

Protein Quality Calculations Overview

The nutritive value of protein depends on its ability to provide amino acids in adequate amounts to meet the requirements of the human. This relative quality among food sources is particularly important for children and for populations lacking calories and wholesome foods that contain a mixture of food protein sources. In the early 1980's the Codex Committee on Vegetable Proteins recognized the need to elaborate guidelines for utilization of vegetable protein products in foods and as a consequence identified a need to establish a suitable indicator to express protein quality (rather than the historic protein efficiency ratio or PER generally reported). After some years of deliberation, it was established that an amino acid scoring procedure, corrected for true digestibility of protein and/or bioavailability of limiting amino acids, would be the preferred method to assess protein quality of vegetable protein and other food products.¹

Human requirements for established minimum quantities of dietary essential amino acids from biologically available sources vary with age, physiological condition, state of health and other factors. In the nonpregnant or lactating adult, protein is required in the diet to maintain body nitrogen and a supply of indispensable amino acids owing to losses during protein turnover.² The relative quality of protein containing foods is thus a measure of the relative amounts of the dietary essential amino acids – with the limiting amino acid being the focus of the “protein quality,” using an amino acid scoring pattern with a correction for digestibility for the food.³ Human clinical trials, to measure growth and/or other metabolic indicators provide the most accurate assessment of protein quality for humans but are costly and potentially invasive.

For decades the protein efficiency ratio [PER (ability of a protein to support growth in young, rapidly growing rats)] was believed to be the best predictor of clinical tests. Historically reference patterns for amino acid/protein comparison were based on egg or milk protein patterns. The PER now is reported to over-estimate the value of some animal proteins for human growth while under-estimating the value of some vegetable proteins for human growth. Amino acid analysis that is accurately determined chemically is critical to the assessment of relative protein quality.⁴ The amino acid score, by itself is not an appropriate alternative to the PER. Some systematic mechanism to account for differences in digestibility and/or biological availability must also be a component of the consideration of quality among protein-containing foods. There now exists a hypothetical standard reference protein used for comparative purposes, which is derived from a pattern of human amino acid requirements. Use of this pattern, relative to the specific amino acid composition of a food, corrected for digestibility, is known as the protein digestibility-corrected amino acid score (PDCAAS).⁵

The United States Department of Health and Human Services, Food and Drug Administration references use of the PDCAAS method in its regulations regarding nutrition labeling for protein in foods.⁶ Using the guidance provided, The Solae Company provides PDCAAS information for its soy protein-containing products. The method of determining PDCAAS for individual foods and food mixtures, as developed by FAO includes the following components.

Determination of Protein Digestibility-Corrected Amino Acid Score⁷

To calculate a protein digestibility-corrected amino acid score (PDCAAS), the test food is analyzed for proximate and amino acid composition. A protein digestibility value also must be obtained from a database or must be determined by the rat balance method.⁸

- from the proximate composition, the protein can be calculated using the nitrogen conversion factor of 6.25.
- amino acid ratios are calculated using the 1985 FAO/WHO/UNU suggested pattern of amino acid requirements for pre-school children.
- true protein digestibility is determined using an identified, standardized rat balance method.

To make the calculation, the lowest amino acid ratio is multiplied by the true protein digestibility. *In this report, the score is expressed as a decimal but it may be expressed in percentage terms.*

In the case of soybean protein concentrate (from the FAO report):

Lowest Amino Acid Ratio=1.04

True digestibility=95%

Protein digestibility-corrected score would be $1.04 \times 0.95=0.99$ or 99%

Protein digestibility-corrected amino acid scores above 1.00 would be considered as 1.00 or 100%

Sources:

- 1 FAO/WHO Expert Consultation. 1991. Protein quality evaluation. FAO Food and Nutrition Paper 51, Rome Italy.
- 2 Zello, G.A. 2006. Dietary reference intakes for the macronutrients and energy: Considerations for physical activity. Appl. Physiol. Nutr. Metab. 31:74-79.
- 3 Ibid.
- 4 21CFR 101.9(7). 2005. Office of the Federal Register. Nat'l Arch. and Records Admin. Wash, D.C.
- 5 Zello, G.A. 2006 Dietary reference intakes for the macronutrients and energy: Considerations for the physical activity. Appl. Physiol. Nutr. Metab. 31:74-79.
- 6 21CFR 101.9(7). 2005. Office of the Federal Register. Nat'l Arch. and Records Admin. Wash, D.C.
- 7 FAO/WHO Expert Consultation. 1991. Protein quality evaluation. FAO Food and Nutrition Paper 51, Rome Italy.
- 8 Bodwell, C.E. et al. Plant Foods for Hum. Nutr., 39:3-11(1989).

The Solae Company
P.O. Box 88940
St. Louis, MO 63188

Tel: 800.325.7108 or 314.659.3000
www.thesolaecompany.com

The information contained herein is, to the best of our knowledge, correct. The data outlined and the statements made are intended only as a source of information. Also, we may suggest technical solutions for incorporating this ingredient into products, however, it is the user's responsibility to comply with appropriate government standards and requirements. No warranties, expressed or implied, are made. On the basis of this information, it is suggested that you evaluate the product on a laboratory scale prior to use in a finished product. The information contained herein should not be construed as permission for violation of patent rights.

The Solae Company Logo is a trademark of Solae, LLC. ©2006, Solae, LLC. All rights reserved.

**The Solae
Company™**