

Metabolic Profiling and Health Risk in Transition Dairy Cows

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Metabolic Profiling

- Use of metabolic profiles to determine health status has been advocated, but acceptance has been limited due to costs and interpretation difficulties
- Laboratory reference values for blood metabolite concentrations do not account for potential variation due to age or physiologic state, which may limit their interpretation relative to periparturient disease status or risk

Objectives

- **Determine effects of time relative to calving and health status on blood metabolite concentrations**
- **Determine if any diagnostic relationships are present between prepartum metabolite concentrations and postpartum health status**

Materials and Methods

- 113 cows on 15 commercial dairies
- 3 collection periods
 - Early dry: > -30 days
 - Close-up dry: -3 to -21 days
 - Fresh: $3 - 30$ days in milk
- Disease diagnosis and treatment events were recorded
- ANOVA for repeated measures for period, health and interaction as main effects on analyte levels
 - Log transformed non-normal data
 - Herd was covariate
- Relative risk of postpartum disease determined using contingency tables
 - Metabolite concentration categories
 - Health status

Blood Analytes Measured

➤ Energy status:

- Glucose
- NEFA
- β -OH butyrate
- Triglycerides

➤ Protein status:

- Urea nitrogen
- Creatinine
- Total protein
- Albumin

➤ Creatine kinase

➤ Liver function:

- AST
- GGT
- SDH
- Total bilirubin
- Cholesterol

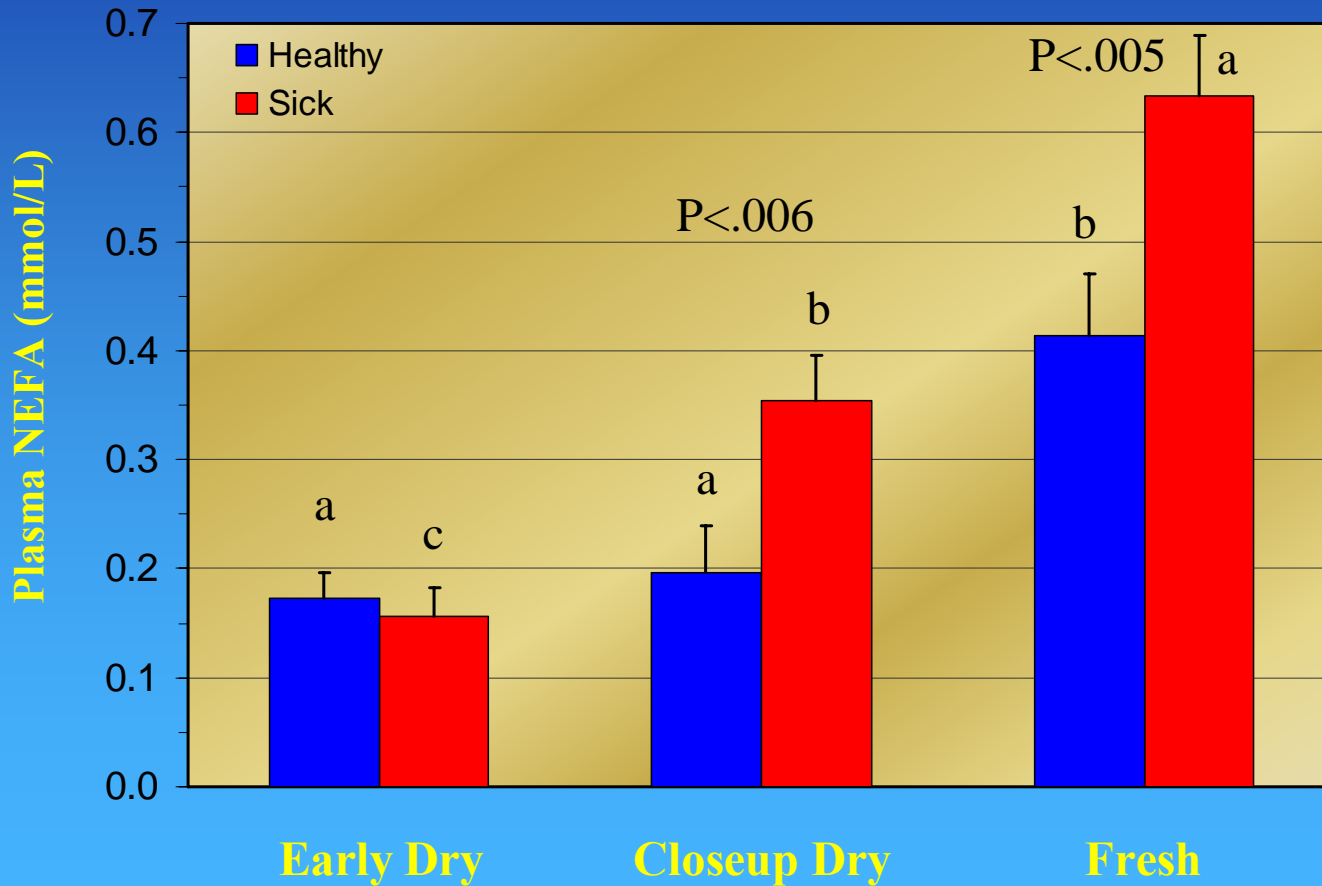
➤ Minerals/Electrolytes:

- Na, K, Cl
- Ca, P, Mg

Results

- 53% of calvings experienced 1 or more health events
- Time period influenced all parameters, except Albumin, Total bilirubin, Ca, P, K
- Health status, independent of time, influenced:
 - NEFA, BHB, TG, GGT, AST, NEFA:Chol
 - All higher in sick cows
- Fresh cows with postpartum disease:
 - Lower: Albumin, PUN, Glucose, Cholesterol
 - Higher: NEFA, BHB, NEFA:Chol, AST

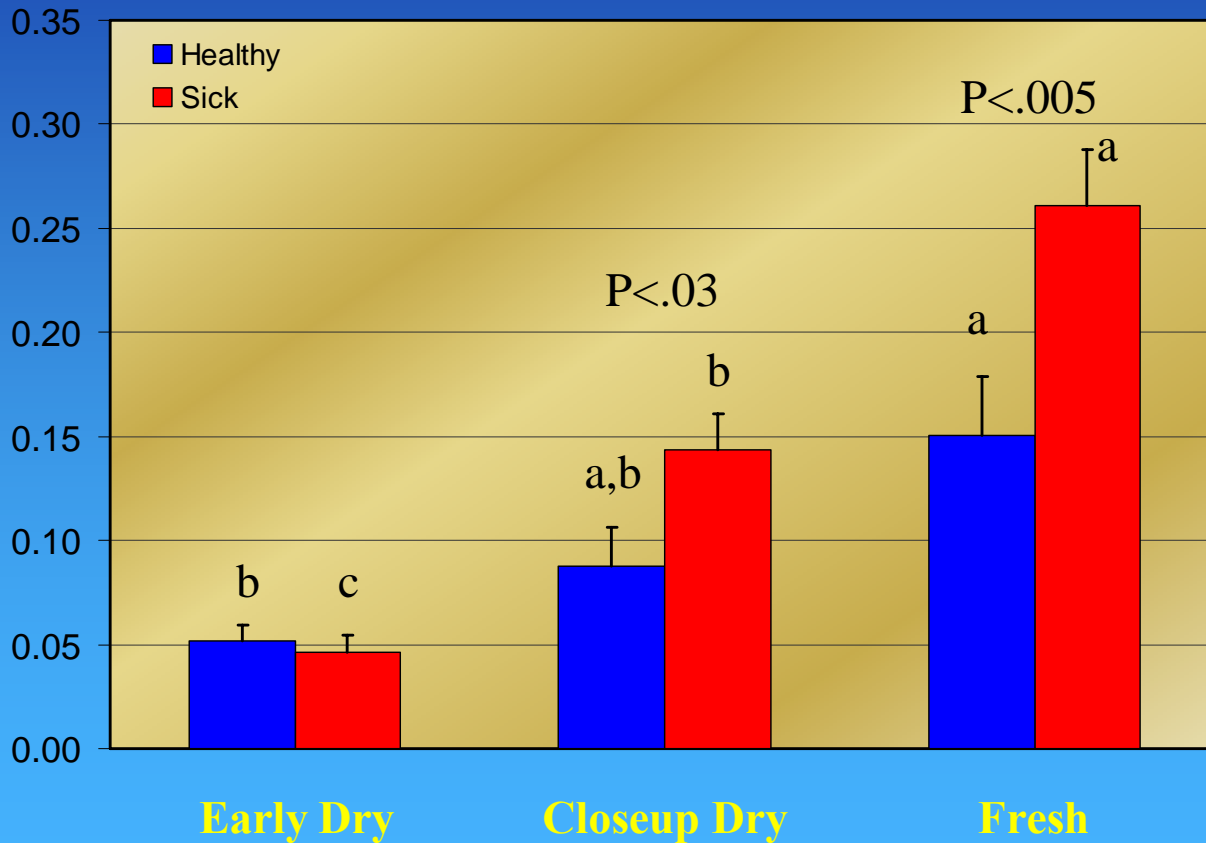
Plasma NEFA



Effect	Pr > F
Period	<.0001
Health	.002
Period x Health	.001
Herd	.14

abc $P < .0001$

Plasma NEFA:Cholesterol Ratio



Effect	Pr > F
Period	<.0001
Health	.001
Period x Health	.0014
Herd	.02

abc $P < .0001$

Protein Status and Disease

Measured Concentration in Fresh Cows

Albumin	Healthy	Abnormal
≤ 30 g/L	33.3% (6/18)	66.7% (12/18)
> 30 and ≤ 35 g/L	38.9% (21/54)	61.1% (33/54)
> 35 g/L	67.7% (21/31)	32.3% (10/31)

Overall Model: $P < 0.02$

Relative Risk for Disease

Parameter	Criteria	Period	RR	95% CI	P
NEFA	≥ 0.6 mmol/L	Close-up	1.69	1.24 – 2.31	.02
	≥ 0.6 mmol/L	Fresh	1.85	1.33 – 2.57	.0007
NEFA	≥ 0.4 mmol/L	Close-up	1.57	1.13 – 2.18	.03
	≥ 0.4 mmol/L	Fresh	1.47	1.00 – 2.17	.04
NEFA:Chol	> 0.2	Close-up	1.64	1.18 – 2.28	.03
	> 0.3	Fresh	1.72	1.27 – 2.34	.005

Relative Risk for Disease

Parameter	Criteria	Period	RR	95% CI	P
BHB	≥ 0.96 mmol/L	Fresh	1.65	1.17 – 2.33	.006
	≥ 1.34 mmol/L	Fresh	1.74	1.26 – 2.40	.003
Albumin	≤ 32.5 g/L	Close-up	1.46	1.04 – 2.04	.04
	≤ 32.5 g/L	Fresh	1.46	1.03 – 2.07	.04
	≤ 33 g/L	Fresh	1.79	1.19 – 2.70	.003
	≤ 35 g/L	Fresh	1.89	1.13 – 3.15	.005

Conclusions

- Reference ranges for diagnostic interpretation of blood metabolite concentrations should be adjusted to time periods relative to calving
- Prepartum blood metabolite concentrations may provide some indication to postpartum disease risk and can be useful as a herd monitoring tool
- Elevated concentrations of blood metabolites reflecting energy balance, lipid metabolism, liver function and low protein status are highly associated with postpartum disease

Acknowledgements

- Carolyn Burns
- Louise Byler
- Participating dairy farms
- Participating veterinarians
- Funding support from Pennsylvania Department of Agriculture