Intrinsic factors contribute to variation in the AMEn value of corn for broiler chickens

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Introduction

Corn is a major component of feed and contributes significantly to the total dietary energy consumed by broilers. In feed formulation, it is therefore important to accurately estimate the nutritive value of corn. Previous research showed apparent metabolizable energy (AMEn) of corn varied due to differences in proximate composition, as well as intrinsic kernel factors such as kernel hardness, density, size, and vitreousness. However, current prediction equations used to estimate the AMEn of corn do not consider differences in digestibility arising from differences in kernel hardness or physiochemical structures.

The objectives of this study were to determine which intrinsic kernel factors contribute to the observed variance in AMEn of corn samples and if these factors improved the accuracy of a model to predict the AMEn of corn.

Methods

- White (n=471) and yellow (n=639) corn samples from the 2015/2016 (n=338) and 2016/2017 (n=772) harvest seasons were collected from different regions in SA.
- Samples were analysed for moisture, gross energy, AMEn, crude protein, crude fat, milling index, and grit yield using near-infrared transmittance (NIT; Infratec™ 1241 Grain Analyser, Foss, Denmark).
- 60 samples from the 2015/2016 harvest season were selected and analysed through wet chemistry and AMEn calculated using prediction equations of CVB (2012).
- The relationship between NIT-AMEn and each parameter was analysed using Pearson correlation coefficients.
- Model development used Multiple Regression Model Fit test (JMP Pro 13.1) with dependent variables included in the final model using stepwise regression to minimise the Bayesian Information Criterion (BIC).
- The final model to predict AMEn was validated using an independent dataset of 787 samples from the 2017/2018 harvest season.

Results

Table 1: Pearson correlation coefficients between variables

Variable	by Variable	Correlation	F Probability
Oil (DM)	AMEn (DM)	0,630	<0,001
Protein (DM)	AMEn (DM)	0,584	<0,001
Starch (DM)	AMEn (DM)	-0,603	<0,001
Starch (DM)	Protein (DM)	0,857	<0,001
L/kg	AMEn (DM)	-0,469	<0,001
L/kg	Oil (DM)	-0,162	<0,001
L/kg	Protein (DM)	-0,635	<0,001
Milling index	AMEn (DM)	0,551	<0,001
Milling index	Oil (DM)	0,131	<0,001
Milling index	Protein (DM)	0,571	<0,001

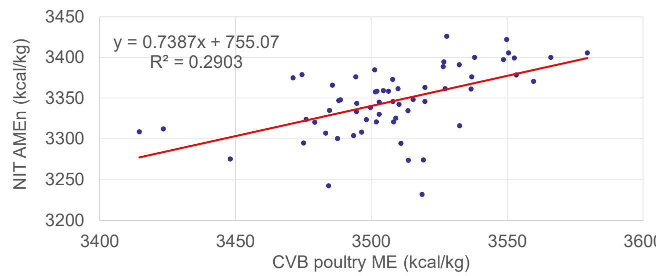

Figure 1: Measured AMEn (kcal/kg) using NIT vs predicted CVB poultry ME (kcal/kg) from 60 samples analysed using Wet chemistry and NIT.

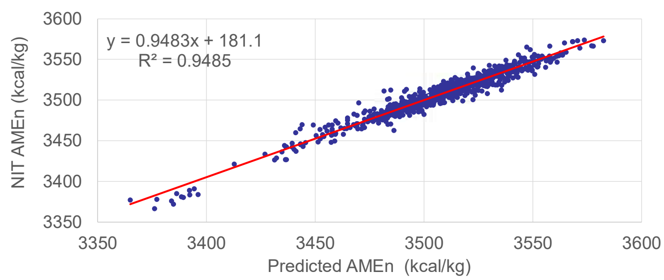

Figure 2: Measured AMEn (kcal/kg) using NIT vs predicted AMEn (kcal/kg) output from the new model using an independent dataset of 787 samples from the 2017/2018 harvest year.

Model development: Model selection using stepwise forward selection to minimise the BIC resulted in a final model:

AMEn = 3589.8 + 37.59*crude fat + 9.76*crude protein - 30.32*moisture + 0.3*milling index.

- R^2=0.89; RMSE=8.95 kcal/kg
- Surprisingly, corn starch did not further improve predicted AMEn (P=0.07) after other independent variables were included in the model.

Conclusion

Prediction equations such as CVB (2012) that only included proximate analysis as dependent variables were not able to adequately explain the measured variation in corn AMEn (R^2=0.29; Fig. 1). A new model developed to predict AMEn from proximate analysis and intrinsic kernel characteristics had an R^2 of 0.875 and root mean square error (RMSE) of 8,94 kcal/kg. The final model was validated on an independent dataset of 787 samples and predicted AMEn with an R^2 of 0.949 (Fig. 2). The significance of milling index in the model suggested that physical properties of the corn kernel contributed to observed variation in AMEn and should be included in prediction equations of AMEn of corn for broilers.

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