

6. Summary

Two precaecal (PC) digestibility experiments with intact laying hens and four balance experiments with caeectomised laying hens were conducted in order to contribute to a standard method for measurement of amino acid (AA) digestibility.

Experiment 1 investigated whether the net disappearance (ND) of crude protein (CP) and AA is different in sub-sections of the ileum and whether such differences can become relevant for AA digestibility studies. Solvent extracted meals from either soybeans (SM) or rapeseed (RM) were compared. A low protein basal diet (BD) was based mainly on maize, wheat gluten and maize starch. In the other four diets either SM or RM was included at levels of 14 % and 28 % at the expense of maize starch so that the change in AA concentrations of the diets resulted from SM or RM only. Diets contained TiO₂ as the indigestible marker. Two hundred and ten Lohmann Brown laying hens 27 wk old were used for this experiment. Digesta from intestine sub-sections, three parts of equal length, between Meckel's diverticulum (MD) and 2 cm anterior to the ileo-caeca-colonic junction (ICCJ) were taken immediately and frozen. Net disappearance for each diet and protein ingredients (SM and RM) was calculated based on standard equation and multiple linear regression analysis. For CP and all AA, diet ND was significantly lower in the proximal sub-section than in the central and terminal sub-sections. For RM, ND was significantly lower in the proximal sub-section than in the central and terminal sub-section. For SM, ND of arginine, aspartic acid, glutamic acid and phenylalanine was significantly lower in the proximal than in the terminal sub-section. No significant differences were detected between the central and terminal sub-sections. SM had a significantly higher CP and AAs (except cystine and methionine) ND than RM in the proximal sub-section. It was concluded that AA still disappears from the ileum of hens after MD. This should be accounted for in protocols for precaecal digestibility studies by limiting the sampled ileum sub-section to the last two thirds. Variation exists in digestibility of AA between RM and SM and within one protein source for hens.

Experiment 2 investigated with intact hens the precaecal digestibility of nitrogen (N) and AA for toasted soybeans (TS) and maize gluten (MG). A low protein

BD was based mainly on maize, wheat gluten, and maize starch. In the other diets either TS or MG was included at levels of 15 % or 30 % at the expense of maize starch, so that the change in the AA concentrations resulted from TS or MG only. One hundred and eighty Tetra Brown laying hens 27 wk old were used. Digesta from the terminal two thirds of the section between MD and 2 cm anterior to the ICCJ was taken and frozen. N and AA digestibility for diets and the protein ingredients (TS and MG) was calculated based on standard equation and multiple linear regression analysis. The differences in precaecal digestibility of AA and N for TS and MG were sometimes as high as 6 % (lysine) but never reached a significant level. Precaecal digestibility ranged from 0.84 (cystine) to 0.96 (arginine) in TS and from 0.82 (tryptophan) to 0.95 (proline) in MG.

It was the objective of Experiment 3 to study the effect of caeectomy on AA unexcreted proportion (UP) and energy metabolisability (EM) of diet. Twelve hens were kept individually in balance crates for quantitative measure of feed intake and excretion (faeces plus urine). The caeca of six of these hens were surgically removed when the hens were 20 to 21 wk old. Excreta were collected for 5 consecutive days when the hens were 27 wk old. All hens received the same diet. The UP was calculated as the proportion of intake not recovered in excreta. The mean UP of all AA was 0.82 and 0.80 in intact and caeectomised laying hens, respectively. The UP of DM and 6 AA (aspartic acid, cystine, glycine, proline, serine and threonine) and also EM were significantly higher in intact than caeectomised laying hens.

It was the objective of Experiment 4 to study whether the birds' age affects diet UP of AA in caeectomised hens. The 6 caeectomised hens from Experiment 3 were further fed with the diet from Experiment 3. Excreta were collected for 5 consecutive days when hens were 40, and 57 wk old. The range in UP of all the 15 AA studied across all weeks was 0.64 (glycine) to 0.89 (glutamic acid) and for the essential AA, 0.73 (threonine) to 0.88 (arginine). The mean UP of all AA was 0.80, 0.80, and 0.82 in wk 27, 40 and 57. For 8 AA the diet UP and also EM was significantly higher in wk 57 than in wk 27 or 40.

In Experiment 5 the appropriate time for adaptation to a new diet before starting the excreta collection period in caeectomised hens was studied. For this experiment 5 birds were caeectomised between 29 to 30 wk of age. A diet supplemented with 1 % TiO₂ was fed in wk 37 for 24 h. Excreta were collected

and preserved during the 24 h of feeding with the marker and the four subsequent days of feeding the without TiO₂ three times daily. The TiO₂ concentration in DM of excreta reached up to 22.5 g/kg during the first 24 h, to 5 g/kg on the first day, 0.2 g/kg in the second day and to below 0.1 g/kg on the third and fourth day after TiO₂ withdrawal from the diet. TiO₂ in excreta reached detection level after three days of TiO₂ withdrawal from the diet. It was concluded that 5 d is an appropriate time for adaptation to a new diet before starting excreta collection.

Experiment 6 investigated with caeectomised hens, the total tract digestibility of AA and N from tasted soybeans (TS) and maize gluten (MG) used already in Experiment 2. Measurements in caeectomised hens were to be compared with precaecal measurements from Experiment 2. Fourteen Lohmann Brown hens were caeectomised between 20 to 30 wk of age. The experiment was conducted in 3 subsequent periods between 46 and 50 wk of age. Diets were allocated between hens in the 3 periods in a way that 7 replicated measures per diet were made. Each period consisted 5 d for adaptation to the new diet and 5 for excreta collection. Excreta were collected 3 times per day and feed refusals once per day and maintained in a freezer. Amino acid UP for diets and total tract digestibility for the protein ingredients (TS and MG) were calculated based on standard equations (by using the marker) and by multiple linear regression method. TS and MG differed in total tract digestibility of alanine, glutamic acid, glycine, leucine, lysine, proline, serine, threonine and tryptophan. Digestibility ranged from 0.61 (glycine) to 0.97 (arginine) for TS and from 0.45 (glycine) to 0.97 (leucine, methionine and phenylalanine) for MG.

It was concluded that that caeectomised hens can be used to study AA digestibility of protein ingredients as an alternative to using precaecal measurements. This helps to avoid slaughtering a large number of birds in the process of sample collection and reduce the SE of measurements.