EVALUATION OF THE BEEF QUALITY OF YOUNG SENEPOL CROSSBRED HEIFERS UNDER TROPICAL GRAZING CONDITIONS

Alejandra S.Torres[1*], Cristina I. Mántaras[2], Aixa Rivera[3], Américo Casas[4], Héctor L. Sánchez[5], Danilo Cianzio[6] and Melvin Pagán[7]

[1,2] Graduate Student, Department of Animal Science, UPRM, Mayaguez, Puerto Rico
[3] Cooperative Extension Service, Department of Animal Science, UPRM, Mayaguez, Puerto Rico
[4,5] Agriculture Experimental Station, Department of Animal Science, UPRM, Mayaguez, Puerto Rico
[6,7] Faculty of Agricultural Sciences, Department of Animal Science, UPRM, Mayaguez, Puerto Rico
*alejandra.torres@upr.edu

In order to improve the commercialization of locally produced beef, a strategic supplementation regime and the percent of Senepol blood in beef heifers was evaluated. *Longissimus dorsi* samples were collected from a total of forty-four Senepol x Charolais x Charbray crossbred heifers under three dietary treatments (T1= grazing; T2= grazing plus light protein supplementation; T3= grazing plus heavy protein supplementation) for three slaughter years (2011, 2012 and 2013). Those were analyzed for intramuscular fat percentage and Warner-Bratzler Shear Force at 0 days (24 hrs *post mortem*) and after 14 days of aging. Our results showed improvement in tenderness of meat samples after 14 days of aging (4.77± kg, P=0.039). In 2013, T3 was superior in intramuscular fat percentage (3.84±0.39%; P<0.05). Also in 2013, more Senepol (More_S) heifers showed greater fat percentage than the less Senepol (Less_S). Also, More S showed a fat percentage increase depending on the plane of nutrition (P=0.006) and was superior to Less S in T2 but inferior in T1. Therefore, it seems that More S heifers presented better intramuscular fat percentage than Less S under light protein supplementation. Also, a 14 days aging period resulted in a tenderness improvement irrespective of the amount of Senepol inheritance.

I. INTRODUCTION

The Senepol breed was introduced in the Caribbean in the early 1900s by crossing Red Poll bulls with N'Dama cows (1). The breed was developed to meet the specific requirements of the tropical Caribbean environment by combining the heat tolerance and insect resistance of the N'Dama breed with the gentle disposition and overall productivity of the Red Poll. (2). This breed has proven to be an important addition to the genetic pool of cattle that are bred and used for beef in Puerto Rico and other parts of the world like Brazil, Colombia, Venezuela, Panama and even Australia. Also, Senepol crossbreds are considered to be very productive, hardy and adaptable to tropical conditions.

There is little information available that compares the meat quality of traditional pasture-fed Senepol crossbred beef, especially for heifers. In Puerto Rico grass finished young heifers of any breed, that reach processing weight at an age of 20 to 24 months receive an unreasonably large price discount at the feeder and slaughter levels. This price discount is jeopardizing the economic viability of local cow-calf operations. The grazing performance, carcass characteristics and beef quality of young grass-fed heifers needs to be characterized if feeder heifer prices, at any level, are going to improve. The objectives of this study were to determine carcass characteristics, beef quality, and intramuscular fat percentage from Senepol crossbred cattle pasture-fed and to evaluate the effect of aging over beef tenderness.

II. MATERIALS AND METHODS

A total of forty-four Senepol (S) x Charolais (CHA) x Charbray (CH) crossbred heifers were evaluated between December 2010 and September 2013. Treatments consisted of 1) grazing at an average stocking rate (SR) of 1.30 head/acre (T1); 2) grazing at a SR of 1.32 head/acre plus supplemental feeding of a protein supplement at 0.50% of live weight (T2); and 3) grazing at a SR of 1.33 head/acre plus supplemental feeding at 0.70% of live weight (T3). Each year, at the start of spring, pastures received 181.4 kg/acre of 15-5-10 of fertilizer. Average on test weights in T1, T2 and T3 were 232.1, 229.4, and 230.4 kg/head, respectively at approximately 9 to 10 months of age. After

approximately of 277.3 days of grazing, average final live weights were 370.4, 388.9 and 403.2 kg for T1, T2 and T3, respectively.

At the end of each the grazing period heifers from each treatment were slaughtered at 17-18 months of age, estimated by the number of permanent incisive (3). Animals were slaughtered at a USDA inspected commercial abattoir. After processing, carcass measurements were taken and the left hindquarter was dissected into muscle, fat, bone and fascia/tendon (connective tissue) groups at the Meat Science Laboratory at UPR Mayaguez. Two roasts (10 cm thick) were harvested from the *Longissimus dorsi* (LD) muscle posterior to the 12th rib from the left half of the carcass. One roast was analyzed immediately (0 days) and stored at −28°C under vacuum-packaging. The other was vacuum-packed and aged for 14 d at 5°C. After the 14 d of aging, the roasts were moved and stored at -28°C until quality assessment and analysis could be completed.
Prior to analysis, meat samples were ground in a mini food processor (Premium, model PMC155) and stored at -28°C until analysis. Samples were defrosted at 5°C, from which approximately 2 grams were weighed and placed in fat filter bags. These were dried in oven at 102°C (Narco, 630) for 24 hrs and the weight was recorded. The filter bags were placed in the ANKOM XT10 Extractor (ANKOM Technology, Macedon, NY, USA) for ether extraction of fat. The filter bags where oven dried for 15-30 minutes. Afterwards, they were weighed and the crude fat percentage was calculated using the AOCS Official Procedure Am 5-04 (4).

Warner–Bratzler shear force (WBSF) analysis was conducted according to AMSA's guidelines (5). The roasts were thawed overnight at 5 C after each aging period, and roasted at 177 C in a convection oven (Vulcan 60SC-2DQ) to an internal temperature of 74 C. Cooked roasts were then cooled and three cores of 1.27 cm in diameter were cut parallel to the muscle fibers. Each core was sheared three times using a Warner-Bratzler machine (Salter, 3000). This procedure was also applied to the roasts prior to cooking (raw). The average measurements of nine cooked meat cores were used for subsequent analysis (5).

The experiment was conducted as a completely randomized design and the data was analyzed by the PROC GLM of SAS with slaughter year, dietary treatment and Senepol influence as independent variable in the model. Body weight at slaughter was used as a covariate in the model. Means were separated by LSD test of SAS Version 9.2.

III. RESULTS AND DISCUSSION

The WBSF values of both aging periods evaluated (0 vs. 14 d) are presented in Figure 1. Aging increased tenderness of meat samples with 0 d and 14 d of aging presenting WBSF values of 6.46±0.56 and 4.77±0.34 kg, respectively, P=0.039, in the meat samples. The meat tenderness is influenced by various factors such as the type of muscle evaluated (support or locomotive), intramuscular fat and *post mortem* proteolysis (6). Aging meat samples for 14 d allows enzymatic processes to take place and ultimately affects the integrity of the muscle fibers, which is directly responsible for changes in tenderness. Our findings agree with previous studies by Hanzelková1 et al. (7) and Bratcher et al. (8), which stated that the vast majority of tenderness improvement, based on WBSF readings, happens at two weeks of aging.

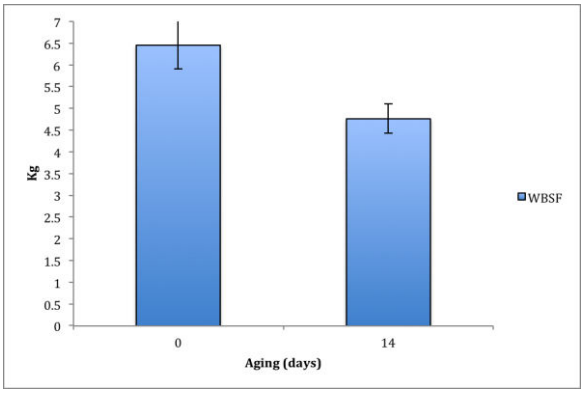

Figure 1. Mean values and standard errors of WBSF for 0 and 14 days of aging in crossbred beef heifers' meat samples

There was an interaction (Fig. 2; P<0.006) between year and breed, which affected the intramuscular fat percentage. For years 2011 and 2012 there were no significant differences in fat percentage associated with breed (P>0.05). Meanwhile, during 2013, More_S animals showed greater fat percentage values than their Less_S counterparts (3.47±0.25 and

2.29±0.28%, respectively). In animals with Less_S, we found that the fat percentage remains constant throughout all three years evaluated (1.92±0.20, 2.28±0.24, 2.29±0.28%, respectively; P>0.05). Meanwhile, animals with More_S influence showed an increase of fat percentage in 2013.

An evaluation of the different factors associated with the environment and handling of the animals could explain the effect of slaughter year. Some of the environmental factors affecting the fat percentage each year are the amount of precipitation, humidity and available minerals and nutrients for the different types of forage fed to the animals. However, we cannot provide a concise explanation for the variability between the years.

Senepol animals are characterized by having a smaller body frame than Charolais and Charbray cattle, and smaller animals have a predisposition of reaching sexual maturity earlier. The fat deposition in these animals is accelerated by sexual maturity and diet (9). Using slaughter weight as a covariate, our data indicated that animals with Less_S influence had meat with a fairly constant fat percentage in all years evaluated. Whereas, animals with More_S influence showed an increase associated with the amount of supplementation offered. Carcasses from animals with heavier supplementation are expected to have greater adipose accumulation regardless of breed as documented in Sterman-Ferraz et al. (10).

An interaction between slaughter year and grazing period (P=0.0047) affecting fat percentage (Fig. 3) was significant. No significant difference between the dietary treatments offered to the animals in this study (P>0.05) could be observed for the year 2011. For animals evaluated in 2013, there were significant differences for all three diets with T3 having an overall greater fat percentage with 3.84±0.39%. Animals in T1 showed no difference (P>0.05) in 2011, 2012 and 2013 (1.72±0.27, 2.14±0.34 and 1.77±0.29%, respectively). The T2 heifers in the last two years, 2012 and 2013, had no differences (P>0.05) but data for 2011 showed to be different for fat percentage (1.97±0.23%, P=0.005). The greater fat percentage was found in T2 throughout the three years experimental period (1.97±0.23, 2.9±0.35, 3.03±0.39%, P<0.001). Although, T3 showed no significant differences in years 2011 and 2012 (1.72+0.25 and 1.99±0.31%; P>0.05) for fat percentage, in 2013 differences were observed (3.84±0.39%; P<0.05).

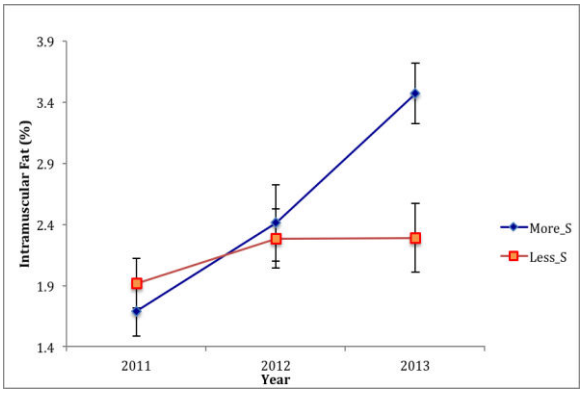

Figure 2. Mean values and standard errors of fat percentage for the different genotypes (Senepol influences) during years of study in crossbred heifers.

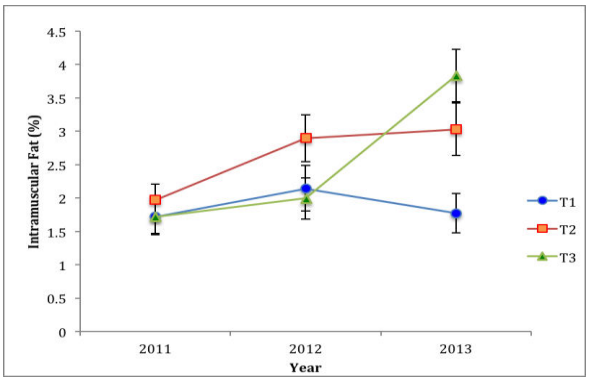

Figure 3. Mean values and standard errors of fat percentage for the different experimental diets during three years of study in crossbred beef heifers.

The interaction between Senepol influence and treatment (P<0.001) over the fat percentage of the meat samples is presented in Fig. 4. For animals with More_S influence we observed significant differences between all three treatments. On the other hand, animals with Less_S influence had significant difference between T1 and T2 and between T1 and T3 (1.52±0.30, 3.54±0.29 and 1.52±0.30, 2.50±0.20, respectively). Pasture-fed animals (T1) showed significant difference between More_S and Less_S influence (1.52±0.30 and 2.23±0.23%, respectively). The T2 heifers showed differences with a much higher fat percentage in animals with More_S influence (3.54±0.29%, P<0.001). Animals offered T3, had constant fat percentage

for both Senepol influences: Less_S and More_S (2.53±0.27 and 2.50±0.20%, respectively; P<0.001).

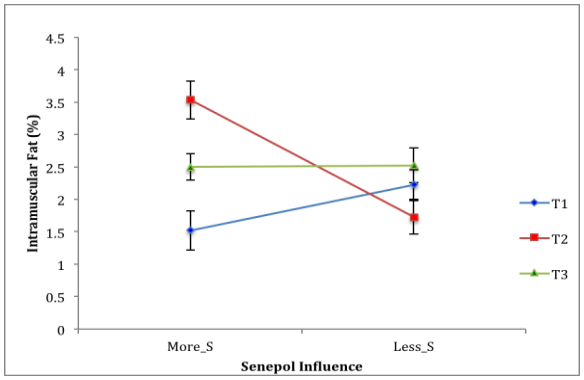

Figure 4. Mean values and standard errors of fat percentage for the experiment diets in the different genotypes of crossbred beef heifers.

IV. CONCLUSION

The present study showed that improvements in tenderness of the meat, the most important characteristic for consumers, could be achieved by allowing the meat to age for a period of two weeks. Furthermore, meat from animals with More_S influence and light supplemental feeding showed to have an effect on intramuscular fat deposition. The use of Senepol crossbred heifers should be taken into consideration as a model for improvement of carcass characteristic and beef quality in the tropics. The adaptability to high temperatures and very humid conditions displayed by these animals is key in an effort to further develop the commercialization of local beef, specially under grazing and limited supplementation conditions.

REFERENCES

1. Hupp, H. D. (1981). Senepol Cattle: History and Development. Agr. Exp. Sta. Rep. II. College of the Virgin Islands, St. Croix.
2. Thrift, F. A., Franke, D. E., Aaron, D. K. (1986). Preweaning Breed-of-Sire Comparisons Involving The Senepol Breed of Cattle. Journal of Animal Science 62:1247-1254.
3. Casas, A., Cianzio D., Rivera A., Cantisani L., Añeses L. (2001). Estimación de la edad del ganado vacuno por sus insicivos. Boletn 299, Estación Experimental Agrícola.
4. AOCS Official Procedure AM 5-04. (2009). Rapid Determination of Oil/Fat Utilizing High Temperature Solvent Extraction. ANKOM Technology Method 2.
5. AMSA. (1995). In: Research Guidelines for Cookery, Sensory Evaluation, and Instrumental Tenderness Measurement of Fresh Meat. American Meat Science Association and National Live Stock and Meat Board, Chicago, IL.
6. Belew J. B., Brooks J. C., McKenna D. R., Savell J. W. (2003). Warner-Bratzler shear evaluations of 40 bovine muscles. Meat Science 64: 507-512.
7. Hanzelková, Š., Simeonovová, J., Hampel, D., Dufek, A., & Šubrt, J. (2011). The effect of breed, sex and aging time on tenderness of beef meat. *Acta Veterinaria Brno*, *80*(2), 191–196
8. Bratcher C. L., Johnson D. D., Littell R. C., Gwartney B. L. (2005). The effects of quality grade, aging, and location within muscle on Warner-Bratzler shear force in beef muscles of locomotion. Meat Sci 70: 279-284.
9. Huerta, N. (2002). La Experiencia Venezolana en la Implantación de Sistemas de Clasificación de Ganado y Canales Bovinas. XI Congreso Venezolano de Producción e Indrustria Animal. Trujillo, Venezuela.
10. Sterman-Ferraz J. B. and J. E. de Felício. (2010). Production systems – An example from Brazil. Meat Science 84: 238-243.