INFLUENCE OF AGEING IN SENSORY MEAT QUALITY OF YOUNG BULLS AND STEERS FROM THE NORTHWEST OF ARGENTINA

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Abstract – Beef quality from cattle raised in different regions of Argentina has only been partially characterized. The aim of this study was to carry out a sensory survey on beef meat quality of 2-teeth young bulls vs. steers of three breeds "Criollo", Zebu, Brangus/Braford from a commercial cattle population raised on feedlot system in the north-western region of Argentina, looking at its sensory profile considering the effect of ageing up to 14 days. Samples of *Longissimus dorsi* muscle (9th-13th rib) were collected on steers or young bulls slaughtered at 20-23 month of age. Sensory attributes of appearance, flavour and texture were evaluated by eight trained assessors. Data were analysed using the Proc Mixed (SAS); and differences among treatments were analysed by Tukey test. Categories of "castrated" or "intact animal" (steers vs. young bulls (MEJ)) showed to be the most influential factor on main sensory descriptors of meat from cattle raised on feedlot system production for typical breeds of the Northwest of Argentina, resulting in tougher meat (more number of chews), with higher persistence, flavour intensity and typicity of odour and flavour, and higher residue quantity. This paper provides information for the new category of Argentinian cattle (MEJ) through conducting a survey of data in a rearing region of livestock, laying the foundation for sensory profile development.

Key Words – Intact male, MEJ, Sensory descriptors

- INTRODUCTION

In 2010, the Ministry of Agriculture, Livestock and Fisheries of Argentina established the creation of a new commercial category of bovine for slaughter, "young bull" (MEJ *macho entero joven*) with up to two permanent incisors at the time of slaughter, allowing the use of a product that is currently little explored in Argentine beef market. This proposed category may increase feed conversion efficiency through faster growth rates and leaner finished carcasses. The information available in Argentina on the meat quality of this new category of animals is really scarce, especially when it comes from "Criollo" and Zebu breeds.

Meat quality, including sensory characteristics of beef, is affected by a number of factors, such as breed 1, nutrition 2, ante-mortem treatment of animals 3, post-mortem treatment & ageing 4, 5, and cooking methods 6. Tenderness is a primary determinant of the eating quality and acceptability of meat 7, 8. This is readily confirmed by the positive relationship between the price of a cut of meat and its relative tenderness 9. In the same way, Argentinean consumers are very demanding in terms of high beef quality 10. In natural conditions, ageing and breeds are important components that influence the final perception of the product 4.

Some researchers have focused their studies about ageing or breed effects on the crossbreeding between *Bos taurus* and *Bos indicus* or British versus Continental beef breeds 11.

Some authors have observed differences in tenderness 12 or meat colour from animals which have been castrated or not, while other studies showed no differences between the two categories, probably due to differences in the age of the animals at the time of comparison 13. To the best of our knowledge there have not been a detailed and complete study about beef quality from young bulls for the different areas of Argentina and much less, a study of the northwest productive region for native and Zebu breeds. Our objectives were to determine the sensory meat quality from steers and young bulls according to the productive area on "Criollo", Zebu and Brangus/Braford cattle raised on feedlot system production and to study the effect of different ageing times up to 14 days under refrigerated conditions.

- MATERIALS AND METHODS

This work was conducted with steers (S) and young bulls (B) of three different breeds "Criollo" (C), Zebu (Z) and Brangus/Braford (BB) breeds, produced on a confined system in the North-western region of Argentina (region III). Animals were slaughtered at the same age within each breed when dental chronological age was 2 permanent incisors.
Samples: Longissimus dorsi muscle (9^{th} to 13^{th} ribs) from 35 animals slaughtered at 20-23 months old were sampled, frozen (-18ºC ± 1) and sent to the Sensory Analysis Laboratory of the Faculty of Agriculture (Buenos Aires University).The samples were vacuum-packed (Multivac packaging A300-16) as a method of conservation, to be subsequently stored in a refrigeration chamber (2.5 ± 0.5°C) during 4 or 14 days. After ageing, samples were frozen (-18.0 ± 0.5°C) until further analysis.

Sensory analysis: Twenty four hours before sensory performance, samples were thawed at 2.5 ± 0.5°C. Beef samples (2.5 cm of thickness) were cut and cooked in a double contact grill to reach 71ºC ± 1ºC in the centre of the sample (cold point, monitored by thermocouples). For sensory evaluation, samples were analysed by an analytical panel of 8 trained assessors according to international standards and experience in sensory analysis of meat [14, 15, 16, 17]. Each assessor received the samples (cubes: 1x1x1cm) in Petri dishes coded with three-digit, randomized numbers. The following descriptors were assessed from the three different attributes: overall colour and colour homogeneity in appearance attributes; intensity and typicity odour/flavour; acid, sweet, salty and bitter tastes; persistence; hardness, chewiness, number of chews, untuosity and juiciness, using an unstructured linear scale of 10 cm, without anchorage where 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 [18]. Differences among treatments were analysed by Tukey test ($p < 0.05$).

- RESULTS AND DISCUSSION

Significance of breed, ageing, category and their interactions on sensory attributes are shown in Table 1. Table 2 shows the average of the sensory parameters. Texture attributes were more affected by the interactions category x breed and category x ageing days ($p<0.05$) than the others parameters. Ageing time and category were the most important factors in most of the sensory descriptors analysed, according to the results published by Bureš et al. [19]. Monsón et al. [5] found that breed had influence mostly on texture parameters, which agrees with this report, and also concurs with Chambaz et al. [1]. The main textural differences were found in tenderness values (Table 2), in agreement with other authors [20, 21]. Significant differences among breeds were observed at 4 and 14 days of ageing. Also other authors [5, 19, 21, 22]

have reported that ageing time reduces the toughness differences among breeds. Young bulls were tougher, with more chew numbers than steers ($p<0.05$). The differences in tenderness between breeds could be due to the quantity, solubility and space organization of the collagen, fatness and calpain and calpastatin activity. Ageing time affected the sensory hardness values in all breeds studied. In general, sensory values for hardness were lower as the ageing time increased, which agrees with Monsón et al. [5]. Other authors also observed differences in tenderness between young bulls and castrated animals, being higher in semimembranosus than in longissimus, due to the higher content of total and insoluble collagen [23]. Breed effect was not significant for basic tastes, intensity and authenticity of odour and flavour. Hoving-Bolink et al. [24] did not observe differences in flavour intensity between breeds (Piemontese and Limousin) with different percentages of intramuscular fat, and Campo et al. [4] did not found differences in global flavour intensity among Spanish breed types. In the report of Hankey and Kay [25], it was proposed that fatness influenced the meat flavour because it was in the lipid fraction where the species-specific characteristic compounds are found. The ageing time is an important factor for the development of flavour precursors. In general, bovine meat with 1 day of ageing does not have a specific aroma. More ageing improves the flavour, reaching an optimum and then, at longer ageing times, off-flavours develop. In this study the ageing time did not significantly affect the odour and flavour typicity, but effects on odour and flavour intensity were observed. Meat nitrogen-containing compounds may be formed by the natural degradation that occurs during ageing, and some of them have been reported to have a variety of meat flavours [26], which might partially explain the increased scores for odour. At the end of the ageing period, the Zebu and "Criollo" animals had significantly higher values of flavor and odour intensity than Brangus/Braford, especially in young bulls.

Table1 Sensory descriptors: significance of factors and interactions

									Probability (p value)							
		Category		Breed			Days		**C**	**Br**	**D**	**C * Br**	**C * D**	**Br * D**	**C * Br* D**	**RMSE**
		S	B	C	Z	BB	4	14								
Sensory Parameters	Global Colour	--	--	ns	ns	ns	--	--	ns	ns	ns	ns	0.0327	ns	ns	0.998
	Colour homogeneity	ns	ns	ns	ns	ns	5.8a	6.4b	ns	ns	0.047	ns	ns	ns	ns	0.721
	Odour Intensity	ns	ns	ns	ns	ns	4.8a	5.2b	ns	ns	0.081	ns	ns	ns	ns	0.621
	Odour typicity	3.8a	4.3b	ns	ns	ns	3.8a	4.2b	0.034	ns	0.018	ns	ns	ns	ns	0.520
	Sweet Taste	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	2.994
	Salty taste	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	0.482
	Acid taste	ns	ns	ns	ns	ns	1.1a	1.5b	ns	ns	ns	ns	ns	ns	ns	0.483
	Flavour intensity	5.5a	5.9b	ns	ns	ns	5.5a	5.9b	ns	ns	0.052	ns	ns	ns	ns	0.596
	Flavour typicity	4.0a	4.7b	ns	ns	ns	ns	ns	0.053	ns	ns	ns	ns	ns	ns	0.725
	Hardness	--	--	--	--	--	--	--	--	ns	--	0.021	0.144	ns	ns	0.946
	Chewiness	--	--	--	--	--	--	--	--	ns	--	0.016	ns	ns	ns	1.081

	Juiciness	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	0.954
	Untuosity	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	0.603
	Residue	--	--	--	--	--	--	--	--	--	--	ns	0.0009	ns	0.0149	0.910
	Persistence	5.7a	6.2b	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	0.645

Br: Breed; C: Category; D: Days of ageing / S: steer; B: young bull / Breeds: C: "Criollo"; Z: Zebu; BB: Brangus/Braford / RMSE: Root Mean Square Error / Different letters mean significant differences $p<0.05$.

Residue after chewing and juiciness also tended, mostly, to decrease with the ageing time, but in most cases the differences were not significant. In contrast with that reported by Revilla et al. [27], who found no differences due to sex or breed with regard to juiciness and residue at the beginning of ageing, we have observed differences as a function of ageing time ($p<0.05$). Regarding untuosity, Zebu young bulls obtained lower values than the rest of the samples analysed. In general, all samples showed low values of untuosity, probably due to the size of the animals used in this work, and no differences were found. With regard to persistence, only category had influence on it ($p<0.05$), being higher in bulls than steers.

Table 2 Sensory meat descriptors average values in every breed type at every ageing time by each category

Breed	*"Criollo"*		Zebu				Brangus / Braford			
Category	S		S		B		S		B	
Ageing (days)	4	14	4	14	4	14	4	14	4	14
Overall Colour	4.4	4.0	5.9	3.8	4.7	5.6	4.5	4.5	4.8	5.4
Colour Homogeneity	5.8	6.7	5.4	5.9	5.5	5.5	6.1	6.8	5.8	6.4
Odour Intensity	4.9	5.1	4.5	5.1	4.3	5.1	4.4	5.5	5.3	4.9
Odour Typicality	3.7	4.1	3.6	4.3	3.8	4.6	3.4	3.9	4.4	4.3
Sweet Taste	1.0	5.6	1.0	1.2	0.9	1.1	1.3	1.3	1.0	1.0
Salty Taste	2.4	2.3	2.7	2.5	2.4	1.4	2.2	2.4	2.5	2.4
Acid Taste	1.1	1.5	1.1	1.5	1.6	1.4	0.8	1.5	1.2	1.2
Flavour Intensity	4.9	5.7	5.6	6.0	5.3	6.1	5.3	5.9	6.2	5.7
Flavour Typicality	3.6	4.1	4.0	4.4	4.8	4.7	3.9	4.1	4.7	4.6
Hardness	3.1	2.2	2.6	2.4	6.6	4.2	4.0	3.9	5.3	3.4
Chewiness	3.9	2.6	3.2	3.3	7.9	5.7	4.7	4.9	5.6	5.3
Number of Chews	27	20	28	21	44	28	30	26	34	24
Juiciness	2.0	3.3	2.6	2.7	2.4	1.9	2.2	2.6	2.7	2.5
Untuosity	2.0	2.9	2.4	3.0	1.9	1.7	2.5	2.4	2.4	2.7
Residue	3.1	2.2	2.6	3.2	5.8	1.9	3.3	3.2	4.1	3.2
Persistence	5.4	5.9	6.1	5.5	6.6	5.6	5.7	6.0	6.5	5.8

CONCLUSION

The category of "castrated" or "intact animal" (steers vs. young bulls (MEJ)) showed to be the most influential factor on main sensory descriptors of meat from cattle raised on feedlot system production for typical breeds of the Northwest of Argentina, resulting in tougher meat (more number of chews), with higher persistence, flavour intensity and typicity of odour and flavour, higher residue quantity. Breed was shown to have impact, mostly in textural attributes, such as hardness, chewiness, number of chews, and residue, showing differences ($p<0.05$) between samples mainly from "Criollo" animals and of British crosses, where the

"Criollo" beef has lower hardness and fewer chews that animals from Brangus/Braford. Ageing time influenced the intensity of odour and flavor, in the typical odour, hardness and number of chews, as well as the residue after chewing. In conclusion, the breeding of biotypes: ''Criollo'', Zebu and Crossbred intact males in confined systems, showed tougher meat than steers, requiring longer ageing times to reach similar tenderness to that of their castrated peers. Furthermore, we observed that the behaviour of olfactory and gustatory attributes was similar to the castrated animal profile. This paper attempts to provide information for the new category of Argentina cattle (MEJ) through conducting a survey of data in a rearing region of livestock, laying the foundation for sensory profile development.

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