

Additivity of apparent and true ileal amino acid digestibility coefficients in complete broiler diets

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The additivity of apparent and true ileal amino acid digestibility values in three complete diets based on maize (M), wheat (W), rice bran (RB), soybean meal (SBM) and canola meal (CM) for broilers was investigated. The three complete diets contained the following as the main ingredients: M + SBM, W + SBM and M + RB + SBM + CM. Endogenous amino acid flow was determined using the enzyme hydrolysed casein method and used to calculate the true digestibility values. In general, for both apparent and true digestibility, there were no significant differences ($P > 0.05$) between the determined and predicted values in the M + SBM diet. In the W + SBM diet, the determined and predicted true digestibility values were similar ($P > 0.05$), but the determined apparent digestibility values were higher ($P < 0.05$) than predicted values for some amino acids. In the M + RB + SBM + CM diet, the determined and predicted true digestibility values were similar ($P > 0.05$), but the determined apparent digestibility values were higher ($P < 0.05$) than predicted values for five essential amino acids. The present results indicate that apparent digestibility values of individual ingredients are not additive when ingredients with low amino acid digestibility and/or anti-nutritive factors are used in feed mixtures. The data also suggest that true digestibility values are additive, irrespective of the ingredient type used.

Key words: amino acid digestibility; additivity; broilers

Introduction

The use of ileal amino acid digestibility values increase the range and inclusion levels of ingredients that could be incorporated in practical diets, and improve the precision of poultry feed formulations (Lemme et al., 2004). Amino acid digestibility values may be expressed in two ways, namely, apparent digestibility and true digestibility. The latter estimate involves a correction for endogenous amino acid secretions and is considered to be a fundamental characteristic of the feedstuff.

When diets are formulated, it is assumed the digestible amino acids in a mixture of feed ingredients are equal to the sum of digestible amino acids based on the digestibility values determined for single ingredients. However, only limited studies have examined the validity of this assumption for poultry. Additivity of apparent and true digestibility values has been demonstrated by Angkanaporn et al. (1996). On the other hand, Hong et al. (2001) reported that true digestibility values are more additive than apparent values. The objective of the present study was to investigate the additivity of apparent and true ileal amino acid digestibility values in three complete diets based on maize (M), wheat (W), rice bran (RB), soybean meal (SBM) and canola meal (CM) for broilers.

Materials and Methods

The three complete diets contained the following as the main ingredients: M + SBM, W + SBM and M + RB + SBM + CM. The five ingredients and the three complete diets were each fed to four pens of five male broilers from day 28 to 35 post hatch. In the case of M, W and RB, assay diets contained 93.8% of the test ingredient. For SBM and CM, assay diets were based on dextrose and the test ingredient to supply 20% dietary protein. No supplemental xylanase was added to W and W + SBM diets. All diets had titanium oxide (0.3%) as an indigestible marker. On day 35, digesta from the lower half of the ileum was collected and apparent amino acid digestibility coefficients were calculated. Endogenous amino acid flow was determined by feeding assay diets containing 10% enzyme hydrolysed casein (Ravindran et al., 2004) to four pens of five birds each from day 28 to 35 post hatch. and this used to calculate the true digestibility values. Additivity was tested by comparing the differences between the determined digestibility coefficients of ingredient combinations and the predicted values from measurements with individual ingredients. The predicted values for the mixtures were not based a simple mean, but calculated for each amino acid based on respective contributions from each ingredient to the mixture.

Results and Discussion

The endogenous losses of essential amino acids, determined by the enzyme hydrolysed casein method, were as follows (g/kg dry matter intake): arginine, 0.322; histidine, 0.201; isoleucine, 0.354; leucine, 0.489; lysine, 0.324; methionine, 0.098; phenylalanine, 0.311; threonine, 0.725; and valine, 0.426.

The differences between observed and predicted coefficients of apparent and true digestibility of essential amino acids in the three diets mixtures are summarised in Tables 1 to 3. For both apparent and true digestibility, there were no significant differences ($P > 0.05$) between the determined and predicted values in the M + SBM diet (Table 1). In the W + SBM diet, the determined and predicted true digestibility values were similar ($P > 0.05$), but the determined apparent digestibility values were higher ($P < 0.05$) than predicted values for histidine, leucine, threonine, and valine (Table 2). In the M + RB + SBM + CM diet, the determined and predicted true digestibility values were similar ($P > 0.05$), but the determined apparent digestibility values were higher ($P < 0.05$) than predicted values for five of essential amino acids (Table 3).

Table 1. Differences between observed and predicted apparent and true digestibility coefficients of essential amino acids in the maize + soybean meal combination

	Apparent digestibility ¹	True digestibility ¹
Arginine	-0.020	-0.016
Histidine	-0.027	-0.019
Isoleucine	-0.008	0.002
Leucine	-0.016	-0.010
Lysine	-0.013	-0.007
Methionine	-0.007	-0.012
Phenylalanine	0.003	0.015
Threonine	-0.012	0.007
Valine	-0.015	-0.004

¹ Differences not significantly different ($P < 0.05$).

Table 2. Differences between observed and predicted apparent and true digestibility coefficients of essential amino acids in the wheat + soybean meal combination

	Apparent	True
Arginine	-0.022	-0.007
Histidine	-0.041*	-0.004
Isoleucine	-0.018	-0.012
Leucine	-0.033*	-0.011
Lysine	-0.024	-0.015
Methionine	-0.018	-0.008
Phenylalanine	-0.011	-0.007
Threonine	-0.038*	-0.007
Valine	-0.024*	-0.010

* (P<0.05).

Table 2. Differences between observed and predicted apparent and true digestibility coefficients of essential amino acids in the maize, soybean meal, canola meal + rice bran combination

	Apparent	True
Arginine	-0.023*	-0.008
Histidine	-0.023	-0.013
Isoleucine	-0.028*	-0.015
Leucine	-0.019	-0.010
Lysine	-0.021	-0.012
Methionine	-0.018	-0.011
Phenylalanine	-0.027*	-0.015
Threonine	-0.039*	-0.12
Valine	-0.024*	-0.014

* (P<0.05).

The present results indicate that apparent digestibility values of individual ingredients are not additive when ingredients with low amino acid digestibility and/or anti-nutritive factors are used in feed formulations. This finding may be related, in part, to the limitations in the methodology used in digestibility bioassays for the cereals (Ravindran and Bryden, 1999). The use of direct method, with the test ingredient as the sole source of protein, for low-protein feed ingredients, such as cereals, results in the underestimation apparent digestibility coefficients because of the relatively greater proportion of endogenous amino acids in the ileal digesta. The present data also suggest that true digestibility values are more additive and digestible amino acid supply in a complete diet can be predicted from true digestibility coefficients of individual ingredients. Further research with a wider range of feed ingredients is warranted to ascertain the additivity, which could further improve the precision of feed formulations.

References

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