

Use of hand-held meter in monitoring sheep ketone and glucose concentrations

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Introduction

Due to the high mortality and morbidity rates of pregnancy toxemia in small ruminants, there needs to be improved practical on-site monitoring for blood ketone and glucose levels. More timely intervention based on animal-side diagnostics may improve pregnancy toxemia outcomes. The objective of this study was to validate use of the CentriVet® hand-held meter for on-farm testing of blood glucose and β -hydroxybutyrate (BHB) concentrations during late pregnancy in meat-breed sheep.

Materials and methods

All animal procedures were approved by the Pennsylvania State University IACUC. All samples in this study were from the Pennsylvania State University sheep unit and consisted of Dorset and Hampshire breeds. Blood samples were collected between 14 and 21 days prior to expected lambing. Test strips for glucose and BHB were used to determine whole blood concentrations with the CentriVet® meter. Serum was harvested from these samples, frozen (-20°C), and stored until analyzed. Frozen serum samples were sent to Oregon State University Veterinary Diagnostic Laboratory for complete metabolic profiles, which included blood urea nitrogen, creatine, triglycerides, cholesterol, glucose, total protein, albumin, creatinine kinase, total bilirubin, gamma-glutamyl transferase, aspartate aminotransferase (AST), sorbitol dehydrogenase, calcium, phosphorus, magnesium, sodium, potassium, chloride, nonesterified fatty acids (NEFA), BHB, anion gap, and total carbon dioxide. Comparison of meter and laboratory values for glucose and BHB were statistically evaluated with Pearson Correlation coefficient and ANOVA models.

Results

Blood samples (n = 42) were collected from 32 Hampshire cross ewes and 10 Dorset ewes. Mean \pm standard deviation (median, range) for time between blood sampling and lambing was 9.5 \pm 8.9 d (7.5, 0-31). Lamb numbers per ewe were 1.8 \pm 0.6. Lab and meter BHB concentrations were 4.1 \pm 2.4 mg/dL (3.6, 2.1-16.8) and 4.0 \pm 3.4 mg/dL (3.1, 1.0-20.8), respectively. Lab and meter

glucose concentrations were 66.5 \pm 8.4 mg/dL (68, 31-82) and 76.8 \pm 9.7 mg/dL (78, 38-95), respectively. Meter values for BHB ($r^2 = 0.871$, $P < 0.0001$) and glucose ($r^2 = 0.858$, $P < 0.0001$) were highly associated with respective lab values. A regression equation relating the meter value to laboratory BHB concentration was y (mg/dL) = 1.32 \times - 1.41 ($r^2 = 0.87$, $P < 0.0001$). The regression equation relating the meter to laboratory glucose concentration was y (mg/dL) = 0.79 \times + 5.99 ($r^2 = 0.86$, $P < 0.0001$). Metabolite associations of interest included glucose and albumin ($r = 0.41$, $P = 0.006$) and AST ($r = -0.62$, $P < 0.0001$). Total bilirubin was highly associated with BHB ($r = 0.53$, $P = 0.0003$) and NEFA ($r = 0.63$, $P < 0.0001$), while BHB and NEFA were associated ($r = 0.88$, $P < 0.0001$).

Significance

Study findings suggest the CentriVet® hand-held meter can accurately measure blood glucose and ketone concentrations in late pregnant ewes. This predictability may help with diagnosing and monitoring ewes with pregnancy toxemia during the last 3 weeks pre-partum, though specific threshold criteria need to be established. Identifying at-risk ewes early in disease progression can enable early intervention and decrease potential poor disease outcomes. The positive association between glucose and albumin, and the negative relationship between glucose and AST, are intriguing. These associations may suggest a role of amino acid status relative to glucose during late pregnancy. The association between total bilirubin and BHB and NEFA might suggest some impact on liver function, possibly predictive of fatty liver infiltration often associated with pregnancy toxemia. Further research is needed to establish more diagnostic and predictive indicators of pregnancy toxemia morbidity and mortality in sheep.

