

## THE MANAGER

## DAIRY RESEARCH

By Julie Huzzey and Tom Overton

Study examines biomarker alarm levels that identify high-risk cattle

# Stress and Inflammation Around Calving Can Compromise Milk Yield and Reproductive Performance

Cornell University PRO-DAIRY conducted research to identify biomarker alarm levels for high-risk cows during the transition period.

The biomarkers are associated with stress and inflammation that can compromise milk production and reproductive success during the transition period.

Cows are at the greatest risk for developing health complications that may affect performance around transition calving transition period. During the transition period dairy cattle must face a variety of

nutritional, environmental and management changes. Some cows cope better than others.

Improving the early detection of animals or herds at increased risk for reduced milk yield or compromised reproductive performance should be an important component of herd health programs. Blood analyte testing is useful to identify high-risk animals.

Nearly all cows undergo a period of negative energy balance as dry matter intake is often insufficient to meet the increased energy demands of lactation. Previous research shows that high concentrations of  $\beta$ -hydroxybutyrate (BHB) and nonesterified fatty acid (NEFA), biomarkers of negative energy balance, are associated with reduced milk yield and poor reproductive performance. Cows above the following suggested cutpoints are at the highest risk:

- Prepartum NEFA  $\geq 0.3$  mEq/L
- Postpartum NEFA  $\geq 0.70$  mEq/L or BHB  $\geq 10$  mg/dL

Transition cows also face a number of non-nutritional stressors, including high stocking densities,

## FYI

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social regroupings, pen-moves, cow-calf separation, and for primiparous animals, exposure to novel environments such as the milking parlor. Biomarkers that are associated with these types of stressors may also be useful for the detection of high-risk animals but this has not previously been investigated.

### The research

We enrolled 412 Holstein dairy cattle from two New York State commercial dairy herds in the study. At each dairy we took blood and fecal samples from cows beginning 3 weeks before calving (wk -3, wk -2, wk -1) and one sample within 3 to 10 days after calving (Postpartum).

Blood and fecal samples were used to measure the concentration of the following biomarkers at each period relative to calving:

- Haptoglobin (Hp; Biomarker of inflammation)
- Fecal Cortisol Metabolites (FCORT; Biomarker of physiological stress)

We followed the animals over time and recorded the following information related to milk production and reproductive success:

- 305-d mature equivalent (305ME) milk yield based on the 3rd DHI test (approx. 102 DIM)
- Pregnant animals by 150 DIM

After evaluating a range of possible concentration cutpoints for each biomarker, the cutpoint that was most strongly associated with changes in milk yield or reproductive performance was selected. Cows that had concentrations of the biomarker that were above the cutpoint were considered the high-risk group while cows below the cutpoint were considered the low-risk group.

### The results

Increased concentrations of analytes associated with stress (fecal cortisol metabolites) and inflammation (Hp) during the periparturient period, are associated with lower milk yield and compromised reproductive performance (Tables 1 & 2). These relationships depended on parity and when the sample was collected relative to calving, with the strongest relationships when samples were taken during the week before or after calving.

### Interpretation of Biomarkers

**Increased haptoglobin** concentration is a sign of inflammation and levels of Hp generally increase dramatically in response to any infection or injury. Healthy cattle have very low concentrations of Hp in their blood. Therefore, when levels of this biomarker are high, producers should inspect their transition cow groups for potential problems related to inflammation. Hp may increase due to:

- Mastitis
- Metritis
- Lameness
- Other injuries
- Dystocia

**Increased fecal cortisol metabolite** concentrations are better

than plasma cortisol as an indicator of chronic stress in ruminants. Levels of this biomarker are not influenced by the stress associated with handling and sample collection and so are easier to interpret. Although more work is still required to identify sources of chronic stress during the transition period, the following list may be sources of increased stress during the transition period

- Excessive group changes
- Overstocking
- Commingling heifers and cows
- Uncomfortable resting or feeding areas
- Novel environments (e.g. milk parlor)

### What you can do

Presently no commercial laboratories measure fecal cortisol metabolites, so this biomarker is not yet practical for on-farm testing programs. Blood samples can be analyzed for Hp at the Kansas State University Veterinary Diagnostic Laboratory and at the Ontario Veterinary College Animal Health Laboratory.

Additional research is required to identify herd alarm levels or the proportion of sampled animals with Hp above the cut point associated with production losses or poor reproductive performance.

Projected 305-d milk production loss (**Table 1**) and % decreased risk of pregnancy (**Table 2**) associated with haptoglobin (Hp) and fecal cortisol metabolite (FCORT) cutpoints for 412 Holstein dairy cows [230 multiparous cows (MP) and 182 primiparous cows (PP)].

**Table 1.**

Analyte Cutpoint	At Risk Group	Proportion of Animals at risk	305-d ME milk loss
<b>Prepartum (wk +1)</b>			
Hp > 0.20 g/L	MP	23 %	- 943 kg
<b>Postpartum (3 to 10 DIM)</b>			
Hp > 1.1 g/L	MP, PP	33 %	- 947 kg
FCORT > 400 ng/g fecal DM	MP	32 %	- 663 kg

**Table 2.**

Analyte Cutpoint	At Risk Group	Proportion of Animals at risk	Decreased risk of Pregnancy
<b>Prepartum (wk +1)</b>			
Hp > 0.4 g/L	PP	22 %	- 41 kg
FCORT > 2300 ng/g fecal DM	PP	42 %	-42 %
<b>Postpartum (3 to 10 DIM)</b>			
Hp > 1.3 g/L	PP	31 %	- 41 kg