EFFECT OF BREED, CASTRATION AND FINISHING PERIOD ON THE SENSORY QUALITY OF BEEF FROM EXTENSIVE SYSTEMS

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Background

Climate conditions and forage resources of Northern Spain provide the opportunity to produce beef from extensive systems. Traditionaly, forage-fed beef has been discriminated against due to the darker colour and the higher toughness of meat. However, in many experiments comparing grass and grain finishing of cattle the dietary effects are confounded by differences in animal age or carcass weight at slaughter. Some authors have reported forage-fed beef to be similar in sensory traits than grain-fed beef (Schaake et al., 1993; Simonne et al., 1996; Sapp et al., 1999) or have described minor differences between beef produced at pasture or finished for up to 100 days on a feedlot (Muir et al. 1998). Also, there is evidence that eating quality may be influenced by intrinsic characteristics related to genotype (Monin, 1991; Campo et al. 1999) and that castration affects to physico-chemical and sensory traits of meat (Field 1971, Arthaud et al. 1977, Steen 1995, Osoro et al. 2001, Oliván et al. 2001a).

Objective

The purpose of the present work was to determine the effect of breed, castration and finishing period on the sensory quality of beef from extensive system.

Material and Methods

Sixty four animals of two local bovine breeds (Asturiana de los Valles "AV" and Asturiana de la Montaña "AM") were reared under extensive conditions on ryegrass and clover pastures Half of the animals were bulls and half were steers (castrated at 10 months of age). All the animals were slaughtered around 500 kg live weight. Animals received three different finishing treatments: 16 animals were slaughtered directly from pasture (FIN1), 16 animals were fed with concentrate during 70 days before slaughtering (FIN2) and 32 animals received concentrate during 100 days (FIN3).

At 24 h *post mortem* the pH was measured on the *longissimus* muscle of the left carcass and the loin from the 6th to the 11th ribs was extracted and transported to the laboratory. The muscle was sliced and kept at 4ºC for 7 days ageing. Meat colour was measured by a colorimeter Minolta CR 200 in the CIE L* a* b* space. Water holding capacity (WHC) was measured as juice exudation using the modified Grau and Hamm method as described by Sierra (1973). The instrumental evaluation of texture (maximum load "WB" and toughness) was conducted in an Instron equipment with a Warner-Bratzler shearing device. Sensory analysis was performed by an eight member trained panel on steaks cooked to an internal temperature of 70ºC. On a 100 mm scale, panellist assessed a profile composed of overall and fat odour intensity, overall flavour, hardiness, juiciness and chewiness. Consumer acceptance was analysed by a panel composed by 100 subjects (44 males, 56 females, age range 18-60 years) which evaluated tenderness and overall acceptability using a nine point hedonic scale.

Analysis of variance was performed to study the effect of breed, castration (bull or steer), finishing period (0, 70 or 100 days) and their interactions, using the GLM procedure of SAS (1998). A principal component analysis was performed to understand the relationship between variables.

Results and Discussion

There was a significant effect of breed on colour, WHC and texture traits. Meat from AV breed had significanlty higher values of lightness (L*: 40.6 *vs* 38.4), redness (a*: 22.5 *vs* 20.6) and juice exudation (WHC: 23.5 *vs* 21.5, $p<0.001$) than AM breed. Also, AV meat was tougher (higher toughness, hardiness and chewiness) and received lower evaluation of tenderness and acceptability by consumers.

Castration showed a significant effect on colour, fat odour, flavour and texture traits. Steer meat was lighter and had lower toughness (1.99 *vs* 2.66, $p<0.001$). Also, meat from steers presented higher fat odour and flavour, due to the increase of intramuscular fat produced by castration (Osoro et al. 2001, Oliván et al. 2001 a,b).

Finishig period had significant effect on meat colour, being significantly darker meat from pasture fed (L*=35.0) than meat from concentrate fed animals (L*=41.0, no differences between 70 or 100 days feeding). Concentrate feeding also affected to pH, which was significantly lower when animals received concentrate (pH=5.4, no differences between 70 or 100 days) than when slaughtered directly from pasture (pH=5.6), and to WHC, having significantly higher juice exudation meat from pasture (23.61%).

The principal component analysis showed that juiciness, tenderness and acceptability were positively correlated. The first component contrasted toughness, hardiness, chewiness. pH and juice exudation (the meat of bulls, AV breed and pasture feeding were found in this zone) with overall odour, fat odour, overall flavour, juiciness, tenderness and acceptability (steers, AM breed and concentrated finishing were in this zone). The second component related meat of animals receiving concentrate (FIN2 and FIN3) with higher values of lightness (L*), redness (a*) and yelowness (b*).

The was a significant interaction breed x castration ($p<0.05$) on lightness and breed x finishing period ($p<0.05$) on WHC. The breed x castration x finishing period interaction had a significant effect ($p<0.05$) on juiciness.

Conclusions

The effect of breed and castration on the beef characteristics was higher than the effect of finishing period. Finishing period affected mainly to colour variables (L*, a*, b*), but the increase of concentrate feeding period from 70 to 100 days did not produce a significant improvement of meat quality. Consumer acceptability was positively related with juiciness and tenderness and negatively related with juice exudation and toughness.

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Table 1. Effect of breed (B), castration (C) and concentrate finishing period (FIN) on the sensory traits of beef.

Breed	AV						AM						Significance		
Castration	Bull			Steer			Bull			Steer			B	C	FIN
Finishing	FIN1	FIN2	FIN3	FIN1	FIN2	FIN3	FIN1	FIN2	FIN3	FIN1	FIN2	FIN3			
n	4	4	8	4	4	8	4	4	8	4	4	8			
L	35.8	42.5	41.9	37.0	40.8	42.3	31.9	39.3	38.8	35.3	41.6	40.8	***	*	***
a	18.31	22.06	22.97	20.76	23.72	24.80	19.61	21.50	19.33	19.94	21.24	22.09	*	*	**
b	4.15	10.33	10.37	5.13	10.58	11.21	4.61	9.82	9.06	4.23	10.27	10.18	NS	NS	***
pH	5.70	5.38	5.39	5.58	5.37	5.34	5.51	5.40	5.47	5.57	5.40	5.42	NS	NS	***
WHC	23.92	23.53	23.81	25.67	21.48	22.90	21.57	19.82	20.80	23.30	20.85	22.57	***	NS	*
WB	5.97	6.11	5.77	4.81	4.11	4.69	5.31	4.38	4.98	3.82	3.80	4.06	***	***	NS
Toughness	2.93	3.04	2.74	2.36	1.77	2.26	2.75	2.17	2.48	2.02	1.70	1.79	**	***	NS
Odour	4.14	4.21	4.14	4.51	4.32	4.36	4.48	4.03	4.30	4.78	4.12	4.12	NS	NS	NS
Fat odour	0.62	0.49	0.59	1.37	0.83	0.62	0.74	0.61	0.88	1.05	0.85	0.87	NS	*	NS
Flavour	3.44	3.53	4.02	4.70	4.95	4.21	4.08	3.88	4.14	4.88	4.67	4.76	NS	***	NS
Hardiness	4.58	4.01	4.09	2.83	2.30	2.64	3.63	2.65	3.87	2.28	1.93	2.30	**	***	NS
Juiciness	2.31	1.88	2.69	3.34	3.58	2.93	3.09	3.33	2.66	3.17	3.53	3.72	*	**	NS
Chewiness	5.20	4.15	4.54	3.78	3.13	3.46	3.98	3.17	4.29	3.24	2.94	3.16	**	***	**
Tenderness	4.59	4.78	4.58	5.23	6.33	5.94	5.58	5.93	5.56	6.00	6.55	6.60	***	***	NS
Acceptab.	4.91	5.23	4.89	5.53	6.43	5.98	5.55	5.90	5.56	6.08	6.25	6.26	*	***	NS

Figure 1: PCA plot of variables and beef treatments.