COMPARISON OF IMPORTED VS. DOMESTIC BEEF CUTS FOR RESTAURANT USE IN VENEZUELA. I. COOKERY TRAITS, CONSUMER IMPRESSIONS AND SHEAR FORCE.

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Background

According to the U.S Meat Export Federation, in 2002 Venezuela took up the third position among the leading markets for U.S. beef in Central and South America. Currently, Venezuela has kept a ban on imports of U.S. beef due to its BSE status. Substitution of high quality U.S. beef in the Venezuelan HRI trade is a clear opportunity but a serious challenge for national beef producers. Some Venezuelan cattlemen, particularly from the Zulia State regions, have been modifying traditional practices (genetics, gender, feeding, and management) to offer competitively, young steer carcasses that grade in the high-quality Venezuelan standards (Decreto 1896, 1997). Despite all these particular efforts, there is a lack of information about how well this new concept of "high-quality" Venezuelan beef will compare in consumer acceptance to imported U.S. beef of the top USDA grades.

Objectives

The purpose of this study was to compare particular samples of high-valued HRI beef cuts of different background (domestic vs. imported) in cookery traits, consumer sensory ratings, and shear force values, according to grade.

Materials and methods

Procurement of high-quality, imported U.S. beef samples. A total of 12 wholesale Beef Loin, Top Sirloin Cap (IMPS/NAMP 184D, commonly referred as Coulottes) and 10 Beef Rib, Ribeye, Lip-On (IMPS/NAMP 112A, commonly referred as Ribeyes) cuts (NAMP, 1997), were procured from the two major food trading companies of Venezuela. The U.S. wholesale cuts were individually vacuum packaged, imported in boxes labeled as "Choice or higher" (CH-or-Higher) and kept in frozen storage (-20ºC). U.S. wholesale cuts were transported to Universidad del Zulia and three 2.54 cm thick steaks were fabricated and kept frozen (-20ºC) until further analyses.

Procurement of high quality, domestic samples. Twenty steers of known genetics (10 F1 Red Angus and 10 ¾ Brahman) were selected to represent a unique "high-quality" domestic beef sample produced in a particular zone of Zulia State. The steer group was placed on pastures during the stocking phase. The semi-intensive fattening (concentrate supplementation) phase lasted 60 d. The group was subjected to typical industry procedures. At 24 h post-mortem, chilled carcasses were evaluated and graded according to Venezuelan (Decreto Presidencial 1896, 1997) and USDA standards (USDA, 1989). Ribeyes and coulottes were removed from the right side of each carcass 48h postmortem. Three 2.54cm-thick steaks were identified, vacuum packaged, and immediately stored at 4ºC during 15 d for aging. When the aging period was completed, samples were blast frozen at -20ºC. Frozen samples were transported in a refrigerated truck to LUZ. Upon arrival, the samples were stored in home freezers during 20 d until further analyses.

Cookery, sensory evaluation and shear force determinations. Sample preparation, cooking procedures and cooking equipment followed those guidelines described by AMSA (1995). Sensory evaluation of the LDT samples was conducted with 69 consumers. Sensory evaluation of the BF samples was conducted two days after with 77 consumers. Overall first impression, flavor, and tenderness were surveyed by using hedonic, non-descriptive, 1-to-9 rating scales (1= Dislike very much; 9= Like very much). Additionally, flavor intensity was evaluated by a descriptive, non-structured hedonic scale (1= Insipid; 9= Strong). Warner-Bratzler shear force determinations (WBS) of LDT and BF samples were conducted simultaneously during two days.

Statistical Analyses.
Carcass data. A simple one-way analysis of variance (F-test) to test differences due to breed type was conducted (SAS, 1996).
Cookery and sensory data. Muscle data were subjected to analysis of variance (ANOVA) by SAS (1996) using cold carcass grade as the main effect, and consumer panelist as a block. The least squares means (LSMEAN) were separated by Tukey-Kramer´s (SAS, 1996). The proportion (%) of consumers indicating rating values of 6 or higher for the overall first impression was used as a measure of acceptability.
WBS data. The effects of grade, muscle and the two-way interaction were analyzed and LSMEANS were separated by Tukey-Kramer´s test (SAS, 1996). The proportion of Tender (WBS value = <3.88 kg), Intermediate (WBS value = 3.88 to 4.98 kg) and tough (WBS value = >4.98 kg) steaks, were determined using tenderness thresholds values (Huerta-Leidenz and Rodas-Gonzalez, 1998).

Results and discussion

Carcass quality of the samples. F1 Red Angus steer carcasses were younger (A^{84} ± 2.91 vs. B^{01} ± 2.91; P=0.0006) according to their skeletal maturity, and trended to exhibit an overall better fleshing as compared to the ¾ Brahman steers. While 70% of the F1 Red Angus carcasses fell in the top quality Venezuelan grade, none of the cold ¾ Brahman carcasses did. Ribeye marbling scores of F1 Red Angus (Practically devoid^{94} ± 27.1) and ¾ Brahman steers (Traces^{70} ± 27.1) were not different (P> 0.05). Average marbling levels for the samples of U.S. "Choice or higher" beef used in the present study, were Small^{98} ± 26.24 and Moderate^{59} ± 32.39, for BF and LDT muscles, respectively.
Cookery traits. Table 1 shows LSMEAN values for cookery traits according to grade and muscle. BF Choice-or higher samples required less (P<0.05) time to reach the endpoint temperature. LDT samples showed similar cooking times to longissimus samples derived from Venezuelan "A" bulls (Malaver et al., 2000). Percentage of cooking loss did not vary across breed types or grades. The greater (P<0.05) weight losses of the U.S. beef steaks are attributed to their larger sizes.
Consumer Sensory Evaluation. Table 2 shows LSMEANS for consumer ratings of sensory traits of LDT and BF according to grade. Consumers assigned higher (P<0.01) ratings to the U.S. imported LDT in all sensorial traits under study. The fact that U.S. CH-or-Higher LDT samples obtained the highest (P<0.001) consumer ratings for flavor and flavor intensity was unexpected. It is commonly believed that many Latin American consumers; accustomed to the strong flavor of relatively old, grass-fed beef, are not pleased with the taste of U.S. beef, due to its bland flavor. In regard to BF muscles, non-significant differences in tenderness were found between the BF steaks graded AA and their Choice-or-higher counterparts.
Level of consumer acceptability. Table 3 shows percentages of consumer acceptability of LDT and BF according to grade. CH-or-higher LDT exhibited the highest level of acceptability (80%). Level of acceptability for each grade, calculated by pooling sensory data from both muscles showed (not presented in tabular form) the highest acceptability level --approximately 67% of 146 evaluations-- was reached by the CH-or-Higher beef. No previous consumer preference studies had been conducted in Venezuela to compare beef from different origins.
Shear force determinations and tenderness classes. No significant variation (P> 0.05) in WBS values due to muscle, or to muscle x grade was detected; therefore, muscle data were pooled. LSMEANS values for WBS by grade, were decreasing in the sequence A >AA> CH-or-Higher, with a significant difference between the top-quality, Venezuelan AA grade and its U.S. counterpart (Table 4). It is noteworthy to indicate that no tough steaks were detected for any sample of the three grades (Table 4). An outstanding proportion (94%) of tender steaks was exhibited by the CH-or-Higher samples.

Conclusions

The use of imported Choice-or-higher BF and LDT cuts is highly justified based on the high consumer acceptability level observed herein. The inferior and unacceptable tenderness impression ratings of Venezuelan grade A BF and LDT steaks, prevents its use in gourmet-type restaurants.
Similar tenderness ratings between the Venezuelan top quality AA and Choice-and-higher, BF steaks, does not necessarily indicate that they can be used interchangeably in the HRI trade, because the first impression and flavor of AA steaks were rated as unacceptable (<6 points). The shorter cooking time of "Choice and higher" BF steaks is another important consideration for food service operators.
Due to the low number of observations and the very specific nature of the samples under study, the present findings must be taken as preliminary.

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TABLE 1. Least squares means ± standard error for cookery traits by grade and muscle[a].

	Venezuelan grade				U.S. grade	
	A		AA		CH-or-higher	
Trait	BF (n=11)	LDT (n=8)	BF (n=5)	LDT (n=5)	BF (n=10)	LDT (n=6)
Cooking time, min	72.3 ± 3.17[d]	84.4 ± 5.08	61.1 ± 4.16[de]	85.5 ± 6.22	52.5 ± 3.87[e]	79.00 ± 8.20
Cooking losses, g	65.2 ± 4.40	97.8 ± 8.90[f]	59.1 ± 5.76	98.5 ± 10.9[f]	54.6 ± 5.33	137.5 ± 14.1[g]
Cooking losses, %	24.3 ± 1.36	26.3 ± 1.41	20.3 ± 1.78	23.4 ± 1.73	25.5 ± 1.62	25.9 ± 2.09

[a] Abbreviations of commercial terminology used to designate quality grades for beef carcasses in Venezuela and U.S.A. Letters A and AA corresponds respectively, to the second ("Excelente") and first ("Optima") quality grades in Venezuela (Decreto 1896, 1997); CH-or-Higher corresponds to imported U.S. boxed beef labeled as "Choice or higher".
[d,e] LSMEANS bearing different letters among *biceps femoris* (BF) samples in the same row indicate statistical difference (P<0.05).
[f,g] LSMEANS bearing different letters among *longissimus dorsii thoracis* (LDT) samples in the same row indicate statistical difference (P<0.05).

Table 2. Least squares means ± standard error for sensory traits[a] of cooked muscles, by grade.

	A		AA		CHOICE OR HIGHER	
Trait	BF (n=12)	LD (n=12)	BF (n=7)	LD (n=7)	BF (n=10)	LD (n=6)
First impression	5.15 ± 0.28	4.56 ± 0.32[e]	5.66 ± 0.37	6.04 ± 0.24[f]	5.14 ± 0.29	7.07 ± 0.22[g]
Flavour	5.25 ± 0.28	4.79 ± 0.31[e]	5.81 ± 0.38	6.11 ± 0.24[f]	5.17 ± 0.29	7.36 ± 0.22[g]
Flavour intensity	5.10 ± 0.26	4.22 ± 0.32[e]	4.42 ± 0.35	4.79 ± 0.24[e]	4.37 ± 0.27	6.01 ± 0.22[f]
Tenderness	5.52 ± 0.27[c]	5.42 ± 0.38[e]	6.41 ± 0.37[cd]	6.28 ± 0.29[e]	7.17 ± 0.28[d]	7.24 ± 0.26[f]

[a] A and AA corresponds respectively, to the second and first quality grades in Venezuela (Decreto 1896, 1997); CHOICE OR HIGHER corresponds to imported U.S. boxed beef
[b] Sensory traits were rated by non-trained panelists using hedonic, 1-to-9 rating scales (1= Dislike very much, bland; 9= Like very much, strong).
[c,d] Within *biceps femoris* comparisons, values bearing different letters in the same row indicate statistical difference (P<0.05).
[e,f,g] Within *longissimus dorsi thoracis* comparisons, values bearing different letters in the same row indicate statistical difference (P<0.05).

TABLE 3. Level of consumer acceptability for cooked muscles according to grade

	Grade[a]					
	A		**AA**		**CH-or-higher**	
Muscle[b]	BF	LDT	BF	LDT	BF	LDT
(n[c])	**(37)**	**(17)**	**(27)**	**(46)**	**(43)**	**(55)**
Acceptability[d], %	44.1	37.8	52.9	66.7	55.8	79.7

[a] Abbreviations of quality grades for beef carcasses in Venezuela and U.S.A. Letters A and AA corresponds respectively, to the second ("Excelente") and first ("Optima") quality grades in Venezuela (Decreto 1896, 1997); CH-or-Higher corresponds to imported U.S. boxed beef labeled as "Choice or higher".
[b] *biceps femoris* (BF) , *longissimus dorsi thoracis* (LDT) .
[c] n= number of samples rated by consumers with a first overall impression rating of 6 or higher by using a hedonic, non-descriptive, 1-to-9 rating scale (1= Dislike very much; 9= Like very much).
[d] Percentage of steaks from the total tastings of any muscle, declared as "Acceptable" based on reaching a first overall impression rating of 6 or higher by using a hedonic, non-descriptive, 1-to-9 rating scale (1= Dislike very much; 9= Like very much).

TABLE 4. Least squares means ± standard error for shear force values of cooked lean beef, samples by grade[a] and tenderness classification

	Venezuelan grade		**Unknown U.S. type**
	A	**AA**	**CH-or-higher**
Trait	**(n=13)**	**(n=9)**	**(n=18)**
Warner Bratzler shear force, kg	3.53 ± 0.19 [c]	3.15 ± 0.22 [c]	2.67 ± 0.15 [d]
Tenderness class [b] , n (%)			
Tender	8 (61.5)	7 (77.8)	17 (94.4)
Intermediate	5 (38.5)	2 (22.2)	1 (5.6)
Tough	0 (0.0)	0 (0.0)	0 (0.0)

[a] Abbreviations of commercial terminology used to designate quality grades for beef carcasses in Venezuela and U.S.A. Letters A and AA corresponds respectively, to the second ("Excelente") and first ("Optima") quality grades in Venezuela (Decreto 1896, 1997); CH-or-Higher corresponds to imported U.S. boxed beef labeled as "Choice or higher".
[b] n = number and percentage (in parenthesis) of steaks (pooled muscled data) classified as follows:
Tender: Warner-Bratzler shear force value less than 3.88 kg.
Intermediate: Warner-Bratzler shear force value between 3.88 kg and 4.98 kg.
Tough: Warner-Bratzler shear force value higher than 4.98 kg.
[c,d] LSMEANS bearing different letters within a grade comparison in the same row indicate statistical difference ($P<0.05$).