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Biological evaluation of the effect of processing conditions on feather meal amino acid digestibility

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Abstract. Amino acid digestibility determinations by excreta analysis and estimations of ileal and plasma amino acid levels in young chickens proved that processing can affect digestibility of feather meal amino acids to the animal. It was concluded that although ileal and plasma studies may provide useful information on the relative digestibility of dietary feather meal protein, quantitative digestibility measurements by excreta analysis of the individual amino acids have to be used for feather meal quality evaluation.
Key-words: feather meal, amino acids, biological digestibility, processing conditions.

Introduction. Feather meal is subjected to various processing treatments to improve its digestibility but the resulting products are not uniform in quality due to variable effects of treatments. Whereas some treatments might increase protein digestibility they could, at the same time, reduce the nutritional value of the dietary proteins by changing the amino acid pattern (Provansal et al., 1975; Hurrell et al., 1976). In a previous communication it was demonstrated that there are losses of amino acids during processing of feather meal especially in cystine (Papadopoulos, 1985). If the digestibility and/or the availability of its amino acids were known, the value of feather meal as a component of animal feeds could be properly assessed.

Literature studies have reported considerable variations in amino acid digestibility between feather meals (Burgos et al., 1974; Bielorai et al., 1983) but factors and conditions causing this variation are hardly quantified. This investigation was con-

ducted to make quantitative and qualitative studies on feather meal protein digestion in vivo as affected by processing methods and conditions.

Materials and methods. Three experiments were conducted to determine the effects of different processing conditions on feather meal amino acid digestibility in chickens: by excreta (Expt 1), intestinal (Expt 2) and blood plasma (Expt 3) analyses.

Nine differently processed feather meals have been used in this study. Three processing times (30, 50 and 70 min) and three treatments (no addition, added 0.4 % NaOH and added 0.4 % proteolytic enzyme) were involved in the preparation of the test samples. Seven male young chickens per test group were precision-fed (Sibbald, 1976) receiving the same amount of test feather meal as a sole feed. The feed was given to each bird in 3 doses at equal intervals of 3 h.

The digestibility of the amino acids was determined by quantitative excreta collection over a period of 36 h after the first feedding of the test feather meal. Intestinal amino acid concentrations in ileal digesta were measured $2\frac{1}{2}$ h after the last feeding of the test feather meal, while plasma amino acid levels were estimated 1 h after the last feeding.

Results and discussion. The results of the present investigation showed that processing conditions and methods have a substantial influence on amino acid digestibility of feather meal (Expt 1). Processing time, being the most significant effect, reduced digestibility linearly. Comparison between the three methods of feather meal treatment revealed higher values for the enzymatically treated samples and lower values for the chemically treated ones compared with untreated samples. Considerable variation in true digestibility was found between individual amino acids ranging from 36 % for aspartic acid to 87 % for isoleucine. The average true digestibility values for lysine, histidine and methionine, the most frequently limiting essential amino acids in feather meal, were 49 %, 53 % and 63 %, respectively. Cystine, the most heat-sensitive of the amino acids (Papadopoulos, 1985) had an average digestibility of 49 %.

Differences in the ileal (Expt 2) and plasma (Expt 3) amino acid levels in chicks, related to treatment conditions of the dietary feather meal, and in particularly in processing time, were also found. The amino acid levels were increased in ileum and decreased in plasma as processing time of the ingested feather meal was increased. This can be accounted for by differences in the digestibility of dietary proteins (Expt 1). Thus, the amino acids are less available for absorption when long-time processed feather meal was fed to the chicks. The notable changes in ileum and plasma however can give a relative rather than a quantitative measure of amino and digestibility.

The negative effect of processing on feather meal quality can be explained by the fact that thermal treatment may have altered the protein structure in such a way that the digestion in vivo by enzymes is hindered. In the previous communication it was reported that processing caused destruction of feather meal amino acids, especially cystine, with parallel formation of the unnatural amino acid lanthionine

(Papadopoulos, 1985). It seems likely that these changes may reduce the rate of protein digestion possibly by preventing enzyme attack. It was also found that protein digestibility in vitro and solubility of feather meal were increased as a result of increasing processing time and added NaOH or enzyme. These observations however are not confirmed by the in vivo amino acid digestibility measurements in the present study. This leads to the conclusion that in vitro evaluation is not a reliable index to detect inferior protein-amino acid quality in feather meal prepared under different treatments.

Conclusion. Feather meal amino acids are affected in both their contents and biological digestibility by different processing conditions, time being the most significant one. Furthermore, total amino acids, in vitro tests and qualitative in vivo assays in intestinal and plasma amino acids are not adequate to evaluate feather meal protein quality as affected by different processing conditions. Feather meal must be evaluated by quantitative in vivo digestibility measurements of the individual amino acids and should be used in poultry rations on the basis of the digestible amino acids it supplies.

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