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Anatomy

Biological value (BV) of protein is a measure of the proportion of absorbed protein from a food which becomes incorporated into the proteins of the organism's body. It captures how readily the digested protein can be used in protein synthesis in the cells of the organism. Proteins are the major source of nitrogen in food.

The biological value of a protein extends beyond its amino-acid composition and digestibility, and can be influenced by additional factors in a tissue-specific manner. In healthy individuals, the slow appearance of dietary amino acids in the portal vein and subsequently in the systemic circulation in response to bolus protein ingestion improves nitrogen retention and decreases urea production. This is promoted by slow absorption when only protein is ingested (e.g. casein). When a full meal is ingested, whey achieves slightly better nitrogen retention than soy or casein, which is very likely achieved by its high content of essential amino acids (especially leucine). Elderly people exhibit 'anabolic resistance' implying that more protein is required to reach maximal rates of muscle protein synthesis compared to young individuals.

Methods of assessing protein quality

Biological Value (BV) - (grams of nitrogen retained / grams of nitrogen absorbed) x 100

Protein Efficiency Ratio (PER) - (grams of weight gained / grams of protein consumed)

This method is commonly performed in growing rats.

Chemical or Amino Acid Score (AAS) - (Test food limiting essential amino acid (mg/g protein) / needs of same essential amino acid (mg/g protein))

Protein Digestibility Corrected Amino Acid Score (PDCAAS) - (Amino Acid Score x Digestibility)

This is the most widely used method and was preferred by the Food and Agriculture Organization and World Health Organization (WHO) until recently. The following table shows the protein quality measures for some common foods.

BODY PROTEIN METABOLISM

Assessing protein quality with respect to its efficiency in supporting body protein metabolism should include consideration of the capacity of the diet to provide substrate needs for protein synthesis and any other biosynthetic pathways, ie, a suitable source of nitrogen and IAA (lysine, threonine, valine, isoleucine, leucine, methionine, phenylalanine, tryptophan, and histidine). However, to this assessment method should be added provision of sufficient signal amino acids, (eg, leucine), required for those regulatory steps whereby metabolism is optimized and anabolism is stimulated.

DIETARY PROTEIN AND AMINO ACID BIOAVAILABILITY

A second important issue in quality evaluation relates to the bioavailability or digestibility of a protein or the capacity to provide metabolically available nitrogen and amino acid to tissues and organs. The food matrix in which a protein is consumed can have significant impact on the bioavailability of amino acid for metabolic needs. Digestive losses and structural changes of amino acids are caused by numerous antinutritional factors in foods. These issues have been addressed with particular attention to animal compared with plant proteins.