POST-MORTEM AGEING AND TENDERNESS CLASSIFICATION OF RIB STEAKS FROM GRASS-FED SENEPOL CROSSBRED BULLS.

Rodas-González, A.[1] and Huerta-Leidenz, N.[2]

[1]Ciencias Veterinarias y [2]Facultad de Agronomía, Nucleo Agropecuario, La Universidad del Zulia, Maracaibo, Venezuela.

Background

There is enough information to affirm that beef derived from post puberal bulls is less tender than that derived from castrated males (bulls) or intact females (heifers or heiferettes) of the same age (Huerta and Rios, 1993). Additionally, grass feeding and predominance of Zebu genes to impart adaptability to the tropical environment, are being also responsible for the high variability observed in tenderness of Venezuelan beef (Huerta-Leidenz and Jerez-Timaure,1996).. Crossbreeding Senepol with Zebu types has been suggested as an effective breeding strategy to reduce tenderness problems in heat-tolerant cattle (Tatum et al., 1996). In Venezuela there is little information about the combined use of electric stimulation and ageing to improve tenderness of meat from Zebu-type bulls and promissory effects had been presented by Riera et al.(1995). Recently, Huerta-Leidenz and Rodas-Gonzalez (1998) use a sensorial data bank gathered in Venezuela for developing tenderness thresholds for rib steaks.

Objectives

The present work evaluate the effect of different periods of postmortem vacuum ageing on cookery traits and palatability of electrically stimulated *longissimus* muscles from grassfed crossbred (F1 Senepol X Zebu) bulls.

To classify rib steaks under study into tenderness groups (tender, intermediate, tough) within ageing periods.

Methods

Crossbred bulls (n=14) were produced by mating three Senepol sires (sire 424 mated six cows; sire 593 three cows and 770 five cows) to Commercial Zebu cows (high percent Nellore). Cattle were slaughtered at 39 to 40 mo of age and were raised on native (*Paspalum fasciculatum, Leersia hexandra* and *Hymenachne amplexicaulis*) or improved pastures (*Brachiaria. humidicola)* in an alternate manner according to the season. Thereafter, the fattening phase was completed by assigning the bull calves to a grazing module. The calves group was rotated among four pastures (total area of 115 ha) of *Brachiaria plantaginea*, without other suplementation than minerals.

All animals were slaughtered at a commercial packing plant. After evisceration, all entire carcasses were electrically stimulated with high voltage (550 V, 60 Hz, 1 to 2 amps) within one hour postmortem approximately. After 24-h chilling (0°C), right sides were ribbed and USDA quality and yield grade data were recorded (USDA,1989). At 48 h postmortem, 12 steaks (2.54 cm thick) were removed from longissimus alternating the position of the steaks and vacuum-packaged for palatability and shear force studies. Two rib steaks were chosen for sensorial analyses and another pair served for the Warner-Bratzler shear test (RCWB) by treatment assignments (2d, 7d and 14d of ageing). Control steaks (2 d ageing time) were blast frozen immediately (-30°C), and stored to that temperature until further analysis. The steaks assigned to the other ageing treatments (7 and 14 d after death) were placed in a refrigerator at 4°C. After completion of the assigned storage time, treated steaks were blast frozen on the same manner as those steaks left as control until further analysis. Frozen samples were stored (-30°C) for 15 d maximum before they were thawed and cooked. Steaks were thawed (4°C) and broiled on open-hearth broilers until reach final internal temperature of 70°C (AMSA, 1995). The taste panel, was constituted by five highly trained judges (Jerez et al.,1994) that tasted a maximum of 15 samples (in two sessions) per day. Two or three cubed samples from each treatment were served warm to each judge. To RCWB, cooked steaks were cool down to room temperature and four to ten core samples (1.27cm in diameter) were removed parallel to the muscle fiber orientation. Each core was sheared using a Warner-Bratzler shear machine.

A analysis of variance was used to evaluate the effects of sire, ageing period and their interaction on cooking traits, RCWB and palatability attributes. When F-test were significant least squares means were compared using LSD tests (SAS, 1985). Additionally, for each treatment, a frequency analysis of the observations allowed to determine the proportion of Tender (RCWB = <3.88 kg), Intermediate (RCWB = 3.88 to 4.98 kg) and tough (RCWB = >4.98 kg) steaks, according to the tenderness thresholds described by Huerta-Leidenz and Rodas-Gonzalez (1998). They carried out a analysis of linear regression analysis, following the approach taken by other authors as critical limit "lightly tender description" (5 points) of the panel (based on a descriptive scale of AMSA, 1978) of eight points: For the regression equation, the University of Zulia´s sensorial database for longissimus muscle (N=767 rib steaks).

Results and Discussions

According to USDA (1989) quality grade for the whole bull group was Standard. Sire only affected (p=0.0001) RCWB values. No significant variation was attributed to Sire x Ageing treatment interaction. Rib steaks derived from bulls sired by 424 and 770 bulls presented lower RCWB values (3.88 and 3.46 kg, respectively) than those derived from calves sired by the 593 bull (5.13 kg) (data not presented in tabular form).

The variance analysis (ANOVA) did not detect as significant the variation in juiciness and cooking losses (P=0.6 and 0.14, respectively). Table 1 shows that steaks aged by 7 or 14 d were described as more tender, with a lesser amount of connective tissue, and more intense in flavor, as compared to control steaks. Panelists did not detect any significant difference between steaks aged by 7 or 14 days in sensorial attributes. LSM for RCWB values agrees with that perceived significantly by the panelists; that is to say, a decrease of the force required to shear the core samples as the time of VA is prolonged beyond 2d ($p < 0.05$). As compared to control samples, the significant percent reduction in RCWB values by ageing for 14d accounted 17.4 percent. Regardless of feeding regime, Bidner et al.(1985) observed a reduction of 18.6% in the shear force and better punctuation for tenderness and less connective tissue

amount in the meat (strip loins) of young steers Hereford x Angus aged by 21 d. Savell et al. (1981) working with carcasses of steers fed to shepherding, they found a significant reduction of 15.94% in the values of RCWB in steaks (longissimus) of the 6d MAD with regard to the control; however, they did not find additional changes later in RCWB 10d of MAD. The variance analysis detected as significant the effect of aging period on cooking time ($p = 0.03$). Table 1 show the LSM for cooking according to the aging period. Control steaks took less time in reaching the final temperature of cooking as compared to the steaks aged for longer periods (21.1 min and 31.6 min shorter than those aged by 7 d and 14 d, respectively). There were not significant variation in cooking times or cooking losses among steaks aged by 7 vs. 14 days. These findings do not agree with previous research that showed that cooking losses and cooking times decreased significantly as aging time increased from 7 d to 14 d postmortem (Wheeler et al., 1990). Table 2 shows distribution of the samples in every period of aging according to tenderness classes. It was observed that in the control group, 42.9% of the samples were classified as tender and 57.1% fell in the intermediate or tough classes (21.4% and 35.7%, respectively). By d 14 of aging, 71.4% of the steaks fell in the Tender class, 21.4% were classified as intermediate in tenderness and 7.14% fell in the Tough class. Tatum et al. (1996) found a shear force value of 3.85 kg, as the threshold of tenderness and also reported that longissimus muscles derived from 3/8 Bos indicus steers require longer periods of aging (a minimum of 21 d) to produce steaks of acceptable tenderness (i.e., to reach RCWB values less than 3.85 kg).

Conclusions.

Results indicate that the use of postmortem vacuum ageing improves the tenderness of meat from Senepol crossbred bulls. To guarantee that a high proportion of their meats acquire an acceptable tenderness (RCWB value less than 3.88 kg), the ageing period should be prolonged by 14 days like minimum. Cooking of the ageing meats for more than two days took longer time to be cooked, but this does not affect their cooking losses.

Pertinent literature.

AMSA. (1995).Guidelines for cooking and sensory evaluation of meat. American Meat Sci. Assoc. & National Livestock & Meat Board. Chicago, IL.

Bidner, T.D., Montgomery, R.E., Bagley, C.P. and McMillin, K.W. (1985). Influence of electrical stimulation, blade tenderization and postmortem vacuum aging upon the acceptability of beef finishd on forage or grain. *Journal Anim. Sci.* **61**(3), 584-589..

Huerta-Leidenz, N. y Jerez-Timaure, N. (1996). Discovering the commercial value of beef in Venezuela. In *Brahman cattle on the Threshold of the 21st. Century*. Proc. 8th Brahman Cong, ed. N. Huerta-Leidenz and K.E. Belk. pp 329-356. Astro Data. Maracaibo.

Huerta-Leidenz, N. y Rios, G. (1993). La castración a diferentes estadios de crecimiento II. Efectos sobre las características de la canal. Una revisión. *Rev.Fac. Agr.(LUZ)* **10**, 163-187.

Huerta-Leidenz, N. y Rodas-González, A. (1998). El ganado doble propósito. ¿Carne para consumidores exigentes?. In: *Mejora de la Ganadería Mestiza de Doble Propósito*, ed. C. González-Stagnaro, N. Madrid-Bury and E. Soto Belloso. 30, 609-626 Astro Data,. Maracaibo.

Jerez-Timaure, N., Huerta-Leidenz, N., Rincon, E. y Arispe, M. (1994). Estudio preliminar sobre las características que afectan las propiedades organolépticas de solomos de res en Venezuela. *Rev.Fac.Agron.(LUZ)* **11**, 283-295.

Riera, T.J., Huerta-Leidenz, N., Rodriguez-Matos, C. and Moron-Fuenmayor, O.E. (1995). Crossbreeding and postmortem technologies to improve beef quality of savannah-fed Brahman bulls. *Journal of Anim. Sci.* 73(suppl.):157 (Abstract).

SAS. (1985). SAS User's guide; Statistics. SAS Inst. Inc., Cary, N.C.

Savell, J.W., McKeith, F.K. and Smith, G.C. (1981). Reducing postmortem aging time of beef with electrical stimulation. *Journal of Food Science*. **46**, 1777-1781.

Tatum, J.D., Green, R.D., O'Connor, S.F. y Smith, G.C.. (1996). Genetic "critical control points" for improving beef tenderness in heat-tolerant composite cattle breeds. In *Brahman cattle on the Threshold of the 21st. Century*. Proc. 8th Brahman Cong, ed. N. Huerta-Leidenz and K.E. Belk. pp 345-384. Astro Data. Maracaibo.

USDA (1989) *Official United States Standards for Grades of Carcass Beef*. Agric. Marketing Service. US Department of Agriculture. Washington, DC.

Wheeler, T.L., Savell, J.W., Cross, H.R., Lunt, D.K. and Smith, S.B. (1990). Effect of postmortem treatments on the tenderness of meat from Hereford, Brahman and Brahman-Cross beef cattle. .*Journal of Anim. Sci.* **68**, 3677-3686.

TABLE 1. Effect of different periods of postmortem vacuum ageing

Trait	Ageing period (d)		
	2	7	14
RCWB, kg	4.5 ± 0.2 [a]	4.3 ± 0.2 [ab]	3.7 ± 0.2 [b]
Juiciness [y]	4.8 ± 0.1	4.5 ± 0.2	4.7 ± 0.2
M. fiber tenderness [y]	3.5 ± 0.2 [a]	4.6 ± 0.2 [b]	4.7 ± 0.2 [b]
C. tissue amount [y]	3.0 ± 0.2 [a]	4.2 ± 0.2 [b]	4.2 ± 0.2 [b]
Overall tenderness [y]	3.2 ± 0.2 [a]	4.4 ± 0.2 [b]	4.4 ± 0.2 [b]
Flavor intensity [y]	5.4 ± 0.1 [a]	5.8 ± 0.1 [b]	5.9 ± 0.1 [b]
Cooking loss, %	33.2 ± 0.8	34.9 ± 0.8	35.4 ± 0.8
Cooking time, min.	103.2 ± 7.5 [a]	122.1 ± 7.5 [ab]	135.8 ± 9.6 [b]

a,b: Means in the same row bearing different superscripts are different ($P < .05$). y=Based upon an 8-point scale (1= extremely tough, dry, abundant connective tissue and extremely bland; 8= extremely tender, juicy, none and extremely intense)

TABLE 2. Percentage distribution of tenderness classes of rib steaks from grassfed bulls according to three different postmortem vacuum ageing periods.

Ageing period (d)	Tenderness class,%		
	Tender	Intermediate	Tough
2	42.86	21.43	35.71
7	42.86	35.71	21.43
14	71.43	21.43	7.14

Tender: Warner-Bratzler shear force value less than 3.88 kg.
Intermediate: Warner-Bratzler shear force value between 3.88 and 4.98 kg.
Tough: Warner-Bratzler shear force value higher than 4.98 kg.