AVAILABLE AMINO ACID SCORE: METHOD FOR PROTEIN QUALITY EVALUATION

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ABSTRACT

Amino acid score corrected for true digestibility of individual amino acids as determined by the rat balance method has been described as "available amino acid score". Available amino acid scores have been calculated for 7 protein sources /casein, egg white, beef, soy assay protein, pea flour, rapeseed protein concentrate and whole wheat flour/ and their 10 mixtures. Available amino acid scores for the 17 foods were similar to their relative net protein ratio /RNPR/ values and the positive correlation between available amino acid score and RNPR was highly significant /r=0.92/. Available amino acid score is a simple and quantitative measure of protein quality.

INTRODUCTION

Amino acid score /FAO/WHO, 1973/, a rapid and common method of estimating protein quality, does not include corrections for digestibility of protein and amino acids. In calculating amino acid scores, the use of determined or literature values for protein digestibility has been suggested /UNU, 1980/. However, the correction for protein digestibility would be of limited applicability because true digestibility of individual amino acids may differ considerably from the digestibility of total nitrogen in the same protein source /Sarwar, 1984/. Moreover, in a processed food product, digestibility of protein may not be a good predictor of bioavailability of those individual amino acids which are more susceptible to processing loss, such as lysine in early Maillard reactions /Hurrell and Carpenter, 1981/. Therefore, it is necessary to correct amino acid scores for bioavailability /true digestibility/ of individual amino acids. Amino acid score corrected for true digestibility of individual amino acids as determined by the rat balance method has been termed "available amino acid score" /Sarwar, 1984a/.

CALCULATION OF AVAILABLE AMINO ACID SCORE

Sarwar /1984a/ calculated available amino acid scores according to the following formulae:
Available amino acid score

\[ \text{Available amino acid score} = \frac{\text{mg of available amino acid in 1 g of test protein}}{\text{mg of amino acid in 1 g of reference protein}} \times 100 \]

where,

Available amino acid = Total amino acid \times true amino acid digestibility,

True amino acid digestibility = \frac{\text{AAI-} / \text{FAA-MFAA}}{\text{AAI}} \times 100,

where

AAI = amino acid intake, FAA = fecal amino acid, MFAA = metabolic fecal amino acid; estimates of metabolic amino acids were made by analyzing the feces of rats fed the nitrogen-free diet, Reference protein = provisional amino acid scoring pattern as recommended by FAO/WHO /1973/.

RELATIONSHIP BETWEEN AVAILABLE AMINO ACID SCORES AND RELATIVE NET PROTEIN RATIO (RNPR) VALUES

Sarwar /1984a/ calculated available amino acid scores for 7 protein sources /casein, egg white, beef, soya assay protein, pea flour, rapeseed protein concentrate and whole wheat flour/ and their ten mixtures /casein + methionine, soya protein + methionine, pea flour + methionine, wheat flour + lysine, wheat flour + casein, wheat flour + egg white, wheat flour + beef, wheat flour + soya protein, wheat flour + pea flour and wheat flour + rapeseed concentrate, Table 1/.

The available amino acid scores and RNPR values of the 17 diets, which were recently tested in a collaborative rat growth study, are given in Table 2. Available amino acid scores were similar to the RNPR values, the differences being less than 10 units in most cases. In general, RNPR values were slightly lower than available amino acid scores which reflected the higher essential amino acid requirements of the growing rat than humans. The positive correlation between available amino acid scores and RNPR values of the 17 diets was highly significant /r=0.92/.

The calculation of available amino acid score is simple and this method is applicable to a wide variety of protein products including processed foods. When data for digestibility of amino acids in typical foods become available, the determination of available amino acid score would be no more expensive than analysis of amino acids. In the Canadian Health Protection Branch Laboratories, values for the true digestibility /bioavailability/ of amino acids are being tabulated for a range of protein sources.

Additional information on the differences between digestibilities of protein and of individual amino acids in the same protein sources, as well as standardization of procedures for amino acid analysis and digestibility determinations are required before the available amino acid score can be recommended for routine application. Moreover, consideration would have to be given to the selection of the most appropriate human amino acid requirement pattern. Although the FAO/WHO /1973/ pattern was used in the calculation of available amino acid scores, it now appears that the NRC /1980/ pattern would be more appropriate for humans, especially in terms of sulphur amino acids.