AUGOYE OMESIRI

ANATOMY

18/MHS01/094

BIOLOGICAL VALUE

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. Protein utilization in inflammatory or traumatic conditions increases substantially in the splanchnic tissues containing most of the immune system, and in wounds and growing tissues. This happens especially in the elderly, which often suffer from chronic inflammatory activity due to disease, physical inactivity and/or the aging process itself. Consequently, the proportion of protein absorbed in the gut and utilized for muscle protein synthesis decreases in these situations. This compromises dietary-protein-induced stimulation of muscle protein synthesis and ultimately results in increased requirements of protein (∼1.2 g/kg body weight/day) to limit gradual muscle loss with age. To optimally preserve muscle mass, physical exercise is required. Exercise has both direct effects on muscle mass and health, and indirect effects by increasing the utilization of dietary protein (especially whey) to enhance rates of muscle protein synthesis.

Protein quality has been identified as a critical question by international authorities (FAO). Protein nutritional quality is related to the capacity of the different food sources of protein to achieve the different functions associated to the supply of nitrogen and amino acids in the body. The nutritional efficiency of a protein can be determined from the extent to which dietary protein nitrogen is absorbed and retained by the organism and is able to balance daily nitrogen losses. The capacity to provide an adequate profile of bioavailable indispensable amino acid is considered as a limiting factor for protein quality.

The Amino Acid Scoring approach considers the capacity of a protein source ingested at the level of the mean protein requirement derived from nitrogen balance (0.66 g/kg/d in adult) to meet indispensable amino acid needs. The Protein Digestibility Corrected Amino Acid Score (PD-CAAS) corrects the content of each indispensable amino acid of the protein by the faecal digestibility of the protein in order to evaluate the bioavailable part of these amino acids in comparison to a reference amino acid profile. The new discussed Digestible Indispensable Amino Acid Score (DIAAS) considers the specific ileal digestibility of each indispensable amino acid separately. The application of DIAAS faces to several methodological difficulties for measurement of amino acid ileal digestibility particularly in humans.

The definition of “true” digestibility is the proportion of the dietary amino acids that have disappeared from the intestinal lumen at the terminal ileum. By using ileal cannulation the apparent digestibility, ie the net disappearance of amino acid as a proportion of dietary intake can be measured. This includes endogenous secretions from mucus, enzymes and microbial biomass as well.

Digestibility can be determined at the faecal level, but the value are underestimated due to the colon stasis and the microbiota metabolism of proteins. Ileal digestibility is the more accurate measurement because amino acids are absorbed in the small intestine and those that reach the colon can be transformed by the microbiota. However, such determinations cannot be done easily on various sources of proteins with the currently available methods and there is a need to develop alternative methods to assess protein and amino acid bioavailability and nutritional quality in humans.