

# Ketosis and negative energy balance: How can we monitor and what are the consequences in transition cows?

Julie Ainsworth, Dairy Production Analyst, P.A.S



Recently we attended the Dairy Cattle Reproductive Council conference and had a chance to see many presentations on reproduction. Among the programs presented was one by Daryl Nydam, DVM, PhD, Cornell University. He spoke on transition cows with these learning objectives:

- Basic transition cow objectives.
- Understanding cow-level metabolite indicators for downstream performance.
- Understanding herd-level metabolite indicators for downstream performance.
- Develop rational sampling plans to detect cows and herds at risk of poor performance.

## Ketosis and Negative Energy Balance

After a cow calves there is a rapid change in a cow's metabolic demands. There is a two-fold increase in her energy requirements and this causes all cows to at least "visit" negative energy balance (NEB). NEB can be measured in blood by non-esterified fatty acids (NEFA). NEFA's in blood come from adipose tissue and this is caused by the mobilization of triglycerides with a little from dietary fats.

In turn, subclinical ketosis (SCK) can result from negative energy balance in early lactation or insulin resistance starting in the dry period. It may be secondary to diseases causing decreased feed intake. Ketosis is an elevation of ketone bodies and can be measured with the level of beta-hydroxybutyric acid (BHB) which is most stable in blood.

### Cow level affect

Knowing all cows "visit" NEB in early lactation, how do we know a cow is at risk for poor performance? To answer these questions the researchers evaluated metabolites and their association with clinical disease, reproduction and milk production. From this data they established cow-level critical thresholds for NEFA and BHB. Results are indicated in Table 1.

Table 1 - Predicting Any Disease: Sample Size 12-15 Animals

Risk Factor	Threshold	Risk Ratio	Area Under Curve
Pre-partum NEFA (mEq/L)	0.3	2.0	0.6 Accurate
Post-partum BHB (mg/dL)	10	4.4	0.74 Highly Accurate
Post-partum NEFA (mEq/L)	0.6	4.4	0.81 Highly Accurate

To further explain this chart let's look at line one. If the pre-partum NEFA is 0.3 mEq/L or higher than a cow is on average two times more likely to get a disease such as displaced abomasum, ketosis, retained placenta or metritis. The "area under the curve" tells how predictive the variable is of the outcome, the larger number the better.

Relatively small amounts of NEB and SCK largely impact reproductive performance and milk production. Current work suggests this may be due to immune compromise and subsequent endometritis, as well as ovarian function. They are approximately 14-18 percent less likely to get pregnant and will produce approximately 1,000 pounds less ME305 milk. The exception to this would be first lactation heifers.

### Herd level affect

Now let's explore objectives at the herd level. Researchers attempted to determine the herd level for the proportion of sampled animals with elevated metabolites resulting in herd level effects. They also wanted to describe the herd-level prevalence of elevated metabolite concentrations. Results can be found in Table 2.

Table 2: Metabolite Impact

Metabolite Level	Herd Alarm	Effect
Pre-partum NEFA $\geq$ 0.3 mEq/L	15%	-1.2% Pregnancy Rate +1.4% Disease -240kg ME305 milk
Post-partum NEFA $\geq$ 0.6-0.7 mEq/L	15%	-1.3% Pregnancy Rate +1.3% Disease Heifers -290kg ME305 Cows- 577kg ME305
BHB $\geq$ 10-12 mg/dL	15%	-0.7% Pregnancy Rate +1.2% Disease Heifers -535kg ME305 Cows -332kg ME305

### Testing strategies

We have now discussed problem levels, so when is testing warranted? Individual cow testing for ketosis should only be done in early lactation and reasons to test would include:

- Not eating well
- Looks dull (eyes, ears)
- Low milk yield
- Atypical behavior
- Other disease problem

There are several cowside tests on the market, but two of the most reliable would be the milk ketone test Keto-Test® and Precision Xtra®. Keto-Test milk test strips are 83 percent sensitive and 82 percent specific. Precision Xtra requires a drop

of blood and has a sensitivity of 95-100 percent and a specificity of 97-100 percent. Urine Ketostix are also available but only have a sensitivity of 75 percent and a specificity of 96 percent.

There are no cowside tests for NEFA's. Testing includes drawing blood and sending samples to a laboratory. For this testing you should use a lab with validated tests. Red top tubes are preferred for sampling and it's important to keep samples chilled and separate serum as soon as possible (less than 24 hours).

If you think you may have a problem with transition cow performance, how many cows should you sample and what samples should you take?

#### Sample size:

1.  $\geq 12$  cows at risk, 15 would yield 90 percent confidence.

#### Cows at risk to sample:

1. Pre-partum: 14 to 2 days before calving.
2. Post-partum: 3 to 14 days in milk. NEFA a better predictor, BHB cheaper and easier to handle.

#### Sample Type:

1. Blood / BHB: Precision Xtra
2. Blood/ NEFA: Lab

#### What to do with results:

1. Interpret percent above cut point.
2. A problem is suggested if greater-than approximately 15-20 percent is above the cutpoint for NEFA and BHB.


#### Final thoughts


This research concluded that on the individual cow level, many transition cows have high NEFA and BHB and there is opportunity to decrease clinical disease, increase milk production and improve reproductive performance. The herds where the research was done were not selected because of ongoing problems, and still they could demonstrate unrecognized clinical disease, lost reproductive performance and lost milk.

It's important to recognize that even in well-managed herds; there is lots of opportunity for better management in transition cows. To learn more about

transition cow management and ways to improve it, email me at [ainsworthj@northstarcooperative.com](mailto:ainsworthj@northstarcooperative.com). 


# 2<sup>nd</sup> Crop Success from





**7HO8221**  
**ALEXANDER**  
OVER 1,000 NEW DTRS  
+17% F +.01% P +2.48 T +1.74 UDC  
+2.53 FLC +1725 GTPI<sup>SM</sup>  
RELIABILITY: 98% USDA 94% HA

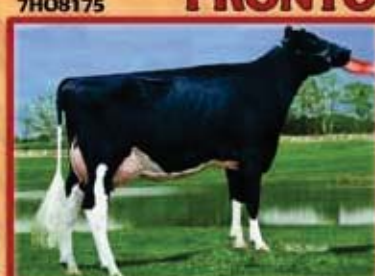
Miller II & Julie Duchane & Family  
Rudolph, WI



**7HO7004**  
**DAMION**

Karmelene Champion & Reserve Grand  
Champion 2011 International Holstein Show

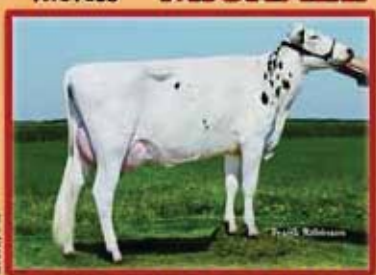
**BREED LEADER FOR TYPE**  
**WITH OVER 17,000 DTRS.**  
+3.17 T +2.20 UDC +3.17 FLC  
+1549 GTPI<sup>SM</sup>  
RELIABILITY: 99% USDA 99% HA



**7HO8175**  
**PRONTO**

(VG-88)




**PRODUCTIVE LIFE SPECIALIST**  
**WITH OVER 7,000 DTRS.**  
+731 M +4.6 PL +1.4 DPR  
+2.05 T +1.29 UDC +1.86 FLC  
+1821 GTPI<sup>SM</sup>  
RELIABILITY: 99% USDA 99% HA



**7HO7853**  
**MICHAEL**

Green Meadow Farms, Inc.,  
Elsie, MI

**NOW OVER 3,000 DTRS.**  
.11% F +2.9 PL +1.07 T  
+1.48 FLC +1764 GTPI<sup>SM</sup>  
RELIABILITY: 99% USDA 97% HA

12/11 USDA & HA. TPI is a trademark of Holstein Association, USA. HerdLife Builder, Diamond Selection, Showcase Selections, gender SELECTed, FeedPRO, Superior Selection are trademarks of Select Sires.

1.800.631.3510  
[northstarcooperative.com](http://northstarcooperative.com)