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AGE AT PUBERTY IN BEEF HEIFERS: CRIOLLO CATTLE VERSUS BRITISH CROSSBRED CATTLE

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ABSTRACT: Age at puberty is an important factor in estimating the potential productivity of the bovine female. A study was conducted at the ARS-USDA Jornada Experimental Range in 2006 and 2007 to compare onset of puberty, BW, and serum insulin in Criollo and Angus-Hereford crossbred heifers. In 2006, 7 Criollo and 5 crossbred heifers were used to determine length of the estrous cycle and insulin concentrations. Heifers grazed the same pasture during the study with free access to water and mineral supplement. Blood samples were collected twice weekly for both years. In 2007, 15 Criollo and 15 crossbred heifers were used to determine age at puberty (2 or more consecutive progesterone concentrations > 1 ng/mL), length of the estrous cycle, and insulin concentrations. Initial BW in both 2006 and 2007 crossbred heifers were heavier ($P < 0.01$), when compared to Criollo heifers (251.7 and 166.4 ± 12.9 kg; 236.2 and 158.8 ± 4.7 kg, respectively). In 2006, BW gain did not differ ($P < 0.01$) between breeds (80.5 and 71.1 ± 4.4 kg for crossbred and Criollo heifers, respectively). In 2007, crossbred heifers gained more BW than Criollo heifers during the study ($P < 0.01$; 128.2 and 91.2 ± 4.1 kg, respectively). In 2007, BW at puberty ($P < 0.01$) was greater for crossbred heifers than Criollo heifers (323.8 and 213.9 ± 6.6 kg, respectively). However, Criollo heifers tended ($P = 0.15$) to reach puberty earlier than crossbred heifers (363.5 and 376.7 ± 6.3 d, respectively). Estrous cycle length in crossbred and Criollo heifers in both 2006 and 2007 did not differ ($P \geq 0.53$; 18 and 19 ± 1 d; 18 and 19 ± 1 d, respectively). Serum insulin concentrations were also greater ($P < 0.01$) for Criollo compared to crossbred heifers in both 2006 and 2007 (0.67 and 0.54 ± 0.02 ng/mL; 0.68 and 0.58 ± 0.02 ng/mL, respectively). This study suggests that Criollo heifers may reach puberty earlier than British breeds.

Key words: beef cattle, Criollo cattle, puberty.

INTRODUCTION

Criollo cattle came from the Canary Islands of the north-west coast of Africa (Primo, 1992). These cattle were introduced into the New World by Christopher Columbus in 1493, on his second trip (Rouse, 1977). Criollo cattle spread to the southwest and southeast United States by Spanish missions and ranches with Spanish influence (Sponenberg and Olson, 1992). It is believed that fewer than 300 were transported to the new world (Olson, 1988). This type of cattle was one the main food supplies not only

for the Spanish conquistadors but also to the natives. Through the years, the Criollo cattle brought to the New World adapted to different environments (Portillo et al. 2006) until new breeds were introduced, changing the initial purpose of the Criollo cattle for food supply to entertainment purposes such as rodeo. Russell et al. (2000) compared the genetic material present in Criollo cattle with Angus, Hereford, Charolais, and Simmental, finding the Charolais breed as the most genetically similar to the Criollo breed and the Angus breed as the most different. Many efforts have been made in order to keep the breed as a potential genetic source for lands with limited forage production or extreme environments. Because reproduction is the most important factor that influences the productivity of the animal industry, it is crucial to understand all the physiological events involved. Puberty is the process of acquiring reproductive competence and the age at which mature gametes are first produced (Foster and Nagatani, 1999; Senger, 2003). Age at puberty in British breeds of cattle has been well established by many researchers (Day et al. 1987; Rodrigues et al., 2002; Gasser et al., 2006abc). However, age at puberty in Criollo cattle has not been well established. The objective of this study was to evaluate the onset of puberty between Criollo cattle and British crossbred cattle.

MATERIALS AND METHODS

Location

A 2-yr study was conducted at the Jornada Experimental Range, operated by the Agricultural Research Service of the U.S. Department of Agriculture, and located 37 Km. north of Las Cruces, NM. at an elevation of approximately 1,188 m. The annual precipitation in this area is 247 mm, beginning July 1 to September 30 when 53% of the annual rainfall occurs. The vegetation present in the area of study was Honey mesquite (*Prosopis glandulosa*), Soap tree yucca (*Yucca elata*), Broom Snakeweed (*Gutierrezia sorostrae*), Black gramma (*Bouteloua eriopoda*), and Tarbrush (*Artriplex canescens*).

Animals

In 2006, 7 Criollo heifers and 5 British crossbred heifers were used to determine length of the estrous cycle and insulin concentrations. The mean BW of the groups was 166 kg and 251 kg (at trial start, Sep. 1, 2006), respectively. Both groups of heifers were maintained in the same pasture under the same environmental conditions. In 2007, 15 Criollo and 15 British crossbred heifers were used to determine age at puberty (2 or more consecutive progesterone concentrations > 1 ng/mL),

length of the estrous cycle, and insulin concentrations. The mean BW was 159 kg and 236 kg (at trial start, Apr. 18, 2007) for Criollo and crossbred heifers respectively.

Sample Collection

Serum samples were collected for progesterone and insulin concentration analysis twice weekly to determine onset of estrus. Heifers were gathered and bled by caudal venipuncture for five mo. Blood was collected in 9 mL Corvac serum separator tubes (Kendall Healthcare, Mutansfield, MA) with 20 gauge x 2.54 cm needles (BD Vacutainer Systems, Franklin Lakes, NJ). Blood was transported to Las Cruces and centrifuged at 2000 x g for 20 min at 4°C. Serum was decanted and stored at -20°C prior to subsequent assay for progesterone and insulin concentration. The progesterone assay was conducted at NMSU Endocrinology Laboratory, using a commercial RIA kit (Coat-A-Count, Siemens Medical Solutions Diagnostics, Los Angeles, CA) modified for use in ruminant serum as established by Scheneider and Hallford (1996). The average CV for progesterone within assay was 9.3% and between assays was 11.3%. For insulin analysis, samples were composited for 2-wk week intervals. The insulin assay was performed, using a solid phase RIA (DPC kit, Siemens Medical Solutions Diagnostics, Los Angeles, CA) as established by Reimers et al. (1982). The average CV for insulin was 6.8% within assays and 18% between assays.

Statistical Analysis

Data were analyzed as completely randomized design using the GLM procedure of SAS (SAS Inst. Inc., Cary, NC) for estimation of age to puberty. For analysis of BW, cycle length, and insulin concentrations, a completely randomized design, using the MIXED procedure of SAS was performed.

RESULTS AND DISCUSSION

Initial BW of crossbred heifers in both 2006 and 2007 were heavier ($P < 0.01$), when compared to Criollo heifers (251.7 and 166.4 ± 12.9 kg; 236.2 and 158.8 ± 4.7 kg, respectively). In 2006, BW gain did not differ ($P < 0.01$) between breeds (80.5 and 71.1 ± 4.4 kg for crossbred and Criollo heifers, respectively) during the 151 d study. In 2007, crossbred heifers gained more BW than Criollo heifers during the 147 d the study ($P < 0.01$; 128.2 and 91.2 ± 4.1 kg, respectively).

In 2007, BW at puberty ($P < 0.01$) was greater for crossbred heifers than Criollo heifers (323.8 and 213.9 ± 6.6 kg, respectively; Figure 1). However, Criollo heifers tended ($P = 0.15$) to reach puberty earlier than crossbred heifers (363.5 and 376.7 ± 6.3 d, respectively; Figure 2). Criollo cattle are considered in the range of the breeds with lighter BW at puberty and early puberty when compared with the breeds used by Laster et al. (1976, 1979). This comparison with other breeds is an option to maintain reproduction in places with limited forage available, keeping animals with low BW at puberty, but capable of reach puberty earlier with limited access to feed.

Estrous cycle length between crossbred and Criollo heifers in both 2006 and 2007 did not differ ($P \geq 0.53$; 18 and 19 ± 1 d; 18 and 19 ± 1 d, respectively;

figure 3). Serum insulin concentrations were also greater ($P < 0.01$), for Criollo compared to crossbred heifers in both 2006 and 2007 (0.67 and 0.54 ± 0.02 ng/mL; 0.68 and 0.58 ± 0.02 ng/mL, respectively). These concentrations appear higher than those reported by Amstalden et al. (2000) and Giacomini (2006). Insulin plays a very important role in controlling metabolic factors that are critical to the reproductive axis in cattle and also is an indicator of the nutritional status of the animal (Hess et al., 2005). These data suggest that while Criollo heifers were lighter than crossbred heifers in BW at puberty, the nutritional status of the Criollo heifers determined by insulin levels appear optimum for reproductive functions.

IMPLICATIONS

Reproduction is a major factor in the livestock industry. The use of breeds capable of achieving puberty sooner, allow producers to breed heifers as soon as possible and extend the productive life of the animals. This study suggests that Criollo heifers may reach puberty earlier and at lighter BW than British breeds.

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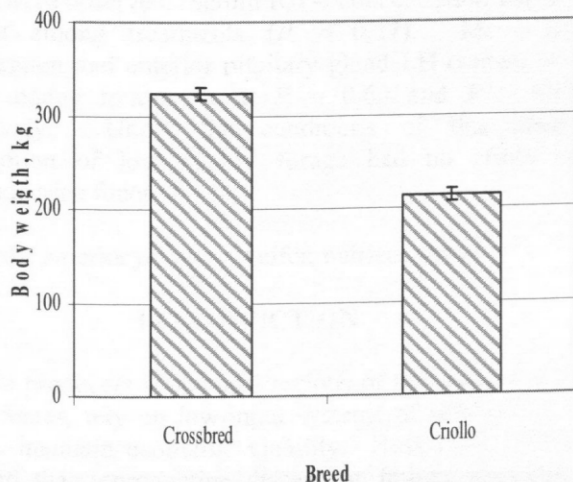


Figure 1. Weight at puberty ($P < 0.01$) in crossbred heifers ($n=30$) and Criollo heifers ($n=30$).

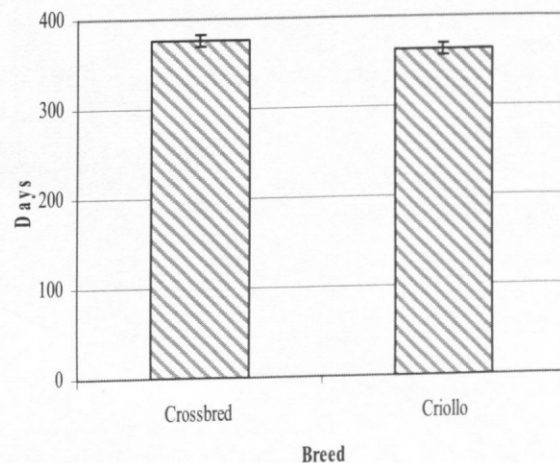


Figure 2. Days to puberty ($P = 0.15$) in crossbred heifers ($n=30$) and Criollo heifers ($n=30$).

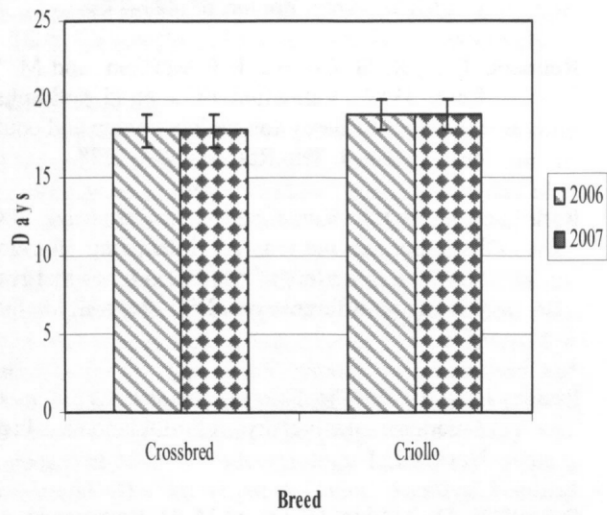


Figure 3. Estrous cycle length ($P \geq 0.53$) in crossbred heifers in 2006 and 2007 ($n=5$ and $n=30$, respectively) and Criollo heifers ($n=7$ and $n=30$, respectively).