CARCASS AND SENSORY CHARACTERISTICS OF DIFFERENT BREEDS OF BEEF CATTLE RAISED IN A RANCHING OPERATION

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ABSTRACT

Twelve junior bulls with age ranging from 2 to 2.5 years raised under extensive grazing system with no concentrate supplementation from four breeds (Bali, Brahman, Philippine Native and Simbrah) were slaughtered from September 2012 to July 2013. This study was conducted to evaluate and characterize breed differences in carcass characteristics and sensory quality of beef. The experiment was conducted with three replications per treatment using a completely randomized design. Standard slaughter procedures were followed. The beef forequarters and hindquarters were cut into standard wholesale cuts following the modified USDA procedure. Ten (10) experienced panelists participated during the sensory evaluation of broiled beef samples. Average slaughter weight of the four cattle breeds ranged from 208.9 to 262.0 kg. There were no significant differences in the dressing percentage, lean-fat-bone yield, loin-eye area and percent slaughter by-product of the four cattle breeds. Simbrah had longer ($P<0.05$) carcass whereas the shortest was obtained in the Philippine Native. Wholesale cut yield based on live weight did not differ significantly among breeds except for the chuck and the brisket. For the sensory quality,

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flavor, aroma and juiciness scores of beef from the four different breeds did not differ significantly. Tenderness score and general acceptability was higher in beef from Philippine native (*P*<0.05) than the other breeds. In conclusion, Philippine Native cattle grown under extensive grazing system until 2 to 2.5 years of age compares well with Bali, Brahman and Simbrah in terms of carcass yield and wholesale cut yield. Beef from Philippine native has a higher degree of tenderness and general acceptability based on sensory evaluation.

Keywords: Beef cattle breeds, carcass, Philippine native, sensory characteristics

INTRODUCTION

The current thrust of the national government as one of the mitigating measures to cope with climate change is the development of Philippine native animals. Efforts on documentation of past studies and characterization of native animals are in the pipeline in order to determine the genetic potential of native animals.

The Philippine native cattle is an admixture of *Bos indicus*, *Bos taurus, Bos brachycerous* and *Bos banteng* types (Villegas, 1985; Arboleda, 1987; Aquino *et al.*, 2006). A study on the genetic diversity of beef cattle from selected agro-ecological zones of the country revealed a genetically distant relationship between the populations of Siquijor and Cebu. Using microsatellite analysis, Aquino *et al*. (2006) identified Siquijor cattle as Taurine type and Bohol cattle as a group closely related to Cebu cattle that is predominantly Bali type.

With this genetic make-up, it is presumed that there are differences in carcass yield and meat quality but no data is available; hence, this research was proposed. The study was conducted to evaluate and characterize breed differences in carcass characteristics and sensory quality of beef. The baseline data that was gathered may serve as basis for the development of beef cattle breeds that are inherently present in different areas of the Philippines.

MATERIAL AND METHODS

Experimental animals

Junior bulls were raised under the grazing system with no concentrate supplementation at the Ubay Stock Farm. Bulls with age ranging from 2 to 2.5 years from four breeds that include Bali, Brahman, Philippine Native and Simbrah were randomly selected and were slaughtered from September 2012 to July 2013. The experiment was conducted with three replications in a completely randomized design. Each batch of animals from the four breeds was considered as a replicate.

Pre-slaughter management

Handling of animals prior to slaughter influences the ultimate meat quality thus proper management was used. Management practices include fasting, proper handling (i.e. avoiding any form of maltreatment like whipping, boxing, etc.), providing a rest period and cleaning the animal before slaughter. The animals were removed from the herd two days before the scheduled slaughter and were given ad libitum water.

Slaughtering of animals

The standard procedure for the slaughter of beef cattle was followed. The procedure includes ante-mortem inspection, immobilization using a stunning gun, sticking and bleeding, flaying, evisceration, splitting, quartering and post-mortem inspection.

Fabrication of carcasses

The beef forequarters and hindquarters were cut into standard wholesale cuts following the modified USDA procedure. The primal cuts from the forequarter include the chuck, brisket, foreshank, rib and plate. The round, flank and loin were obtained from the hindquarter.

Beef carcass evaluation

The value of the carcass was determined by measuring the yield and quality attributes. The data gathered include dressing percentage, percentage of slaughter by-products, carcass length, loin-eye area and lean-fat-bone yield. The loin-eye area was measured on the 11^{th} rib while the lean-fat-bone yield was

assessed using the joint sample from the 9th to the 11th rib. The yield of the wholesale cuts from the forequarter and the hindquarter were also measured.

Sensory evaluation

The rib roast from the 9th-11th rib were obtained from the right forequarter, chilled for 48 h and frozen until the scheduled session of sensory evaluation. The rib roasts were broiled in an oven set at 163°C until a cooked temperature of 71°C was attained. The cooked *Longissimus dorsi* muscle was separated from the rib roast and was cut into one inch cubes. Palatability attributes like flavor, aroma, tenderness and juiciness were assessed through sensory evaluation. A 7-point hedonic scale was used. Ten experienced panelists participated during the evaluation of broiled beef samples. Three sessions of sensory evaluation were conducted and each session was considered as a replicate.

Statistical analyses

All the data were recorded and analyzed following the model:

$Y_{ijk} = u + B_j + W^c + e_{ijk}$, where
Y = ith observation
U = general mean
B_j = ith observation of the jth breed (4= Bali, Brahman, native cattle and Simbrah)
W^c = fasted slaughter weight as covariate
e_{ijk} = random residual error

General Linear Model procedures and PROC CORR using SAS (SAS Inst. Inc., Cary, NC) were used. For the sensory evaluation, data were analyzed using randomized complete block design using panelist as block. Differences between treatment means were analyzed using the Bonferroni t-test. Statistical significance was set at $P \leq 0.05$.

RESULTS AND DISCUSSION

Carcass Yield

Average slaughter weight of the four cattle breeds ranged from 208.9 to 262.0 kg whereas hot carcass weight ranged from 110.8 to 140.3 kg (Table 1). The dressing percentage did not differ among breeds. Similarly, there were no significant differences in the lean-fat-bone yield, loin-eye area and percent slaughter by-product. Simbrah had longer (P<0.05) carcass whereas the shortest was obtained in the Philippine Native. These coincide with the average body weights of the animals although the slaughter weights did not differ significantly. At 2 to 2.5 years of age, Bali, Brahman, Philippine Native and Simbrah reared in a grazing system have similar carcass yields. Orellana *et al*. (2009) reported that in their study on 2.5 yr old Criollo Argentino and Braford steers that were raised under extensive grazing system, Braford steers had greater (P<0.05) carcass weight, yield, conformation score, marbling degree, fat thickness and fat score than Criollo Argentino steers. Similarly, the dressing percentages of West African Shorthorn, Sanga and Zebu cattle did not differ significantly in the study of Ga and Sunkwa (2010) although carcass components were significantly higher in Zebu than the other two breeds. In the present study, Bali, Brahman, Philippine Native and Simbrah, may not have reached their maximum growth potential at the time of slaughter such that any breed differences on carcass components cannot be detected. All the beef samples are practically devoid of intramuscular fat and subcutaneous fat is minimal. It is apparent that supplementation should be done to the breeds of animals used to improve carcass characteristics. Lapitan *et al*. (2007) reported higher slaughter weights and carcass yields on 29 month old crossbred Brahman cattle that were fattened for 180 days.

Table 1. Carcass characteristics of four different breeds of beef cattle raised under extensive grazing system.

Parameter	Breed				% CV
	Bali	Brahman	Native	Simbrah	
Live weight, kg	222.3	254.4	208.9	262.0	
Hot carcass wt, kg	119.9	129.6	110.8	140.3	
Dressing, %	53.7	51.0	53.0	53.6	2.4
L-F-B Yield					
Lean, %	70.52	64.34	64.34	64.26	12.29
Fat, %	14.42	16.31	16.31	17.39	29.63
Bone, %	14.46	18.63	18.63	17.38	30.11
Loin eye area, sq. in.	8.49	8.58	9.28	9.25	17.00
Carcass length, cm	110.00^{bc}	115.00^{ab}	107.67^{c}	118.67^{a}	1.63
Slaughter by-products, %	31.85	28.72	31.17	30.01	9.50

$^{a-c}$Within a row, means without a common superscript differ (P<0.05).

Wholesale Cut Yield

In general, wholesale cut yield based on live weight did not differ significantly among breeds except for the chuck and the brisket. Chuck yield was greatest (P<0.01) in Bali and least in Brahman while brisket yield was greatest (P<0.05) in Simbrah. Based on carcass weight, it was only the brisket and the loin that differed significantly. Yield of brisket was highest (P<0.01) in Simbrah while loin was highest (P<0.05) in Brahman. The significant differences obtained in only a few wholesale cuts seem to indicate that the body conformation of the breeds are not very different at 2 to 2.5 years of age when grown under extensive grazing system without supplementation. It could also mean that the animals have not reached their maximum growth potential under the conditions at which they were raised.

Table 2. Wholesale cut yield of the forequarters and hindquarters of four different breeds of beef cattle raised under extensive grazing system.

Parameter	Breed				% CV
	Bali	Brahman	Native	Simbrah	
FOREQUARTER					
Chuck					
% of live weight	18.85[a]	13.38[b]	15.05[ab]	14.85[ab]	4.10
% of carcass weight	29.48	26.27	28.38	27.72	4.15
Brisket					
% of live weight	2.02[b]	2.01[b]	2.14[ab]	2.36[a]	3.52
% of carcass weight	3.76[b]	3.94[b]	4.03[ab]	4.41[a]	5.12
Ribs					
% of live weight	4.73	4.92	4.99	5.24	11.94
% of carcass weight	8.82	9.65	9.42	9.77	11.90
Plate					
% of live weight	3.23	3.35	3.31	3.49	7.35
% of carcass weight	6.02	6.58	6.23	6.52	6.33
Foreshank					
% of live weight	2.97	2.88	2.76	2.85	8.25
% of carcass weight	5.53	5.64	5.20	5.33	8.60
HINDQUARTER					
Round					
% of live weight	15.07	3.35	3.31	3.49	5.09
% of carcass weight	28.12	29.97	27.81	29.70	3.89
Loin					
% of live weight	7.28	6.93	6.90	6.98	1.40
% of carcass weight	13.57[ab]	13.59[a]	13.00[c]	3.03[bc]	3.60
Flank					
% of live weight	2.06	1.93	1.90	1.92	11.70
% of carcass weight	3.83	3.80	3.58	3.58	12.24

[a-c]Within a row, means without a common superscript differ (P<0.05).

Sensory Quality

The flavor, aroma and juiciness scores of beef from four different breeds did not differ significantly (Table 3). Flavor scores indicate that flavor ranged from slightly full to moderately full with the flavor of beef from Philippine Native having a slight edge over the other three breeds. Aroma ranged from slightly weak to neither rich nor weak. This could be attributed to the lack of intramuscular fat in the *Longissimus dorsi* muscles of the beef samples used. Species flavor and aroma arise from materials in fat, many of which are volatilized when heated (Aberle *et al*., 2001). The lipid components of meat undergo oxidative degradation thereby

generating volatile compounds that are responsible for the aroma of the product. The lack of aroma compounds may have also contributed to the relatively low flavor scores since many of the psychological and physiological responses experienced when meat is eaten are elicited by product flavor and aroma (Aberle *et al*., 2001). All beef samples were judged as neither juicy nor dry. The lack of marbling fat could have contributed to the low juiciness scores. During cooking, melted fat becomes translocated along bands of the perimysial connective tissue and act as barrier to moisture loss (Aberle *et al*., 2001). The lack of juiciness could have also been due to the relatively low degree of tenderness of the meat samples. Since the cooked samples were quite resistant to tooth pressure, rupture of the sarcolemma and myofibrils were also limited so less meat juice came out during the first few chew thereby reducing the panelists' perception of juiciness. The lack of marbling fat could have also affected the tenderness of the meat although to a limited extent. Warriss (2001) reported that intra-muscular fat may improve tenderness by diluting the effects of tougher myofibrillar elements so reducing the shear force needed to cut through muscle fibers, or the fat may reduce the rigidity of the muscle structure or allow muscle fiber bundles to separate from one another easily. The principal reason for the low tenderness scores of the beef samples is the lack of sufficient chilling of the carcass prior to fabrication. The 48-h chilling could have facilitated the resolution of rigor mortis and some proteolysis in the muscle tissues that would eventually improve the degree of tenderness of the meat.

Table 3. Mean sensory scores for the palatability attributes of beef from four breeds of beef cattle raised under extensive grazing system.

Parameter	Breed				% CV
	Bali	Brahman	Native	Simbrah	
Flavor	4.80	5.11	5.48	5.02	12.99
Aroma	3.13	3.10	3.28	3.42	32.54
Tenderness	3.10^{b}	3.17^{b}	4.28^{a}	3.80^{b}	20.67
Juiciness	3.61	3.72	3.96	3.76	24.14
General acceptability	3.72^{b}	3.46^{b}	4.76^{a}	4.37^{b}	20.04

$^{a-c}$Within a row, means without a common superscript differ (P<0.05).
Mean sensory scores given by sensory panel on a 7-point hedonic scale: Flavor (1-7, very weak beef flavor to very full beef flavor); Aroma (1-7, very weak aroma to very rich aroma); Tenderness (1-7, very tough to very tender); Juiceness (1-7, very dry to very juicy); General Acceptability (1-7, very unacceptability to very acceptability).

Tenderness score was higher (P<0.05) in beef from Philippine Native than the other breeds. It is possible that the muscle fiber diameter of the meat is relatively smaller since the average live weight of the Philippine Native is lower than Bali, Brahman and Simbrah. General acceptability of beef from Philippine Native was also higher (P<0.05) than the other breeds. The findings support previous reports that the primary consideration by consumers for the purchase of beef is tenderness. The results of the current experiment indicate the advantage of Philippine Native over Bali, Brahman and Simbrah in terms of sensory quality.

General acceptability showed positive weak correlations (P<0.01) with flavor and aroma while it showed moderate positive correlations with tenderness and juiciness (Table 4). On the other hand, flavor has positive weak correlations (P<0.01) with aroma, tenderness and juiciness. A significant positive strong correlation exists between aroma and juiciness. The results clearly show that the sensory quality of beef is a close interplay of all the palatability attributes.

Table 4. Correlation of the palatability attributes of beef from different breeds of beef cattle raised under extensive grazing system.

Palatability Attributes	Pearson correlation coefficients (r)			
	Aroma	Tenderness	Juiciness	General Acceptability
Flavor	0.21*	0.32**	0.24**	0.39**
Aroma		-0.23	0.65**	0.34**
Tenderness			0.07	0.49**
Juiciness				0.63**

*Significant at P<0.05 **Significant at P<0.01

CONCLUSION

The Philippine Native cattle grown under extensive grazing system until 2 to 2.5 years of age compares well with Bali, Brahman and Simbrah in terms of carcass yield and wholesale cut yield. Beef from Philippine native has a higher degree of tenderness and general acceptability based on sensory evaluation. One of the limitations of this study is the absence of concentrate supplementation hence it is recommended that studies on concentrate supplementation or fattening be undertaken to determine if the Philippine native cattle have marbling potential.

REFERENCES

Aberle ED, Forrest JC, Gerrard DE and Mills EW. 2001. *Principles of Meat Science*. 4th ed. Iowa: Kendall/Hunt Publishing Company.

Aquino GMB, Laude RP, Jianlin H, Sevilla CC and Hanotte O. 2006. Genetic structure of selected cattle populations in the Philippines using microsatellite. *Phil J Anim Sci* 32(1).

Arboleda CR. 1987. Animal genetic resources conservation and development in the Philippines. *Anim Prod Technol* 3: 1-7.

Ga T and Sunkwa WK. 2010. Carcass characteristics of tropical beef cattle breeds (West African Shorthorn, Sanga and Zebu) in Ghana. *African J Food Agric Nut Dev* 10: 2867-2883.

Lapitan RM, Del Barrion AN, Katsube O, Ban-Tokuda T, Orden EA, Robles AY, Fujihara T, Cruz LCC, Homma H and Kanai Y. 2007. Comparison of carcass and meat characteristics of Brahman-grade cattle (*Bos indicus*) and crossbred water buffalo (*Bubalus bubalis*). *Anim Sci J* 78: 596-604.

Orellana C, Peña F, Garcia A., Perea J and Martos J. 2009. Carcass characteristics, fatty acid composition and meat quality of Criollo Argentino and Braford steers raised in forage in a semi-tropical region of Argentina. *Meat Sci* 81: 57-64.

Villegas VE. 1965. Types of Philippine cattle. *Phil J Anim Sci* 1-2: 22-62.

Warriss PD. 2001. *Meat Science: An Introductory Text*. New York: CABI Publishing.