MEAT QUALITY OF BEEF FROM CROSSBRED ANIMALS FED TWO DIFFERENT DIETS

Renata T. Nassu[1], Maria Lígia P. da Silva[2], Gerlane F. Brito[2], Alexandre Berndt[1],

Rymer R. Tullio[1] and Maurício M. de Alencar[1,3]

[1] Embrapa Southeast Livestock, São Carlos, São Paulo, Brazil

[2] Faculdade de Ciências Agrárias e Veterinárias, Universidade Estadual Paulista, Jaboticabal, SP, Brazil

[3]CNPq Researcher

Abstract – Meat quality can be affected by breed, diet, production systems, pre and post slaughter conditions. This study aimed to evaluate the meat quality from young bulls from Charolais or Hereford bulls and 1/2 Angus x 1/2 Nellore or 1/2 Simental x 1/2 Nellore cows, fed two different diets. Samples were also aged for 28 days. Shear force, water holding capacity, colour, pH and cooking loss were measured. Meat quality was not affected by bull or cow genetic groups and only water holding capacity was affected by diet. Aging time played a major role affecting all the quality parameters except pH and cooking loss.

Key Words – Charolais, Hereford, Physico-chemical analysis

- INTRODUCTION

Brazil has 212-million animals herd and is the largest exporter in the world, with 1.69 million ton of carcass weight equivalent in 2012 [1]. Production efficiency and product quality are important factors for producers, retailers and consumers. Improvement in diets, system productions, breeding, animal health and welfare would increase production and profits. Crossbreeding of two or more breeds from *Bos taurus* and *Bos indicus* species is an alternative for obtaining high quality meat from adapted animals to tropical climates. The combination of the use of these animals and different diets can improve meat quality. This study aimed to evaluate the meat quality from crossbred animals fed two different diets.

- MATERIALS AND METHODS

Fifty young bulls, crossbred from Hereford or Charolais bulls and 1/2 Angus x 1/2 Nellore or 1/2 Simmental x 1/2 Nellore cows, were maintained in 30 m^2 individual pens, and randomly assigned to two different diets - A and B (25 animals per treatment). Within the same diet, it was changed from A1 to A2 and B1 to B2 when females and males reached 330kg and 380 kg respectively. Ration formulations are shown in Table 1. Rations were fed *ad libitum* in a total of 122 days.

Table 1 Composition of rations (% dry matter)

	A1	A2	B1	B2
Corn silage	65.0	45.0	68.0	50.0
Ground corn grain	18.0	26.8	12.0	32.8
Wheat meal	3.5	5.0	3.5	8.0
Soybean meal	6.0	5	15.0	7.0
Limestone	0.5	0.7	0.5	0.7

Mineral supplement	1.0	1.0	1.0	1.0
Urea		0.5		0.5
Citrus pulp		8.0		
Corn gluten	6.0	3.0		
Protected fat		5.0		
Concentrate %	35.0	55.0	32.0	50.0

The average live weight at the end of the feeding period was 463 kg. Average age at slaughter was 11 months. Animals were shipped the day before slaughter to a commercial abattoir and held overnight with access to water. Carcasses were chilled overnight at 2°C. At 24 hours post mortem, the left half-carcass was cut between the 12^{th} and 13^{th} rib where rib-eye area and fat thickness were measured and 2.5 cm steaks were removed for quality (pH, water holding capacity, cooking loss, objective colour and shear force) analyses at the Embrapa's Meat Analysis Laboratory. Steaks for aging were vacuum-packed and maintained at 1-2°C for 14 and 28 days and analysed for the same parameters. For objective colour, steaks were exposed to atmospheric oxygen for thirty minutes prior to the analyses, and CIE L*, a* and b* parameters were measured at three locations across the surface of the steaks using a Hunter Lab colorimeter model MiniScan XE with Universal Software v. 4.10 (Hunter Associates Laboratory, Inc., Reston, VA, USA), illuminant D65 and observer 10°. pH was then measured also at three locations across the surface using a Testo pH measuring instrument, model 230 (Testo AG, Lenzkirch, Germany). Water holding capacity was obtained by the difference between the weight of a meat sample of approximately 2g, before and after it was submitted to a pressure of 10 kgf for 5 minutes as described by Hamm [2]. For cooking loss and shear force measurements, the same steak of 2,5 cm thickness was weighed and cooked in a Tedesco combined oven, model TC 06 (Tedesco, Caixas do Sul, RS, Brazil), at 170°C until the temperature at the centre of the sample reached 70°C, controlled by termocouples linked to the FE-MUX software (Flyever, São Carlos, SP, Brazil). The samples were then cooled at room temperature and weighed again. Cooking loss was calculated by the difference between the weights before and after cooking, expressed as percentage. These steaks were transferred to a cooler and held for 24 hours, after which, eight cores, 1.27 cm in diameter, were removed per steak, parallel to the fibre grain. Peak shear force was determined on each core perpendicular to the fibre grain using a 1.016 mm Warner Bratzler probe in a TA.XT Plus Texture Analyzer (crosshead speed 200 $mm.min^{-1}$ and a 50 kg load cell, 40 mm distance, calibration weight 10kg - Stable Micro Systems Ltd., Surrey, UK). Full peak shear force was recorded and maximum shear force was calculated as the average of the eight cores. The experimental design was completely randomized, with bull genetic group (GGT), cow genetic group (GGV) diet and aging time as fixed factors. The proposed model was analyzed by XLSTAT software [3].

- RESULTS AND DISCUSSION

Analysis of variance (ANOVA) is shown in Table 1. Bull genetic group (GGT) and cow genetic group (GGV) did not affect any quality parameters. Diet affected only water holding capacity (WHC). Time of ageing affected all the quality parameters, except pH and cooking loss. No interaction was found among diet, GGT, GGV and time.

Table 1 Analysis of variance

Fixed effects	Sum of squares

	Shear force	WHC	L*	a*	b*	pH	Cooking loss
GGT	0.000	2.615	14.336	2.201	12.652	0.005	93.24
GGV	1.102	0.633	17.298	4.519	0.094	0.104	0.51
Diet	0.223	72.779 **	6.649	2.461	1.527	0.005	7.00
Time	279.32 ***	912.78 ***	64.180 ***	1182.4 ***	92.736 ***	0.058	68.01
Diet x GGT	0.734	16.785	0.593	3.266	0.237	0.001	36.52
Diet x GGV	0.538	0.000	0.634	0.087	2.762	0.004	35.23
Diet x time	1.738	46.169	5.293	1.695	0.656	0.023	23.57
Error	2.099	7.468	8.947	3.782	5.033	0.043	27.81
R^2	0.663	0.657	0.126	0.818	0.226	0.050	0.08
S.D.	2.16	4.52	3.1	4.42	247	0.205	5.33

*$p<0.05$; ** $p<0.01$; *** $p<0.001$

WHC=water holding capacity; GGT=bull genetic group; GGV=cow genetic group; S.D.=standard deviation.

Values of quality parameters by fixed effect are shown in Table 2. No differences ($p>0.05$) between traits of GGT, GGV and diet were found, except water holding capacity for diet. Rate and extent of pH decline, net charge effects, steric effects, mechanisms involving postmortem proteolysis as calpain/calpastatin system and protein oxidation affects the water holding capacity of meat. Diet, breed, ante and post mortem factors can affect the rate of oxidation and differences in the antioxidant system which is related to calpain activity and proteolysis, influencing this quality characteristic [4].

Table 2 Meat quality from animals fed different diets according to bull genetic group (GGT), cow genetic group (GGV) and diet

	GGT		GGV		Diet	
	HF	IC	TA	TS	A	B
Shear force, kgfcm^{-2}	4.00	4.00	3.91	4.08	4.04	3.96
WHC,%	75.47	75.21	75.27	75.41	74.63 a	76.05 b
Meat colour						
L*	39.15	38.51	38.48	39.17	39.05	38.61
a*	11.51	11.27	11.57	11.22	11.26	11.52
b*	13.78	13.18	13.46	13.51	13.38	13.58
pH	5.62	5.63	5.65	5.60	5.63	5.62

Cooking loss, %	27.8 2	26.1 9	26.9 3	27.0 9	26.78	27.23

HF=Hereford; IC=Charolais; TA=Angus x Nellore; TS=Simmental x Nellore; WHC=water holding capacity

[a,b]Means in the same row within the same fixed effect, with different superscripts are significantly different (*P* <0.05).

Table 3 Meat quality from animals fed different diets according to aging time

	Aging time (days)		
	1	14	28
Shear force, $kgfcm^{-2}$	6.73b	2.88a	2.38a
WHC,%	80.26b	73.25a	72.51a
L*	37.54a	39.76b	39.19b
a*	5.84a	13.45b	14.88a
b*	14.70c	13.74a	12.00b
pH	5.60	5.61	5.66
Cooking loss, %	27.46	25.67	27.89

WHC=water holding capacity

[a,b]Means in the same row within the same fixed effect, with different superscripts are significantly different (*P* <0.05).

The meat quality parameters for aging time are shown in Table 3. Shear force values decreased as expected. Aging affects shear force values and differences are related to enzimatic activity, fat content, fibre type and structural characteristics [5]. The water holding capacity also decreased in time and it is explained by structural changes in proteins due to proteolysis during the aging process and drip loss occur [4]. Colour parameters L* and a* had their values increased (p<0.05). The increasing values of L* are related to the lower water holding capacity [4] and reflection in the meat surface increases, turning the meat more clear. Increasing of a* parameter is due to the decrease of enzymes that compete for oxygen, and more oxygen will be available to turn to oxymioglobin, enhancing the red colour [6,7]. Changes in b* are explained by the increase of metmyoglobin content due to oxidation in the meat surface [7]. pH and cooking loss were not affected by aging time.

- CONCLUSION

The meat quality parameters were not affected by bull or cow genetic group, whilst diet had an effect on water holding capacity. Aging time played a major role affecting all the quality parameters except pH and cooking loss.

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