

CONSUMER'S ABILITY TO DETECT TENDER MEAT USING VENEZUELAN TENDERNESS THRESHOLD

Rodas-González A.¹, Jerez-Timaure N.², Huerta-Leidenz N.²

1Facultad de Ciencias Veterinarias y 2Facultad de Agronomía, Núcleo Agropecuario, La Universidad del Zulia- Maracaibo, Venezuela.

Key Words: Beef, Tenderness, Threshold, Warner-Bratzler shear, acceptability.

Background

The tenderness thresholds have been determinate through the relationship between the sensory trained panels and Warner Bratzler shear force (WBS) evaluation (Shackelford *et al.*, 1991; Tatum *et al.*, 1996; Shackelford, *et al.*, 1997; Rodas *et al.*, 2005). The tenderness thresholds could serve as quality control to guarantee tender meats and to assure consumer acceptability, but these tenderness thresholds not always have the same meaning to consumers, because consumers consider besides of tenderness, juiciness and flavor to the overall acceptability of beef steaks (Carr *et al.*, 1998).

Our group developed a tenderness threshold based on trained sensory panel and WBS values (Rodas *et al.*, 2005). A following study that includes consumer acceptability is necessary to establish the true value of tenderness in Venezuelan beef.

Objectives

To assess the consumer's ability to detect three categories of tenderness from steaks classified according to WBS values: <3.86 kg as "tender", 3.86 to 4.98 "intermediate" and >4.98 tough meat.

Materials and methods

Data from three experiments with consumer (untrained) panel were chosen and polled. Experiment 1 and 2 were composed by Crossbred steers and bullocks (n=34) (F1 *Bos indicus* x *Bos taurus*), and experiment 3 by Criollo Limonero steers (*Bos taurus* tropically adapted) (n=23), with different ages (19 mo to 40 mo). Animals were slaughtered at a commercial packing plant. At 24 h *postmortem*, carcasses were ribbed and evaluated by USDA quality grade (USDA, 1989) and by Venezuelan grading system (Decree 1896, 1997). At 48 h *postmortem*, four steaks (2.54-cm thick) were removed from the *longissimus dorsi thoracis* muscle (ribeye) from the right side of each carcass and vacuum-packaged for consumer panel and Warner Bratzler shear force (WBS) evaluation. These steaks were frozen at -30°C immediately (2 d *postmortem*) until the date of their evaluation.

Steaks were thawed at 4 °C for 24 h prior to sensory or shear tests. Preparation and cooking of samples for sensory and shear force evaluation were carried out following the

general recommendations of the American Meat Science Association (AMSA, 1995). The steaks were cooked on an electric grill, which was preheated (approximately at 165 °C). Steaks were turned once during broiling and removed from the grill when they reached the desired internal temperature (70 °C).

The total consumer panelists were comprised of 302 persons from both sexes with different education levels, income between \$46 and \$ 651 and more, age between 18 and 60, which tasted a maximum of 4 to 5 samples in one session per day (1 d for experiment one and two; and 2 d for the experiment three). Two or three samples taken from steaks of each animal were served warm to each untrained judges. Consumers scored the samples through hedonic scale from 1 to 9 (1=dislike extremely; 9=like extremely) for each of the attributes: overall impression, flavor, flavor intensity and tenderness (AMSA, 1995).

Cooked rib steaks for shear evaluations were allowed to cool down to room temperature and four to ten core samples (1.27cm in diameter) depending on the area of the *longissimus* muscle. Cores were removed parallel to the muscle fiber orientation, taking care not to include pieces of fat or chunks of connective tissue in the core. Each core was sheared once using a Warner-Bratzler shear machine (G-R Elec. Mfg. Co, Manhattan, KS). The four to ten Warner-Bratzler Shear force (WBS) values were recorded and averaged to obtain a single shear force value for each steak.

Data collected were analyzed as a RBD using ANOVA by SAS (SAS, 1996) using tenderness categories as main effect (according to WBS, <3.88 kg= "tender"; 3.86 to 4.98kg= "intermediate"; >4.98 kg= "tough" meats), and consumer panelist as block. When a significant effect was detected ($P<0.05$) the least square mean were compared using LSD test. Additionally, for each tenderness categories, a frequency analysis of the observations allowed to describe the proportion of consumer's acceptability; taking as acceptable when cooked meat had equal or higher 6 points of the hedonic scale (6=Like slightly).

Results and Discussion

Some researcher have reported (Shackelford et al., 1991; Miller et al., 1995; Huffman et al., 1996, Miller et al., 2001) that consumer are able to distinguish differences in beef tenderness that have been classify based on Warner-Bratzler shear force. Tenderness classes evaluated in this study were obtained by lineal regression analysis of WBS on overall tenderness ratings (Rodas-Gonzalez et al., 2005, this congress). Result from that study allowed to classify as "tender" meat if its WBS value was less than 3.86 kg.; an intermediate meat (which tenderness rating and acceptance could be improved with ageing) if its WBS values is between 3.86 and 4.98 kg., and "tough" meat (showing off their doubtful acceptance, being even ageing), if its shear value is higher than 4.98 kg. Considering that the next step after getting our tenderness threshold, was to evaluate our tenderness threshold with a consumer panel.

The effect of tenderness class on consumer sensory traits is shown on Table 1. Flavor and flavor intensity ratings were not different ($P>0.10$) among the tenderness classes. Even though, significant differences ($P<0.05$) were not detected by ANOVA for overall impression and tenderness when comparing tenderness categories the results revealed a

trend that shows that overall impression and tenderness ratings are greater in meat classify as “tender” than in meat classify as “tough”, but statistically ($P>0.10$) similar to the ones classify as “intermediate”. Consumer were able to differentiate between “tender” and tough” meat in overall impression and tenderness ($P=0.08$ and $P=0.10$, respectively), but these differences were not highly significant.

The ability of consumers to differentiate the degree of tenderness is important for the beef industry and its attempt to implement a tenderness threshold classification system that would allow segregating tender from tough meat. The overall acceptability ratings are shown in Table 2. In general, consumer tenderness acceptability increased as WBS values decreased. However, only 53.6 % of consumer found meat with WBS force <3.86 kg acceptable. Miller et al. (2001) suggested that consumer WBS tenderness values of 4.0 kg. would result in 94 % of customer satisfaction for beef tenderness. These differences could be due to variation in tenderness perception, consumer may not require the same tenderness in beef to be satisfied and that either beef flavor o juiciness may influence their perception of tenderness and their overall acceptability ratings.

Conclusions

Results from present study show that consumer can segregate differences between “tender” and “tough” meats. The low percent of consumer acceptability for “tender” meat could be explained by the individual perception of tenderness.

References

- AMSA. 1995. Guidelines for cooking and sensory evaluation of meat. Chicago, IL. American Meat Science Association and National Live Stock and Meat Board. 48pp.
- Carr, M.A., Kerth, C.R., Crockett, K.L., Miller, M.F., Ramsey, C.B. 1998. Consumer tenderness evaluation of beef loin steaks cooked to a medium degree of doneness. *J. Anim. Sci.* 76, Suppl.1/*J. Dairy Sci.* 81, suppl.1(Abtract) 156.
- Decreto Presidencial N° 1896. 1997. *Gaceta Oficial de la República de Venezuela*. N° 36.242. Caracas, Venezuela. 4pp.
- Huffman, K.L., Miller, M.F., Hoover, L.C., Wu, C.K., Brittin, H.C., Ramsey, C.B. 1996. Effect of beef tenderness on consumer satisfaction with steaks consumed in the home and restaurant. *J. Anim. Sci.* 74:91–97.
- Miller, M.F., Carr, M.A., Ramsey, C.B., Crockett, K.L., and Hoover, L.C. 2001. Consumer thresholds for establishing the values of beef tenderness. *J. Anim. Sci.* 79:3062–3068.
- Miller, M.F., Hoover, L.C., Cook, K.D., Guerra, A.L., Huffman, K.L., Tinney, K.S., Ramsey, C.B., Brittin, H.C., Huffman, L.M. 1995. Consumer acceptability of beef steak tenderness in the home and restaurant. *J. Food. Sci.* 60:963–965.
- Rodas-González A.; Jerez-Timaure N.; Huerta-Leidenz N. 2005. Identification of tenderness threshold for Warner-Bratzler shear force in Venezuelan Beef. *Proc. 51st ICoMST*, Baltimore, Maryland, USA.
- SAS. (1996). *SAS/STAT User’s guide: statistics*. SAS Institute Inc. Cary, NC, USA.
- Shackelford, S.D., Morgan, J.B., Cross, H.R., Savell, J.W. 1991. Identification of threshold levels for Warner-Bratzler shear force in beef top loin steaks. *J. Muscle Foods.* 2:289–296.

- Shackelford, S.D., Wheeler, T.L., Koohmaraie. 1997. Tenderness classification of beef: I. Evaluation of beef longissimus shear force at 1 or 2 days postmortem as a predictor of aged beef tenderness. J. Anim. Sci. 75:2417–2422.
- Tatum, J.D., Green, R.D., O'Connor, S.F., Smith, G.C. 1996. Puntos críticos de control genético para mejorar la terneza en carnes de res de cruces de bovinos tolerantes al calor. In: N. Huerta-Leidenz, K.E. Belk, El Ganado Brahman en el Umbral del Siglo XXI (pp. 375–403). Maracaibo, Venezuela. Ed. Astro Data S.A.
- USDA. 1989. Official United States standards for grades of carcass beef. United States Department of Agriculture. Agricultural Marketing Service. Washington, D.C.

Table 1. Least squares means $\pm$ standard error for consumer panelist trait by tenderness categories

Trait	Tenderness Categories*			P-value
	Tender	Intermediate	Tough	
Overall impression	6.43 $\pm$ 0.26 ^a	5.5. $\pm$ 0.44 ^{a,b}	5.21 $\pm$ 0.53 ^b	0.08
Flavor	6.07 $\pm$ 0.29	5.41 $\pm$ 0.50	6.09 $\pm$ 0.619	>0.10
Flavor intensity	5.34 $\pm$ 0.45	5.79 $\pm$ 0.41	5.07 $\pm$ 0.42	>0.10
Tenderness	6.60 $\pm$ 0.32 ^a	6.11 $\pm$ 0.30 ^{a,b}	5.72 $\pm$ 0.30 ^b	0.10

*Tenderness categories obtained by Rodas-Gonzalez *et al.*, 2005: Tender (WBS values <3.86 kg.), Intermediate (WBS values >3.86 <4.98 kg.) and Tough (WBS values >4.98 kg).

Table 2. Frequency of overall acceptability by tenderness categories

Trait	Tenderness Categories*		
	Tender	Intermediate	Tough
Acceptability**	53.64 %	24.09 %	22.27 %

*Tenderness categories obtained by Rodas-Gonzalez *et al.*, 2005: Tender (WBS values <3.86 kg.), Intermediate (WBS values >3.86 <4.98 kg.) and Tough (WBS values >4.98 kg).

**Acceptable when cooked meat had equal or higher 6 points of the hedonic scale (6=Like slightly).