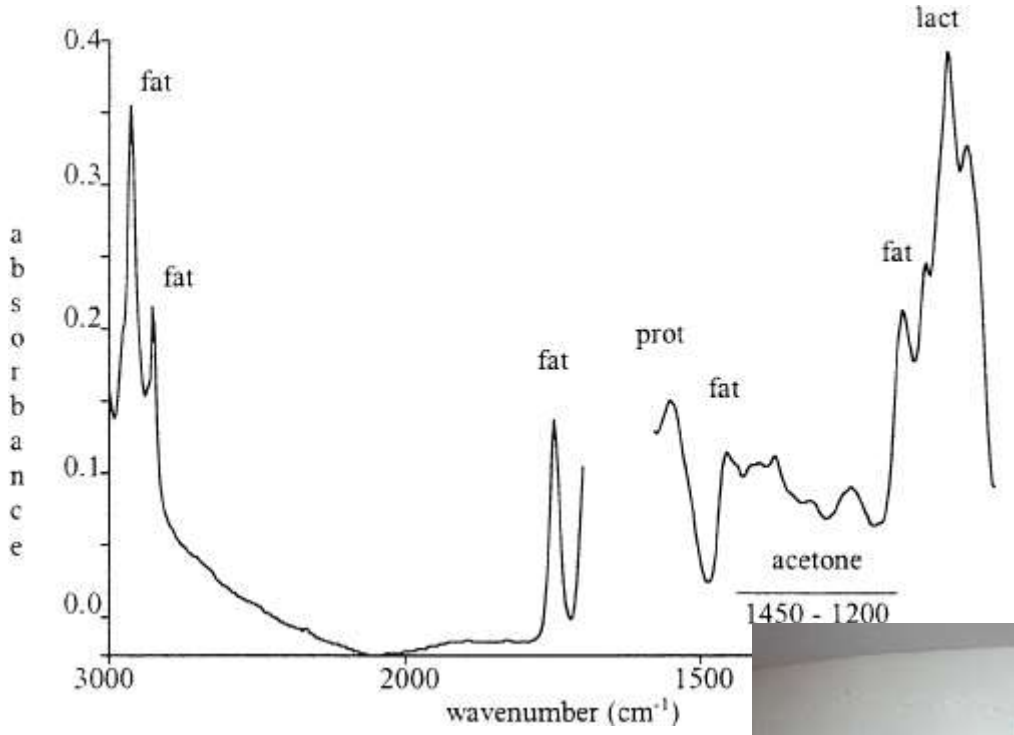
Application of a predictive model for beta-hydroxybutyrate and non-esterified fatty acids using milk Fourier-transform infrared spectroscopy

Background

- Identification of metabolic use disorders is a key issue for animal wellbeing
- Current detection methods are labor intensive and focus on BHB
- FTIR has potential to improve identification of
  - Animals with elevated NEFA (>0.7 mmol/L),
  - While ‘normal’ BHB <1.2 mmol/L)



Objectives

blood BHBA and blood NEFA prediction models

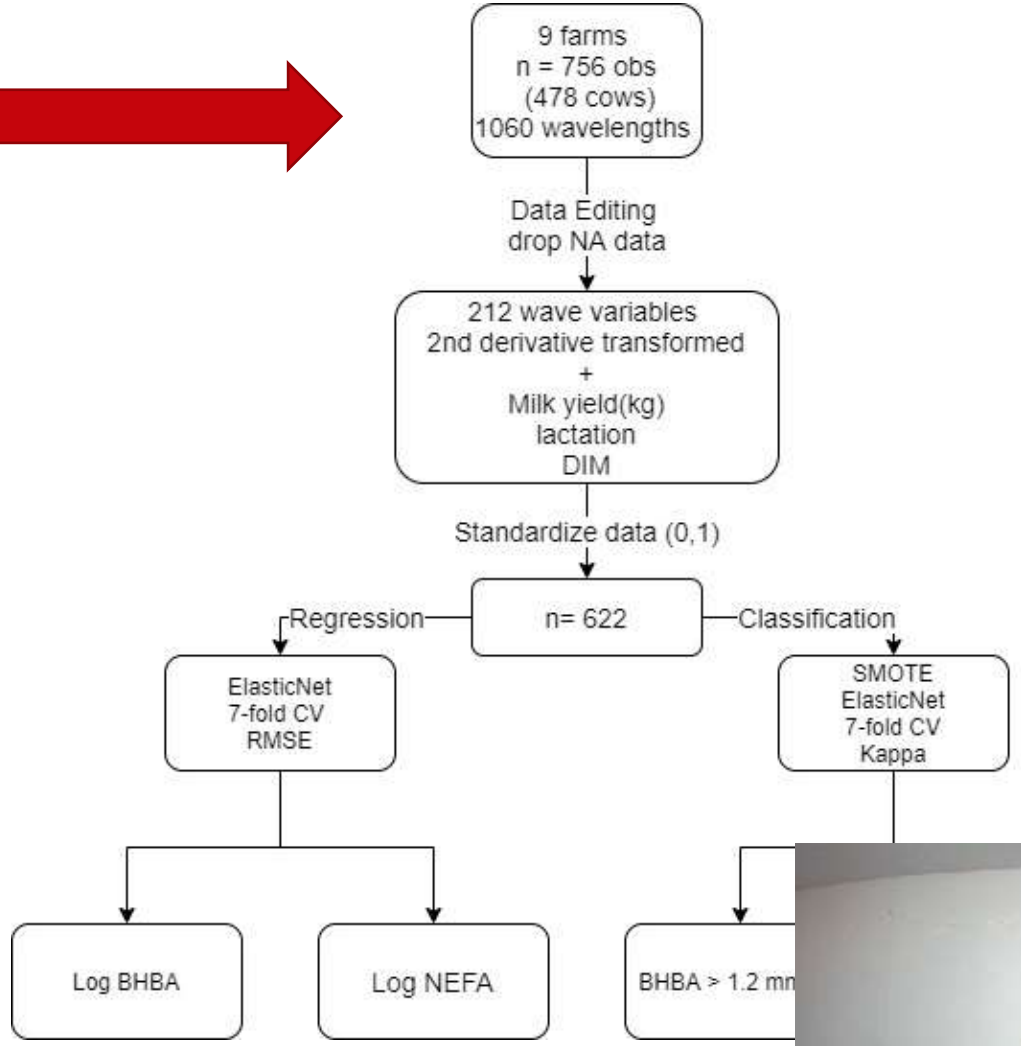
- Cow information
- Milk FTIR data

Classify cows as metabolically challenged

- Based on BHB, NEFA, Fat protein ratio

Material and Methods

- Model developed using Optikuh dataset
- Regression for blood BHB and blood NEFA
- Classification for blood BHB and blood NEFA



Material and Methods

- External Validation
  - Qcheck Dataset (n=9660)
  - Correlation coefficients between real and predicted values

- Classification of Metabolic Imbalance
  - BHBA > 1.2 mmol/L
  - NEFA > 0.7 mmol/L
  - FPQ > 1.4

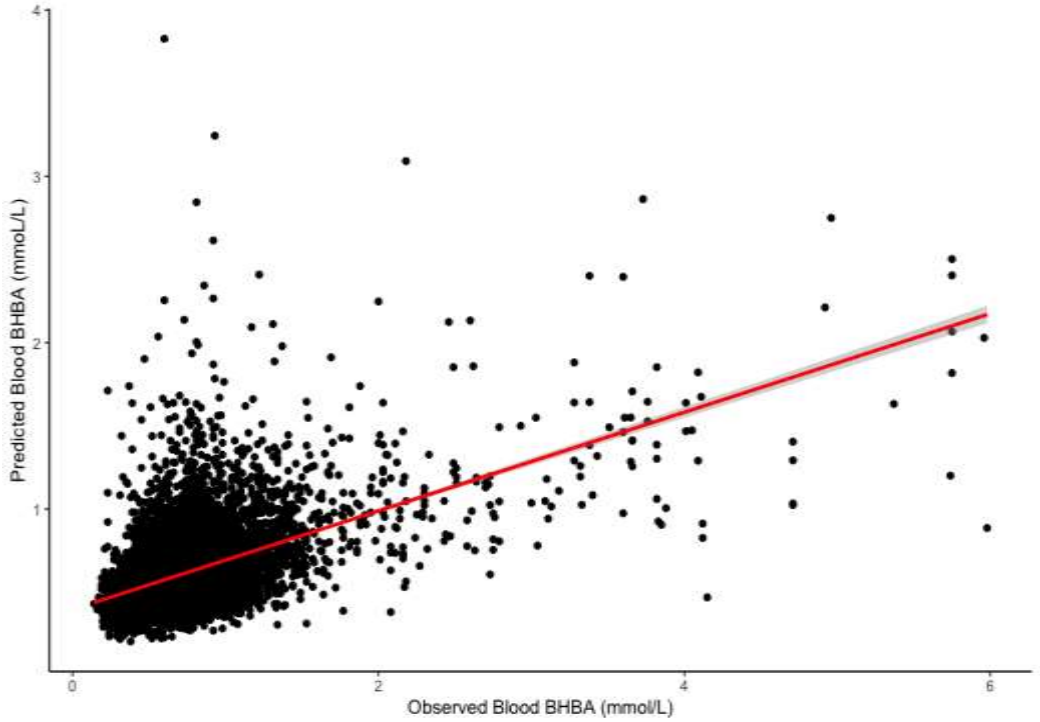
Results

Cross-Validated Results								
	Regression			Classification				
Metabolite	RMSE (log)	R^2	MAE (log)	Sensitivity	Specificity	Balanced Acc.	PPV	NPV
BHB (1.2)	0.3873 ± 0.1380	0.5627 ± 0.2610	0.2958 ± 0.0982	0.90 (0.81 - 0.96)	0.83 (0.80 - 0.86)	0.87 (0.80 - 0.91)	0.43 (0.35 - 0.51)	0.98 (0.97 - 0.98)
NEFA (0.7)	0.4825 ± 0.9260	0.5093 ± 0.2473	0.3755± 0.1968	0.73 (0.66 - 0.79)	0.74 (0.69 - 0.78)	0.73 (0.68 - 0.79)	0.60 (0.54 - 0.66)	0.84 (0.79 -

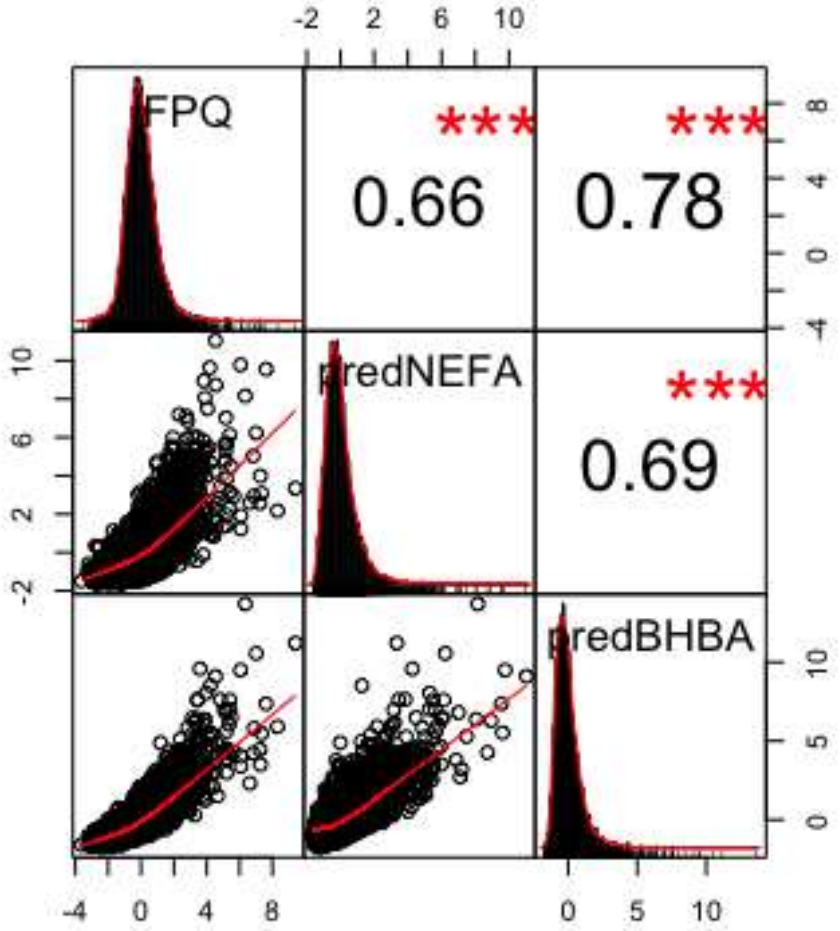
External Validation

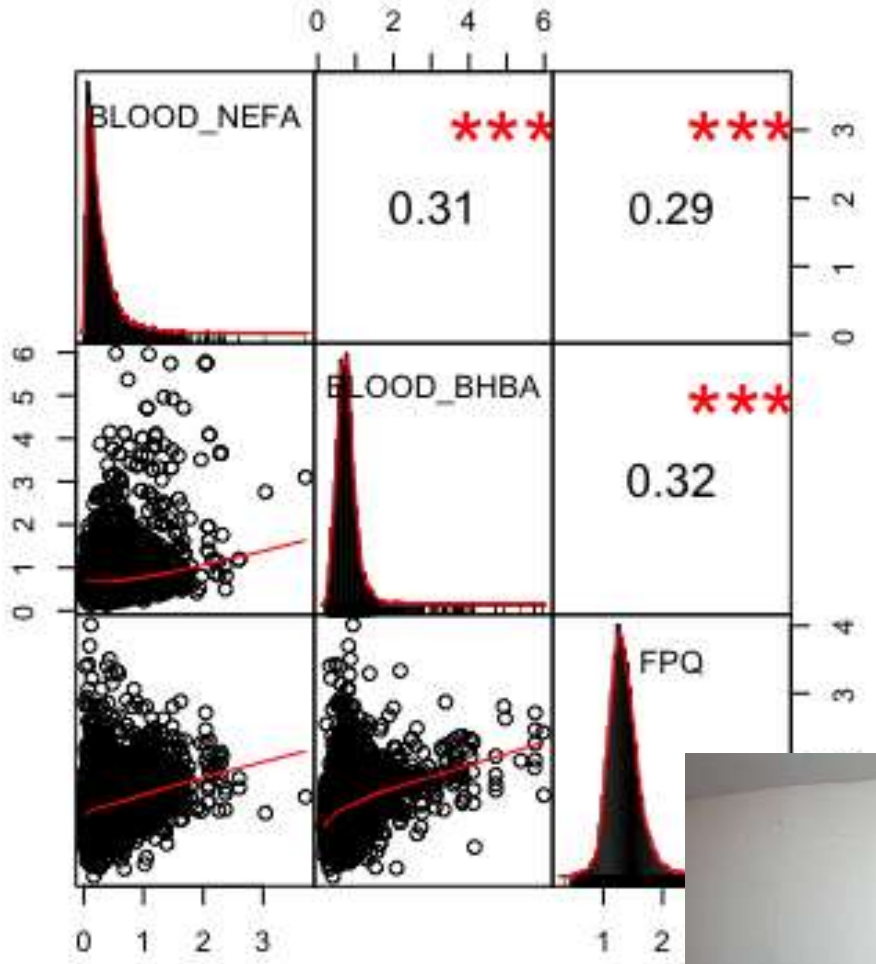
- Log Blood BHB RMSE
- 0.4018 (95% CI 0.3958, 0.4082)

- Log Blood NEFA RMSE
- 0.4043 (95% CI 0.3937, 0.4159)



Correlation Coefficients





Metabolic Imbalance

- Attempt to simplify identification of animals who need attention

		Actual	
		Healthy	Imbalance
Predicted	Healthy	5727	188
	Imbalance	391	3354

Discussion

- ElasticNet based prediction models face similar issues to other modeling options
  - Inability to identify positive animals
- Blood metabolites may be more correlated in certain prediction models
  - Effect of dataset size
  - Review correlation of real and predicted values
- An approach focusing on identifying overall metabolic imbalance may be more practical until modeling improve are complete