Future Protein: Nutritional Quality Assessment

Wantanee Kriengsinyos

Institute of Nutrition, Mahidol University, Thailand

ABSTRACT:
Novel alternative protein sources (e.g., legumes, insects, algae, fungal, cultured meat) have gained increasing popularity over the past decade because of their sustainability. Due to protein's vital function in the human body, priority should be given to alternative protein innovations that mimic meat texture, flavor, and, most importantly, quality.

Protein quality depends on amino acid composition as well as bioavailability or digestibility. The conventional score, known as the protein digestibility-corrected AA score (PDCAAS), compares the first limiting amino acid in a test protein with that of a reference essential amino acid pattern, and correcting for true fecal nitrogen digestibility. However, true fecal nitrogen digestibility does not consider the essential amino acids that are not absorbed in the ileum and are lost into the colon. Consequently, FAO/WHO/UNU expert consultations on protein requirements and quality in 2011 emphasized the need for the Digestible Indispensable Amino Acid Score (DIAAS) as a measure of protein quality. Digestibility is measured using standard oro-ileal balance methods, which can only be achieved by invasive naso-ileal intubation in healthy participants or fistulation at the terminal ileum. AA digestibility is determined based on AA disappearance under the assumption that unaccounted AAs have been absorbed.

An advanced method using stable isotopes (labeled foods) has been developed to measure human AA digestibility. Food proteins isotopically labeled with stable isotopes, usually via nitrogen or carbon, are given to an animal or human in an acute feeding study. With the dual isotope approach, two proteins (the test protein and a reference protein with known ileal AA digestibility) are given together in a mixed meal to a subject. AAs in the test protein and reference protein are labeled using different isotopes (commonly ^{2}H,^{15}N, or ^{13}C), such that plasma ratios (test diet isotope/reference diet isotope) of the isotope can be related to the known digestibility of the reference protein. The dual isotope tracer method measures small intestinal digestibility of multiple amino acids at once and is suitable for use in vulnerable groups.

The noninvasive indicator amino acid oxidation (IAAO) technique, which is routinely employed to measure indispensable amino acid requirements, has been modified by determining the slope ratio for estimating the metabolic availability (a sum of digestibility and utilization) of limiting amino acids in test proteins.

The isotope method has already been applied to a number of foods given to humans. Most of these foods are plant-based proteins with minimal processing. Various food processing procedures can improve protein digestibility by removing food constituents that reduce digestibility (e.g., dietary fiber), breaking down poorly digestible vegetable cell membranes, destroying or neutralizing antiphysiological factors, and increasing the food surface area that can come into contact with gastrointestinal enzymes. For example, soy protein isolate and refined wheat flour have higher protein digestibility than soya flour and whole wheat, respectively. In contrast, food storage and processing in adverse circumstances can reduce protein quality by making some amino acids unavailable for use in the human body. The assessment of protein digestibility is typically considered at the level of ingredients, but novel alternative proteins are blended and processed to formulate palatable foods, which have limited protein quality data. Further studies on the digestibility of novel proteins are needed.