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CHEMICAL COMPOSITION, MEAT QUALITY AND CONSUMER ACCEPTABILITY IN MEXICAN (GUADALAJARA, CHIHUAHUA AND VERACRUZ) RETAIL BEEF

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Introduction

Mexico beef cattle production is diverse and depends on the climate of the region, feeding systems and breeds used. In Mexico, the meat industry is governed by a variety of factors that range from raising the cattle under different conditions to the ways meat is displayed at the supermarket counter. Throughout this chain, many processes affect the final quality of the meat. Therefore, a great variation in the final beef quality is expected. Guadalajara, Chihuahua and Veracruz are three of the most important beef markets in Mexico. Variation in beef quality is generating much discussion in national forums in regards to whether the northern states are producing better meat than the southern regions. A previous research has reported few differences in the quality of beef because of regional differences (Delgado, Rubio, Méndez, Iturbe, Casís & Rosiles, 2005). However, more research is needed to further identify the differences in chemical composition and quality between Mexican meat sources.

Imported beef is toughening the competition for Mexican beef. However, there is only one previous study that has reported some of the differences between both types of meat (Delgado et al., 2005). This study is a continuation of research, which intends to present empirical data about chemical composition, quality traits and consumer acceptability of both Mexican and imported retail beef samples.

Objectives

The objective of this study is to evaluate chemical composition, beef quality and consumer acceptability of both Mexican (from Chihuahua, Guadalajara and Veracruz) and Imported beef samples (bought in the same cities).

Methodology

The study was conducted in three Mexican cities (Chihuhua, Guadalajara and Veracruz). These cities were selected because they represent some of the largest metropolitan areas (INEGI, 2003) and important distribution points for beef.

Samples of packaged (film-wrapped) refrigerated New York steaks of approximately 1 inch thick were purchased from different supermarkets. Meat samples of Mexican, USDA-Choice, and No Roll US beef were purchased, depending on the availability of the relevant sources of beef in the shops. Overall, 65 samples of Mexican beef (25 from Guadalajara, 20 from Chihuahua and 20 from Veracruz) and 65 imported beef (50 samples of USDA-Choice beef and 15 samples of No Roll US beef) were analyzed in the study. A sample unit consisted of three New York steaks from the same primal cut.

Samples were analyzed for moisture, fat and protein content following the procedures described by the AOAC (1990). Total and soluble collagen was estimated from the levels of hydroxyproline (Bergman and Loxley, 1963; Cross, Carpenter, & Smith, 1973). The pH was measured in refrigerated ground meat samples (2-4 ^{0}C) using a pH meter with automatic temperature compensation (HANNA pH meter, Model 8521) (AOAC, 1990). Warner Bratzler shear force (WBSF) and cooking loss were determined according to AMSA Research Guidelines for Cookery, Sensory Evaluation and Instrumental Tenderness Measurements of Fresh Meat (AMSA, 1995). Objective color measurements were performed after the steaks were allowed to bloom for 15 min at room temperature (20 -25^{0}C), on two different sites of each steak using a Minolta Chroma Meter CR-310 (Minolta, Osaka, Japan). The average lightness (L*), redness (a*), and yellowness (b*) of each sample was recorded.

The sensory test was carried out in five different sessions more than 150 panelists Steaks of Mexican and both categories of imported beef (USDA-Choice and No Roll US beef) were cooked following AMSA guidelines, as previously described (AMSA, 1995). An affective evaluation test was accomplished using a 7-point hedonic scale from 1) I dislike it very much; to 7) I like it very much. Panelists were asked to assign scores for tenderness and overall desirability to each sample. Clenbuterol was measured using a competitive inmuno-enzimatic assay called Quantitative ELISA (R-Biopharm, 1996).

The effect of the origin of beef (Mexican beef from northern, central and southern regions, and imported USDA-Choice and No Roll US beef) was tested for significance using one-way analysis of variance (Lentner & Bishop, 1986). Means were discriminated using the Tukey's range procedure (Statgraphics Plus 2.1).

Results & Discussion

Table 1 shows the chemical composition and meat quality of national vs imported (Choice and No Roll) beef. All sources of Mexican beef and No Roll US beef were comparable in terms of moisture, fat, total collagen, and soluble collagen content ($P>0.05$). These results agree with those found previously by Delgado et al (2005), who reported these similarities between both types of meat.

The USDA-Choice beef had lower moisture content ($P<0.05$) and higher fat content ($P<0.05$) than the other beef types. USDA-Choice meat was expected to contain a high fat content, which agrees with previous studies (Delgado et al 2005 and Luchak et al., 1998). No significant differences were found in the collagen content among beef sources. Delgado et al (2005) found USDA-Choice to have lower collagen content than the other imported and Mexican sources.

The pH of the No Roll meat was higher than the other beef sources ($P<0.05$). USDA-Choice beef had the lowest WBSF value and the highest cooking loss compared to the other sources of beef, this matches the previous research on Mexican meat by Delgado et al. (2005). Mexican beef showed a more intense red color compared to the imported samples, this could be an indication of older cattle being slaughtered or the slaughtering conditions in Mexican abattoirs.

Table 2 shows the chemical composition and meat quality of Mexican beef by city. Beef from Guadalajara had the highest fat content and the lowest soluble collagen percentage. Veracruz beef had the lowest fat and protein content and the highest percentage of moisture. Meat quality characteristics show beef from Veracruz to be the most tender compared to the other Mexican beef sources.

The sensory evaluation showed that consumers found similar tenderness for Mexican and No Roll beef; however they found USDA-Choice to be the most tender of all. Results showed no samples with clenbuterol were found.

Conclusions

All sources of Mexican beef and No Roll US beef had comparable chemical compositions. Consumer acceptability was similar for all sources of Mexican beef and for No Roll beef. The present study identified that retail beef in the Mexican market was variable in fat content, Warner-Bratzler shear force, cooking loss, redness (a*-values), and consumer acceptability, depending on the origin of the meat.

Mexico does not implement a carcass evaluation system that segregates meat by quality. This condition makes all sources of Mexican meat to be accounted as one in this study, which decreases the overall quality. However, imported meat found in Mexican markets was graded by quality (Choice and No Roll) which gives an advantage to the USDA-Choice, which has been specifically selected to have a greater meat quality compared to the lower grades like No Roll meats. Therefore, we strongly recommended Mexico to implement a carcass evaluation in order to be competitive with imports.

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Tables and Figures

Table 1. Chemical composition and meat quality of Mexican and Imported beef (USDA-Choice and No Roll) in Veracruz, Chihuahua and Guadalajara.

	Mexican Beef	No Roll Beef^{1}^	USDA-Choice^{2}^	SE
n	65	15	50	
Moisture %	72.55^{a}^	72.58^{a}^	67. ^{b}^	0.14
Fat %	2.45^{a}^	1.95^{a}^	6.52^{b}^	0.07
Protein (Nx6.25) %	20.17^{a}^	19.62^{b}^	19. ^{b}^	0.07
Total collagen mg/g	9.28	9.28	9.17	0.15
Soluble collagen %	14.01^{a}^	13.83^{a,b}^	12.88^{b}^	0.21
pH	5.73^{a}^	5.88^{b}^	5.73^{a}^	0.01
Shear force, Newtons	44.43^{a}^	45.11^{a}^	25.40^{b}^	0.50
Cooking loss %	24.72^{a}^	18. 85^{b}^	26.38^{c}^	0.32
L (lightness)	42.13^{a}^	38.67^{b}^	40.93^{c}^	0.19
a (red)	18.14^{a}^	17.05^{b}^	13.87^{c}^	0.15
b (yellow)	6.94^{a}^	5.30^{b}^	7.32^{a}^	0.09
Price dollars/kg	7.03^{a}^	5.88^{b}^	16.17^{c}^	0.01

^{1}^US beef with no quality grade specified on the label at the point of sale

^{2}^Beef labeled as USDA-Choice at the point of sale

^{a,b}^Means with different letters in the same row are significantly different (P<0.05)

Table 2. Chemical composition and meat quality for Mexican beef bought in Guadalajara, Chihuahua and Veracruz supermarkets.

	Chihuahua	Guadalajara	Veracruz	SE
n	20	25	20	
Moisture %	72.41^{a}^	71.92^{a}^	73.49^{b}^	0.36
Fat %	2.28^{a}^	3.07^{b}^	1.85^{a}^	0.13
Protein (Nx6.25) %	20.16^{a}^	20.79^{b}^	19.39^{c}^	0.17
Total collagen mg/g	9.15	9.50	9.15[a]	0.37
Soluble collagen %	14.02^{a,b}^	13.10^{a}^	15.15^{b}^	0.41
PH	5.63[a]^{a}^	5.87^{b}^	5.66^{a,b}^	0.01
Shear force, Newtons	46.19[a]^{a}^	46.28^{a}^	40.60^{b}^	1.47
Cooking loss %	18.76^{a}^	34.20^{b}^	21.33^{c}^	0.52
L (lightness)	38.63^{a}^	43.05^{b}^	43.78^{b}^	0.40
a (red)	18.89^{a}^	16.32^{b}^	19.15^{a}^	0.33
b (yellow)	6.05^{a}^	7.70^{b}^	6.92^{c}^	0.20
Price dollars/kg	6.89^{a}^	6.67^{a}^	7.80^{b}^	0.12

^{a,b}^Means with different letters in the same row are significantly different (P<0.05)