

MEAT QUALITY CHARACTERISATION IN THREE ARGENTINIAN BEEF PRODUCTION SYSTEMS FOR EXPORT TO ITALY

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Abstract – A sample of Argentinean beef exported to Italy was characterized for quality parameters (tenderness, pH, color, thawing loss, expressible moisture, drip loss (and cooking loss. Three systems were analyzed: 1) a typical Hilton Quota; 2) an intensive system, best suited for the Italian market; and 3) a system which included crossbred steers. Results showed that the sample of Argentinean beef for export, coming from different production system, are qualitatively different and not uniform. Meat from crossbred steers with zebu fed forage and supplemented with finely chopped maize grain and sorghum had a lower quality, when compared to the other groups. Freezing, when applied and transportation reduced the differences between the three systems especially with reference to appearance of meat, which was darker and more opaque.

Key Words – Argentina, Beef, Italy, Meat quality

• INTRODUCTION

In recent years, the production and marketing of Argentinean beef was somewhat troubled because of socio-economic and climate issues. The *per capita* consumption of beef has suffered through, in 50 years, decreasing from 90 to 59 kg/*capita*/year with a migration of consumers to pork and poultry. Especially in the last three years the *per capita* consumption of beef has decreased by 10 kg *per capita* [1]. Exports were also affected.

In Italy, the Argentinean beef is renowned for the quality, the health and production methods attentive to animal welfare. Two quotes of beef are exported to Italy and Europe from Argentina. One is a tariff quota for fresh and frozen beef named "Hilton Quota," regulated by the Commission Regulation (EC) n° 810/2008 and defined as "Selected beef cuts obtained from steers, young steers or heifers having been exclusively fed through pasture grazing since their weaning..." [2]. The other quota is beef to excess the Hilton Quota or with different quality characteristics (feedlot system *e.g.*).

The Italian consumer can not distinguish the two quotes because they are marketed as a generically defined "Argentina's beef".

In Argentina there is an evolution of beef production to better meet the consumer's demands [3]. It has been increased the minimum mass of the carcass at slaughter and introduced the category of "*Macho entero Joven*" or young bull. Feedlots are spreading as feeding is more controlled and constant, growth is faster, the use of space is optimized and younger and heavier steers are product with lighter, tender and leaner meat, although this is not so well confirmed [4].

In Argentina, male cattle are normally castrated and fattening generally occurs in three ways: only pasture, grazing plus integration with grains and finally intensive feedlot. The three systems can be combined with each other at different levels. The breeds are generally British, Zebu and their crosses. Beef is characterized by qualitative variability caused by diet, breed, age and weight of animals [4].

Argentinean beef is well known globally but objective measures of the quality of its beef for the export were seldom reported in the literature. A review to discuss aspects related to the nutritional and eating quality of Argentinean beef was published in 2008 [4].

In our previous work (unpublished data) were compared some quality parameters related to Italian and Argentinean beef coming from different feeding system. The Argentinean beef resulted to be darker, more marbled and tender than Italian beef, leaner and clear. This is probably due to the breeding of steers and breeds with a tendency to store fat more pronounced, as preferred by the food habits of Argentinean consumers, with a longer period of grazing and slaughtered older.

To understand how the beef exported correspond to the demands of the Italian market a sample of Argentinean beef for export was characterized qualitatively, in particular for the color. Three systems were analyzed: a typical Hilton Quota; an intensive one, best suited for the Italian market; and one including crossbred steers.

• MATERIALS AND METHODS

Steers were slaughtered at a private abattoir after resting for 24h in paddocks with available water. Animal handling and experimental procedures were in accordance with the Handbook of Procedures for Animal Welfare of the National Service of Animal Health (*Servicio Nacional de Sanidad Animal*, SENASA) of Argentina.

Three different types of samples were considered. Samples from 12 Angus breed steers, exclusively fed through pasture (EXT) grazing since their weaning and satisfying the requirements of Hilton Quota, bred at about 170 km from the slaughterhouse. 12 Angus breed steers from an intensive farm (INT) or feedlot, with diet based on cereals and similar to the Italian feeding system, about 15 km from the slaughterhouse. 11 selected crossbred steers, with less than 50% of breed of the zebu type, fed with forage and supplemented with finely chopped maize grain and sorghum (MIX) at about 218 km from the slaughterhouse. Fresh beef striploins were bought at the commercial slaughterhouse in Buenos Aires, Argentina. Samples were vacuum packed following commercial practice. The samples after 14 days of aging were divided into two portions and one frozen at $-20 \pm 1^\circ\text{C}$, then transported 400 km before analysis.

pH was measured after 14 days of aging at $2 \pm 1^\circ\text{C}$ directly on the commercial cutting. The beef parameters for the qualitative analysis were the following: tenderness or shear strength on cooked meat (WB) using a Warner Bratzler shear machine (model 300; G-R Manufacturing Co., Manhattan, Kansas, USA); pH to 14 days; meat colour (L^* , a^* , b^* , Chroma, Hue measured by a Minolta Colorimeter); thawing loss (TH), expressible moisture (EM) [5], drip loss (DL), cooking loss (CL).

Statistical analysis compared the three production methods and the effect of freezing by analysis of variance in one or more ways, analysis of repeated measures (GLM) and Canonical Discriminant Analysis (STEPPDISC and CANDISC) with the software SAS/STAT SAS 9.3 [6]. The results are expressed as the estimated means (LSMean and MSE) and then compared with the Tukey-Kramer Test adjusted for multiple comparisons.

• RESULTS AND DISCUSSION

The results of the qualitative analysis on fresh beef samples, after 14 days of aging, were carried out at the laboratory of INTA and are reported in Table 1. With the exception of pH 14gg all the other parameters are significantly different. The MIX beef is clearly differentiated from the INT and EXT methods of production.

Table 1 Comparison of some quality parameters on fresh beef after 14 days of aging (LSMeans, N=35).

Parameters	INT	EXT	MIX	MSE
pH 14gg	5.56	5.61	5.58	0.0046
DL (%)	2.01 ^{aA}	3.58 ^b	4.26 ^{bB}	2.6092
EM (%)	4.05 ^A	4.62 ^A	3.05 ^B	0.6161
WB (N)	34.67 ^A	36.85 ^A	34.79 ^B	1.711
L*	39.35 ^a	38.00 ^{ab}	36.18 ^b	7.7330
a*	25.80 ^A	26.37 ^A	22.88 ^B	3.4970
b*	13.75 ^A	13.86 ^A	11.66 ^B	1.9561
Chroma	29.24 ^A	29.80 ^A	25.70 ^B	5.1138
Hue	27.94 ^a	27.70 ^{ab}	26.86 ^b	1.5213

LSMeans by parameter in the same row with different letters are significantly different (a, b, c: $P \leq .05$; A, B, C: $P \leq .01$)

The MIX beef has a significant: higher drip loss (DL), a lower expressible moisture (EM) and tenderness (WB), a color less bright and saturated with a duller overall appearance. The MIX system bred crossbred steers with less than 50 % of breed of the zebu type and this could be responsible for the difference. As reported by Schor *et al.* [4] as a general conclusion, breed type had a minor effect in terms of physical and nutritional parameters of meat. Different proportion of *Bos indicus* did not result in differences in intramuscular fat contents or shear force values, but when *Bos indicus* steers were compared to very different breed types (Pure British and Continental), their shear force values were higher. However this will depend on the proportion of *Bos indicus* in the cross.

The effects of freezing of beef for transportation on qualitative parameters were also analyzed. In Table 2 results are reported. With the exception of thawing (TH) and drip loss (DL) the other parameters are all significantly different. The EXT beef has lower cooking loss (CL). The colour is confirmed more faded in the MIX feeding system. The differences are less marked than the fresh beef.

Table 2 Comparison of some quality parameters on thawed meat (LSMeans, N=35).

Parameters	INT	EXT	MIX	MSE
TH (%)	3.38	3.55	3.64	2.6622
DL (%)	2.42	1.88	2.52	2.2217
CL (%)	28.39 ^a	24.57 ^b	27.64 ^a	12.458
L*	35.68 ^a	34.60 ^{ab}	32.78 ^b	6.9490
a*	22.46 ^{ab}	23.25 ^a	21.42 ^b	2.6370
b*	7.58 ^a	8.05 ^{aA}	6.51 ^{bB}	1.3733
Chroma	23.71 ^{AB}	24.61 ^A	22.41 ^B	3.3375
Hue	18.61 ^a	19.04 ^a	16.72 ^b	4.4672
WB (N)	49.06 ^{ab}	42.24 ^a	50.06 ^b	86.899
H ₂ O (%)	72.02 ^{aA}	70.33 ^{bB}	71.51 ^a	1.7014

LSMeans by parameter in the same row with different letters are significantly different (a, b, c: $P \leq .05$; A, B, C: $P \leq .01$)

To assess whether freezing has maintained or changed the quality of fresh beef has been applied a GLM for repeated measure. Being the same sample measured twice, once fresh and subsequently thawed, in two laboratories using similar analytical methods. It was found a

significant difference between the fresh and thawed beef with a different behavior for the three systems under consideration. The EXT and MIX systems have a lower DL on thawed then on fresh beef, similar to the INT one. The thawed beef is significantly less bright (34.35 vs 37.85), less red (22.37 vs 25.02), less yellow (7.38 vs 13.09), less saturated (Chroma 23.58 vs 28.25) and less colored (Hue 18.12 vs 27.50) regardless of the feeding system, so thawed beef is more faded and dark. The freezing has affected the tenderness in a negative way but only for the MIX is significantly less tender. Overall, the freezing has a negative impact on the appearance and tenderness.

Multivariate analysis was performed to synthesize the effect of freezing. After a selection with the procedure STEPDISC were considered the parameters: DL, L*, a*, Chroma, Hue and WB. The classificatory variable is the combination between the three systems and the beef preservation, fresh (Fr) and frozen (Th), with n=70.

The results of the analysis are in Figure 1 and show a clear separation due to the preservation, fresh (Fr) and frozen (Th), on the first axis.

The R^2 between Can1 and classificatory variable is equal to 0.977 and even with Can2 was high R^2 of 0.77. This indicates a very strong contribution on the two axes of the parameters used. The first canonical variable separates the fresh and frozen beef independently of the feeding systems and breeds.

The second axis separates the MIX fresh meat from the other two. This effect is no longer evident on frozen beef. The most important contribution is given by Chroma and the index of red (a^*).

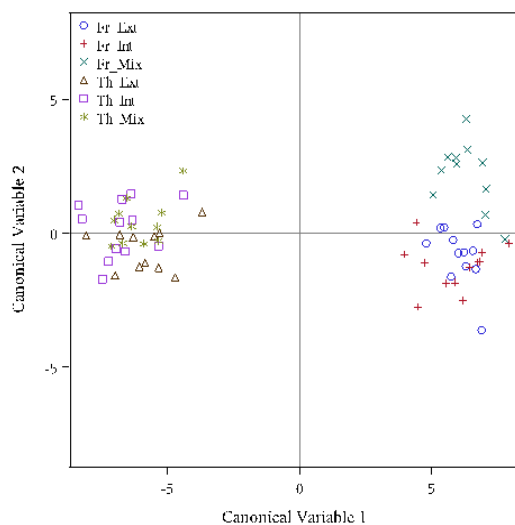


Figure 1. Canonical Discriminant Analysis applied to the feeding systems and processing of meat

Freezing of the beef reduces the differences between the three feeding systems and worsens the color of the meat, making them darker and more opaque. This is confirmed also by Bolesa & Swanb [7] and Payne *et al.* [8] who have found similar results.

• CONCLUSION

The Argentinean beef production is facing a period of great change for both the technical and the socio-cultural aspect which also reflects on the characteristics of the meat for the Italian market. The Argentinean beef is, in the Italian vision, linked to the pampas and a free breeding in which the animal lives according to their needs and which corresponds to the dictates of

Hilton Quota.

A sample of Argentinean beef for export, coming from three production system, was analyzed for the aspect and results showed significant qualitative differences among them. The eventual freezing and transport of the beef reduced the differences between the three systems and worsened the color of the meat, making them darker and more opaque. It would therefore be more effective for the Italian market a more traditional production and qualitatively more uniform looking to improve the beef aspect with regard to the expectations of the Italian consumer, that is clearer and lean meats.

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