Nutrition Brief

The Solae Company™

Human Requirements for Protein

Nutrients are categorized into organic and inorganic depending on whether or not they contain carbon. The organic nutrients are carbohydrates, lipids, proteins and vitamins. The inorganic nutrients are water and minerals. A further classification for nutrients is energy vs. non-energy. An energy nutrient is one which upon burning in the laboratory or in our bodies, yields heat which is measured as calories.

The energy nutrients are carbohydrates, lipids and proteins. Other nutrients are involved in liberating energy, but none of them actually yield heat or can be concerted into a stored form of energy such as fat or glycogen.

The energy issue is important in determining human protein requirements, because the first demand by the body is for energy. If caloric/energy requirements are not met, protein will not be spared to do its jobs of maintenance and growth, thus the term "protein-calorie malnutrition". However, assuming adequate energy/calories are provided and the appropriate other nutrients are available to facilitate energy release and other biological mechanisms, then protein can be reserved for its unique functions. Although the daily allowance is expressed as protein, the biological requirement is for amino acids.

Proteins and other nitrogen-containing compounds are being degraded and rebuilt continuously. Several times more protein is being turned over each day than is typically consumed, indicating that the reutilization of amino acids is a major feature of the economy of protein metabolism. The process of recycling is not completely efficient and some amino acids are lost. Metabolic products of amino acids - urea, creatinine, uric acid and other nitrogen-containing compounds - are excreted in urine. Nitrogen also is lost in feces, sweat and other body secretions and in sloughed skin, hair and nails. All of these losses must be replaced by a continuous supply of dietary amino acids which usually are provided through dietary protein.

Nine amino acids - histidine, isoleucine, leucine, lysine, methionine, phenylalanine, threonine, tryptophan, and valine - cannot be synthesized by mammals and therefore must be consumed. They are commonly called the essential amino acids. The other amino acids can be made by mammals if nitrogen and other needed nutrients are available. Thus, the bottom line is that humans must eat protein for two reasons: first, because food protein is the only source of the essential amino acids and secondly, because food protein is the only practical source of nitrogen with which to build the nonessential amino acids.

So, the question is how much protein do humans require? The daily protein allowance is based on the varying amounts of amino acids needed. Requirements vary depending on age, body size, sex, and physiological condition. For example, during rapid growth periods such as infancy, adolescence and pregnancy, amino acid requirements per unit body mass are higher than during maintenance.

References:

1. Protein Quality Evaluation, Report of a Joint FAO/WHO Expert Consultation, Rome, Italy. Food and Agriculture Organization and World Health Organization. Food and Agriculture Organizations of the United Nations; 1990.

2. Food Nutrition Board. Recommended Dietary Allowances. 10th ed. Washington, DC: National Academy of Sciences; 1989.

3. Food Labeling; Reference Daily Intake and Daily Reference Values; Mandatory Status of Nutrition Labeling and Nutrient Content Revision; Serving Sizes; Proposed Rules. 21 CFR Parts 101, 104, and 105. Washington DC: Department of Health and Human Services, Food and Drug Administration; Federal Register July 19, 1990; 55:29476-29533.

Extensive research has determined the amino acid requirements for various ages and conditions. Table 1[1] shows the suggested pattern of essential amino acid requirements for humans. Cystine is paired with methionine since methionine can be used to make cystine. Thus the methionine requirement is lower if cystine is supplied. Phenylalanine is paired with tyrosine since phenylalanine can be used to make tyrosine. Thus, the phenylalanine requirement is lower if tyrosine also is supplied.

Once the requirements for amino acids are determined, recommended daily protein intakes can be calculated for various ages, genders and conditions. The 1989 RDA[2] recommends a range of 2.2g protein/kg body weight for a young infant to .8g protein/kg body weight for adults. The recommendation takes into account the variability in protein quality of different foods. For labeling purposes, the Food and Drug Administration proposed in July 19903 that the Reference Daily Intake (RDI) for protein should be: 14g for infants, 16g for toddlers, 50g for adults, 60g during pregnancy and 65g during lactation. *See Table 1.*

Table 1. Suggested Patterns of Amino Acid Requirements

Suggested Pattern of Requirement (mg/g crude protein)

Amino Acid	Infant Mean (range)*	2-5 years	10-12 years	Adult
Histidine	26 (18-36)	19	19	16
Isoleucine	46 (41-53)	28	28	13
Leucine	93 (83-107)	66	44	19
Lysine	66 (53-76)	58	44	16
Methionine + Cystine	42 (29-60)	25	22	17
Phenylaline + Tyrosine	72 (68-118)	63	22	19
Theonine	43 (40-45)	34	28	9
Tryptophan	17 (16-17)	11	9	5
Valine	55 (44-77)	35	25	13

From FAO/WHO Joint Expert Consultation (1)
*Amino Acid Composition of Human Milk. Cited in Reference[1]

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