Development and Validation of a Spectroscopy Method to Predict Protein Digestibility

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Protein digestibility is traditionally measured by chemical analyses of protein and marker concentration in digesta and diets. Potentially, protein digestibility can also be predicted by marker concentrations and spectral analyses of digesta and diets. Spectroscopy is a rapid, non-destructive method to ascertain qualitative and quantitative chemical information. Based on Beer’s law, a spectroscopic method was developed to predict in vivo protein digestibility. Thus, 411 samples of digesta and diets from 7 feedstuffs with predetermined apparent ileal digestibility (AID) of protein were scanned on a Fourier transform mid-infrared instrument with a single-reflection attenuated total reflectance attachment. The AID of protein was calculated from peak intensities of spectra and measured marker concentrations in digesta and diets, and then compared with in vivo AID of protein. The AID of protein of wheat-based diets was predicted accurately with a deviation of 0.68 ± 0.86% from in vivo AID ranging from 60.4 to 87.8% in an in vivo trial. The calculated AID of protein based on the amide I peak at 1643 cm⁻¹ best predicted (R²=0.99) in vivo AID of protein. This peak is primarily induced by C=O stretching vibration (80%) plus C-N stretching. For feedstuffs mixed with N-free basal diet, accuracy was lower (R²=0.72 to 0.91). Fine corn starch particles may cover the surface of dietary feedstuff particles causing increased absorbance of corn starch and decreased absorbance of feedstuff protein, resulting in lower calculated AID of protein. The R² between spectroscopy predictions and in vivo AID of protein was 0.91 for corn distillers dried grains with solubles (DDGS), 0.90 for wheat DDGS, 0.70 for blended DDGS, 0.90 for triticale DDGS, 0.72 for field pea and 0.83 for wheat millrun. In conclusion, instead of predictions based on calibration, protein digestibility can also be predicted directly from spectra.

Implications: The proposed method is rapid and non-destructive; and permits micro sampling with less than 0.1 g sample. The main advantage is that reference data to build calibration might not be required, but marker data is required. Thus, this method is a potential alternative approach to estimate protein digestibility of feedstuffs in swine.

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