Using DHIA data sources to predict feed intake in lactating cows

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DAIRY INNOVATION HUB

INTRODUCTION

- Accurate prediction of dairy cow DMI on dairy farms is difficult without individual feeding stations, therefore determining feed efficiency on the cow-level is not currently possible on a large scale
- Recent modeling work used cow factors, milk production, milk mid-infrared spectra, and behavioral sensors to predict DMI with reasonable success
- Prediction models generally use averaged data over time, which is not feasible on most dairy farms
- New Feed Saved PTA could be beneficial for on-farm DMI prediction
- DHIA data streams offer a wealth of information that could be useful for DMI predictions
- Predicting DMI using combination of single DHI milk sample, milk fatty acids, and PTA has not been tested

OBJECTIVE

Develop DMI prediction models using single point-in-time data, including cow descriptive factors, a single DHI milk sample with fatty acid profile, and PTA for production and efficiency

METHODS

- 369 single-day DMI observations in mid-lactation Holstein cows
- Milk sampled at single 4 a.m. milking
- BW and BCS obtained on same day as milk sample
- PTA obtained from AgSource and Council on Dairy Cattle Breeding
- DMI modeled for day prior to morning milk sample
- Stepwise multiple linear regression analysis for multiple combinations of candidate predictor variables:

Model	Model candidate variables
B	Milk yield and components MBW, BCS, Lact. #, DIM
BY	Model B + Fatty acids yield
BYP	Model B + Fatty acids yield, Production PTA
BYE	Model B + Fatty acids yield, Efficiency PTA
BYPE	Model B + Fatty acids yield, Prod. & Eff. PTA

- Models evaluated using R^2, CCC, RMSE, and slope and mean bias
- Best model validated with external dataset from Iowa State University
- Best model compared with NRC-2001

ABBREVIATIONS

DMI: Dry matter intake
BW: Body weight
BCS: Body condition score
SCFA: Short-chain fatty acid
C16: 16-carbon fatty acid
C18: 18-carbon fatty acid
CCC: Concordance correlation coefficient
RMSEP: Root mean squared error of prediction
MSEP: Mean square error of prediction
NRC: National Research Council

MODEL RESULTS

Table 1. Parameter evaluation of models predicting DMI in mid-lactation cows

						MSEP decomposition, %		
Item[1]	N	R^2 adj.	CCC	RMSEP, kg/d	MSEP	Mean bias	Slope bias	Random error
B	366	0.54	0.71	3.36	11.26	0.00	0.00	100.00
BY	367	0.64	0.79	2.99	8.94	0.00	0.01	100.00
BYP	368	0.66	0.80	2.90	8.42	0.00	0.00	100.00
BYE	356	0.69	0.82	2.81	7.89	0.00	0.00	100.00
BYPE	355	0.71	0.84	2.70	7.28	0.00	0.01	99.99
NRC-2001	367	0.46	0.59	3.91	15.34	9.32	0.15	90.53

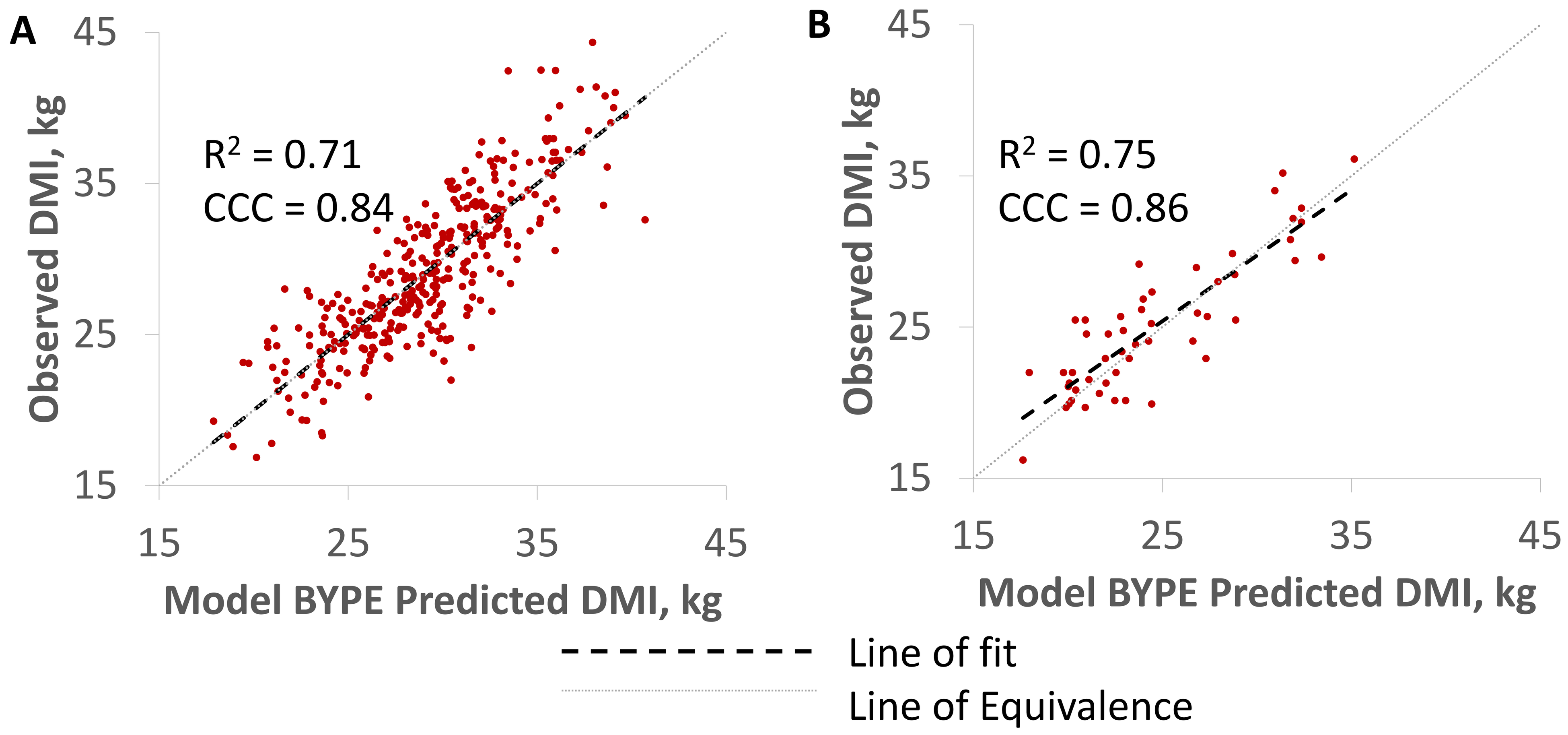
FINAL MODEL AND EXTERNAL VALIDATION

Table 2. Parameter estimates for model BYPE

Item	Estimate	SE	P-value
Intercept	17.4	5.49	0.001
Lactation category	±6.12	0.260	0.02
MBW	0.144	0.019	<0.001
BCS	-0.558	0.582	0.34
True protein, kg[1]	39.4	4.34	<0.001
De novo FA, g[1]	0.769	0.237	0.001
Preform FA, g[2]	-9.98	1.13	<0.001
SCFA, g	-0.0386	0.009	<0.001
C16, g	0.00468	0.005	0.33
C18, g	0.0748	0.013	<0.001
PTA milk	0.00154	0.000334	<0.001
PTA feed saved	-0.00863	0.00173	<0.001
PTA body weight composite	-1.43	0.290	<0.001

[1]Square root transformed; [2]Natural log transformed

Figure 1. Comparison of BYPE predicted vs. observed DMI for the development (A) and external validation (B) datasets



NRC-2001 predicted DMI vs. observed DMI results for external dataset: R^2 = 0.48; CCC = 0.64

CONCLUSIONS

- Inclusion of cow factors, a single milk sample with FA, and PTA for production/efficiency produced a moderately robust feed intake prediction model for mid-lactation cows, an improvement over existing DMI models
- Milk fatty acids related to body fat mobilization were helpful in predicting DMI and may be beneficial for early lactation models
- The new Feed Saved PTA enhanced prediction models and underscores the applicability of the measure for use on dairy farms

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