# SENSORY ANALYSIS OF BEEF FROM CROSSBRED ANIMALS FINISHED ON PASTURE OR FEEDLOT

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**Abstract – 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. Sensory attributes of beef are very important in relation to consumer's point of view, mainly regarding to its tenderness and flavour. This study aimed to evaluate the sensory characteristics of crossbred heifers and steers from Angus or Limousin bulls and 1/2 Angus x 1/2 Nellore or 1/2 Simental x 1/2 Nellore cows, finished on pasture or feedlot. Characteristic beef aroma/flavour, strange aroma/flavour intensity, tenderness and juiciness were evaluated. The system production combined with bull genetic group had effect on aroma and flavour of crossbred animals, but texture characteristics were not affected.**

**Key Words – meat, *Bos taurus*, *Bos indicus*, descriptive analysis**

## I. INTRODUCTION

Sensory characteristics such as tenderness, flavour and appearance are important to verify consumers´ acceptability and need to be addressed on meat quality control. Many factors are involved on beef sensory quality and variations can be induced by production factors as breed, age, diet as well as technological factors as slaughter conditions, ageing time and cooking procedures [1].

Sensory analysis is an important tool to evaluate attributes that cannot be properly measured by objective methods, such as aroma, flavour and texture (tenderness and juiciness), as human perception is more complete, through assessors from a trained panel. This study aimed to evaluate the sensory characteristics of beef from crossbred animals from tropical climate adapted and non- adapted breeds, finished on feedlot or pasture.

## II. MATERIALS AND METHODS

Beef from eighty animals, steers and heifers from crosses of Limousin or Angus bulls and 1/2 Angus x 1/2 Nellore (TA) or 1/2 Simental x 1/2 Nellore (TS) cows from Embrapa Southeast Livestock, São Carlos, Brazil were evaluated. Half of the animals were finished on feedlot and half on pasture. Five animals from each crossbreed/sex/cow/production system, in a total of 16 traits were evaluated. Animals were slaughtered when reached approximately 5 mm of fat thickness estimated by ultrasound measurements. At the end of each feeding period, feedlot-finished animals had an average age and weight of 12.2 months and 425.3 kg and pasture finished animals, 17.7 months and 445.9 kg.

Animals were shipped the day before the 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 and 2.5 cm steaks were removed for sensory analyses. Samples were taken to Meat Analysis Laboratory at Embrapa Southeast Livestock (São Carlos, SP, Brazil) and frozen. The day before the sensory evaluation the steaks were placed in a refrigerator at 5°C overnight. The following day, the steaks were removed from the refrigerator and cooked in a Tedesco combined oven model TC 06 (Tedesco, Caixas do Sul, RS, Brasil) at 170°C, until reach 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 for each panellist were presented in a balanced design assigned by Fizz Software version 2.41 (Biosystemes, Couternon, France). Eight samples were evaluated per session. 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 bull genetic group (GGT), cow genetic group (GGV), sex (sexo) and production system (term) as fixed factors. The proposed model was analyzed by SAS 9.1 software [2].

## III. RESULTS AND DISCUSSION

P values from main effects of this study are presented in Table 1.

Table 1. *P* values of different fixed factors and interactions

| | Sensory attributes[5] | | | | | |
|---|---|---|---|---|---|---|
| Effect | ACCB | ARES | SCCB | SABEST | MZ | SL |
| GGT[1] | 0.87 | 0.20 | 0.94 | 0.78 | 0.33 | 0.93 |
| GGV[2] | 0.98 | 0.43 | 0.26 | 0.28 | 0.22 | 0.04 |
| Sexo[3] | 0.34 | 0.28 | 0.58 | 0.22 | 0.52 | 0.70 |
| Term[4] | 0.00 | 0.11 | 0.04 | 0.25 | 0.71 | 0.74 |
| GGT*GGV | 0.20 | 0.76 | 0.19 | 0.83 | 0.88 | 0.78 |
| GGT*sexo | 0.96 | 0.26 | 0.43 | 0.01 | 0.57 | 0.87 |
| GGT*term | 0.43 | 0.56 | 0.02 | 0.78 | 0.86 | 0.18 |
| GGV*sexo | 0.35 | 0.36 | 0.90 | 0.05 | 0.16 | 0.47 |
| GGV*term | 0.32 | 0.36 | 0.23 | 0.58 | 0.95 | 0.82 |
| sexo*term | 0.39 | 0.97 | 0.24 | 0.60 | 0.69 | 0.53 |
| GGT*GGV *sexo | 0.37 | 0.27 | 0.27 | 0.84 | 0.66 | 0.93 |
| GGT*GGV *term | 0.47 | 0.56 | 0.78 | 0.22 | 0.69 | 0.20 |
| GGT*sexo *term | 0.61 | 0.94 | 0.44 | 0.78 | 0.78 | 0.35 |
| GGV*sexo *term | 0.25 | 0.57 | 0.91 | 0.33 | 0.40 | 0.10 |
| GGT*GGV *sexo*term | 0.35 | 0.45 | 0.32 | 0.75 | 0.38 | 0.27 |

[1]GGT: bull genetic group; [2]GGV: cow genetic group; [3]Sexo: sex; [4]Term: production system; [5]ACCB: beef characteristic aroma; AREST: strange aroma (off-flavour) ; SCCB: beef characteristic flavour); SABEST: strange aroma; MZ: tenderness; SL: juiciness.

Bull (GGT) and sex (sexo) did not show effect for any of the sensory parameters ($P$>0.05). Effect of cow (GGV) had an effect on SL (juiciness) ($P$=0.04), whereas production system (term) had effect on ACCB (beef characteristic aroma) ($P$<0.01) and SCCB (beef characteristic flavour) ($P$=0.04). Beef from feedlot-finished animals showed a more intense characteristic beef aroma and flavour than pasture-finished animals (Table 2). In Figure 1, the principal component analysis shows a separation among pasture- and feedlot-finished animals and can be considered a tool to evaluate difference among the studied samples.

Table 2. Production system (TERM) effect on beef characteristic aroma (ACCB) and beef characteristic flavour (SCCB) sensory attributes

| Production System (Term) | ACCB | SCCB |
|---|---|---|
| Feedlot | 5,1[a] | 4,8[a] |
| Pasture | 4,4[b] | 4,5[b] |

[a,b]Means in the same column with different superscripts are significantly different ($P$ < 0.05); s.e.m., standard error of mean.

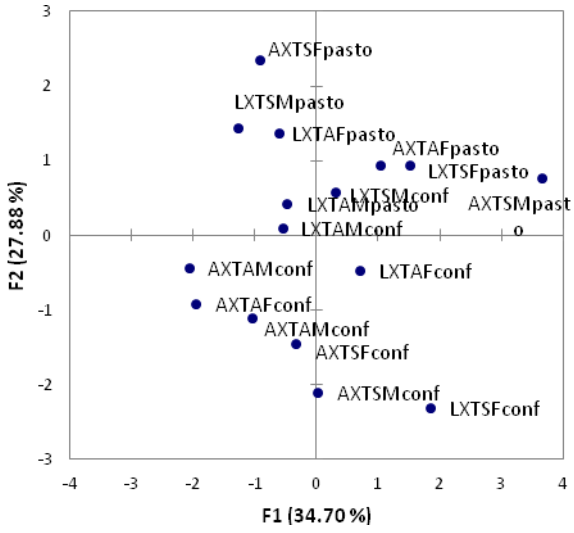


Figure 1. Principal component analysis of sensory attributes and studied traits. AX=Angus bull cross; LX=Limousin bull cross; TS=1/2 Simental x 1/2 Nellore cow; TA=1/2 Angus x 1/2 Nellore cow; F=heifers; M=steers; pasto=pasture; conf=feedlot.

An interaction between GGT and sexo (sex) was found for SABEST (off-flavour), where Limousin female animals showed higher values of SABEST (off-flavour), meaning these animals showed less off-flavour than Limousin male animals, and the opposite occurred to Angus animals (Figure 2). Another interaction between GGT and term (production system) was found (Figure 3), on which feedlot-finished Angus animals showed a more intense beef flavour (SCCB) than pasture-finished Limousin animals. In a previous study, beef from steers fed high-energy, corn containing diets for at least 90 d, compared with beef from fed pasture grasses usually had more intense beefy flavor [3]. Feedlot- and pasture-finished Limousin animals did not differ ($P$>0.05). These differences may be the result of flavour compounds of beef. Beef flavour is known to be affected by the breed of cattle. Nitrogen- and sulfur compounds, free amino acids, alcohols, aldehydes and ketones in the flavor volatiles differ among beef from different breeds of cattle [4, 5]. In relation to production systems, in general, grass-fed (pasture) and grain-fed (feedlot) ruminant animals show different fatty acid profiles, which can lead to distinct flavour and off-flavour in the beef [6].

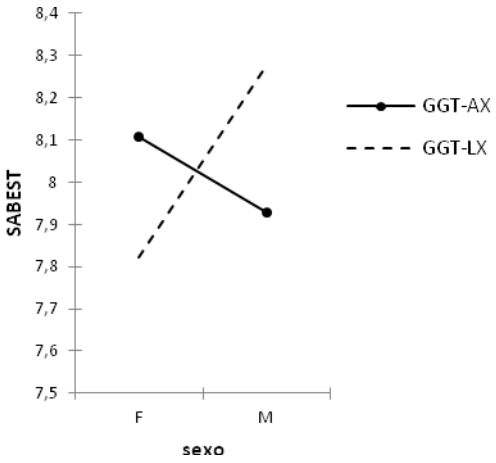


Figure 2. Interaction between GGT (bull) and Sexo (sex) effects for SABEST (off-flavour) sensory attribute. AX=Angus bull cross; LX=Limousin bull cross; F=heifers; M=steers.

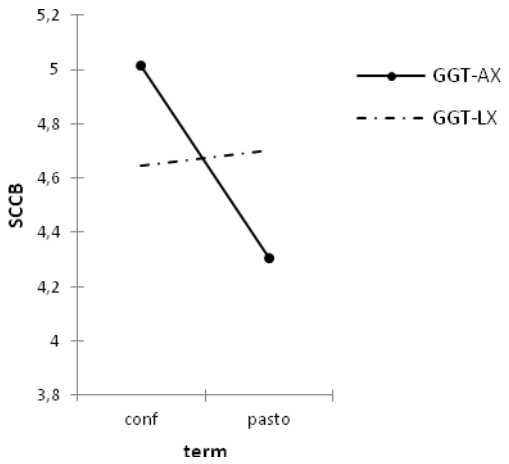


Figure 3. Interaction between GGT (bull) and Term (production system) effects for SCCB (beef characteristic flavour). AX=Angus bull cross; LX=Limousin bull cross; pasto=pasture; conf=feedlot.

Table 3. Average values of aroma and flavour sensory attributes for different traits

| Production System | Trait[2] | Sensory attribute[1] | | | |
|---|---|---|---|---|---|
| | | ACCB | AREST | SCCB | SABEST |
| Pasture | AXTAM | 4.1 | 8.4 | 3.7 | 7.6 |
| | AXTAF | 5.0 | 8.6 | 4.8 | 8.2 |
| | AXTSM | 5.4 | 8.3 | 5.2 | 8.5 |
| | AXTSF | 5.0 | 8.4 | 4.8 | 8.1 |
| | LXTAM | 4.7 | 8.3 | 4.7 | 7.9 |
| | LXTAF | 4.2 | 8.3 | 4.4 | 7.8 |
| | LXTSM | 5.1 | 8.0 | 5.0 | 8.2 |
| | LXTSF | 4.1 | 8.2 | 4.3 | 7.8 |
| Feedlot | AXTAM | 4.9 | 8.5 | 4.7 | 8.0 |
| | AXTAF | 4.1 | 8.7 | 4.3 | 7.7 |
| | AXTSM | 5.0 | 8.4 | 4.9 | 8.2 |
| | AXTSF | 4.7 | 8.4 | 4.6 | 7.9 |
| | LXTAM | 4.6 | 8.2 | 4.5 | 7.9 |
| | LXTAF | 4.7 | 8.3 | 4.7 | 8.0 |
| | LXTSM | 5.3 | 8.0 | 5.0 | 8.3 |
| | LXTSF | 5.3 | 8.2 | 5.1 | 8.4 |

[1]ACCB: beef characteristic aroma (1= extremely bland; 9= extremely intense); AREST: strange aroma (1= extremely intense, 9=none); SCCB: beef characteristic flavour (1= extremely bland; 9= extremely intense); SABEST: strange aroma (1= extremely intense, 9=none).
[2]AX=Angus bull cross; LX=Limousin bull cross; TS=1/2 Simental x 1/2 Nellore cow; TA=1/2 Angus x 1/2 Nellore cow; F=heifers; M=steers.

There was no interaction between three and four effects ($P$>0.05). Average values for aroma/flavour and texture attributes and traits are shown in Tables 3 and 4 respectively.

Table 4. Average values of texture sensory attributes for different traits

| Production System | Trait[2] | Sensory attribute[1] MZ | SL |
|---|---|---|---|
| Pasture | ANTAM | 4.0 | 4.8 |
| | ANTAF | 5.8 | 5.5 |
| | ANTSM | 6.1 | 6.0 |
| | ANTSF | 5.7 | 5.4 |
| | LITAM | 5.3 | 5.3 |
| | LITAF | 5.0 | 5.1 |
| | LITSM | 5.9 | 5.5 |
| | LITSF | 5.0 | 5.0 |
| Feedlot | ANTAM | 5.6 | 5.4 |
| | ANTAF | 4.9 | 4.9 |
| | ANTSM | 5.8 | 5.5 |
| | ANTSF | 5.2 | 5.3 |
| | LITAM | 5.1 | 5.1 |
| | LITAF | 5.6 | 5.3 |
| | LITSM | 6.0 | 5.7 |
| | LITSF | 6.0 | 5.9 |

[1]MZ: tenderness (1=extremely tough; 9= extremely tender); SL: juiciness (1=extremely dry; 9= extremely juicy).
[2]AX=Angus bull cross; LX=Limousin bull cross; TS=1/2 Simental x 1/2 Nellore cow; TA=1/2 Angus x 1/2 Nellore cow; F=heifers; M=steers.

## IV. CONCLUSION

The system production combined with bull genetic group had effect on aroma and flavour sensory characteristics of crossbred animals, but texture characteristics were not affected.

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