Improvement of near infrared calibrations for estimating barley feed quality

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Introduction

Near infrared (NIR) spectroscopy is a rapid, non-destructive technology that uses a mathematical relationship (calibration) between wet chemistry reference data and the near infrared absorbances of a set of samples to predict particular quality traits of unknown samples. For a calibration to be effective, it must be developed using many representative samples. As the reference data for feed quality includes expensive and complex analyses and feeding trials with associated animal ethics issues, sample numbers have been limited and calibrations developed by combining grain types. Through the GRDC investment in the Premium Grains for Livestock Program (PGLP), a calibration was developed for feed quality traits using wheat, barley, triticale and sorghum. With Pork CRC funding, the PGLP calibration for digestible energy (DE) has been expanded to include 32 more samples. Digestible energy is the energy released from grains during digestion, i.e. the energy in the feed less the energy in the excreta.[1] This paper describes the continued development of NIR calibrations specifically for digestible energy for pigs.

Materials and methods

Calibrations developed from the PGLP program[2] were obtained including the original NIR scans and reference data. Samples used to produce the new DE reference data were scanned using a Foss NIRSystems model 6500. This instrument was standardised to spectrally match the instrument used to create the original calibration. Faecal and ileal digestible energy data from the additional 32 grain samples were added to the data from the original 97 grain samples from the PGLP calibration set. A new calibration was produced using Win ISI II software. Different mathematical treatments were applied to the data and the combinations that produced the highest correlation and the smallest error were chosen for the calibration. The Pork CRC samples were used as a validation set by using the new calibration to predict the energy values of the new samples and then compare to the actual values.

Table 1. Statistical evaluation of the new calibration with additional pork CRC data compared to original PGLP calibration.

Trait	Calibration	Mean	R^2	*SECV*
Pig faecal DE as fed	New	13.67	0.87	0.30
Pig faecal DE as fed	Original	13.48	0.84	0.38
Pig ileal DE as fed	New	11.56	0.83	0.60
Pig illeal DE as fed	Original	11.26	0.85	0.68
Ileal / faecal ratio	New	0.85	0.81	0.03
Ileal / faecal ratio	Original	0.83	0.69	0.04

Results

An improvement in the calibrations is shown by an R^2 value approaching 1.0. This can be seen in Table 1 with Faecal DE and the Ileal / Faecal Ratio R^2 values improving from 0.84 to 0.87 and 0.69 to 0.81 respectively. There is also a smaller cross validation error (*SECV*) in all cases.

The new data from the Pork CRC were used as a validation set for the original and new equations.

Figures 1 and 2 are graphs of the observed against predicted DE values for the original and new equations. These figures demonstrate the improvement of R^2 values by showing predicted results that are closer to the actual observed results. It is also possible to see the segregation in DE for the different grain types, e.g. the barley samples had a lower DE than sorghum.

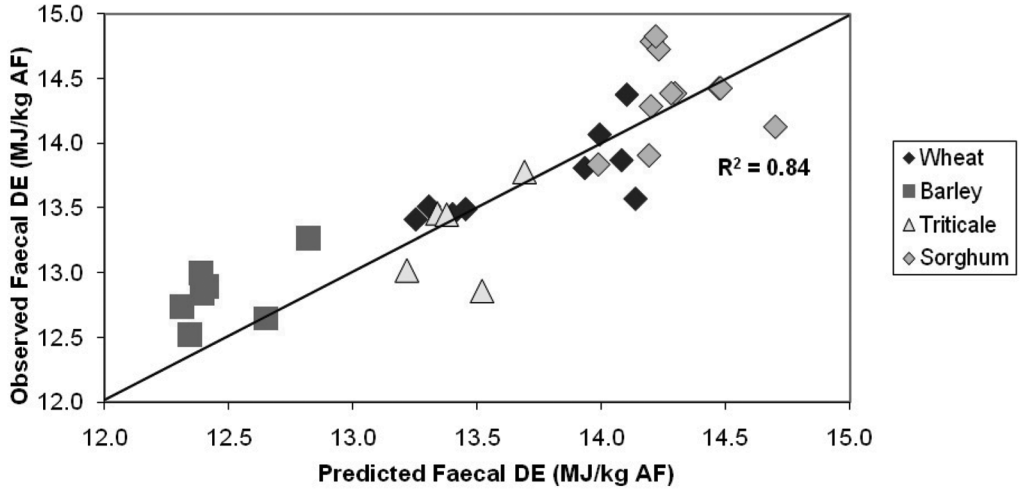

Figure 1. Observed against predicted faecal DE using original PGLP calibration.

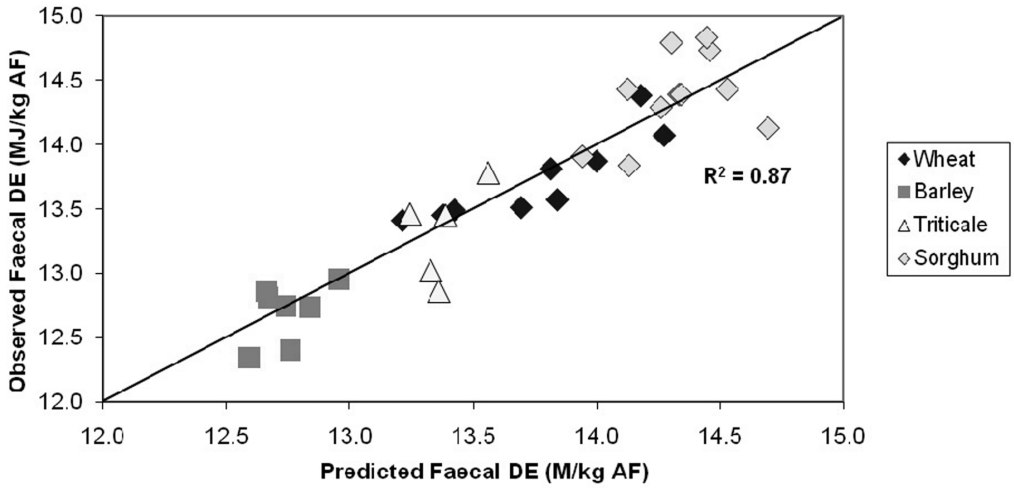

Figure 2. Observed versus predicted faecal DE for new calibration.

Conclusions

The addition of the 32 grains from Pork CRC supported projects to the NIR calibrations has improved the equation correlation and reduced the error. These equations are strong enough to give predictions of feed quality that can be used in a breeding program as a selection tool to rank lines. The calibrations have been developed using four grain types – barley, wheat, triticale and sorghum. It would be more robust to have separate calibrations for each of these grains and as more reference data is produced this may be possible in the future.

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