EATING QUALITY OF THE KNUCKLE DID NOT DIFFER BETWEEN GENOTYPES AND SEX AFTER 8 DAYS OF AGEING IN COMMERCIAL BEEF

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Abstract – Forty eight Blonde d'Aquitaine, Limousin or crossbred commercial animals (young bulls or heifers) were used to assess beef palatability assessed by consumers. All animals were slaughtered within the European commercial category between 12 and 24 months of age on commercial premises. The knuckle was aged for 8 days, kept vacuum packaged and tasted by eighty consumers. The genotype had a high effect on age at slaughter and conformation score, the crossbred animals being younger and with lower conformation scores. Heifers showed lighter and fatter carcasses, associated to a higher intramuscular fat deposition, with more monounsaturated fat and lower water losses. However, after 8 days of ageing, no significant differences were observed between genotypes and sexes in the organoleptic acceptability of the knuckle. Therefore, it seems unnecessary to indicate in the label the genotype or the gender of the animals, unless other marketing strategies are predominant.

Key Words – Blonde d'Aquitaine, Limousin, Crossbreeds, Bulls, Heifers, Eating quality

I. INTRODUCTION

The European beef market establishes that entire males between 12 and 24 months of age are classified as bulls, and females from the same age that have never calved are classified as heifers [1]. This is the most common beef that Spanish consumers will find at the retailer, especially in the age range closer to 12 months. The reference price for the producer is also regulated according to carcass classification [2]. But the consumer is hardly aware of these identifying data, even when some of them are compulsory in the label due to traceability legislation [3].

The increasing demand of quality meat from consumers is driving the big retailers to investigate beef consumer's acceptability in order to offer homogeneous products to reach consumers expectations. However, the variability of breeds is so large that it is difficult to take a decision from the farming side without compromising some meat quality traits, such as marbling or colour, which might affect the consumer purchase decision. The aim of this work was to assess the influence of genotype and sex of young bulls and heifers over 12 months of age, with different carcass and meat characteristics, on consumer's assessment of eating quality.

II. MATERIALS AND METHODS

Forty eight animals from three different genotypes (Blonde d'Aquitaine, Limousin and crossbreed between Spanish beef breeds and dairy females) and two sexes (entire bulls and heifers) were used. All of them were reared intensively under commercial premises with a feeding based on concentrates and straw ad libitum. They were chosen at the abattoir from the whole set of animals slaughtered everyday by the main beef supplier in Spain, all of them within the European commercial category between 12 and 24 months of age without calving. Cold carcass weight, conformation and fatness scores were recorded.

At 48 h after slaughtering, pH was measured by a penetration electrode and the loin joint (including the muscle *longissimus dorsi*) and the knuckle (including the muscles *vastus lateralis* and *rectus femoris* of the *cuadriceps femoris*) were excised and vacuum packaged. When the knuckle reached

8 days of ageing at 4 ºC, 11-mm thick steaks were obtained, vacuum packaged and kept frozen at -18 ºC. Also water holding capacity was assessed by a compression test. When the loin reached 14 days of ageing at 4 ºC, samples were obtained to assess intramuscular fat content [4], fatty acid composition (expressed as percentage of total fatty acids) [5, 6] and water holding capacity.

A panel of 80 untrained consumers (55 % males, 45% females; 37.5% <35 years old, 35.0 % 36-50 years old, 27.5 % >50 years old), from which 87.7 % claimed to consume beef twice or more times a week, tasted the steaks that were grilled at 200 ºC until reaching 70 ºC of internal temperature. Each consumer was presented with six samples, one from each treatment group (2 sexes x 3 genotypes), which were tasted in a random order to avoid the effect of sample order presentation, first-order or carry-over effects [7]. Consumers evaluated overall acceptability, tenderness acceptability and flavour acceptability using a 9-point structured hedonic scale (one = dislike extremely to nine = like extremely).

Statistical analyses were performed with genotype and sex as fixed effects with a GLM (SPSS 22.0). For consumers' assessments, consumer was also included in the model as a random effect.

III. RESULTS AND DISCUSSION

Genotype had a significant effect on age at slaughter and conformation (Table 1). To reach a similar carcass weight, Blonde d'Aquitaine animals were slaughtered older than Limousin and crossbred animals (Table 2). This is related with the presence of double-muscled genotype in this breed. One of the characteristics of double-muscled animals at this age is their slower daily growth rate [8] in comparison with other beef breeds. On the other hand, Blonde d'Aquitaine (between U and U+) and Limousin (between R+ and U+) showed a better carcass conformation than crossbred animals (R to U). This was expected because the crossbred with unimproved animals or dairy breeds implies less amount of saleable meat. Sex had a higher influence on carcass characteristics, since heifers were older than bulls to reach a carcass weight between 13.2 and 23.2% lower than the bulls' carcass weight. This lower carcass weight implied a poorer conformation score (U- to U+ for bulls *vs* R to U for heifers). Nevertheless, due to the higher physiological maturity of females, heifers produced fatter carcasses (2 to 3- for bulls *vs* 2+ to 3 for heifers). The higher fatness score might lower the price for the producer since the Spanish consumer prefers leaner beef, which implies that producers try to slaughter females younger than 12 months of age at another commercial category. Nonetheless, it is difficult to achieve this strategy in beef specialized breeds that do not incorporate enough intramuscular fat to make the meat more palatable.

Genotype had a great impact on the fat content of the *longissimus dorsi* muscle (Table 3). One of the characteristics of double muscle animals is their low intramuscular lipid deposition [8]. This is the main reason why Blonde d'Aquitaine animals had less intramuscular fat than Limousin, and especially than crossbreed animals (Table 4). The relationship between carcass fatness score and intramuscular fat content was stronger due to the sex than to the genotype, because heifers, with the fattest carcasses, showed a considerably higher intramuscular fat content (IMF) than bulls in all genotypes, especially in the crossbred animals, with more than two-fold IMF. Females also showed a significant higher percentage of monounsaturated fatty acids and lower percentage of polyunsaturated fatty acids than bulls. With normal pH values in all animal groups and without pH differences between groups (data not shown), water holding capacity was only affected by sex when measured in the knuckle, with heifers having the lowest water losses.

Although there were clear differences due to the genotype and the sex on the composition and characteristics of the meat, consumers did not find any difference in beef quality between groups (Table 5). All acceptability values were higher than 6.0 on a 1-9 scale. Neither the higher marbling of heifers or their higher content of monounsatured fatty acids nor the lower water losses affected eating quality scores. The meat

from double-muscled animals is also thought to be more tender due to their different myofibrils composition in number and size, and their faster tenderization rate [8] where tenderness is the first attribute that drives consumer overall preference. However, after 8 days of ageing, those possible differences in tenderness might have disappeared between meat from Blonde d'Aquitaine and the other genoypes [9].

IV. CONCLUSION

After ageing beef for more than seven days, all potential differences in beef palatability due to genotype or sex in commercial animals between 12 and 24 months of age have disappeared. Therefore, information of sex and genotype is irrelevant in the labelling of beef unless consumers are seeking for specific cues due to cultural or marketing aspects.

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Table 1 Significance of genotype and sex on carcass characteristics

	Genotype	Sex	GxS
Age at slaughter	.000	.000	.009
CCW	.915	.000	.029
Conformation	.004	.000	.301
Fatness	.449	.000	.099

CCW: cold carcass weight

Table 2 Effect of genotype and sex on carcass characteristics

	Blonde d'Aquitaine		Limousin		Crossbred	
	M	F	M	F	M	F
n	8	8	8	8	8	8
Age at slaughter[1]	13.7bc	17.5a	12.2c	15.4b	12.8c	12.7c
CCW[2]	338.7a	260.2b	318.4a	276.6b	336.8a	264.1b
Conform[3]	11.4a	10.7ab	11.5a	9.7bc	10.5ab	8.9c
Fatness[4]	6.1	6.9	5.4	8.0	6.5	7.6

[1] months old; [2] kg; [3] 1-18 (1, very poor – 18, very good);
[4] 1-15 (1, very lean – 15, very fat)
Means with different letters indicate significant differences within row (P<0.05)

Table 3 Significance of genotype and sex on loin[1] and knuckle[2] composition and water holding capacity (WHC)

	Genotype	Sex	GxS
Fat[1]	.000	.000	.089
SFA[1]	.015	.116	.019
MUFA[1]	.077	.000	.000
PUFA[1]	.002	.000	.000
WHC[1]	.525	.052	.459
WHC[2]	.050	.027	.300

SFA: Saturated fatty acids; MUFA: monounsaturated fatty acids; PUFA: Polyunsaturated fatty acids; *n*-6: *n*-6 PUFA; *n*-3: *n*-3 PUFA

Table 4 Effect of genotype and sex on loin[1] and knuckle[2] composition and water holding capacity (WHC) (%)

	Blonde d'Aquitaine		Limousin		Crossbred	
	M	F	M	F	M	F
n	8	8	8	8	8	8
Fat[1]	1.3c	2.6c	1.9c	4.4b	2.6c	6.1a
SFA[1]	41.9bc	39.5c	40.6bc	42.5ab	45.1a	41.9bc
MUFA[1]	31.9c	38.8b	29.3c	47.3a	33.0c	46.1a
PUFA[1]	23.6ab	17.9c	27.3a	7.6d	19.1bc	9.3d
WHC[1]	19.2	16.5	18.9	16.6	16.9	16.6
WHC[2]	21.8	19.6	22.4	22.2	22.3	21.2

SFA: Saturated fatty acids; MUFA: monounsaturated fatty acids; PUFA: Polyunsaturated fatty acids;
Means with different letters indicate significant differences within row ($P<0.05$)

Table 5 Significance of genotype and sex on consumer acceptability

	Genotype	Sex	GxS
Global acceptability	.729	.353	.756
Tenderness acceptability	.555	.943	.937
Flavour acceptability	.678	.208	.425

Table 6 Effect of genotype and sex on consumers' assessment of eating quality *N*=80

	Blonde d'Aquitaine		Limousin		Crossbred	
	M	F	M	F	M	F
n	8	8	8	8	8	8
Global acceptab.	6.34	6.01	6.03	6.00	6.15	6.03
Tendernes acceptab.	6.20	6.30	6.09	6.08	6.05	6.00
Flavour acceptab.	6.56	6.06	6.15	6.15	6.24	6.35

Scale: 1, extremely dislike – 9 extremely like