

Low Cost On-Farm Ketosis Detection Tools

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Early lactation data from 3 studies (n=176 cows) were composited to develop on-farm prediction tools for cows at risk for elevated serum beta-hydroxy butyrate (**BHBA**), non-esterified fatty acids (**NEFA**), and liver triglycerides (**TG**). Additionally, we aimed to determine the efficacy of utilizing fat to true protein ratio (**FPR**) as a determinant of success of transition cow management. To evaluate FPR cut point for risk of lipid related disorders, cows were divided into two groups post hoc, < or > 1.4 FPR during the first month postpartum. The objectives of this retrospective analysis were to determine if low-cost, on-farm measures of colostrum yield (**CY**), colostrum specific gravity using Brix refractometer (**CSG**), and body condition score (**BCS**) at calving are good predictors of cow health and production in early lactation, and also to describe lipid metabolism in cows with FPR < or > 1.4. Analysis for FPR was conducted using PROC MIXED in SAS with model including, year, diet×year and treatments of < or > 1.4 FPR. Pearson correlation coefficients were calculated for CY, CSG, BCS, BHBA, NEFA and ME 305d milk production. Cows with a FPR > 1.4 vs. < 1.4 had greater serum **BHBA**, mmol/L and **NEFA**, µEq/L on d 1, 7 and 14 postpartum indicating cows > 1.4 FPR had subclinical ketosis (**Table 1**). Compared with FPR < 1.4, FPR > 1.4 had greater liver **TG** on d 7 and 14. Cows with FPR >1.4 lost more kg body weight (**BW**) through the first four weeks of lactation. Yield of mature equivalent (**ME**) 305d milk yield tended to be greater for cows > 1.4 FPR. Utilizing FPR of 1.4 as a minimum cut point is an adequate herd level diagnostic tool for determining herd transition cow success as mean BHBA concentration for cows with a FPR > 1.4 was slightly greater than 1.2 mmol/L, which is the beginning range of subclinical ketosis. Colostrum yield is correlated with serum BHBA on d 1 and d 7 postpartum (**Table 2**). Serum NEFA is correlated with CSG on d 1, 7 and 14. Both CY and CSG are significantly correlated with liver TG on d 7 and CY and CSG are correlated with DMI during the first week postpartum. Precalving BCS is negatively correlated with serum calcium concentration 24 hrs postpartum and may be a predictor of cows at risk for hypocalcaemia. Precalving BCS was positively correlated with serum BHBA at d 1 and d 14, serum NEFA at d 7 and d 14 and ME 305d milk yield. Calculations of sensitivity and specificity was also conducted to determine the accuracy for these correlations within simple models to predict cows at risk for subclinical ketosis. Using FPR resulted in a sensitivity of 0.49 and a specificity of 0.75. Using CY, CSG, and BCS resulted with a sensitivity of 0.43, 0.33, and 0.48 and a specificity of 0.73, 0.67, and 0.82 respectively. Combining CY and CSG or CY and BCS resulted in the greatest accuracy and had a sensitivity of 0.80 and 0.75, and specificity of 0.60 and 0.83 respectively. Utilizing low cost, on farm measures of CY, CSG and BCS provides insight into rates of body reserve mobilization without blood or liver sample collection. FPR can also aid in herd detection and management of lipid related metabolic disorders. The implementation of these tools together can allow dairy producers to quickly identify cows at risk for hypocalcaemia, ketosis, and low DMI shortly after parturition. Rapid, low cost identification of cows at high risk for these disorders allows for early treatment or implementation of tailored feeding and management strategies to minimize the incidence and severity of subclinical fresh cow disorders.

Table 1. Effects of fat to true protein ratio on early lactation lipid metabolism and milk yield.

	FPR <1.4	FPR >1.4	SEM	P-value
N	119	57		
NEFA d 1, $\mu\text{Eq/L}$	442.14	603.57	45.24	<0.01
d 7, $\mu\text{Eq/L}$	575.29	857.44	51.23	<0.001
d 14, $\mu\text{Eq/L}$	513.31	715.50	42.96	<0.001
BHBA d 1, mmol/L	0.96	1.22	0.08	0.01
d 7, mmol/L	0.86	1.34	0.12	<0.01
d 14, mmol/L	0.77	1.25	0.13	<0.01
Liver TAG 7, %	3.80	9.53	0.99	<0.001
Liver TAG 14, %	4.11	7.70	0.73	<0.001
BW change, kg	-33.57	-59.24	2.63	<0.001
ME 305d milk, kg	10,590.00	11,541.00	186.74	0.08

Table 2. Pearson Correlations between colostrum yield (CY), colostrum specific gravity (CSG) and BCS on cow health parameters.

	CY	CSG	BCS
Ca 12H	0.005	-0.14	-0.03
Ca 24 H	-0.06	-0.20	-0.31*
NEFA d 1	0.20*	0.17*	-0.04
d 7	0.11	0.29***	0.39**
d 14	0.03	0.20**	0.29*
BHBA d 1	0.19*	0.01	0.38**
d 7	0.16*	-0.02	0.13
d 14	0.02	-0.01	0.39**
Liver TG 7	0.20*	0.13**	0.23
Liver TG 14	0.15 [†]	0.07	0.16
DMI week 1	-0.18*	0.32***	-0.16
ME 305d milk	-0.08	0.08	0.29 [†]

[†] = ($P = < 0.1$)

* = ($P = < 0.05$)

** = ($P = < 0.01$)

*** = ($P = < 0.001$)

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