Relationship of Lactate Dehydrogenase Activity with Body Measurements of Angus x Charolais Cows and Calves[1]

M.L. Looper[2], T.P. Neidecker[3], C.W. Wall[4], S.T. Reiter[5], R. Flores[5], A.H. Brown, Jr.[5], Z.B. Johnson[5], and C.F. Rosenkrans, Jr.[5]

Story in Brief

Objectives were to examine 1) relationships between lactate dehydrogenase (LDH) activity and body measurements of beef cows, and 2) the association between maternal LDH activity in late gestation and subsequent calf birth weight (BRW), hip height (CALFHH) at weaning, and adjusted weaning weight (205-day WW). At 60 days before calving, BW, body condition score (BCS), and cow hip height (COWHH) were recorded, and *longissimus* muscle area (LMA), intramuscular fat percentage (IMF), and rib fat (RF) were measured via ultrasonography from Angus x Charolais cows (n = 88). A blood serum sample was collected from each cow and concentrations of LDH activity were determined and ranked (mean ± 1 SD) into 3 categories. Cows with low reverse LDH activity had calves with increased ($P < 0.05$) CALFHH and 205-day WW compared with cows with high LDH activity. Cow LMA was correlated ($P < 0.05$) with BW, BCS, and COWHH, and 205-day WW of calves. The canonical correlation between cow forward and reverse LDH activity, and 205-day WW and CALFHH of calves tended to be significant ($r = 0.30$; $P = 0.08$). Further, the canonical correlation between cow traits including LMA, IMF, and RF, and calf traits of 205-day WW and CALFHH was significant ($P = 0.02$). Cow LMA and reverse LDH activity were correlated ($P < 0.01$) to 205-d WW and CALFHH ($r = 0.38$). Decreased reverse LDH activity in prepartum cows was associated with taller and heavier calves at weaning; increased weaning weights will enhance profitability of Arkansas cow-calf operations.

Introduction

Measurement of maternal body condition and (or) blood metabolites late in gestation may help predict subsequent calf performance. Body condition score (BCS) of cows can be assessed with the nine point BCS system with 1 being thin and 9 being fat (Wagner et al., 1988). Ultrasonography is a good estimator of subcutaneous fat thickness in grazing cattle (Aiken et al., 2004), and recently, several research groups (Miller et al., 2004; Schröder and Staufenbiel, 2006) have suggested ultrasonography may alleviate some of the subjectivity of BCS.

Relationships between various prepartum metabolic hormones in cows and subsequent calf birth weights have been investigated; however, the relationship between maternal lactate dehydrogenase (LDH) activity and calf performance has not been examined. Lactate dehydrogenase is the last enzyme of the glycolytic pathway, and catalyzes the reversible conversion of pyruvate to lactate. Reduced LDH activity has been associated with increased carcass quality in steers (Flores et al., 2005) and increased reproductive performance of heifers (Looper et al., 2002). Objectives were to examine 1) relationships between LDH activity and body measurements of grazing beef cows, and 2) the association between maternal LDH activity in late gestation and subsequent calf birth weight (BRW), hip height (CALFHH) at weaning, and adjusted weaning weight (205-day WW).

Experimental Procedures

Eighty-eight Angus and Charolais cows (age = 5.1 ± 2.6 yr) and their Angus-sired calves (n = 86) from a private farm in Crawford County, Ark., were used. Cattle grazed endophyte-infected tall fescue pastures during the cooler months and common bermudagrass pastures during the warmer months. At 60 days before calving (mean calving date = January 29), BW, BCS, and cow hip height (COWHH) were recorded, and *longissimus* muscle area (LMA), intramuscular fat percentage (IMF), and rib fat (RF) were measured via ultrasonography using an Aloka SSD-500V with a 3.5-MHz linear array transducer. Cross-sections of the LMA were scanned between the 12th and 13th ribs, and RF at 3-quarters the width of the LMA. Blood samples were collected into vacutainers (Becton Dickinson, Franklin Lakes, N.J.), allowed to clot for 24 h at 40°F, and centrifuged (1500 x g for 25 min). Serum samples were stored at 0°F until analysis.

Lactate dehydrogenase activity was measured via a colorimetric assay. Enzyme activity is expressed in IU/L. Concentrations of LDH activity were ranked into three categories by using the mean concentration ± 1 SD. The 3 categories with associated concentrations of LDH activity are shown in Table 1.

Calves were spring-born, and birth weight and sex of calf were recorded. Calves remained with dams until weaning, and CALFHH and weight were recorded at weaning. Eleven calves were early-weaned (June 19) while the remaining 75 calves were weaned on August 31. Weaning weight was adjusted to a standard 205-day weaning weight.

[1] Names are necessary to report factually on available data; however, the USDA does not guarantee or warrant the standard of the product, and the use of the name by the USDA implies no approval of the product to the exclusion of others that also may be suitable.

[2] USDA-ARS, Dale Bumpers Small Farms Research Center, Booneville, Ark.

[3] Neidecker Farms, Van Buren, Ark.

[4] University of Arkansas Cooperative Extension Service, Van Buren, Ark.

[5] Department of Animal Science, University of Arkansas, Fayetteville, Ark.

Statistical analyses. The effect of cow age on LDH forward and reverse activity was analyzed by ANOVA using the MIXED procedure of SAS (SAS Inst. Inc., Cary, N.C.). The effects of prepartum LDH forward and reverse activity category (low, medium, or high) on BRW, CALFHH, and 205-day WW also were analyzed by ANOVA using the MIXED procedure of SAS. Chi-square analysis was used to determine the effect of prepartum LDH forward and reverse activity category (low, medium, or high) on gender of calf. Relationships among prepartum cow traits (BW, BCS, COWHH, LMA, IMF, and RF), and between prepartum cow traits and subsequent calf traits (BRW, CALFHH, and 205-day WW) were examined by Pearson and canonical correlations. Objective of canonical correlation analysis was to find a linear combination of one group of variables (cow traits) that had a maximal correlation with a linear combination of a second group of variables (calf traits). The analysis continues until the number of pairs of canonical variables equals the number of variables in the smaller group. Three separate canonical analyses were examined in this experiment. The first canonical correlation analysis (Analysis 1) compared cow LDH forward and reverse activity (Set 1) with 205-day WW and CALFHH of calves (Set 2). The second canonical correlation analysis (Analysis 2) compared the cow traits of LMA, IMF, and RF (Set 1) with the set of calf traits that included 205-day WW and CALFHH (Set 2). The third canonical correlation analysis (Analysis 3) was a combination of LDH activity and ultrasound measurement with cow reverse LDH activity and LMA (Set 1) with 205-d WW and CALFHH of calves (Set 2).

Results and Discussion

Relationships among cow measurements. Age of cow did not influence prepartum forward ($P = 0.19$) or reverse ($P = 0.46$) LDH activity. Mean concentrations of forward and reverse LDH activity were 748 ± 48 IU/mL and 227 ± 26 IU/mL, respectively. Sire breed of the cow did not influence ($P = 0.82$) forward LDH activity (mean = 747± 18 IU/mL); however, Angus-sired cows tended ($P = 0.07$; 242 ± 7 IU/mL) to have greater prepartum reverse LDH activity than Charolais-sired cows (219 ± 11 IU/mL). Prepartum LDH activity (forward or reverse) was not correlated ($P > 0.10$) with any cow measurements with the exception of cow BCS and forward LDH activity ($r = 0.21$; $P = 0.09$).

Longissimus muscle area ($r = 0.39$; $P < 0.05$) and RF ($r = 0.26$; $P < 0.05$) measured with ultrasound were moderately correlated to visual BCS. Others (Miller et al., 2004; Schröder and Staufenbiel, 2006) have suggested that ultrasound provides a more precise estimate of body condition than visual BCS.

Relationships between cow prepartum LDH activity and calf measurements. Distribution of calf gender was similar ($P > 0.10$) among the 3 categories of prepartum LDH activity (forward or reverse). Cows with low reverse LDH activity had calves with increased 205-day WW ($P = 0.03$; Fig. 1) and CALFHH ($P = 0.001$; Fig. 2) compared with cows with high LDH activity. Reverse LDH activity was inversely correlated with CALFHH ($r = -0.28$; $P = 0.01$) and 205-day WW ($r = -0.21$; $P = 0.05$) of calves. Forward LDH activity tended ($P = 0.11$) to be negatively correlated ($r = -0.18$) with CALFHH. Similarly, reduced LDH activity in steers (Flores et al., 2005) and heifers (Looper et al., 2002) was associated with increased animal performance.

Cow LMA was correlated ($P < 0.05$) with BW ($r = 0.37$), BCS ($r = 0.39$), and COWHH ($r = 0.25$) in cows, and with 205-day WW of calves ($r = 0.28$; $P = 0.01$). First canonical correlation (Analysis 1) between cow forward and reverse LDH activity, and CALFHH and 205-day WW tended to be significant ($r = 0.30$; $P = 0.08$; data not shown). Further, the canonical correlation between the set of cow traits including LMA, IMF, and RF (Analysis 2) was correlated ($r = 0.36$; $P = 0.02$; data not shown) with the set of calf traits that included 205-day WW and CALFHH. Of all 3 canonical correlation analyses, a linear combination of cow LMA and reverse LDH activity (Analysis 3) had the highest ($P < 0.01$) canonical correlation with a linear combination of calf 205-day WW and CALFHH ($r = 0.38$; Table 2). Our data suggest that a combination of both ultrasonography measurements as well as LDH activity in cows may be a better predictor of calf measurements (hip height and adjusted weaning weight) at weaning than ultrasound or LDH activity alone.

Development of a 'chute-side' LDH activity test (enzyme-linked assay) is warranted if threshold concentrations of LDH activity are substantiated with future research studies using larger numbers of cattle. Ideally, producers would collect a minimal amount of blood from the cow (i.e., skin prick of ear), place blood in the LDH test cartridge, and wait a short amount of time (i.e., 2-3 minutes) for a positive/negative result. It is estimated that such a chute-side test would cost producers $10-15/test. Beef producers are likely to utilize any test that will allow them to make management decisions about weaned calves much earlier in the production cycle; however, economic analyses of a chute-side LDH activity test are needed.

Implications

Decreased reverse LDH activity in prepartum cows was associated with taller and heavier calves at weaning. Use of prepartum maternal LDH activity may help in selection of superior calves earlier in the production cycle enhancing profitability of cow-calf operations in Arkansas.

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Table 1. Concentrations of maternal lactate dehydrogenase (LDH) activity (forward and reverse) ranked (mean ± 1 SD) into one of three categories.

Category	n	LDH activity (IU/mL)
LDH forward		
Low	9	592 ± 66
Medium	66	741 ± 56
High	13	920 ± 41
LDH reverse		
Low	17	164 ± 13
Medium	56	231 ± 27
High	15	327 ± 21

Table 2. Canonical correlations of prepartum cow traits (Set 1) with subsequent calf performance traits (Set 2) (Analysis 3).

Set 1 (cow traits)[a]	V_1	V_2
LMA	0.67	0.74
LDHr	-0.66	0.76
Set 2 (calf traits)	W_1	W_2
205-day WW	0.97	0.23
CALFHH	0.73	-0.68
Canonical correlation	0.38*	0.18

*P < 0.01

[a]LMA is longissimus muscle area; LDHr is lactate dehydrogenase reverse activity; 205-day WW is 205-d weaning weight of calves; and CALFHH is hip height of calves at weaning.

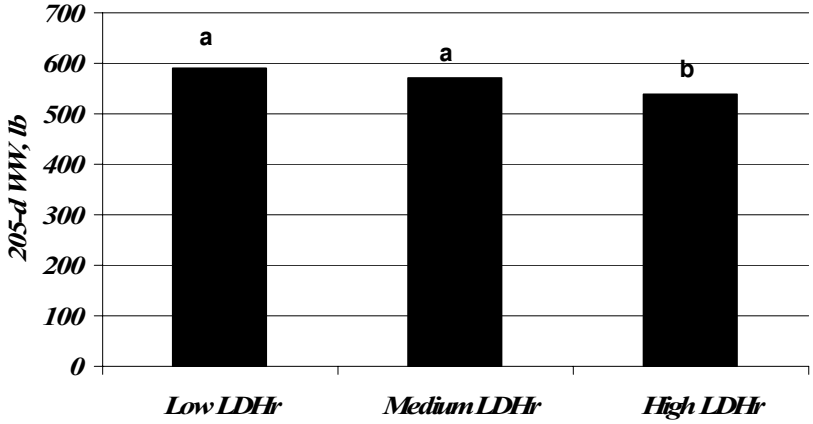

Fig. 1. Influence of maternal reverse lactate dehydrogenase (LDHr) activity on 205-day weaning weight (205-d WW) of Angus-sired calves ($^{a,b}P = 0.03$).

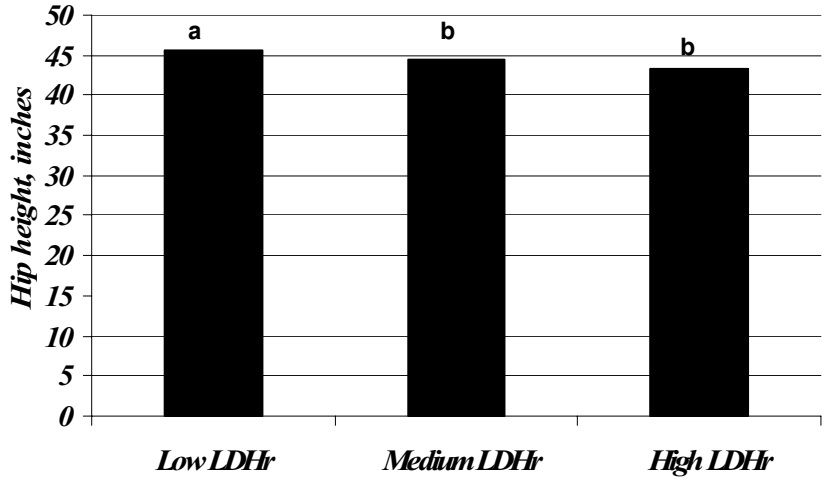

Fig. 2. Influence of maternal reverse lactate dehydrogenase (LDHr) activity on hip height at weaning of Angus-sired calves ($^{a,b}P = 0.001$).