

Metabolic Profiling and Health Risk in Transition Cows

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Introduction

Blood chemistry analyses are frequently used by veterinarians for disease diagnosis. Use of blood chemistries in the form of metabolic profiles to determine nutritional status has been advocated, but acceptance has been limited as a result of high cost and interpretation difficulties. Different criteria are needed using blood metabolite concentrations to determine disease potential compared to disease diagnosis. Blood metabolite measures are compared to laboratory defined reference ranges, however, these reference ranges often are based on mid to late lactation cow populations and may not be appropriate for evaluating transition cows. Objectives of this study were to determine effects of time relative to calving and health status on blood metabolite concentrations and determine if any diagnostic relationships are present between prepartum blood metabolite concentrations and postpartum health status.

Materials and Methods

Metabolic profiles were performed on plasma samples collected from 111 cows housed at 15 commercial dairy farms over three time periods relative to calving. These periods were defined as: Early dry (ED), >30 days precalving; Close-up Dry (CU), 3 to 21 days precalving and Fresh (FR), 3 to 30 days postcalving. Metabolic profile analyses included urea nitrogen (BUN), creatinine (Cr), glucose (Glu), total protein (TP), albumin (Alb), total bilirubin (TB), alkaline phosphatase (ALP), creatine kinase (Ck), gamma-glutamyltransferase (GGT), aspartate aminotransferase (AST), sorbitol dehydrogenase (SDH), sodium (Na), potassium (K), chloride (Cl), calcium (Ca), phosphorus (P), magnesium (Mg), total cholesterol (Chol), triglycerides (TG), beta-hydroxybutyrate (BHB), and nonesterified fatty acids (NEFA). Disease diagnosis and treatment events were recorded. Blood metabolites were evaluated by ANOVA for repeated measures with period, health and their interaction as main effects and herd as a covariate. Relative risk of postpartum disease was determined using contingency tables of selected metabolite concentration categories and health status.

Results

Of all cows, 58 % had one or more disease events postcalving. Percent healthy calvings varied greatly between herds. Herd was significant in all metabolite models, except NEFA and Ck. Time period influenced ($P<0.05$) all metabolite concentrations, except Ca, P and K. Health status influenced NEFA ($P<0.002$), BHB ($P<0.005$), TG ($P<0.03$), GGT ($P<0.02$) and AST ($P<0.04$) independent of time period. An interaction between time period and health status was found for Alb ($P<0.03$), BUN ($P<0.001$), Glu ($P<0.001$), Chol ($P<0.02$), TG ($P<0.02$), AST ($P<0.0002$), BHB ($P<0.005$) and NEFA ($P<0.001$). Sick cows had lower Alb, BUN, Glu and Chol and higher AST, BHB and NEFA compared to healthy cows in the FR period. Fresh cow Alb concentration was stratified into three groups: < 3.0 g/dl, 3.0 to 3.5 g/dl and >3.5 g/dl and associated with

Van Saun, R.J.. Metabolic profiling and health risk in transition cows, pp. 212-213, In: Proceedings 37th Annual American Association of Bovine Practitioners Convention, Ft. Worth, Texas, September 23-25, 2004.

health status. Percent of FR cows experiencing a health event within each group was 67, 61 and 32, respectively ($P<0.02$). Cows with CU Alb concentrations < 3.25 g/dl were 1.46 ($P<0.04$; 1.04-2.04 95% CI) times more likely to experience a postpartum disease event. Within FR cows, Chol concentration increased ($P<0.01$) with increasing Alb concentration. Cows with FR Alb concentration < 3.30 g/dl were 1.79 ($P<0.003$; 1.19-2.70 95% CI) times more likely to have a disease event. If NEFA values were >0.4 mEq/l in either CU or FR samples, cows were 1.57 ($P<0.03$) and 1.47 ($P<0.04$) times more likely to have a disease event, respectively. Disease risk was greater if NEFA concentration was >0.6 mEq/l at CU (1.69, $P<0.02$) and FR (1.85, $P<0.0007$) periods. No metabolites measured in the ED period were associated with disease risk.

Significance

Based on these findings, reference ranges for diagnostic interpretation of blood metabolite concentrations should be adjusted to time periods relative to calving. Interactions between time period and health status suggest prepartum blood metabolite concentrations may provide some indication to postpartum disease risk and can be useful as a herd monitoring tool. Preliminary data suggest Alb and NEFA concentrations in CU and FR periods can be used to predict potential disease risk.

Research supported in part by funding from Pennsylvania Department of Agriculture.