A simple laboratory method for estimating the standardised precaecal digestibility of crude protein and amino acids in pigs

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Introduction

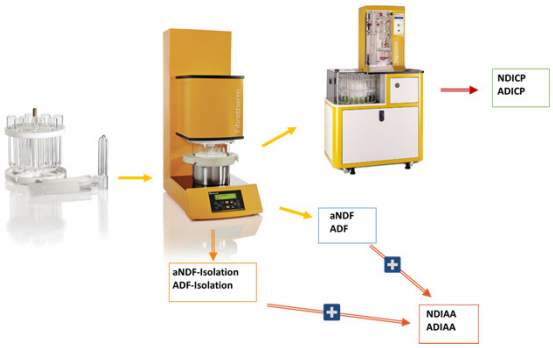
The adequate protein supply for pigs to secure performance and animal health can be determined *in vivo* from standardised precaecal digestibility (spcD) values of crude protein (spcDCP) and amino acids (spcDAA). Until now, only a costly and time-consuming multi-enzyme *in vitro* method (MenzM) according to Boisen and Fernandez (1997) is available to estimate spcD values from laboratory measurements without *in vivo* experiments.

The objective was to develop and establish a rapid and cost-effective laboratory method for estimating spcDCP and spcDAA based on the determination of neutral- or acid-detergent insoluble crude protein (NDICP, ADICP) and amino acids (NDIAA, ADIAA). This approach is based on knowledge that, e.g., the acid-detergent insoluble fraction contains indigestible N-compounds such as Maillard products and N bound to tannin- or phytate-complexes.

Literature: Boisen S., Fernandez, J.A. (1995): Prediction of the apparent ileal digestibility of protein and amino acids in feed stuffs and feed mixtures for pigs by *in vitro* analyses. Anim. Feed Sci. Technol. 51, 29-43.

Material and Methods

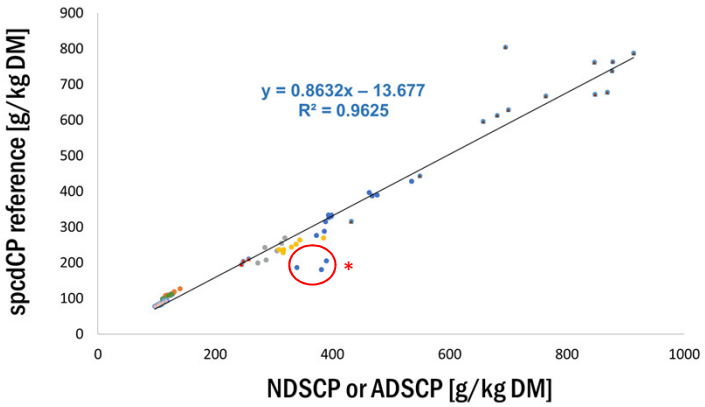
A unique, large sample pool of straight feedingstuffs (differently heat-treated legumes, cereal grains) was available on which *in vivo* spcDCP and spcDAA were determined on pigs. Crude protein (N · 6.25) in feedstuffs and in ND and AD residues of feedstuffs was determined by Kjeldahl analysis. The concentrations of ND and AD soluble CP (NDSCP/ADSCP) were calculated by difference, i.e., CP – NDICP and CP – ADICP. Amino acid concentrations in the detergent residues were determined by HPLC. These values were then used for regression analysis for estimating *in vivo* standardised precaecally digestible CP (spcdCP) and AA (spcdAA) concentrations.



Results

Protein over all samples

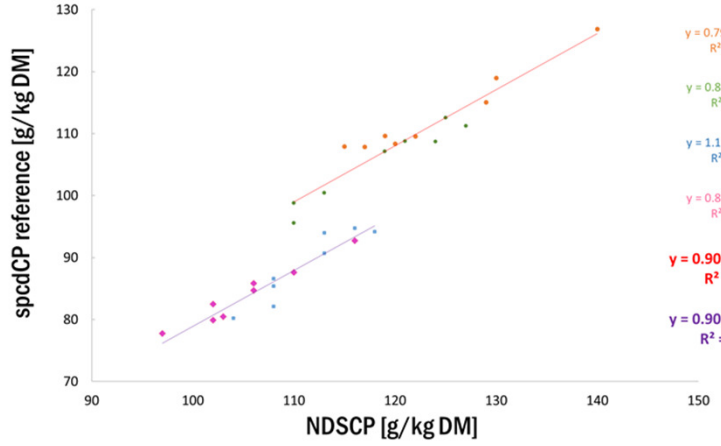
NDSCP resp. ADSCP vs. reference *in vivo* spcdCP

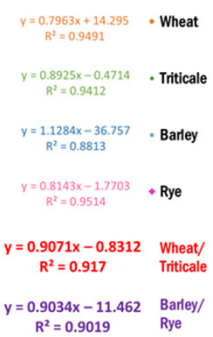


Whole soybeans and low heat-treated soybeans (*) were partially removed, as they are usually not used in pig nutrition in this way. The regression has hardly changed as a result
y= 0.8683x – 9.9911; R²=0.9760
x= NDSCP
y= spcdCP estimated

Protein in grains

NDSCP vs. reference *in vivo* spcdCP

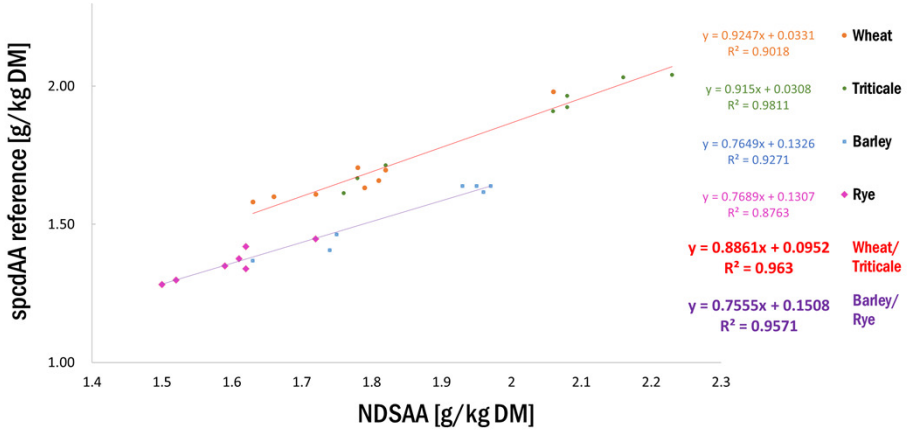




Regression for grouping of Wheat/Triticale and Barley/Rye.
x= NDSCP
y= spcdCP estimated

Methionine in grains

NDSAA vs. reference *in vivo* spcdAA



x= NDSAA
y= spcdAA estimated

Regression equations AA in grains

Wheat/Triticale

Lysine: y = 0.8709x – 0.1299; R^2 = 0.9377

Methionine: y = 0.8861x + 0.095; R^2 = 0.9630

Threonine: y = 0.7272x + 0.481; R^2 = 0.8653

Tryptophan: y = 0.8033x + 0.1213; R^2 = 0.9992

Arginine: y = 0.8822x + 0.581; R^2 = 0.9457

Histidine: y = 0.9039x + 0.1253; R^2 = 0.9922

Isoleucine: y = 0.8489x + 0.3333; R^2 = 0.9246

Leucine: y = 0.8598x + 0.624; R^2 = 0.9172

Phenylalanine: y= 0.9013x + 0.1508; R^2 = 0.9509

Barley/Rye

Lysine: y = 0.5319x + 0.678; R^2 = 0.681

Methionine: y = 0.7555x + 0.150; R^2 = 0.9571

Threonine: y = 0.6957x + 0.202; R^2 = 0.9018

Tryptophan: y = 0.7665x – 0.021; R^2 = 0.9803

Arginine: y = 0.6953x + 1.019; R^2 = 0.8742

Histidine: y = 0.777x + 0.167; R^2 = 0.9000

Isoleucine: y = 0.7725x + 0.1789; R^2 = 0.9751

Leucine: y = 0.7907x + 0.3415; R^2 = 0.9884

Phenylalanine: y = 0.7277x + 0.606; R^2 = 0.9218

y: spcdAA estimated (g/kg DM)
x: NDSAA (g/kg DM)

Conclusion

Determination of NDICP and ADICP is a routine analysis for protein evaluation in ruminants and, therefore, the fast and cost-effective laboratory method is an alternative to the *in vitro* MenzM to estimate spcDCP and spcDAA values from routinely available chemical feedstuff characteristics. Therefore, the comparability of the NDS values between the laboratories is very good.

What's next

- Analyses of the ADICP/AA; NDICP/AA in the remaining samples.
- Validation of regressions.
- NIRS calibration of NDICP/AA and ADICP/AA.
- Another project with regard to NDSCP/AA and ADSCP/AA for poultry.

Abbreviations

CP: crude protein
AA: amino acid

ND: neutral detergent
AD: acid detergent

NDICP/AA; ADICP/AA: neutral/acid detergent insoluble CP/AA
NDSCP/AA; ADSCP/AA: neutral/acid detergent soluble CP/AA

spcD: standardised precaecal digestibility
spcDCP/spcDAA: standardised precaecal digestibility of CP/AA

spcdCP/AA: standardised digestible CP/AA

aNDF/ADF: neutral/acid detergent fibre

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