Establishing Blood Parameters for Different Classes of Cows

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In recent years, the dairy industry has been undergoing a transformation with fewer, but larger herds. As the industry has consolidated, producers have switched from focusing on managing the individual animal to managing groups with increasing emphasis on the prevention of disease and metabolic abnormalities. Large herd (500 or more cows) management has been successful in reducing the percentage of cows leaving the herd permanently from 27.4 % in 1996 to 23.4 % in 2007 (USDA, 2008) with reproductive problems, udder or mastitis problems, poor production, and lameness remaining as the major reasons for removal. Despite the reduction in the percent of cows permanently leaving the herd, the percentage of cows with clinical mastitis, lameness, respiratory problems, infertility problems and displaced abomasum has increased, while milk fever cases have declined (USDA, 2008).

REVISION OF TRANSITION PERIOD DIAGNOSTIC TOOL

During the transition period dairy cattle experience an onslaught of challenges, both metabolically and physiologically, as the cow completes a dramatic change from a non-lactating state to a lactating state. Although not all symptoms of the health problems in Table 1 are manifested during this period, frequently events occurring during this timeframe may predispose the cow to subsequent clinical diagnosis of the disorder. Consequently, management strategies have been implemented during the transition period in an attempt to mitigate the impact of the significant changes occurring during this time on these and other health issues. Some of these strategies include: reducing stocking density to prevent overcrowding and competition at the feed bunk (Friend et al., 1977; Huzzey et al., 2006), feeding a higher concentrate ration containing components of the postpartum ration in the weeks leading up to parturition (Grummer, 1995), feeding a ration balanced utilizing the dietary cation-anion difference (DCAD) method (Block, 1984), reducing the number of pen moves thereby decreasing the need for reestablishment of social hierarchy (Schirmann et al., 2011), separating heifers from cows, and monitoring body condition score at dry off (Gearhart et al., 1990). While the implementation of these added management strategies has proven beneficial by decreasing disease incidence in some circumstances (milk fever), some animals may still experience at least one of the disorders typically associated with the transition period including retained placenta, metritis, milk fever, mastitis, displaced abomasum, fatty liver, or ketosis. Further, genetic improvement has occurred over time for dairy cattle as can be noted by the significant increases in milk production (Chen et al., 2009).

Table 1. Percent of cows with various disorders in the Dairy 2007 study (USDA, 2008).

Problem	Percent of Cows
Clinical Mastitis	16.5
Lameness	14.0
Respiratory Problems	3.3
Retained Placenta	7.8
Infertility	12.9
Other reproductive problems	4.6
Milk Fever	4.9
Displaced abomasum	3.5

Addressing the potential need for a separate set of reference values for the metabolic profile of Jersey and Holstein breeds depends upon the discovery of true differences between the breeds when it comes to the metabolic profile. Differences have been demonstrated regarding dry matter intake around calving, as well as significantly greater plasma non-esterified fatty acid (**NEFA**) levels from 3 d prepartum to 1 d postpartum for Holsteins as compared to Jerseys (French, 2006). In the postpartum period, glucose and triglyceride levels have also been shown to differ between the two breeds (Janovick Guretzky et al., 2006). Mineral levels differ as well, as greater serum calcium (**Ca**) levels occur for Holstein cows as compared to Jersey cows at parturition (Ballatine and Herbein, 1991).

With the many advancements in management and genetics, having an available tool in the metabolic profile to monitor health would be advantageous; however, its usefulness is limited unless it accurately represents modern dairy cattle under current management, genetic, and environmental conditions.

OBJECTIVES

The objectives of this study were to determine:

1) Whether differences exist on an extensive metabolic profile between seasons for transition Holstein dairy cows with current genetics and dairy management strategies, as well as to assess whether the metabolic profile as a tool to monitor health needs requires updated reference values and
2) Whether differences exist between Holstein and Jersey metabolic profiles that indicate different standards are needed for the two breeds.

METHODS

Blood samples were collected from coccygeal vessels at morning feeding in summer (**S,** June-Sept., n = 1787) and winter (**W,** Dec.-Jan.; n = 1871) from 8 commercial Holstein dairy herds. In addition to the Holstein herds, blood samples (n=1699) were also collected from 8 Jersey herds. The herd size ranged from 500 to 6000 cows. Samples were placed on ice and processed within 6 hr, then stored frozen at -20° C until analyzed. Serum was analyzed for:

- Calcium (Ca),
- Phosphorus (**P**),
- Magnesium (**Mg**),
- Albumin (**Alb**),
- Urea,
- Glucose (**Glu**),
- Cholesterol (**Chol**),
- Sodium (**Na**),

- Potassium (**K**),
- Chloride (**Cl**),
- Non-esterified fatty acids (**NEFA**), and
- Beta-hydroxy butyrate (**BHBA**).

At the time of blood sample collection, feed samples from each management group of cows were collected. The total mixed ration (**TMR**) sample was analyzed for dry matter, crude protein, acid detergent fiber, neutral detergent fiber, Ca, Mg, K, Na, iron, manganese, zinc, and copper. Herd records were reviewed to identify data points from cows experiencing ketosis, dystocia, retained placenta, displaced abomasum, twin births, stillbirths, and cows being dry < 30 d or > 80d. The week relative to calving was assigned in 7 d intervals for wk -3 to +3 relative to calving with the period from -3 d prepartum to 3 d postpartum being defined as week 0. Initial data analysis was done via regression with further analysis via Proc GLIMMIX (SAS v9.2).

RESULTS

With substantial genetic, nutritional, and laboratory analytical advancements over the last 20 yr, the requirements of the Holstein dairy cow have changed accordingly and consequently the requirements for supplementation in the ration have been adjusted. This, in turn, affects

a) The environment through excretion of excess nutrients; or

b) Animal performance and well-being through a possible lack of nutrients.

This study was designed to illustrate and document these changes, which can lead to new nutritional and veterinary care recommendations for Holstein and Jersey dairy cows.

Seasonal effects were present for Ca, P, Mg, Alb, Urea, Glu, Chol, NEFA, K and CL. Only Na and BHBA did not have seasonal interactions. For some parameters (Chol, Glu, Alb and Urea) there were lactation by week by season interactions that occurred ($P < 0.05$). In addition, various metabolic profile components were associated with specific diseases:

- Glucose and NEFA were associated with mastitis
- Cloride was associated with milk fever
- Cholesterol, K, Cl and BHBA were associated with the reproduction disease complex of metritis, retained placenta, still born calf, or dystocia score
- Cholesterol was associated with milk fever
- Days dry was associated with both ketosis and mastitis

In addition to the changes observed for season, significant breed differences were noted between Holsteins and Jerseys for Ca, P, Mg, Na, K, Alb, Urea, Chol, and NEFA. No statistical differences between breeds were noted for BHBA, Glu, or Na. Furthermore, lactation by week by breed effects exist for P, Alb, urea, glucose, cholesterol and NEFA.

SUMMARY

In summary, the results from this study indicate that there is some seasonal variation in the metabolic profile; therefore seasonality must be considered when interpreting results. By utilizing updated metabolic profile standards, nutritionists and veterinarians can maintain animal health and well-being while protecting the environment by reducing overfeeding and subsequent excretion of nutrients.

The transition period is a crucial point in the life cycle of the dairy cow. During this period the animal undergoes significant metabolic changes from only requiring enough energy to maintain body functions and for fetal development to consuming over 3.5% of her body weight in feed to compensate for the high energy demands of lactation. The ability to accurately detect herd health status through collecting and analyzing blood samples will improve management and assist the producer in identifying the potential for health issues so that herd management might be altered in an attempt to minimize clinical manifestations of certain diseases. Also, establishing an accurate metabolic profile for Jersey dairy cattle with current genetics and management schemes provides insight into management alterations that may be necessary to customize response for herds comprised of these genetically different animals. Finally, with the observed variability in the metabolic profile due to sampling time relative to calving, specific recommendations for proper timing for blood sampling around calving to ensure accuracy in diagnosing potential animal health concerns during this period of significant metabolic change are needed. Properly identifying the metabolic profile provides an additional tool to ensure the cow is receiving the proper nutrition to meet her nutritional demands for maximum production.

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