

USING BLOOD CONSTITUENTS AS INDICATORS OF PERFORMANCE POTENTIAL IN HOLSTEIN-FRIESIAN COWS

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Cows of differing genetic merit for milk yield have associated differences in feed intake and energy balance as well as differences in plasma concentrations of various hormones and blood metabolites (Veerkamp *et al.* 2003). This is probably associated with genetic control of partitioning energy and results from changes to several metabolic pathways. Blood constituents such as non-esterified fatty acids (NEFA), beta-hydroxybutyrate (BHB), glucose, urea and insulin are considered to be more direct indicators of energy balance and metabolic status than insulin-like growth factor-1 (IGF-1). However, the use of plasma IGF-1 as an indirect selection criterion for improving feed efficiency has been investigated in the pig and beef industries (Johnston *et al.* 2002) and may be useful for predicting performance potential (both productive and reproductive) in dairy cattle. The aim of this study was to compare the efficacy of using various blood constituents as indicators of performance potential in Holstein-Friesian cows.

Plasma IGF-1 and serum NEFA, BHB, glucose, urea and insulin were measured in 72 pasture-fed Holstein-Friesian cows at the same time of day, on a regular basis over a 12-month production cycle. Mean concentrations of each constituent for each stage of lactation were then correlated with interval to first ovulation (IFO; as an indicator of a cow's fertility), and annual milk production (AMP) using Pearson's correlation coefficients. Blood constituent profiles indicated typical physiological adaptations for the peripartum period, with low NEFA and BHB, and high insulin, IGF-1 and urea prepartum, followed by an increase in NEFA and BHB concentrations and a decrease in plasma IGF-1 and urea around calving. Plasma IGF-1 and insulin measured in the prepartum period were the only blood constituents measured at that time that correlated significantly with IFO, -0.44 and -0.41; ($P < 0.01$). Furthermore, IGF-1 was the only blood constituent that related significantly to IFO when measured during lactation. The strength of the relationship between IGF-1 and IFO ranged from -0.33 to -0.38 ($P < 0.01$) at various stages of lactation, while those for the other blood constituents did not exceed ± 0.22 ($P = 0.12$). No blood constituents correlated significantly with AMP when measured in the prepartum period. All blood constituents measured in early lactation correlated significantly with AMP, apart from NEFA. The strength of these correlations ranged between 0.26 ($P = 0.03$) for urea and -0.43 ($P < 0.01$) for IGF-1. Unlike any of the other blood constituents measured, IGF-1 remained significantly related to AMP for the remainder of lactation, with correlations ranging from -0.31 ($P = 0.01$) in mid-lactation to -0.51 ($P < 0.01$) in late lactation.

Serum NEFA, BHB, glucose, urea and insulin had lower between-cow variation, particularly beyond early lactation and lower intra-class correlation coefficients than IGF-1. This meant that the relative concentration in an individual animal at any one stage of lactation would less accurately indicate the relative concentration in the same animal at other stages of lactation. It also suggested that plasma concentrations of IGF-1 represented energy balance in a more chronic, rather than acute sense and could be more strongly associated with fertility and productive potential apart from those periods when the other blood constituents were acutely elevated or depressed. Another consideration when measuring blood constituents is that many undergo rapid fluctuations associated with factors such as diurnal variation, feeding time and stress (Chamberlain and Wilkinson 1996). This places limitations on sampling programs, as samples must be collected at a consistent time of day. Plasma IGF-1 does not show significant diurnal variation, nor undergo rapid fluctuations. The stability of circulating concentrations of IGF-1 may be partly due to the presence of IGF binding proteins which prolong the half life of IGF in circulation and play a role in reducing the rate of clearance of IGF-1 from circulation. Although IGF-1 may be an indirect measure of energy balance and nutrient partitioning, it also may be a more robust indicator of performance traits. It has greater variation between cows, samples are able to be collected at almost any time of day and stage of lactation, and results will be less affected by acute changes in feeding management or time from feeding. In conclusion, plasma IGF-1 across lactation was more consistently and significantly related to production and reproduction than the other blood constituents that were measured.

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