

**ASSOCIATION BETWEEN REPRODUCTION AND PREWEANING GROWTH
TRAITS AND ELISA SCORES FOR PARATUBERCULOSIS IN AN
ANGUS-BRAHMAN MULTIBREED HERD OF CATTLE**

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SUMMARY

Genetic evaluation for production traits assume that records come from healthy animals. Records from animals suffering from chronic diseases with long subclinical stages may be difficult to identify, thus likely to be included in genetic evaluations, and disease effects not accounted for. One such disease is paratuberculosis. A common diagnostic test for paratuberculosis is ELISA. Regression estimates of four cow and two calf traits on ELISA scores (0 = negative to 3 = positive) were obtained here. These regressions indicated that cows with greater ELISA scores tended to stay open longer, to have larger weight losses from December (pre-calving) to September (weaning), and to have calves with lower birth and weaning weights than cows with lesser ELISA scores.

INTRODUCTION

Genetic evaluation of animals for reproduction and production traits in beef cattle relies on models that account for environmental and genetic effects in the records used to perform computations. Usual environmental effects include contemporary groups, age of dam effects, and sex of calf. Records are assumed to come from healthy animals. This assumption is likely to be appropriate for acute or subacute infectious diseases that have short subclinical stages, where sick animals can be easily identified, and their records excluded from genetic evaluations. However, for chronic infectious diseases with long subclinical stages, it may be difficult to accurately identify sick animals. Their records are likely to be included in genetic evaluations, and losses in performance due to subclinical disease effects will not be accounted for. One chronic incurable disease of cattle and other ruminants is paratuberculosis. Paratuberculosis is caused by *Mycobacterium avium* subspecies *paratuberculosis* (MAP). The disease can remain subclinical for years, but eventually animals will show clinical signs such as diarrhea, weight loss, decreased milk production, and finally die. A commonly used serological test to detect subclinical paratuberculosis is ELISA. The ELISA detects antibodies against MAP in the serum of exposed animals. This test is primarily a herd-screening tool, and it can detect approximately 50% of infected animals. In spite of its low sensitivity, Elzo *et al.* (2006) found significant associations between ELISA scores for paratuberculosis and several cow and calf traits in a multibreed herd of beef cattle. The next step was to evaluate these associations from a genetic evaluation perspective, i.e., to quantify the association between individual traits of interest and ELISA scores. Thus, the objective of this research was to obtain regression estimates of gestation length (GL), calving interval (CI), time

open (TO), weight change of cow (WC) from late November (pre-calving) to September (weaning), birth weight of calf (BW), and weaning weight of calf (WW) on ELISA scores for paratuberculosis in an Angus-Brahman multibreed herd of beef cattle.

MATERIAL AND METHODS

Detection of paratuberculosis. Blood was sampled from the coccygeal vein of cows in late May every year using a collection tube with a 3.8 cm, 18 gauge needle. Serum was separated, stored at -6.7 °C, and later evaluated by ELISA using a *Mycobacterium paratuberculosis* Antibody Test Kit from IDEXX Laboratories, Westbrook, Maine. This kit had 50% sensitivity (detection of infected animals) and a 99% specificity (detection of non-infected animals). The assay was performed according to the manufacturer specifications. The ELISA sample to positive (s/p) ratios were transformed into four scores using the S/P categorization of Collins (2002): a) 0 = negative, for s/p ratios from zero to 0.09: antibodies to MAP were not detected; b) 1 = suspect, for s/p ratios from 0.10 to 0.24: low level of serum antibodies but above normal background levels; c) 2 = weak positive, for s/p ratios from 0.25 to 0.39: low level of serum antibodies to MAP, but above the standard cutoff for a positive test; and d) 3 = positive, for s/p ratios from 0.40 to 10.00: moderate to high level of serum antibodies to MAP.

Animals, feeding, and management. Animals belonged to the Angus-Brahman multibreed herd of the University of Florida, USA. The herd used a diallel mating strategy. Reproduction, weight, and ELISA score data were collected from 430 purebred and crossbred cows (79 Angus, 79 $\frac{3}{4}$ A $\frac{1}{4}$ B, 47 Brangus (5/8 A 3/8 B), 105 $\frac{1}{2}$ A $\frac{1}{2}$ B, 57 $\frac{1}{4}$ A $\frac{3}{4}$ B, and 63 Brahman) produced by the mating of 97 maternal grandsires (21 Angus, 10 $\frac{3}{4}$ A $\frac{1}{4}$ B, 17 Brangus, 13 $\frac{1}{2}$ A $\frac{1}{2}$ B, 17 $\frac{1}{4}$ A $\frac{3}{4}$ B, and 19 Brahman) and 287 maternal granddams (59 Angus, 55 $\frac{3}{4}$ A $\frac{1}{4}$ B, 39 Brangus, 52 $\frac{1}{2}$ A $\frac{1}{2}$ B, 38 $\frac{1}{4}$ A $\frac{3}{4}$ B, and 44 Brahman). Growth data were collected from 733 purebred and crossbred calves produced by mating 70 sires (13 Angus, 10 $\frac{3}{4}$ A $\frac{1}{4}$ B, 13 Brangus, 11 $\frac{1}{2}$ A $\frac{1}{2}$ B, 11 $\frac{1}{4}$ A $\frac{3}{4}$ B, and 12 Brahman) to the 430 purebred and crossbred cows indicated above. Cows were synchronized in March, artificially inseminated twice, and then exposed to a natural service bull for 60 days. Calves were born from mid December to mid March, and weaned in September. Cows and calves were kept on bahiagrass (*Paspalum notatum*) pastures throughout the year with free access to mineral supplementation. During the calving period, cows were separated into two groups by their ELISA scores: low-risk (zeroes and ones) and high-risk (twos and threes). Winter supplementation consisted of bermudagrass (*Cynodon dactylon*) hay, cottonseed meal, and molasses.

Statistical analysis. Cow (GL, CI, TO, and WC) and calf (BW and WW) traits were analyzed with single-trait linear model methodology (Henderson, 1984) using multibreed models with a homogeneous variance-covariance structure (Koonawootrittriron et al., 2004) that accounted for environmental, additive genetic, and non-additive genetic effects. Models differed by trait. Common fixed effects to all traits were: year (Y), age of dam (A), sex of calf (S), Brahman fraction of sire and dam, and heterosis of dam and calf. Additional fixed effects fitted per trait were: a) Y*A, pre-calving weight of cow, BW, and current year ELISA score (CYES) for GL; b) BW and previous year ELISA score (PYES) for CI and TO; c) GL, BW, WW, PYES, and CYES for WC; d) GL, GL*S, and CYES for BW; and e) Y*A, Y*S, age at weaning, and CYES for WW. Random effects were: a) sire and dam for GL, BW, and WW; and b) residual for all traits. Random effects

were assumed to be uncorrelated, with mean zero, and a common variance. Computations were carried out with procedure MIXED of SAS (SAS Inst., Inc., Cary, NC). Predictions of trait values for individual animals were computed using option OUTPRED of statement MODEL of SAS procedure MIXED. Means of predicted values of traits were plotted against breed group of cow by ELISA score for paratuberculosis using SAS procedure GPLOT.

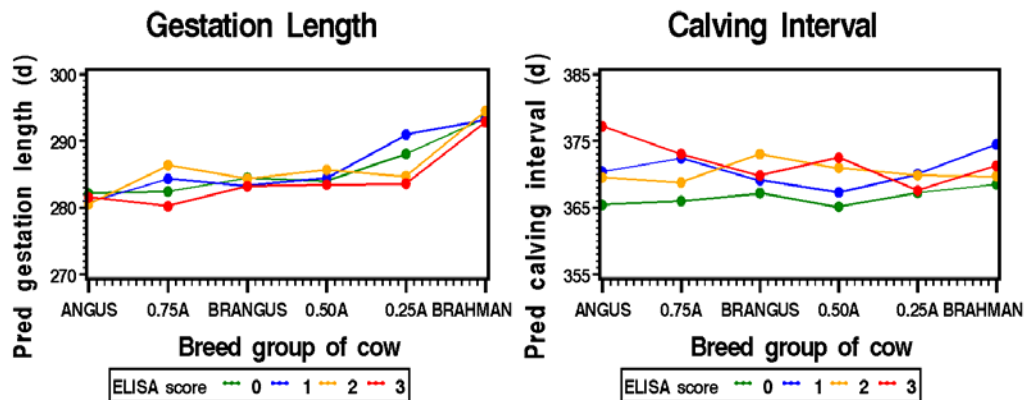
RESULTS AND DISCUSSION

Table 1 contains regression estimates of cow and calf traits on ELISA scores. These regression estimates indicate that cows with greater ELISA scores tended to have: a) longer times open,

Table 1. Regression estimates of cow and calf traits on ELISA score for paratuberculosis from linear model analyses for individual traits in an Angus-Brahman multibreed herd

	Cow traits				Calf traits	
	Gestation length	Calving interval	Time open	Weight change	Birth weight	Weaning weight
ELISA score	-0.3292	1.7988	4.3137	-2.6433	-0.5659	-2.3381
SE	0.4042	1.5792	1.5671	1.3716	0.2577	1.0747
P > t	0.4165	.2553	.00063	0.0548	0.0294	0.0303
No. records	484	448	268	637	485	709
No. sires	52	60	42	60	52	70
No. cows	246	211	153	290	246	292

suggesting that these cows had diminished fertility; b) larger weight losses from December (pre-calving) to September (weaning), suggesting poorer weight maintenance ability; and c) calves with smaller birth and weaning weights, suggesting that they provided a lower level of nutrition to their



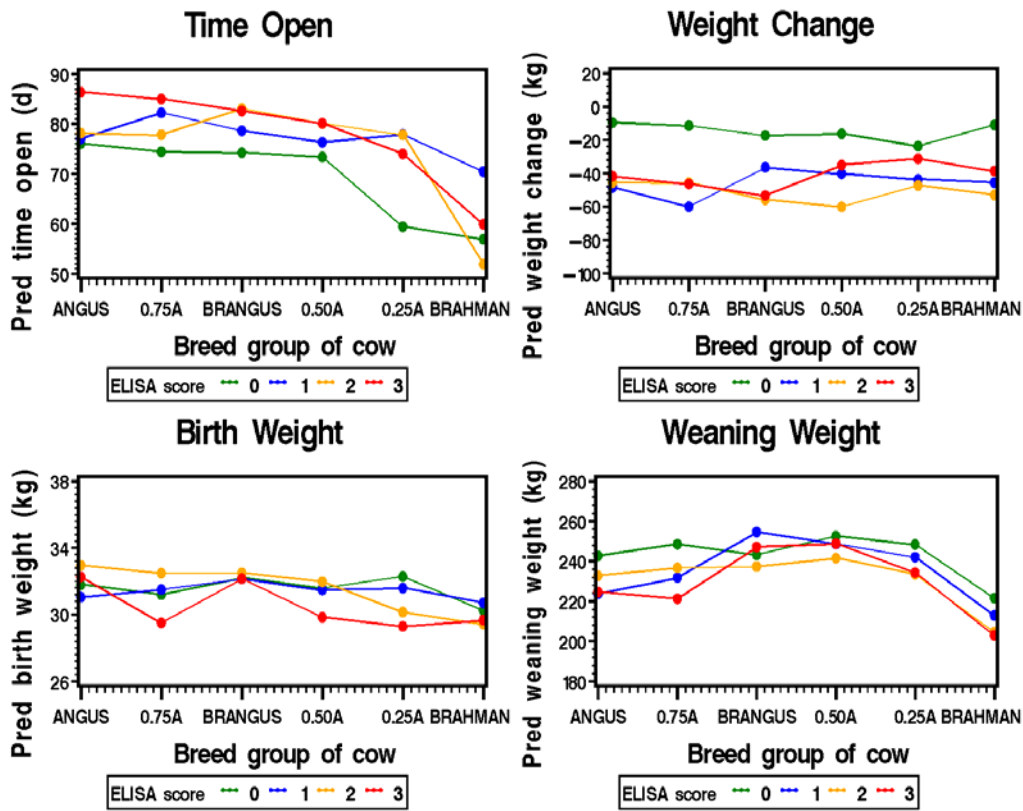


Figure 1. Mean predicted values for cow and calf traits by ELISA score for paratuberculosis across breed groups of cows in an Angus-Brahman herd

calves than cows with lower levels of antibodies. Regression estimates for gestation length and calving interval on ELISA scores were non-significant, but in the expected direction. To illustrate the variability that existed among breed groups of cows in this multibreed dataset, Figure 1 shows mean predicted values for each trait and ELISA score plotted against breed group of cow. Despite the small dataset available, predicted breed group means were generally as expected given the overall regression estimates, i.e., predicted breed group means for cows with greater ELISA scores tended to be larger for positive regressions, and smaller for negative regressions than cows with lesser ELISA scores.

CONCLUSION

Insofar as ELISA scores are an indicator of subclinical paratuberculosis, results here suggest that ELISA scores could be used to account for effects of this disease on cow and calf traits. Inclusion of ELISA scores in genetic evaluation models would help eliminate biases due to subclinical

paratuberculosis effects on cow and calf traits. In areas where paratuberculosis is endemic, tests for paratuberculosis, such as ELISA, should be routinely applied and become integral components of the record of an animal. This would permit their values to be included as indicators in populational genetic evaluation models.

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