ARGENTINE BEEF QUALITY: INFLUENCE OF THE SLAUGHTERHOUSE, BREED AND AGEING TIME

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Abstract –The objective of the study was to carry out a survey on beef quality (British, Braford/Brangus cattle) produced in the central-east wet region of Argentina, looking at its physico-chemical and organoleptic aspects considering the effect of ageing up to 30days. Samples of *Longissimus dorsi* muscle (9-13 rib) were collected from 2 slaughterhouses from the same region, 330km apart. It was measured: pH, color (L*,a*,b*; Minolta), cooking losses, Warner Bratzler shear force (Instron 4442), lipid oxidation (TBAR index) and sensory parameters (8 trained assessors). Data were analyzed using the Proc Mixed (SAS); differences among treatments were analyzed by Tukey test. Neither breed nor slaughterhouse significantly influenced pH, cooking losses and meat color. At 30d, the slaughterhouse influenced lipid oxidation and hardness with no differences between breeds. Sensory analysis showed different tenderness among breeds on 7days aged meat but equal value at 30days when differences due to the slaughterhouse appeared. In conclusion, meat from Brit/Bra breeds raised under grazing conditions, slaughtered in different abattoirs, showed physico-chemical and organoleptic characteristics suitable for consumption up to 30days; slightly differences in lipid oxidation, toughness, taste and sensory tenderness could be expected within the same productive region.

Key Words –long shelf life, productive region, steers.

I. INTRODUCTION

Argentina has been divided into five beef cattle producing areas. Beef quality from animals raised in some of these regions has only been partially characterized [1-4]. Beef quality from grazing animals in the same productive area of Argentina varies due to the different quality of pasture and feeds [5, 6] by the great extension of territory (560.000 km^2) that determines changes in climate and rainfall [7]. Due to the costs of transport, animals are slaughtered at the nearest abattoir; therefore, the quality of meat to the consumer is determined in part by location of the farm with respect the slaughterhouse. Argentinean consumers are very demanding in terms of high quality beef [8]. To the best of our knowledge there have not been a detailed and complete study about beef quality from all productive regions and much less, a study of the sub-regions within each productive region. Our objectives were to determine the qualitative properties of the meat according to the productive sub-area from the central-east wet region on British and Brangus/Braford cattle, and to study the effect of different ageing times up to 30 days, simulating commercial conditions.

II. MATERIALS AND METHODS

The characterization study was conducted within the central-east wet region (Lat.: from 29 to35°S and Long.: 58 to 63°W) on extensive (grazing) productive system on steers slaughtered at the same commercial stage of fattening within each breed. Animals belonged to Brangus/Braford (Bra) and British (Brit; Angus, Hereford and crosses) breeds; dental chronological age was 2 to 4 permanent incisors teeth.

Samples

Samples were collected in two commercial slaughterhouses (SH) belonging to the same commercial firm, authorized to export to the EU (European Union), located 330km from each other (SH1: Lat. 32° 52'S; Long. 60°36'W and

SH2 Lat. 32°12'S; Long. 58°08'W). Animals (26 Bra and 34 Bri; 50% Bri and Bra in each SH) were sampled to obtain the *Longissimus dorsi* muscle (9 to 13 ribs; 60 samples) and transported (4ºC±1) to the Meat Quality Laboratory of the Faculty of Agriculture (University of Buenos Aires). Samples were vacuum packed (Multivac packaging A300-16) as a method of conservation. The packaged samples were placed in a cooler with temperature and light control to simulate retail conditions of exhibition. Ageing times were 4, 7 and 30 days (6cm thick blocks for each aging time to obtain steaks 2.5 cm thick for pH, color and tenderness and 2 cm thick steak for sensory evaluation).

Determinations

Measurements were: final pH (pH meter Hanna with fine-tipped electrode Ingold 406 M3); color according to the CIELAB System, L* (lightness), a* (redness) and b* (yellowness) while saturation was calculated as $[C^* = (a^{*2} + b^{*2})^{0.5}]$ using a Minolta Chroma Meter-CR300 [9]; tenderness with a Warner Bratzler shearing attachment (Instron 4442 Universal Testing Machine; Canton, MA, USA) on cooked samples (1.3 diameter core, water bath heated at 70ºC for 50 minutes); lipid oxidation (TBAR index; µg of malonaldehyde/g meat) [10] and fatty acids that were extracted according to the technique described [11] and analyzed as methyl esters by gas chromatography (Shimadzu 14-B capillary column Resteck 2560). For sensory analysis, the slices were cooked in double contact grill to reach 71ºC ± 1ºC in the center of the sample (cold point), monitored by thermocouples. The samples were analyzed by an analytical panel of 8 trained assessors according to international standards and experience in sensory analysis of meat [12-15]. Each assessor received samples (1x1x1cm cubes) in containers coded with three digit random numbers. The following descriptors were assessed: the overall color, odor, flavor, taste, tenderness, untuosity and juiciness, using an unstructured linear scale of 10 cm without anchorage. The ends of the scales corresponded to the intensity of the attribute: light pink, extremely soft, very tender, dry, not oily (lower limit: 0) and red, extremely strong (intense), very tough, juicy, very oily (upper limit: 10). Statistical analysis of data was performed using the Proc Mixed of SAS [16]. Differences among treatments were analyzed by Tukey test ($p < 0.05$).

III. RESULTS AND DISCUSSION

As expected (Table 1), animals of British and Brangus/Braford breeds of both slaughterhouses had similar pH values, higher at 30 days than meat of 4 days of ageing.

Table 1. Meat quality according to the slaughterhouse and breeds for 4 to 30 days of ageing

Parameters	SH1		SH2		Probability			SE[1]
	Brit	Bra	Brit	Bra	SH	Breed	SHxB	
pH4d	5.46	5.47	5.54	5.50	.180	.799	.531	0.10
pH7d	5.59	5.51	5.62	5.61	.110	.262	.413	0.09
pH30d	5.61	5.57	5.66	5.65	.157	.502	.661	0.09
L* 4d	39.5	38.2	36.5	37.0	.041	.712	.459	3.50
C* 4d	26.5	25.2	25.0	24.8	.392	.524	.631	2.61
L*7d	42.4	45.3	39.4	39.7	.001	.168	.252	2.93
C*7d	24.5	23.5	24.5	24.2	.716	.508	.686	2.59
L*30d	40.8	44.7	40.6	41.2	.141	.080	.198	3.06
C*30d	25.7	24.2	23.4	26.2	.161	.469	.181	2.03
CL4d %	19.7	19.7	19.2	202	.090	.997	.967	3.16
CL7d %	21.0	16.2	21.0	20.9	.284	.066	.065	2.31
CL 30d%	20.8	22.8	21.8	21.8	.308	.250	.187	2.63
WBSF 4d, lb	7.63	7.03	8.25	9.70	.183	.733	.396	1.31
WBSF 7d, lb	6.04	6.02	6.86	7.10	.228	.895	.867	0.83
WBSF 30, lb	4.63	5.14	6.22	6.04	.028	.888	.587	0.74
Tbar 4d,µg/g	0.15	0.20	0.22	0.24	.116	.309	.555	0.08
TBAR 7d	0.10	0.08	0.17	0.21	.000	.720	.220	0.07
TBAR 30d	0.12	0.11	0.17	0.20	.002	.550	.447	0.06

[1]Root Mean Square Error. SH: slaughterhouse; Brit.: Angus, Hereford, AngusxHereford; Bra.: Brangus and Braford; CL: cooking loss

Neither breed nor SH had significant effects on meat color but the brightness differed between the two slaughterhouses, being more luminous

the meat of SH1. Meat tended to be brighter with the ageing time; with thirty days of ageing, L* values were similar in the two SH. Cooking losses slightly increased with ageing but was not influenced either by the slaughterhouse or by breeds. Seven and thirty days aged meats showed lower rates of lipid oxidation for SH1, regardless of the breed, indicating differences in the handling of the meat during deboning and packaging phases; although, in general, lipid oxidation values recorded in this study were negligible, probably due to consumption of natural antioxidants contained in the forage. For each sampling time, the hardness (WBSF) was similar for the different breeds, with values below 10lb, indicating tender meats. As expected, time of ageing determined an increase in tenderness. While values of WBSF tended to be higher for SH2 regarding SH1 at 4 and 7 days ($p>0.05$), these were significant only on 30 days aged meats ($p<0.05$). Similar differences in meat tenderness between abattoirs of the same productive region was noted by Cossu et al. [5] probably due to the different age of the animals slaughtered in the slaughterhouses, at the same stage of fattening.

Sensory analysis (Table 2) in 7 days aged meat showed lack of differences among breeds with regard to tenderness (more tender in Bra respect Brit; $p<0.05$) but in general, assessors described the meat as 'tough'. Slaughterhouse influenced acid taste and untuosity, less in SH2, and overall meat color, being less 'red' in SH1. After 30 days of ageing, there was absence of difference on sensory parameters due to breeds but differences were detected due to the slaughterhouses on tastes and off flavor/odors (less in SH2). According to the instrumental hardness (WBSF), assessors found meat from the SH1 more tender than meat from the other one. This suggests faster ageing of meat from animals raised in the area of influence of SH1, regardless of breed.

IV. CONCLUSION

Neither breed nor slaughterhouse significantly influenced pH, cooking losses and color of meat up to 30 days ageing. Fresh meat brightness depended on the slaughterhouse but at 30 days meat from Braford/Brangus of both slaughterhouses was similar. Four and 7 days aged meat was equally tender in both slaughterhouses and breed groups; the increase in tenderness due to time of ageing up to 30 days was different between slaughterhouses. Also the handling of meat differs between abattoirs causing different lipid oxidation values. Sensory analysis showed different tenderness among breeds on 7 days aged meat but equal value at 30 days when differences due to the slaughterhouse appeared.

Table 2. Sensory meat quality according to the slaughterhouse and breeds for 7 and 30d of ageing.

Parame-ters	SH1		SH2		Probability			SE[1]
	Brit	Bra	Brit	Bra	SH	Breed	SHxB	
7 days ageing								
Colour	4.27	4.03	5.64	5.97	<.001	.933	.629	1.74
Odour	5.79	4.91	5.24	5.16	.803	.277	.182	1.75
Acidic Taste	2.03	1.79	0.88	0.95	<.001	.970	.471	1.28
Metallic taste	0.24	0.91	0.87	1.00	.142	.096	.247	1.40
Flavour	5.94	5.00	4.87	4.70	.062	.102	.134	1.52
Off Flavour	0.40	0.45	0.30	0.33	.431	.257	.148	1.04
Tender-ness	8.70	8.48	8.78	8.04	.307	.001	.428	1.80
Juiciness	5.46	4.56	5.14	4.44	.817	.067	.823	2.77
Untuosity	3.31	2.95	2.20	2.10	.008	.606	.719	2.16
30 days ageing								
Color	5.25	4.92	6.06	5.46	.446	.651	.900	2.54
Odor	4.72	4.55	4.48	4.76	.719	.783	.517	2.08
Acidic Taste	2.09	1.44	1.40	1.36	.034	.275	.258	1.63
Metallic taste	2.95	3.11	2.24	2.66	.018	.287	.666	1.78
Flavour	4.40	5.09	4.78	4.83	.445	.249	.263	1.70
Off Flavour	0.72	0.43	0.23	0.10	.021	.211	.729	1.23
Tender-ness	2.13	2.03	2.76	2.71	.011	.790	.930	1.66
Juiciness	2.80	2.57	2.61	2.29	.348	.256	.846	1.49
Untuosity	2.61	2.60	2.44	2.81	.812	.489	.533	1.83

[1]Root Mean Square Error. SH: slaughterhouse; Brit.: Angus, Hereford, AngusxHereford; Bra.: Brangus and Braford

In conclusion, meat from Brit/Bra breeds raised under grazing slaughtered in different abattoirs in the wet central-east region of Argentina, showed physico-chemical and sensory

characteristics suitable for consumption either as fresh meat or aged up to 30 days; slightly differences in lipid oxidation, toughness, taste and tenderness could be expected inside the same productive region.

ACKNOWLEDGEMENTS

The authors acknowledge the financial support of the Universidad de Buenos Aires within Project. GO51 of the Programación Científica 2008 – 2010 UBA Ciencia y Técnica.

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