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Phenotypic Analysis of Pulmonary Arterial Pressure and Feed Intake Data in Angus Cattle

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ABSTRACT: The objective of the study was to determine if a phenotypic relationship exists between pulmonary arterial pressure (PAP) scores and traits used to evaluate feed utilization**.** We hypothesized there is no evidence that there is a phenotypic correlation between PAP scores and other traits related to feed efficiency. The data included 193 Angus steers sampled for PAP at high elevation and then moved to a lower elevation feedlot where feed intake data was collected. Pearson's correlations between PAP and metabolic mid weight, rib eye area, back fat, average daily intake, and average daily gain were 0.04, -0.004, 0.12,-0.08, and 0.06, but were not significant. We concluded that selection based on PAP scores will not affect feed utilization indicator traits.

Key words: Pulmonary Arterial Pressure; Feed Utilization; Beef Cattle

Introduction

Feed costs represent approximately one-half the total cost of production for most classes of livestock and improvement of feed utilization should be a major consideration for breeding programs (Kennedy et al. (1993)). New feedlot technology provides opportunity to accurately measure individual dry matter intake (DMI). Combining DMI with individual growth and carcass data allows the opportunity to more accurately predict an animal's merit for feed efficiency traits.

While the ability to predict feed efficiency traits is important to cattle producers across environments, animals that are housed at altitudes above 1500m have an increased susceptibility to high altitude disease (HAD), more commonly known as brisket disease. High altitude disease causes pulmonary vasoconstriction, increased pulmonary arterial pressure (PAP), right ventricle stress, congestive right heart failure, and hydrothorax in the chest cavity and brisket (Alexander and Jensen, (1959), (1963); Ahola et al. (2006)). Risk of brisket disease is estimated with a PAP test.

PAP testing is a chute side procedure that is most accurately performed on animals 12 to 16 months of age or older at an elevation above 1524 m (Holt and Callan (2007). To perform a PAP test an animal is restrained in a squeeze chute. A needle is then inserted into the jugular vein of the animal after which a polyethylene catheter is advanced through the needle and down the jugular vein. The external end of the catheter is attached to a pressure transducer placed at a level equal to the base of the heart. Once the catheter reaches the heart it is advanced to the right ventricle and into the pulmonary artery at which point a pressure reading is taken (Holt and Callan (2007).

This procedure is performed at a majority of seedstock and in many commercial operations (on breeding bulls) above of 1524 m. The producers use the results of the PAP test as a tool to help lower the incidence of HAD thereby improving survival of breeding animals and to reduce incidence in subsequent progeny as heritability of PAP is moderate to high (Shirley et al. 2008). Holt and Callan (2007) states that an animal at 16 months of age with a score greater than 49 mmHg are high risk candidates for developing brisket disease. Animals in this range are often culled or sold to ranches that operate at a lower elevations. Selection of breeding animals at high elevation on PAP is designed to improve survival of subsequent offspring through weaning and later ages until shipment to lower elevation feedlots and to improve survival of replacement females remaining at high elevation.

Little is known about the impact of selection on PAP and subsequent performance traits in the feedlot. Therefore, the objective of this study was to evaluate, for the first time, the strength of the phenotypic relationship between PAP score and subsequent phenotypic measurements of metabolic mid-weight (MMWT), scanned rib eye area (REA), scanned 13th rib fat (BF), average daily dry matter intake (ADI), and average daily gain (ADG).

Materials and Methods

Before the initiation of this experiment, all care, handling, and sampling of the animals were approved by the Colorado State University Animal Care and Use Committee.

Cattle and Data. Angus steers (n=193) from Colorado State University's John E. Rouse Beef Improvement Center (CSU-BIC) near Saratoga, Wyoming at an altitude of 2,195 m were evaluated. Pulmonary arterial pressure scores were recorded on cattle between 297 and 629 days of age by an experienced veterinarian. Pedigree data was obtained from historical records at the CSU-BIC where PAP scores have been recorded since 1992. The data represents progeny from 27 unique sires.

Individual feed intake data was recorded at Colorado State University's Feed Intake Unit (FIU) located at the Animal Research, Development and Education Center (ARDEC) in Fort Collins, Colorado at an elevation of 1,525 m. The FIU is equipped with the Growsafe System Feed Intake monitoring system (Growsafe Systems, Ltd., Airdire, Alberta, Canada).

Data were gathered over three test periods, with each having different groups of animals. These periods were May to July 2012, May to July 2013, and

June to August 2013. The cattle were allowed a 21 day adaption period followed by a 70 day feed intake test. Ultrasound measurements for REA and BF were taken on day 70 of the performance test. Traits analyzed during the test were MMWT, REA, BF, ADI, and ADG.

Statistical analysis. Pearson correlations were calculated using CORR procedure in SAS 9.3 (SAS Inst. INC., Cary, NC).

Results and Discussion

PAP, growth, and feed intake data are presented in Table 1. The phenotypic correlations between the traits are presented in Table 2. Correlations involving PAP were not significant and therefore could not be concluded to be different from 0. P-values between PAP and MMWT, REA, BF, ADI, and ADG were 0.60, 0.95, 0.11, 0.32, and 0.40, respectively. These results suggest that the ability to phenotypically select on PAP scores would not have an effect on phenotypic measures of feed efficiency. From this data, BF is the most positively correlated with PAP signifying that as PAP score increases BF likely increases as well.

Table 1. Summary statistics for Angus cattle.

Trait	N	Mean	SD[1]	Min	Max
PAP	192	42.5	6.77	33	95
MMWT,kg	193	104.83	7.11	79.93	126.15
REA, cm^2	185	68.39	8.52	34.45	92.39
BF, cm	190	0.79	0.25	0.18	1.57
ADI, kg/d	193	11.84	1.39	6.45	16.77
ADG, kg/d	193	1.67	0.39	0.71	2.6

[1]SD= standard deviation
PAP= Pulmonary Arterial Pressure
MMWT= Metabolic Mid Weight
REA= Rib Eye Area
BF= Back Fat
ADI= Average Daily Intake
ADG= Average Daily Gain

Correlations between ADG and MMWT, BF, and ADI were found to be moderately positively correlated at 0.48, 0.42, and 0.42, respectively. Positive correlations between these traits suggests that as one trait changes the other resulting trait will change in a like direction. Bishop et al. (1991) found that calves with improved feed conversion rates, gain at a faster rate, yielded carcasses with a higher quality grade, and less desirable yield grade. These results are parallel with results in our study. Williams et al. (2012) found that there was a slight advantage in mean values for post weaning gain in cattle at lower elevations to animals at higher elevations; however phenotypic variances were similar across both environments. Selection based on these estimates should be an effective means of estimating feed efficiency across all environments.

To our knowledge, no other reports of the relationship of high altitude adaptability and feed utilization exist at either the genetic or the phenotypic level. While the results reported herein are derived from an admittedly small population, and should be interpreted with care, these preliminary estimates, suggest no phenotypic antagonisms. Most selection in the US beef industry currently uses phenotypic PAP value as a culling criteria and is therefore this study has special relevance to current practices.

Table 2. Phenotypic correlations Angus Cattle

Traits	MMWT	REA	BF	ADI	ADG
PAP	.038[1]	-.004[1]	.117[1]	-.072[1]	.061[1]
MMWT		.307	.485	.492	.480
REA			.232	.201	.134[1]
BF				.257	.419
ADI					.424

[1]Values= correlations not statistically significant
PAP= Pulmonary Arterial Pressure
MMWT= Metabolic Mid Weight
REA= Rib Eye Area
BF= Back Fat
ADI= Average Daily Intake
ADG= Average Daily Gain

Practical Implications. The findings of this study suggest that animals that are the offspring of PAP-selected parents or are themselves culled from the breeding program based on their PAP score will suffer no detrimental effects on terminal feed utilization traits. This allows feedlot cattle buyers to purchase cattle from higher elevations with less concern that their ability to efficiently convert feed is hindered by their inherent PAP score.

Conclusion

The results of this study indicate that the phenotypic selection on an adaptive trait such as PAP score will have minimal to no effect on subsequent measurements of feed utilization.

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