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Sensory evaluation of several European cattle breeds

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SUMMARY – The present study is part of an EU project. In this paper we examine 211 young bulls from 11 different breeds representing the genetic diversity of European cattle. The objective was to determine the influence of breed (meat with 10 days ageing) on sensory characteristics of beef meat. All animals were fed *ad libitum* with a standard diet comprising barley, soya and chopped straw. Slaughter was about 15 ± 1 months of age. Meat was assessed by a Spanish trained taste panel. Results showed that breed was significant on the studied descriptors. Pirenaica animals (5.62) had the most tender meat and Simmental (4.38), Marchigiana (4.29) and Casina (3.94) the toughest. Limousin (5.30), Charolaise (5.24), Pirenaica (5.12) and Asturiana de los Valles (5.06) showed high scores in juiciness. The breeds with the highest flavour intensity were Asturiana de los Valles (5.40) and Pirenaica (5.38). The lowest score was for Simmental for both flavour (4.85) and juiciness (4.14).

Key words: Beef, meat quality, tenderness, juiciness, flavour.

RESUME – *"Evaluation sensorielle de plusieurs races bovines européennes". Ce travail s'inscrit dans le cadre d'un projet européen qui porte sur la Génétique de la Qualité de la Viande. Dans cet article, nous avons étudié 211 taurillons issus de 11 races bovines représentant la diversité génétique des bovins en Europe. L'objectif était d'étudier l'effet de la race sur la qualité sensorielle de la viande après 10 jours de maturation. Les animaux ont été alimentés à volonté avec un régime à base d'orge et de tourteau de soja et avec de la paille hachée. Les animaux ont été abattus à l'âge de 15 mois. Les animaux de race Pirenaica ont produit la viande la plus tendre (5,62) alors que la viande la plus dure a été produite par les animaux de race Simmental (4,38), Marchigiana (4,29) et Casina (3,94). La jutosité la plus élevée a été observée pour la viande issue des races Limousine (5,30), Charolaise (5,24), Pirenaica (5,12) et Asturiana de los Valles (5,06). Les races qui ont produit la viande avec la flaveur la plus intense étaient l'Asturiana de los Valles (5,40) et la Pirenaica (5,38). La flaveur (4,85) et la jutosité (4,14) étaient les plus faibles pour la viande de la race Simmental.*

Mots-clés : *Viande bovine, qualité de la viande, tendreté, jutosité, flaveur.*

Introduction

Improving animal performance, carcass characteristics and meat quality traits are the main objectives of most of the research carried out in the beef production area. Satisfying the consumer's requirement for a consistent satisfactory product is the major target of beef producers and retailers. Meat quality is an important criterion that influences the decision of a consumer to purchase beef. Many investigators studied the relation among different production factors (feeding plan, age, breed, etc.) and the sensory attributes (tenderness, juiciness, flavour, texture, colour).

Selective breeding in cattle has been very successfull in increasing production factors such as daily gain and feed efficiency. Until now there is limited information and subsequent little knowledge to allow selection programs to be designed to improve product quality. Identification of the genes involved in aspects of carcass and meat quality will provide the basic information to devise breeding programs that enhance quality.

The present study is part of an EU-project which examines young bulls from different breeds (both dairy and beef) that represent the genetic diversity of European cattle. The final objective of the project is to try to correlate genetics traits with meat quality traits. The aim of this paper was limited to the study of the influence of breed on the sensory characteristics of beef after 10 days ageing.

Material and methods

Two hundred and eleven young entire males from 11 different European cattle breeds were used: Asturiana de los Valles, Casina, Avileña-Negra Ibérica and Pirenaica from Spain; Charolais and Limousin from France; Holstein, Danish Red Cattle and Simmental from Denmark and Marchigiana and Piemontese from Italy. All animals were fed *ad libitum* with standardised diet comprising high barley (about 80%), soya (9%) and chopped straw (10%) with minerals and vitamins. Energy density was approximately of 12.5 kJ/kg dry matter.

All the welfare regulations were taken into account when handling the animals. Bulls were slaughtered in each country at the nearest EU licensed abattoir from the farm, to minimise the effect of the transport stress on meat quality. Slaughter was about 15 ± 1 months of age. Stunning was made by captive bolt pistol. Carcasses were chilled at 4°C for 24 hours. After this time the *Longissimus thoracis* muscle (between 8^{th} and 13^{th} ribs) was removed from the left side of carcass and stored at 3°C ± 1°C for a further 24 h. This section was aged for 10 days, sliced in two-centimetre thick steaks, vacuum packaged and frozen at -18°C.

Prior to sensory analysis meat was thawed, in their vacuum bags, in tap water for 4 hours until reaching an internal temperature of 17-19°C. Meat was cooked on a pre-heated double hot-plate grill at 200°C, inside aluminium paper, until it reached 70°C of internal temperature. Then, they were cut in small portions (free of visible connective tissue), wrapped in coded aluminium paper and stored warm (50°C) until tasted.

Samples one by one were served to a Spanish trained nine-member sensory panel in individual booths under red lighting to mask differences in meat colour. Panellist rated the samples on an eight-point category scale for tenderness (defined as the opposite of the force required to bite through the sample with the molars), juiciness (amount of moisture released by the sample after the first two chews) and flavour intensity (flavour associated with the species).

Statistical analysis was performed using SPSS 13.0 software. A GLM procedure was carried out. Means were compared using the Tukey test.

Results and discussion

Global results are shown in Table 1. Significant effects were observed in all measured attributes: tenderness, juiciness and flavour.

Of all meat texture attributes, tenderness has been considered the most important meat quality characteristic for consumers (Love, 1994) and in agreement with Gregory *et al.* (1994), the main textural differences were found in tenderness values. Although ageing is considered main factor afecting tenderisation, it did not affect our samples since all breeds were aged for the same length of time. It has been shown that long ageing periods decrease differences in tenderness (Monsón *et al*., 2004). However, 10 days seems not long enough to avoid these differences.

Results showed that in general specialised breeds (beef and dairy breeds) had the highest values in tenderness. Eight breeds had scores higher than 5 points: Pirenaica, 5.62; Charolais, 5.39; Piemontese, 5.38; Avileña-Negra Ibérica, 5.35; Limousin, 5.32; Asturiana de los Valles, 5.22; Danish Red Cattle, 5.13 and Holstein, 5.07. Casina breed had the toughest meat (3.94).

Our results for tenderness in fast growing breeds (Pirenaica, Charolais) are similar to those obtained by Macíe *et al.* (2000) who observed that the breed had a big effect on tenderness and that the fast growing group reached the highest scores after seven and twenty one days of ageing.

Table1. Sensory characteristics on *m. Longissimus thoracis* after 10 days of ageing in 11 European cattle breeds†: means and (standard deviation)

	cas	marc	simm	hols	red	asv	lim	av	pie	char	pir
N	23	22	13	15	15	23	16	22	23	15	24
Tenderness††	3.94^{a} (1.59)	4.29^{ab} (1.23)	4.38^{ab} (1.09)	5.07^{bc} (0.81)	5.13^{bc} (0.65)	5.22^{bc} (1.18)	5.32^{bc} (0.80)	5.35^{bc} (1.14)	5.38^{bc} (0.91)	5.39^{bc} (0.78)	5.62^{c} (0.99)
Juiciness†††	4.40^{ab} (0.85)	4.37^{ab} (0.87)	4.14^{a} (0.88)	4.38^{ab} (0.76)	4.71^{abc} (0.63)	5.06^{bc} (0.84)	5.30^{c} (0.86)	4.89^{abc} (1.01)	4.71^{abc} (0.78)	5.24^{bc} (0.73)	5.12^{bc} (0.98)
Flavour††††	5.22^{ab} (0.41)	5.18^{ab} (0.33)	4.85^{a} (0.54)	5.02^{ab} (0.29)	5.06^{ab} (0.37)	5.40^{b} (0.38)	5.17^{ab} (0.29)	5.19^{ab} (0.45)	5.10^{ab} (0.34)	5.24^{ab} (0.38)	5.38^{b} (0.36)

†cas: Casina; marc: Marchigiana; simm: Simmental; hols: Holstein; red: Danish Red Cattle; asv: Asturiana de los Valles; lim: limousin; av: Avileña-Negra Ibérica; pie: Piemontese; char: Charolais; pir: Pirenaica.
††Tenderness: 1, very tough – 8, very tender.
†††Juiciness: 1, very dry – 8, very juicy.
††††Flavour: 1, very low intensity – 8, very high intensity.
^{a,b,c}Different letters in the same row mean significant differences ($p < 0.05$).

Some animals of the Piemontese or Asturiana de los Valles breeds presented the double-muscling genotype, which induces more glycolytic muscle fibres (Hanset *et al.*, 1982) and a lower collagen content (Bailey *et al.*, 1982). This could explain the high tenderness score of these breeds. However the effect of double-muscling on meat toughness is complex. Most of the literature described double-muscled animals with a higher tenderness, although Uyterhaegen *et al*. (1994) reported that cooked meat from double-muscled bulls of Belgian Blue breed had significantly higher shear force than meat from normal animals.

A higher precocity as for milk breeds (Danish Red Cattle, Holstein) could influence in the results since a high intramuscular fat content decreases the muscle resistance to shearing (in instrumental analysis) because of dilution of fibrous protein by soft fat (Wood *et al*., 1999).

Meat juiciness is an important contributor to eating quality and plays a role in meat texture (Dransfield *et al*., 1984). The relationship between tenderness and juiciness have been reported in several studies (Crouse *et al.*, 1985; Destefanis *et al*., 2000) with correlation coefficients ranging between r = +0.42 and r = +0.88. The more tender the meat, the more quickly water is released by chewing and the more juicy the meat is perceived (Cross, 1988).

In juiciness, Limousin breed (5.30) had the highest score. Charolais (5.24), Pirenaica (5.12) and Asturiana de los Valles (5.06) breeds had a high score too, following the similar direction as tenderness. Campo *et al.* (1999) found that specialised beef breeds had the highest scores although the differences appeared after 14 days ageing.

With respect to flavour the differences were more reduced. Asturiana de los Valles breed (5.40) and Pirenaica breed (5.38) obtained the highest scores, while Simmental being the breed with the lowest score (4.85). Only between these breeds the effect was statistically significant. So, as was found by Dikeman and Crouse (1975), the breed was not an important effect in flavour intensity. Although it can exist important differences between the animals of our study in intramuscular fat content, the lack of significant differences in flavour intensity could be explained by the higher contribution of the lipid fraction to the species-specific flavour (Wasserman and Talley, 1968) than to the total perceived flavour (which depends itself on a much high number of components). Nevertheless Renand *et al*. (2001) described positive correlations between lipid content and flavour intensity in steaks at 6 and 15 days *post mortem* of Charolais young bulls (slaughtered at 17 months). But flavour depends on several precursors that react during cooking within these compounds, phospholipids play a major role in meat flavour (Mottram and Edwards, 1983) and they can be changed through the diet. Since all animals were reared in similar intensive conditions, these differences may have dissapeared.

Conclusion

The wide variety of breeds in Europe produces meat that can be differentiated by its organoleptic properties. Breed was significant on the studied descriptors although it impacted more on texture parameters. At 10 days of ageing, unimproved breeds are tougher than beef or dairy breeds. Flavour was less affected by breed, mainly due to the similar intensive rearing conditions of all of them.

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