

CONSUMER'S ACCEPTABILITY OF BEEF FROM ANIMALS SUPPLEMENTED WITH ESSENTIAL OILS

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Abstract – *Longissimus* steaks aged for 24 hours from 57 crossbred (n = 30 heifers and 27 young bulls) ½ Angus - ½ Nellore, finished in feedlot with three isoenergetic and isonitrogenous diets, which differed in quantity of a mix of essential oils added (0, 3.5 or 7 g/animal/day, respectively) were used to study consumer acceptability of beef. 120 Brazilian consumers participated in the study. Consumers evaluated tenderness, flavor and overall acceptability of meat from 3 diets and 2 sexes using a hedonic nine point scale. Sex was a significant factor for all attributes ($P \leq 0.001$) and diet (essential oils effect) for tenderness and flavor ($P \leq 0.01$). Also, there was interaction between factors. Meat from heifers was more appreciated than bulls. Addition of 3.5 g/animal/day of essential oils had the highest scores in all variables, without statistical differences with control diet. PCA showed as meat from heifers (three diets) and the group of young bull supplemented with 3.5 g/animal/day was those that had the highest acceptability scores in all variables. In conclusion, meat originated from diets with essential oils could improve meat acceptability in beef when is added at concentration of 3.5 g/animal/day.

Key Words – Crossbred, meat quality, natural additives, sensory evaluation

I. INTRODUCTION

According to FAPRI (1), Brazil has the second largest bovine herd in the world, following by India, but presenting the biggest commercial herd. Tendency of last years is to increase not only beef production, also exportation, mainly to European Union, Russia, Japan, Arabia (1).

In spite of the most frequent production system is extensive under pasture conditions, finishing animals in feedlot begin to increase (2) due to reduce the time of slaughter and can improve meat quality (3).

In traditionally feedlot systems, additives as ionophores were used to improve alimentary efficiency and animal performance, as consequence of their antimicrobial properties and actuation in ruminal bacteria (4); however use of those products have been forbidden in some regions of the world, as European Union, due to possible risk of toxicity to human health, and the emergence of resistant bacteria. As consequence, search of natural alternatives to replace the effect of these products started (5). Essential oils are natural plant extracts that contain a wide variety of compounds with antimicrobial and antioxidant activities evaluated *in vitro* (6), and some current researches also show possible positive effects of essential oils on animal performance (7). Consumers are becoming more health conscious, and this is leading to growing preference for quality, safety, healthier and more natural food products, being the use of plants' derivate an alternative to replace chemical additives, which seem to be well accepted by consumers, if visual and sensory characteristics are kept (8).

The aim of this study was to evaluate consumer acceptability of meat from heifers and young bulls finished with different concentrations of essential oils.

II. MATERIALS AND METHODS

Fifty seven 12 month-old crossbred ½ Angus - ½ Nellore young bulls (n = 27) and heifers (n = 30), average weight of 243.2 ± 35.3 kg and 219.8 ± 27.9 kg respectively, were randomly assigned to one of three finishing diets (n = 9 for males and 10 for females, per treatment). The principal diet was the same for all animals, been formulated according to NRC (9) recommendations for a 1.5 kg/day weight gain (Table 1). The three experimental treatments were: (E00) diet without

addition of mix essential oil or control diet, (E3.5) diet with 3.5 g/animal/day of essential oil, and (E7.0) diet with 7.0 g/animal/day of the essential oil. Component of mix (Mixoils[®]) consisted on seven plants extracts: oregano (*Origanum vulgare*), garlic (*Allium sativum*), lemon (*Citrus limonium*), rosemary (*Rosmarinus officinalis*), thyme (*Thymus vulgaris*), eucalyptus (*Eucalyptus saligna*) and sweet orange (*Citrus aurantium*). All diets were isoenergetic and isonitrogenous.

Young bulls and heifers were finishing with their respective diets under intensive conditions (90:10; concentrate: forage) during 4 or 3 months, respectively until reach commercial weigh (440.3 \pm 51.2 kg and 345.0 \pm 31.0 kg, respectively).

Table 1 Chemical composition of basal diets (% on dry matter basis)

Dry Matter	88.14
Organic matter	96.58
Crude Protein	12.51
Ether extract	3.15
Total Digestive nutrients	81.43
Fiber carbohydrates	6.37
Neutral detergent fiber	21.02
Acid detergent fiber	10.62
Calcium	0.36
Potassium	0.14

Afterwards, they were slaughtered in a commercial abattoir 20 km from feedlot (Maringá, PR) according to cattle finishing routine in Brazil. The left *Longissimus thoracis* (LT) muscles were removed from each carcass at 24 h after slaughter and cut into 2 cm-thick steaks from the 10th *thoracis vertebrae*. Each sample was vacuum packaged and frozen at -18°C for consumer sensory evaluation less than 3 months.

Samples for consumers test were thawed at 4°C during 24 h prior to the analysis. Consumer test was performed during a National Livestock Exhibition in Maringá (Brazil) and involved 120 local consumers divided in groups of twenty four people by session. Consumers profile was according to Brazilian national profile (10), being participant: 51.6% women and 48.4% men, ranged by the following intervals of age: 28% younger than 25 years old, 30% between 26-40 years; 20% between 41-55 years and 22% older than 56 years old. Each sample was cooked in a grill pre-heated at 200 °C until reaching an internal temperature of 70 °C monitored with a penetration thermocouple and wrapped individually with aluminum foil,

identified with a single three digits code. Samples were cut in 2 x 2 cm cubes and kept warm until consumer evaluation (less than 10 minutes from cooking). Meat was served following a randomized design to avoid order and carry-over effects (11). For each sample, consumers evaluated three different attributes: tenderness acceptability, flavor acceptability and overall acceptability; using a structured hedonic 9 point scale ranging from (1 = dislike extremely to 9 = like extremely). Also they were asked to fill in a survey, questions about socio-demographic variables, meat consumption frequency and their opinion about use of natural (essential oils) of synthetic molecules (antibiotics) in livestock alimentation, in order to increase information about each consumer and global perception of natural additives.

Meat attributes were assessed by analysis of variance using a General Lineal Model (GLM) Procedures (12). Diet and sex were considered fixed effects, and consumer as a random effect. Mean and standard error of mean (SEM) were calculated for each variable. When differences were statistically significant a Duncan test was used ($P \leq 0.05$). Principal Component Analysis (PCA) and Pearson correlations were also performed with the XLSTAT statistical package.

III. RESULTS AND DISCUSSION

As compiles Table 2, diet effect (inclusion of essential oils) was a significant factor for tenderness and flavor acceptability scores ($P \leq 0.01$) showing a tendency in overall acceptability ($P \leq 0.10$). However, sex had a significant effect in all variables analyzed ($P \leq 0.001$) and interaction between both factors happened in tenderness and overall.

When data are analyzed respect to the three diet groups, the highest values for all attributes were showed in E3.5 group, although not significant differences were found in comparison with control diet (E0.0), being acceptabilities for E7.0 group statistically lower than those from the others groups, but without significant differences from (E0.0) (Table 3).

Table 2. P-values of the inclusion of essential oils in the diet and sex effects on consumer sensory beef characteristics

	D	S	D x S
Tenderness	0.009	≤0.001	0.003
Flavour	0.003	≤0.001	0.630
Overall	0.061	≤0.001	0.016

D: Diet (effect of essential oils inclusion: E0.0; E3.5; E7.5), S: Sex; D x S: Interaction Diet x Sex.

Meat from heifers showed significant highest values than young bulls group in all attributes. Globally the most accepted meat was that from heifers respect to young bulls, result according to this was also observed by O'Connor *et al.* (13) studies. This fact could be related to fat quantity and by fiber type.

Table 3. Effect of diet (essential oils inclusion) and sex on consumer acceptability

	Diets			Sex	
	E0.0	E3.5	E7.0	Bulls	Heifers
T.	7.39ab	7.66a	7.29b	7.19x	7.71z
Fl.	7.35ab	7.52a	7.11b	7.11x	7.54z
Ov.	7.41ab	7.56a	7.26b	7.17x	7.65z

E0.0: Without essential oil mix; E3.5: 3.5 g essential oil/animal/day; E7.0: 7.0 g essential oil/animal/day.

T.: Tenderness, Fl.: Flavor, Ov.: Overall

a,b: indicate statistical differences in the same row into the diets ($P \leq 0.05$).

x,z: indicate statistical differences in the same row into the sex ($P \leq 0.05$).

Due to existence of interaction between sex and diet groups, acceptability scores were also analyzed in six groups (Table 4).

Table 4. Effect of diet (essential oils inclusion) and animal sex on consumer acceptability

	Young bulls			Heifers			SEM
	E0.0	E3.5	E7.0	E0.0	E3.5	E7.0	
T.	7.03b	7.62a	6.92b	7.76a	7.70a	7.66a	0.060
Fl.	7.08bc	7.37ab	6.88c	7.61a	7.67a	7.34ab	0.062
Ov.	7.14bc	7.47ab	6.89c	7.67a	7.65a	7.63a	0.058

E 0.0: Without essential oil mix; E3.5: 3.5 g essential oil/animal/day; E7.0: 7.0 g essential oil/animal/day.

T.: Tenderness, Fl.: Flavor, Ov.: Overall.

a,b: indicate statistical differences in the same row ($P \leq 0.05$)

Meat from heifers showed the highest values without statistical differences with young bull group (E3.5) in all attributes. The lowest scores were showed in young bulls supplemented with 7.0 g/a/d of essential oils, however those differences were not significant different from male control group (E0.0). Globally, any score

was less than 7 points in a 9 point scale, which demonstrate a good acceptability in all cases.

In relation to PCA, the first two PC axes, mainly by PCA1, explained >99% of total variance (Figure 1). Tenderness, flavor and overall acceptabilities are placed on the ride side of PC1, closely located to the three heifers' diets and young bulls supplemented with 3.5 g/anim/d. Being the groups control and 7.5g/anim/d. in young bulls, placed in the negative side of PC1 axis and negatively related to acceptability and tenderness scores. Overall acceptability was a little bit more correlated with tenderness ($r = 0.978$) than with flavor ($r = 0.941$).

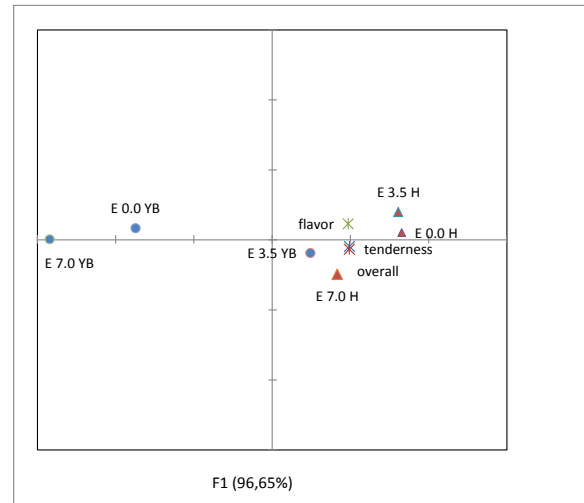


Figure 1. Principal Component Analysis of the scores for tenderness, flavor and overall acceptability of the meat from heifers (H) or young bulls (YB), with different levels of essential oils (E0.0; E3.5; E7.0).

When consumers were asked about what kind of product they would prefer buy: “meat from animals in which natural (vegetal extracts) or synthetics (antibiotics) additives have been used”, the 98.3% of people answered that they would prefer buy meat with natural additives.

IV. CONCLUSION

Inclusion of natural additives (essential oils) in the diet of crossbred beef cattle did not affect negatively to consumer meat acceptability scores or product perception. In this study sex had greater effect than diet; however addition of 3.5

grams/animal/day of this mix of essential oils could improve sensory meat characteristics.

Addition of higher concentrations of essential oils is not synonymous of a greater effect. More studies about concentration, different compound mixtures of essential oils, other breeds of cattle and consumers from different countries would be recommended in order to better understand the action that inclusion of essential oils in the diet have in meat sensory characteristics.

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