MEAT QUALITY OF CANCHIM BREED STEERS FED FRESH OR ENSILED SUGARCANE

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Abstract – Sugarcane is a very important agricultural product in Brazil and feeding beef cattle with sugarcane silage is an alternative. This study aimed to evaluate the quality (rib-eye area, fat thickness, meat and fat objective colour, pH, water holding capacity, cooking loss and shear force) and sensory (characteristic beef aroma/flavour, strange aroma/flavour intensity, tenderness and juiciness) parameters of beef from Canchim (a synthetic beef cattle breed developed in Brazil by crossing Charolais with Zebu breeds, resulting in a 5/8 Charolais and 3/8 Zebu) steers fed different diets, containing fresh sugarcane (T1), sugarcane silage (T2) or corn silage (T3). Generally, diets did not affect meat quality and sensory characteristics, except fat colour (b*) in beef from steers fed corn-silage and off-flavour in beef from steers fed fresh sugarcane.

Key Words – forage, beef, sensory, physical-chemical analysis

I. INTRODUCTION

Brazil is the world largest sugarcane producer, with approx. 630 million ton in 2011/2012, in a harvested area of 8.4 million hectares [1]. Sugarcane has been used as silage as there is need of feeding livestock and using sugarcane with higher efficiency in the country [2]. Ensilage allows better feed and field management and avoids wasting surplus sugarcane at the end of the harvest season or total loss of the forage due to fire or frost. Sugarcane has some advantages when used as silage, presenting an adequate dry matter (DM), higher sugar content and low buffering properties, but sugarcane silages are also characterized by intense alcoholic fermentation making the use of additives for yeast control essential [3]. Research involving beef cattle nutrition and feeding must address consumers´ needs regarding to meat quality and its nutritional properties. Feeding can modify meat quality characteristics such as colour, tenderness and fat content, depending on ingested energy and diet composition [4, 5]. Therefore, it is important to evaluate the effect of feeding sugarcane silage, comparing to traditional feeds as fresh sugarcane and corn silage.

II. MATERIALS AND METHODS

Forty-five Canchim steers were maintained in 30 m^2 individual pens, and randomly assigned to three different diets (15 animals per treatment). Ration formulations are shown in Table 1. Rations were fed *ad libitum* for 68 days.

Table 1. Composition of rations (% dry matter)

	Fresh sugarcane (T1)	Sugarcane silage* (T2)	Corn silage (T3)
Fresh sugarcane	35.0	-	-
Sugarcane silage	-	35.0	-
Corn silage	-	-	35.0
Ground corn grain	45.0	51.0	37.5
Soybean meal	-	12.0	-
Wheat meal	17.0	-	25.0
Urea	1.2	1.0	0.7
Limestone	0.8	.	0.8
Mineral supplement	1.0	1.0	1.0

*Produced with 1% $Ca(OH)_2$ as additive for yeast control

The average live weight at the end of the feeding period was 457 kg., corresponding to an average daily weight gain of 1.8 kg/animal. Average age at slaughter was 25 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 and 13th 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) and sensory analyses at the Embrapa's Meat Analysis Laboratory. The steaks for quality analysis were immediately analyzed while steaks for sensory analyses were labelled, vacuum-packed and frozen. 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 weights 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 [6]. 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 thermocouples 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 aTA.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. Steaks for sensory evaluation were placed in a refrigerator at 5°C overnight. The following day, the steaks were cooked in a Tedesco combined oven, model TC 06 (Tedesco, Caixas do Sul, RS, Brasil), at 170°C, until reaching an internal temperature of 75°C. Each steak was cut into 1.5 cm cubes and each sample was randomly assigned to a ten-member trained taste panel. The samples were presented for each panellist in a balanced design assigned by Fizz Software version 2.41 (Biosystemes, Couternon, France). Attribute ratings were electronically collected using nine point descriptive scales for beef characteristic aroma/flavour (1 = extremely bland; 9 = extremely intense), strange aroma/flavour (1 = extremely intense; 9 = none), tenderness (1 = extremely tough; 9 = extremely tender) and juiciness (1 = extremely dry; 9 = extremely juicy).

The experimental design was completely randomized, with diet as fixed factor. The proposed model was analyzed by SAS 9.1 software [7].

III. RESULTS AND DISCUSSION

Diet had no effect (P>0.05) on meat quality characteristics, except for fat colour a* and b* parameters (P=0.047 and P=0.005, respectively) (Table 2). Fat from animals fed corn silage showed higher (P<0.05) red (a*) and yellow (b*) values. This result may be related to higher ingestion of carotenes by animals fed sugarcane silage (higher % of ground corn in the ration) and corn silage (high % of grain in the forage) among treatments. Appearance of beef fat is mainly affected by carotene concentration and hemoglobin concentration, on yellowness (b*) and redness (a*), respectively. An increase in the concentration of carotenoids, increases yellowness of the fat [8]. The chemical state of hemoglobin and the translucency of fat and connective tissue also affects fat colour [9].

There was an effect of diet on "strange flavour" attribute (P=0.021) (Table 3). Meat from animals fed fresh sugarcane showed lower value (8.0), which corresponds to "very bland", while meat from animals fed sugarcane silage showed a 8.6 value, next to "none" (no strange flavour). Meat from animals fed corn silage was not different from the two other traits. Diet had no effect (P>0.05) on the attributes "characteristic beef aroma/flavour", "strange aroma", "tenderness" and "juiciness". In previous studies, comparing diets containing corn silage or fresh sugarcane fed to Canchim or Hereford animals, no difference was found in sensory nor meat quality characteristics, such as rib-eye area, fat thickness, pH, water holding capacity, shear force and cooking loss [10, 11]. In these other studies, sensory characteristics were described only as "flavour" and different scales and trained panel were used , making it difficult to compare to the results obtained in this study. Fatty acid composition is significantly correlated with flavour [12, 13] and differences in diet composition; mainly between silage-based and fresh sugarcane-based diets might lead to differences in beef off-flavour.

Table 2. Meat quality from animals fed different diets

	Diet[1]				P
	T1	T2	T3	s.e.m.	value
Rib-eye area, cm^2	68.46	69.71	71.27	0.185	0.753
Fat thickness, mm	2.54	2.93	3.50	0.177	0.156
pH, 24h	5.55	5.59	5.60	0.179	0.235
Cooking loss, %	24.77	23.88	26.59	0.180	0.257
Water holding capacity, %	79.26	80.33	79.24	0.182	0.421
Initial meat colour, 24h					
L*	40.53	41.53	40.82	0.181	0.350
a*	14.66	14.18	14.32	0.182	0.419
b*	13.29	13.26	13.08	0.185	0.842
Fat colour					
L*	75.13	75.10	73.67	0.179	0.230
a*	7.11	7.58	9.22	0.172	0.047
b*	17.41[b]	17.77[b]	20.22[a]	0.162	0.005
Shear force, $kgfcm^{-2}$	6.82	7.21	6.87	0.185	0.846

[1]T1: fresh sugarcane; T2: sugarcane silage; T3: corn silage
[a,b]Means in the same row with different superscripts are significantly different (P<0.05); s.e.m., standard error of mean.

Table 3. Sensory analysis of meat from animals fed different diets

	Diet[2]				
Attributes[1]	T1	T2	T3	s.e.m.	P value
Characteristic beef aroma	5.6	5.2	5.5	0.24	0.46
Strange aroma intensity	8.5	8.4	8.3	0.23	0.27
Characteristic beef flavour	5.2	4.9	4.8	0.24	0.53
Strange flavour intensity (off-flavour)	8.0[b]	8.6[a]	8.4[ab]	0.20	0.02
Tenderness	4.6	5.5	5.7	0.22	0.17
Juiciness	5.4	5.2	5.5	0.24	0.61

[1]beef characteristic aroma/flavour (1 = extremely bland; 9 = extremely intense), strange aroma/flavour (1 = extremely intense, 9 = none), tenderness (1 = extremely tough; 9 = extremely tender) and juiciness (1 = extremely dry; 9 = extremely juicy).
[2]T1: fresh sugarcane; T2: sugarcane silage; T3: corn silage
[a,b]Means in the same row with different superscripts are significantly different (P<0.05); s.e.m., standard error of mean.

IV. CONCLUSION

The different rations, containing fresh sugarcane, sugarcane silage or corn silage, in general, did not affect meat quality. However, some characteristics as fat colour and flavour were affected by the diets. Further studies must be addressed to verify if these parameters will really affect consumers' preferences.

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