COMPARISON OF IMPORTED VS. DOMESTIC BEEF CUTS FOR RESTAURANT USE IN VENEZUELA. II. MARBLING LEVELS, PROXIMATE AND MINERAL COMPOSITION.

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Background

Ante mortem and *post mortem* factors influence nutritive value of beef (Seideman *et al*., 1989). Production patterns and the grading system in Venezuela differ from those applied in the U.S.A. Therefore, notorious differences in beef chemical composition and quality might be expected. Based on the wide variation in palatability of Venezuelan beef, the hotels, restaurants and other food service institutions (HRI) have been purchasing imported U.S. Choice or Select beef. Beef imports from U.S.A. have been banned since January 2004 because of the BSE issue. If import resumes, it is anticipated that consumer preference towards U.S. beef will continue. Top quality, well-marbled U.S. beef generally has a thick cover of fat that an increasing number of consumers find repelling. These consumers are either concerned with diet/health issues or are simply typical, price-oriented Venezuelans, who always look for lean beef, with no plate waste. The Venezuelan diet-health oriented, high-income market niche, could be satisfied by a national product if nutrient compositional advantages were guaranteed. To our knowledge, differences between Venezuelan and American beef in proximate and mineral composition have not been scientifically proven. The only available report (Huerta-Leidenz, 1998) compared beef *longissimus* from both origins indicating nutrient reference values from indirect sources; this is, without performing simultaneous analyses of samples under the same laboratory conditions.

Objectives

a) To compare marbling levels, proximate and mineral composition of top-graded Venezuelan and American beef samples commonly used by restaurants of Venezuela; and
b) To examine the variation in marbling levels and chemical composition due to muscle.

Materials and methods

Procurement of high-quality, imported U.S. beef samples

Twenty wholesale Beef Loin, Top Sirloin Cap (Coulottes) and 10 Beef Rib, Ribeye, Lip-On (Ribeyes) cuts were procured frozen in boxes labeled as "Choice or higher" (CH-or-Higher), and transported to Universidad del Zulia (LUZ). Upon arrival, marbling scores were individually assigned. One 2.54cm thick steak was fabricated and kept frozen (-20ºC). To be prepared for chemical analyses, partially thawed steaks were trimmed to zero fat cover (and other surrounding muscles in the case of ribeye). *Longissimus dorsi thoracis* (LDT) and *biceps femoris* (BF) muscles, from ribeyes and coulottes, respectively, were ground for homogenization with a Black & Decker™ food manual processor. Ground muscles were packed by duplicates in plastic Zip-lock™, bags and immediately stored at -20ºC until chemical analyses.

Venezuelan samples of known production history.

A first group of Venezuelan samples were derived from 18 steers of known genetic history (9 F1 Angus and 9 ¾ Brahman) semi-intensively fed during 60d. Animals were slaughtered and hot carcasses were graded (Decreto Presidencial 1896, 1997). In each breed type two carcasses were graded as Optima ("AA") and seven carcasses were graded as Excelente ("A"). At 72 h *post-mortem* ribeyes and coulottes were removed. Steak fabrication and preparation for chemical analyses was similar to the U.S. beef steaks.

Venezuelan samples of unknown production history

Twenty coulottes (10 "A" and 10 "AA") and 20 Ribeye roasts (10 "A" and 10 "AA") were purchased fresh from different butcher stores and supermarkets of Maracaibo city. Both types of retail cuts were reduced to 2.54cm thick steaks and the marbling level was determined with marbling photographs. Steak fabrication and preparation for chemical analyses was similar to the U.S. beef steaks.

Chemical analyses

Except for total lipids (by the Folch *et al.,* 1957 method), proximate analysis was performed according to the A.O.A.C. (1997). Except for phosphorus (by the A.O.A.C., 1997 method), mineral analyses were conducted by atomic absorption and/or atomic emission with ashing procedure (A.O.A.C, 1997), following the analytical methods described by Perkin-Elmer (1994).

Statistical analyses

Marbling scores and proximate compositional data were subjected to a simple one-way analysis of variance (ANOVA) to test differences due to grade (SAS, 1996). ANOVA of mineral contents included the effects of muscle, grade and the two-way interaction. The least squares means (LSMEANS) were separated by Tukey-Kramer´s test (SAS, 1996).

Results and discussion

Marbling levels

ANOVA detected effect (P=0.0001) of carcass grading on marbling level of BF and LDT samples (mean values are not shown in tabular form). Mean marbling levels in domestic BF samples were described as "Traces", while IMPORTED counterparts averaged a higher (P<0.01) "Small" amount of marbling. Top quality ("AA") domestic LDT exhibited "Slight" amounts of marbling, higher (P<0.05) than the "Traces" level described for the second-quality Venezuelan ("A") LDT, but still inferior (P<0.05) to the "Moderate" level found in CH-or-Higher LDT.

Proximate composition

Highly significant effects (P<0.001) of carcass grade on moisture and total lipid contents of BF and LDT were detected. Variation of protein content in BF samples was detected at P<0.10. CH-or-higher BF and LDT samples had lower (P<0.0001) moisture and higher lipid contents when compared to A and AA domestic samples (Table 1 and 2). To our knowledge there are no available reports in Venezuela regarding to the effect of carcass grade on proximate composition of the retail cuts under study.

Table 1. Least square means ± standard error for proximate composition of *biceps femoris*

Component (g/100g of fresh tissue)	Grades[a]		
	A (n=24)	AA (n=14)	Choice-or-higher (n=20)
Moisture	74.35 ± 0.30 [b]	74.27 ± 0.40 [b]	71.71± 0.34 [c]
Ash	1.22 ± 0.02	1.18 ± 0.03	1.20 ± 0.02
Protein	20.46 ± 0.15	20.36 ± 0.21	19.94 ± 0.15
Total lipids	3.46 ± 0.43 [b]	4.18 ± 0.57 [b]	6.01 ± 0.48 [c]

[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,c] different letters in the same row indicates significant differences (P<0,05)

Table 2. Least square means ± standard error for proximate composition of longissimus dorsii thoracis

	Grade[a]		
Component (g/100g of fresh tissue)	A (n=24)	AA (n=14)	Choice-or-higher (n=10)
Moisture	74.68 ± 0.32 [b]	74.03 ± 0.42 [b]	68.17 ± 0.52 [c]
Ash	1.13 ± 0.01	1.14 ± 0.02	1.10 ± 0.02
Protein	21.87 ± 0.12	21.48 ± 0.16	21.94 ± 0.19
Total lipids	1.96 ± 0.38 [b]	2.99 ± 0.50 [b]	7.97 ± 0.60 [c]

[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,c:] LSMEANS bearing different letters in the same row indicate statistical difference (P<0.05).

Mineral composition

ANOVA detected significant effects (P<0.05) of muscle and carcass grade on the mineral content.

Muscle effects

Except for Mg, P and Na, ANOVA detected the effect of muscle (P<0.05) on variation of most individual minerals under study (Table 3).

Table 3. Least Square means ± standard error for the mineral content of fresh, lean muscles.

	Muscle				
	Biceps Femoris		*Longissimus dorsi thoracis*		
Mineral (mg/100g of fresh tissue)	n		n		P value
Ca	58	6.8 ± 0.18	48	7.4 ± 0.21	0.026
Fe	58	2.4 ± 0.03	48	1.9 ± 0.04	0.001
Mg	54	23.3 ± 0.22	47	23.4 ±0.26	NS
P	58	197.0 ± 1.00	48	198.1 ± 1.14	NS
K	56	347.0 ± 2.02	45	354.3 ± 2.33	0.021
Na	58	61.3 ± 0.71	48	59.4 ± 0.81	0.09
Zn	58	3.8 ± 0.06	48	3.5 ± 0.06	0.002
Cu	58	0.04 ± 0.004	48	0.02 ± 0.004	0.001

NS = Non significant (P> 0.1)

Grade effects

Table 4 shows adjusted LSMEANS for the mineral content of muscles according to grade. "Choice or higher" samples showed higher Ca, Fe and Zn and lower P and K as compared to domestic samples. Mineral content did not vary (P>0.05) across Venezuelan grades. Mineral concentrations for domestic samples coincide with that presented in a previous report (Huerta-Leidenz *et al*., 2003).

Conclusions

Both imported and domestic beef muscles are highly nutritious foods and good sources of protein, Fe, P and Zn; Venezuelan beef steaks should have comparative advantages in the diet/health market niche due to their exceptional leanness.

Table 4. Least Square means ± standard error for the mineral content of 100g of fresh, lean sample, according to carcass grade.

Mineral (mg/100g of fresh tissue)	Grade[a]					
	A		AA		CH-or-higher	
	n		n		n	
Ca	48	6.0 ± 0.20 [b]	28	6.6 ± 0.26 [b]	30	8.6 ± 0.26 [c]
Fe	48	2.1 ± 0.04 [b]	28	2.0 ± 0.05 [b]	30	2.4 ± 0.05 [c]
Mg	43	23.9 ± 0.25 [b]	28	23.2 ± 0.31 [bc]	30	22.9 ± 0.32 [c]
P	48	201.4 ± 1.07 [b]	28	199.1 ± 1.40 [b]	30	192.0 ± 1.44 [c]
K	44	360.7 ± 2.24 [b]	27	349.9 ± 2.86 [b]	30	341.3 ± 2.87 [c]
Na	48	60.3 ± 0.76 [b]	28	60.8 ± 0.99 [b]	30	59.9 ± 1.02 [b]
Zn	48	3.3 ± 0.06 [b]	28	3.5 ± 0.08 [b]	30	4.2 ± 0.08 [c]
Cu	48	0.030 ± 0.004 [bc]	28	0.034 ± 0.005 [b]	30	0.021 ± 0.005 [c]

[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,c]: different letters in the same row, indicate significant differences ($p<0.05$).

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