5±0.06 at 24 hours. Meat with high ultimate pH values (dark-cutting or Dark, Firm, Dry-DFD) is a persistent quality defect that shortens shelf life, especially for vacuum-packaged meat and affects meat colour, texture and water holding properties (Gill & Newton, 1981). No DFD carcasses were identified in this study and, in general, the rate of pH fall was similar for all animals.
Table 1 shows colour parameters evolution in *Longissimus dorsi* of Podolian meat as affected by ageing and different supplementation. Colour parameters were unaffected by different supplementation. Lightness (L*) was not affected by ageing while red index and chroma (color saturation) decreased as ageing time increased and yellow index and hue angle (proportions of redness and yellowness) were found higher ($P < 0.001$) at 21 days post mortem. Meat colour changed during ageing period. The colour of the muscle surface is determined mainly by both the amount and the redox state of myoglobin (Fox, 1987). In the present trial, we found that red index decreased during ageing, in agreement with the results obtained by Feldhusen et al. (1995) that found no obvious connections between oxygenation and measurements of red index. These authors claimed that higher percentages of oxymyoglobin did not lead to an increase in a* in the muscle surface of the meat that has been ripening for time periods longer than 5 days.
In Figure 1 tenderness parameters of meat from Podolian young bulls are reported. Warner-Bratzler shear force (WBS) was affected by ageing and different supplementation. After 21 days meat from HC group was significantly more tender ($P < 0.001$) than after 15 days. Meat from the HC group showed, after 15 days, higher WBS values than LC ($P < 0.01$). Extending ageing period produced an improving in tenderness, intended as sensory attribute, in both group. Tenderness was scored significantly higher ($P< 0.05$) in the LC group than HC after 15 days of ageing.

Both instrumental and sensorial analyses gave the same results: 1) the meat from LC group was more tender than that from the HC group after 15 days of ageing; 2) during the ageing period the meat became more tender even if only in the HC group the increase in tenderness was significant. Comparison between sensory and objective measures of meat tenderness in previous researches gave very variable results. Some authors have found a good correlation (e.g. Touraille, 1982) whereas others found very poor coefficients (e.g. Shackelford et al. 1995). We found a positive relation between WBS and sensorial tenderness using raw meat. Indeed, shear force on raw meat reflects the background of collagen toughness, collagen being the main component of muscle connective tissue and the major determinant of the texture of meat, whereas shear force on cooked meat may be considered a measure of myofibrillar toughness (De Smet et al. 1998). Our WBS values are in agreement with values found by Torrescano et al.(2003) in raw samples of 14 bovine muscles. Forage finishing of beef has produced mixed results on tenderness and palatability attributes. Our findings showed that major forage fed animals produced a more tender meat than major concentrate fed animals after 15 days of ageing along with French et al.(2001), who found that supplementing grass with low levels of concentrates produced the most tender and acceptable meat two days post mortem, and in disagreement with Mitchell et al. (1991), who reported a negative effect of forage finishing on meat tenderness. After 21 days the different forage to concentrate ratio didn't affect meat tenderness.

Figure 2 shows flavour evolution of Podolian meat as affected by ageing and different supplementation.

The flavour was unaffected by different supplementation and ageing time. In both experimental group the ageing time improved flavour and HC and LC groups showed very similar values at 15 and 21 days of ageing. Flavour intensity increased with ageing time. This result is due to post-mortem processes such as proteolysis and lipolysis which result in the development of flavour precours. We found no effect of different forage to concentrate ratio supplementation of meat flavour. Muir et al. (1998) claimed that the differences in flavour and acceptability due to feed accounted for differences in carcass fatness.

Conclusions

The results of this study showed that a longer ageing time improved the tenderness of meat as determined through an instrumental and sensorial approach. A higher forage to concentrate ratio can improve tenderness but a longer ageing eliminates all diet effects on eating quality of beef. A longer ageing time didn't affect the colour parameters regarded by consumers as appreciating features.
We can conclude that ageing time is one of the main technological factors affecting beef quality and that the choice of a proper ageing time is critical for optimising the organoleptic properties of meat.

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Table 1 Colour characteristics of Podolian meat as affected by ageing (days) and different supplementations during the finishing period (means ± SE).

		Ageing					P		
	diet	**15 d**		**21 d**		**SEM**	**days**	**diet**	**days x diet**
L*	HC	35.06		35.88		0.67	NS	NS	NS
	LC	36.22		35.90					
a*	HC	19.81	a	13.74	b	0.55	***	NS	NS
	LC	18.94	a	13.86	b				
b*	HC	4.25	b	5.58	a	0.29	***	NS	NS
	LC	4.04	b	5.07	a				
C	HC	20.29	a	14.82	b	0.54	***	NS	NS
	LC	19.37	a	14.78	b				
H	HC	12.24	b	22.24	a	1.06	***	NS	NS
	LC	11.96	b	20.20	a				

NS = not significant; ***=P<0.001. Means followed by different letters differ significantly at P < 0.05.

Fig.1 Tenderness parameters (WBS and tenderness as sensory attribute) of Podolian meat as affected by ageing (days) and different supplementations (means ± SE).

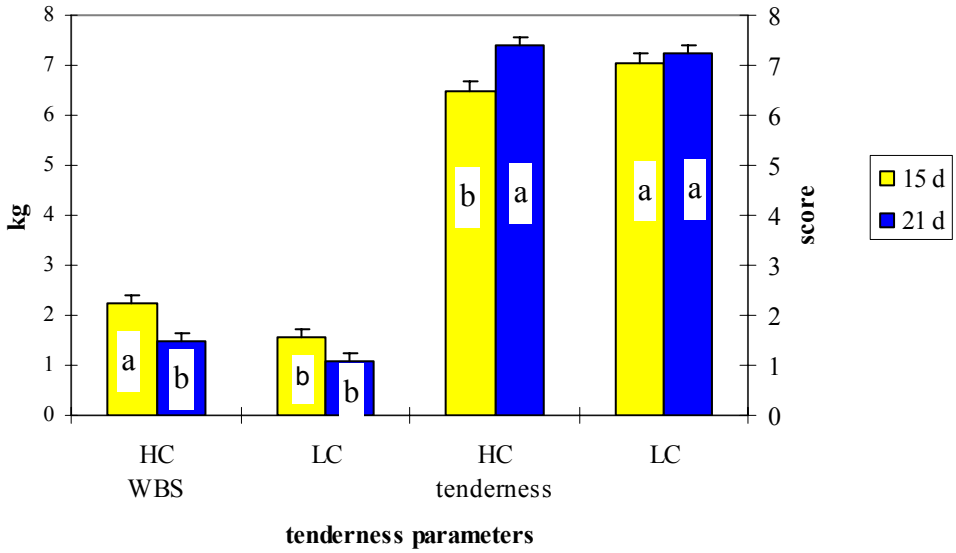

Fig. 2 Flavour of Podolian meat as affected by ageing (days) and different supplementations (means ± SE).