CHARACTERISTICS OF MEAT TEXTURE OF SEVERAL EUROPEAN CATTLE BREEDS

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Introduction

The present study is part of an ongoing EU project with animals from 15 different breeds representing the genetic diversity of European cattle. This project will undertake a rigorous comparison meat quality from this range of cattle breeds with animals raised under similar management conditions in order to minimise environmental variation and to identify and define genetically determined component of that variation.

In particular, meat tenderness is the most important cause of consumer dissatisfaction and any improvement would increase the value of the final product (Brooks *et al*., 2000).

Objectives

The main objective was to determine the influence of breed and ageing time on the instrumental textural characteristics of beef meat, related to the myofibrillar and connective components.

Methodology

Four hundred and thirty six young entire males from 15 different European cattle breeds: Jersey, South Devon, Aberdeen Angus and Highland from United Kingdom; Holstein, Danish Red Cattle and Simmental from Denmark; Asturiana de los Valles, Casina, Avileña and Pirenaica from Spain; Piemontese and Marchigiana from Italy and

Limousin and Charolais from France. All animals were fed *ad libitum* with a 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. The bulls were slaughtered at the nearest EU licensed abattoir, to minimise the effect of the transport stress on meat quality. Slaughter was about 14-16 months of age. Stunning was by captive bolt pistol. Carcasses were chilled at 4º C for 24 hours. After this time the *m. longissimus thoracis* (between 8^{th} and 13^{th} ribs) was remove from the left side of carcass and stored at 3º C until 48 hours. Later on a section was subdivided in slices, vacuum packaged and frozen; another section was aged for 10 days, cut, vacuum packaged and frozen. Samples were frozen at –18º C, until instrumental analysis. To analyse the texture in raw meat the loin samples were sliced into 4 cm thick steaks.

Before instrumental analysis meat was thawed, in their vacuum bags, in tap water for 4 hours until reaching an internal temperature of 17-19º C. Samples, 1 cm^2 in cross-section were cut with muscle fibres parallel to the longitudinal axis of the sample. Samples were analysed using a modified compression device that avoids transversal elongation of the sample (Lepetit & Culioli, 1994). Stress at 20% (C20) and 80% (C80) of maximum compression were assessed using an Instron 4301 machine. Lepetit and Culioli (1994) observed that low compression values (C20) were related to the resistance of the myofibrils to deformation (compression) and it is known that higher stress rates (C80) are mainly related to the connective tissue components (Lepetit and Culioli, 1994).

Statistical analysis was performed using SPSS 11.5 software. An ANOVA procedure was carried out with breed as unique effect, within ageing time.

Results & Discussion

Global results are shown in Table 1.

Myofibrillar component (C20)

Breed was a very important factor on C20 texture measurements. With a short ageing (48 h.) breeds ranged from 5.45 N/cm^2 to 9.77 N/cm^2. Rustic breeds (Highland, Avileña, Casina) or dual purpose breeds (Simmental) had the highest C20 values whilst dairy breeds (Holstein and Danish Red Cattle) had the lowest values. Double-muscled breeds gave intermediate values. These results apparently contradict the two opposite ideas that double-muscled animals have tough myofibres (Clinquart, Hornick, Van Eenaeme and Istasse, 1998) and that animals with high muscle development have faster protein degradation and higher ageing rates due to a predominance of fast contracting white fibres (Ouali, 1990) Therefore the observed results are likely to be a compromise between two different biological mechanisms.

With 10 days ageing values in C20 were lower. The C20 variable reflected a progressive tenderization of the meat as ageing advanced confirming that myofibrils are the components that change the most during ageing (Lepetit, Salé and Ouali, 1986; Tornberg, 1996). Asturiana de los Valles (double muscled breed) had the lowest value (3.84 N/cm^2) and Marchigiana, Simmental and Aberdeen Angus had the highest values (5.48 N/cm^2, 5.15 N/cm^2 and 4.49 N/cm^2 respectively).

Connective component (C80)

C80 values for breeds ranged from 30.68 N/cm^2 to 46.29 N/cm^2 (48 h. ageing) and from 31.21 N/cm^2 to 52.52 N/cm^2 (10 days ageing). C80 values were significantly different between breeds with a short ageing (48 h.), higher in dairy breeds (Holstein and Danish Red Cattle) and rustic breeds (Highland, Casina) and lower in specialised beef breeds (Asturiana de los Valles, Piemontese, Pirenaica and Limousin).

Holstein, Danish Red Cattle (dairy breeds) had the highest values in C80 with 10 days ageing whilst some specialised meat breeds (Piemontese, Limousin and Asturiana de los Valles) had the lowest values. This agrees with the general view that double-muscling is associated with lower collagen content in muscles (for review, see Culioli, 1999).

Ageing did not affected C80 values. Differences between ageing times ranged from 0.1% to 16.3%. These results agree with those of Eikelenboon, Barbier, Hoving-Bolink, Smulders and Culioli (1998) who reported that connective tissue did not change during ageing.

Conclusions

We can conclude that breed is an important factor on meat tenderness in beef. Differences between breeds in myofibrillar texture were reduced with ageing times. With 10 days ageing Asturiana de los Valles, Limousin, Piemontese, South Devon and Pirenaica breeds showed lower texture values than other breeds.

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Tables and Figures

Table 1. Texture determinations on *longissimus thoracis* muscle aged 48 hours and 10 days in 15 European cattle breeds: means and (standard deviation)

	JER	SD	AA	HIG	HOLS	RED	SIMM	ASV	CA	AV	PI	PIE	MARC	LIM	CHAR
N	*31*	*27*	*30*	*29*	*29*	*29*	*20*	*30*	*31*	*30*	*31*	*30*	*28*	*31*	*30*
Carcass weight (kg)	189.68	346.92	335.72	245.12	319.97	318.72	344.35	348.74	244.69	328.91	371.45	335.86	307.52	360.68	386.64
48 hours of ageing															
C20 (N/cm^2)	7.18 ^{cde} (2.17)	7.01 ^{cde} (1.95)	7.31 ^{cde} (1.98)	9.77 ^{a} (2.51)	5.45 ^{f} (2.02)	6.25 ^{ef} (1.94)	8.29 ^{abc} (2.52)	6.96 ^{cde} (2.78)	8.07 ^{abc} (4.21)	8.37 ^{abc} (3.30)	6.63 ^{def} (2.45)	6.48 ^{def} (2.72)	9.37 ^{ab} (3.44)	6.45 ^{def} (1.84)	7.43 ^{cde} (3.07)
C80 (N/cm^2)	37.58 ^{cd} (8.95)	35.46 ^{de} (9.13)	39.89 ^{cd} (6.58)	42.27 ^{abc} (12.30)	43.50 ^{ab} (7.35)	46.29 ^{a} (6.76)	40.22 ^{bc} (8.27)	30.68 ^{f} (6.99)	42.35 ^{abc} (10.57)	37.76 ^{cd} (6.44)	31.28 ^{ef} (6.35)	29.81 ^{f} (6.37)	42.87 ^{ab} (8.85)	31.83 ^{ef} (5.06)	39.40 ^{bcd} (7.96)
10 days of ageing															
C20 (N/cm^2)	4.21 ^{bc} (0.76)	4.06 ^{bc} (0.50)	4.49 ^{b} (0.84)	4.35 ^{bc} (0.79)	4.03 ^{bc} (0.47)	4.40 ^{bc} (0.66)	5.15 ^{a} (1.81)	3.84 ^{c} (0.39)	4.22 ^{bc} (0.60)	4.20 ^{bc} (0.84)	4.03 ^{bc} (0.46)	4.13 ^{bc} (0.81)	5.48 ^{a} (2.54)	4.00 ^{bc} (0.42)	4.26 ^{bc} (0.74)
C80 (N/cm^2)	39.58 ^{bcd} (8.15)	35.21 ^{def} (9.03)	39.93 ^{bc} (6.61)	36.45 ^{cde} (6.64)	49.52 ^{a} (8.99)	52.52 ^{a} (11.35)	40.01 ^{bc} (7.63)	32.57 ^{ef} (9.17)	39.03 ^{bcd} (6.52)	41.56 ^{b} (6.19)	36.38 ^{cde} (8.16)	27.83 ^{g} (6.17)	41.82 ^{b} (7.12)	31.21 ^{fg} (3.71)	43.25 ^{b} (8.12)

Different letters in the same row mean significant differences (at least $p \leq 0.05$)

C20: Stress at 20% of maximum compression; C80; stress at 80% of maximum compression.

JER: Jersey; ***SD:*** South Devon; ***AA:*** Aberdeeen Angus; ***HIG:*** Highland; ***HOLS:*** Holstein; ***RED:*** Danish red Cattle; ***SIMM:*** Simmental; ***ASV:*** Asturiana de los Valles; ***CAS:*** Casina; ***AV:*** Avileña; ***PI:*** Pirenaica; ***PIE***: Piemontese; ***MARC***: Marchigiana; ***LIM:*** Limousin; ***CHAR:*** Charolaise.