

GM 20. EVIDENCE FOR THE EXISTENCE OF A MAJOR GENE INFLUENCING HAIR LENGTH AND HEAT TOLERANCE IN *Bos taurus* CATTLE

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Resumen

Evidencia de la existencia de un gen mayor con influencia sobre la longitud del pelo y la tolerancia al calor en ganado *Bos taurus*

Se evaluó la tolerancia al calor de 28 becerros hijos de toros Angus (A) y vacas F₁ Senepol (S) X Hereford con el objetivo de investigar la existencia de un gen mayor con influencia en la resistencia al estrés calórico. Los becerros Angus (n= 10) se incluyeron como control. Las mediciones se hicieron en tres semanas consecutivas durante el verano y se repitieron hacia el final del otoño. La longitud del pelo se evaluó utilizando un sistema subjetivo de clasificación (1 - 4). Los valores más bajos describen el pelo extremadamente corto típico del ganado Senepol puro y de sus cruces F₁ con razas de origen templado *Bos taurus*. Doce de los 28 becerros cruzados (25 % S) se clasificaron como de pelo corto y 16 como de pelo normal; la proporción obtenida de 12:16 no es significativamente diferente de la proporción 1:1. La temperatura rectal (TR) de los becerros de pelo corto fue menor (P < .02) que la de los A en dos de las fechas en el verano y en dos de las fechas en el otoño. La TR de los becerros 25 % S de pelo corto fue menor (P < .04) que la de sus contemporáneos de pelo normal en dos de las tres fechas en el verano. La TR de los becerros 25 % Senepol hijos de toros A y con pelaje normal, no se diferenció (P > .07) de los A en ninguna de las fechas. Un grupo de 15 becerros hijos de toros Charolais en vacas F₁ A X S fue clasificado por longitud del pelo a finales de Septiembre. Siete de estos becerros se clasificaron como pelo corto y ocho como pelo normal. Estos datos sugieren que un gen mayor para longitud del pelo y tolerancia al calor pudiera existir en la raza Senepol.

Palabras claves: Tolerancia al calor, control genético, Senepol

Key words: Heat tolerance, genetic control, Senepol

Introduction

Senepol cattle were developed on St. Croix (U.S. Virgin Islands) and are noted for being very short-haired and tolerant of high temperatures. The extremely short hair of the Senepol seems to be shared by a number of the Central and South American Criollo breeds of *Bos taurus* cattle. Data collected in Florida (Hammond and Olson., 1994) and Puerto Rico (Cianzio, 1996) have consistently demonstrated that Senepol heifers show high levels of heat tolerance, as evidenced by nearly always having slightly lower rectal temperatures than those of contemporary Brahman and always having lower rectal temperatures than those of Holstein, Angus and Hereford heifers when evaluated during periods of elevated ambient temperatures. Senepol F₁ crosses with both the Hereford and the Angus breeds show rectal temperatures nearly as low as those of contemporary purebred Senepol cattle (Hammond et al., 1996, 1997). This suggests that the Senepol's ability to control heat is dominant in mode of inheritance. Observations of Senepol crossbred cattle (particularly animals with less than 50 % Senepol breeding) have indicated that some show normal haircoats while others show the "slick" haircoats of purebred and F₁ Senepol. This, along with the fact that purebred Senepol occasionally are born with normal haircoats, lends support to the possibility that a single, "major" gene could be responsible for the short hair and perhaps most of the heat tolerance of Senepol cattle.

Materials and methods

A total of 28 calves from Angus sires and Senepol X Hereford or Hereford X Senepol dams were evaluated for hair length, rectal temperatures, respiration rates, and weights. In addition, 10 purebred Angus calves were included in the study as controls. Measurements were taken on three consecutive weeks during the hot summer months (Jul 17, Jul 26 and Aug 2) and also during the cooler late fall (Nov 23, Dec 1 and Dec 7). The ambient temperature surpassed 32.5 °C on two of the summer dates and averaged 23.3 °C during the fall. A subjective system was used to evaluate hair length on Jul 26. The three lowest scores (1⁻, 1 and 1⁺) describe the extremely

short-haired “slick” condition of purebred Senepol cattle and their F_1 crosses with temperate *Bos taurus* breeds. Most of such F_1 crosses have somewhat more hair on their polls than do purebred Senepol and are coded as 1^+ rather than 1. One of the 10 Angus calves was also coded as a 1^+ . Two other Angus calves were coded as 2^- , one as a 2 and one a 2^+ , with the remainder being scored as 3^- or higher, scores that indicated a somewhat “shaggy” to thick coat for cattle in the summer. The Angus-sired calves from Senepol X Hereford or reciprocal cross F_1 dams that were coded as 1^- , 1 and 1^+ were considered to be slick-haired and those 2^- and higher coded as normal-haired in this analysis. Twelve of the 28 calves were thus coded as slick-haired and 16 as normal-haired; this ratio does not differ significantly from the 1:1 ratio that would be expected given the assumption that all of the F_1 dams were heterozygous for a dominant “slick hair” gene. The dams of these calves were all slick-haired. The data were analyzed using the PROC GLM procedure of SAS. The initial model used in the analyses of the temperature and respiration rate data included the effects of breed type of calf (Angus, normal-haired 25 % Senepol and slick-haired 25% Senepol), sex of calf, age and weight of calf, with a covariate of order of working of the calf.

Results and discussion

The rectal temperatures of the calves on the warmest summer date and coolest winter date are shown in table 1. Only the effect of breed type and the covariate of order of working consistently affected rectal temperature. The 12 slick Angus-sired 25 % Senepol calves had the lowest average body temperature during each of the 6 data collection dates, ranging from a low of 38.82 °C on December 7 to a high of 39.58 °C on August 2. The RT of Angus-sired 25 % Senepol calves with “normal” haircoats tended not to differ ($P > .05$) from those of Angus calves. The RT of the Slick calves were always lower than those of their normal-coated counterparts with the same breed composition and were significantly so ($P < .05$) on two of the three summer evaluations and one of the three fall sessions. The slick-haired calves were heavier ($P < .02$) than their normal-haired counterparts at the end of the trial since they gained over 13 kg more than the normal-haired calves from July 19 to Dec 7 (table 2). An independent set of 15 Charolais-sired calves from Angus X Senepol F_1 dams evaluated in the fall (September) has offered further evidence of the existence of such a gene responsible for short, slick hair. Using the same hair coat scoring system, seven of these calves were coded as 1^+ 's, four as 3^+ 's and four as 4^+ 's, for a 7:8 ratio of slick:normal hair coats. While these data suggest that much of the ability of the Senepol breed and its crosses to control body temperature can be attributed to a dominant gene that produces the slick hair condition, there may be other genes in the Senepol that also influence heat tolerance.

Conclusions

The results of these two data sets, as well as previous observations of Senepol, Senepol crossbred and Criollo cattle, indicate that a major gene exists in the Senepol breed and some of the Criollo breeds that results in an extremely short, slick haircoat. This gene seems to be responsible, at least in part, for the greater heat tolerance of the Senepol breed over that of temperate *Bos taurus* breeds. In addition, there may be an advantage in growth rate during the summer months for animals carrying this gene and thus a shorter hair coat.

Table 1. Rectal temperatures of Angus and Angus-sired 25 % Senepol calves on August 2 and December 7.

Breed/Hair Type	n	August 2	December 7
		Rectal temperature, °C (SE)	Rectal Temperature, °C (SE)
Angus	10	40.19 (0.14)	39.27 (0.09)
Angus X (S X H) (normal hair)	16	39.98 (0.13)	39.03 (0.07)
Angus X (S X H) (slick hair)	12	39.58 (0.13)	38.82 (0.08)
P-values for contrasts			
Angus vs. normal hair		0.2404	0.0517
Angus vs. slick hair		0.0036	0.0009
Slick vs. normal hair		0.0234	0.0369

Table 2. Least-Squares mean weights, kg, of calves by breed/hair coat score.

Date	Angus (SE)	Normal-Coated A X (S X H) (SE)	Slick-Coated A X (S X H) (SE)	P value Slick vs. Normal
07/19	150.6 (6.8)	185.1 (5.4)	195.0 (5.9)	0.2232
08/02	158.8 (7.3)	193.2 (5.4)	205.9 (6.4)	0.1414
11/23	208.2 (8.6)	251.3 (6.8)	276.2 (7.3)	0.0149
12/07	211.8 (8.2)	254.0 (6.4)	278.1 (7.3)	0.0172

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