FOOD AND HEALTH: CONSIDERATIONS OF THE PROTEIN METABOLISM WITH SPECIAL REFERENCE TO AMINO ACID REQUIREMENTS AND IMBALANCE

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Health versus hunger is the most drastic and also the most important contrast in today's world. It is no exaggeration to state that one of the main conditions for man's health is the availability of a well balanced nutrition in adequate quantity. There are three reasons to focus these considerations on proteins:

-- They represent - as indicated by the name given to this class by Muldern in 1838 - the body constituent of primary importance. This is true not only quantitatively, but also qualitatively, since all enzymes, the catalysts of living matter, belong to this class.

-- As a food component they have the unique property to be a source of amino acids required for protein synthesis as well as to serve as an energy donor, both aspects being closely related.

-- World wide shortage in supply is most pronounced in this class of foods. The following discussion on the relationship between food and health focuses on the production of more, inexpensive, edible proteins, since this is the most significant area to attack in the battle against hunger.
Protein metabolism in normal man is characterized by more or less rapid turnover of proteins and amino acids in all organs and compartments of the body. The turnover rate varies over a wide range, the average half-life time varying between several months, e.g., collagen in skin, connective tissue, bones and blood vessels; a few days, e.g., intestinal epithelium; and a few hours only, e.g., enzymes and protein hormones. Although protein metabolism is a good example of how material can be economized by recycling, there is a continuous need for it in order to compensate for nitrogen losses. In the normal adult the average protein intake accounts for only a relatively small fraction of the daily protein turnover due to continuous synthesis and breakdown. With regard to the quantitative aspect it is assumed that the overall turnover rate is equivalent to a replacement of one to two percent of body protein each day; this corresponds to an average half-life time of total body protein of about 80 days. Since the overall protein content of adult man is 12 to 15 kilograms this would mean that the total body protein synthesis amounts to 200 to 300 grams per day. On the other hand, the obligatory nitrogen loss is 45 to 60 mg N (or equivalent to 0.3 to 0.4 g protein) per kg of body weight. This figure represents the sum of urinary and fecal nitrogen output, and of skin and other obligatory nitrogen losses. The data are based on observations made in healthy humans on a protein free diet for a period of at least 10 to 14 days (1-6). Consequently, the ratio between internal N-turnover and obligatory N-loss is of the order of ten to one.

The obligatory N-loss is a suitable reference - by definition - for the calculation of the minimal protein requirement; however, the composition of urinary and fecal N-products may vary considerably. If protein intake is very low, urea is no more the main endproduct of N-metabolism. Whereas on a strictly vegetarian low protein diet urinary-N is eliminated in almost equal amounts as urea, ammonia salts, hippuric acid, creatinine, uric acid, and other amino-N-compounds, a relatively large quantity of protein-N, probably of bacterial origin, is lost in feces (7). Recent studies made in malnourished children by means of 13 C and 15 N-labeled compounds, such as amino