

### III. Protein: Quality and Questions

Protein serves as the structural basis for a wide variety of body tissues and functions, is essential for regulating metabolism, and can be used as a source of energy. Additionally, proteins help regulate acid/base balance in the body, are components of hormones and enzymes and enhance immune response or the body's ability to fight infection.<sup>1,2</sup>

Amino acids, the building blocks of protein, play a varied and vital role in human physiology and function. During the process of digestion, dietary proteins are broken down into amino acids that are then absorbed by the body and used to create enzymes and tissues

(e.g., skin, internal organs, muscles). There are at least 18 amino acids that make up all proteins. The body is able to synthesize in adequate amounts nine of them. These amino acids are called nonessential or dispensible. The remaining nine amino acids must be supplied in the diet. These essential or indispensable amino acids are histidine, isoleucine, leucine, lysine, methionine, phenylalanine, threonine, tryptophan, and valine.<sup>2</sup>

All animal and plant cells contain protein, but the amount of protein varies widely among foods. Also, the quality of protein in specific foods varies. Protein quality depends on the pattern and abundance of amino acids. If a protein

contains essential amino acids in the proportion required by humans, it is said to have a high biological value. If a protein is comparatively low in one or more of the essential amino acids, it is said to have a low biological value. Proteins from animal sources, such as beef, have a higher biological value than proteins from most plant sources.<sup>2</sup>

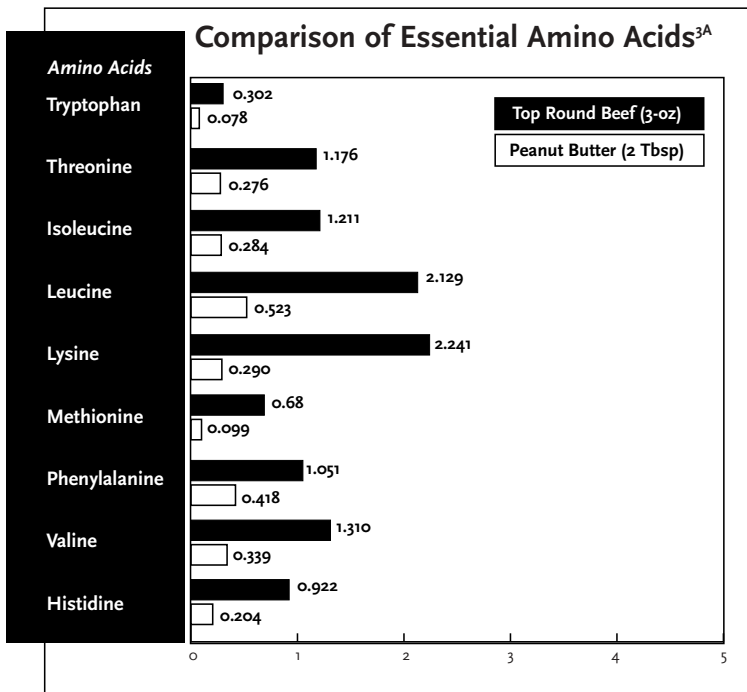


TABLE 12

1. Stryer, L. Biochemistry. 4th edition. New York: WH Freeman and Company; 1998.  
 2. Matthews, D.E. Proteins and amino acids. In: Shils, M.E.; Olson, J.A.; Shike, M.; Ross, A.C. (eds). Modern Nutrition in Health and Disease. 9th edition. Philadelphia: Williams & Wilkins; 1999, pp. 11-48.

Beef is considered a complete protein because it contains all nine of the essential amino acids needed by the human body. Additionally, one 3-ounce serving of beef provides 50% of the Daily Value of protein for adults and children aged 4 years and older.<sup>3B</sup>

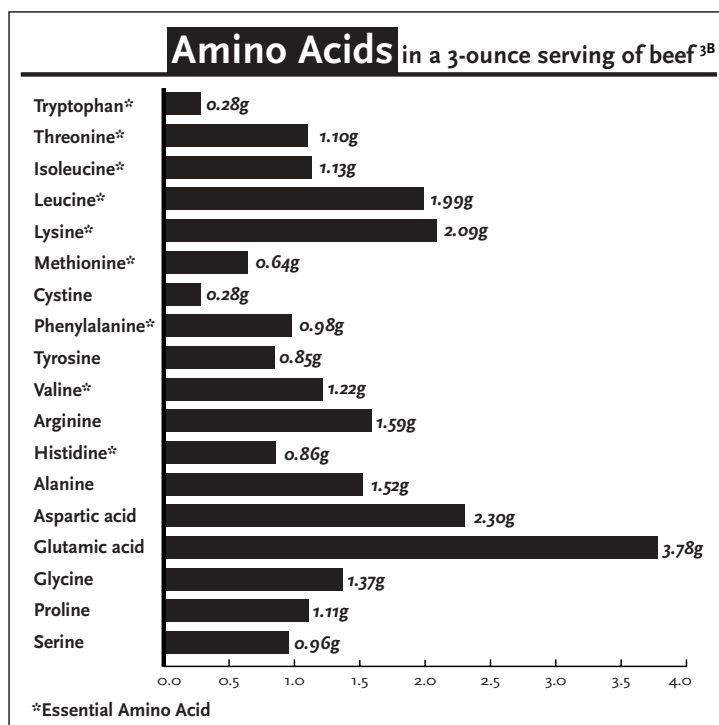


TABLE 13

### THE ROLE OF PROTEIN IN WEIGHT LOSS, CHRONIC DISEASE, AND ATHLETIC PERFORMANCE

The recent popularity of high protein, low carbohydrate diets raises questions about the optimal distribution of carbohydrate, protein and fat in the diet for good health and prevention of disease.

### Obesity/Weight Loss Diets

The appeal of high protein, low carbohydrate diets is attributed to the rapid weight loss achieved by such diets. The initial weight reduction on these diets is due to the loss of body fluids.<sup>4</sup> Later weight loss results from decreases in both muscle tissue and body fat.

Some high protein, low carbohydrate diets offer no long-term advantage in facilitating weight loss and may be hazardous to health for the following reasons. These diets may trigger ketosis, which can lead to dehydration, gout and electrolyte imbalance potentially resulting in liver and kidney damage. Because some high protein, low carbohydrate diets are high in saturated fat, they may raise blood cholesterol levels and increase the risk of developing heart disease. Since high protein, low carbohydrate diets limit intake of many grains, fruits and vegetables, these diets can be low in essential nutrients such as folate, vitamin C, fiber and phytochemicals. A recent advisory to healthcare professionals cautions that high protein diets currently are not recommended because they can restrict healthful foods that provide essential nutrients and do not provide the variety of foods needed to adequately meet nutritional needs.<sup>5</sup>

Constipation, fatigue and nausea are reported unpleasant side effects of high protein, low carbohydrate diets. Adverse effects of these diets are largely explained by the low carbohydrate, high fat intakes, and not by the “high” protein intake per se. Because these diets are low in calories

3. U.S. Department of Agriculture, Agricultural Research Service. 2001. USDA Nutrient Database for Standard Reference, Release 14. Nutrient Data Laboratory Home Page, [www.nal.usda.gov/fnic/foodcomp](http://www.nal.usda.gov/fnic/foodcomp). (A: Beef, round, top round, separable lean only, trimmed to 1/4" fat, all grades, cooked, broiled, NDB No:13217; Peanut butter, smooth style, with salt, NDB No:16098. B: Beef, composite of trimmed retail cuts, separable lean only, trimmed to 1/4" fat, all grades, cooked, NDB No: 13012.)

4. Health Magazine. The Diet Advisor. The Complete Guide to Choosing the Right Diet for You. Alexandria, VA: Time Life Books; 2000.

5. American Heart Association Nutrition Committee. AHA Science Advisory. Dietary protein and weight reduction. *Circulation* 104: 1869-1874; 2001.

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(i.e., 800 to 1500 calories), the actual amount of protein consumed is not necessarily high.<sup>4,6</sup>

Preliminary research findings indicate that moderate protein diets may be beneficial for weight reduction.<sup>7</sup> Studies demonstrate that specific branched chain amino acids such as leucine may have broader roles in metabolic regulations than previously thought, and that the dietary protein required to achieve these roles may be higher than current recommendations for protein.<sup>8</sup> One of the metabolic effects of a moderately high protein, weight loss diet may be greater loss of fat tissue and maintenance of more lean muscle tissue compared to low protein, high carbohydrate diets.<sup>7,8</sup> Clearly, more research is needed, but data indicate that in certain situations a moderately increased protein intake may be beneficial.

### **Type 2 Diabetes and Syndrome X**

There is a small, but growing amount of scientific evidence regarding the effectiveness of high protein, low carbohydrate diets as treatment for conditions associated with impaired glucose metabolism including insulin resistance, Type 2 diabetes and Syndrome X. Insulin resistance occurs when body tissues do not respond to normal levels of insulin, but plasma glucose levels are not elevated enough to be consistent with diagnostic criteria for Type

2 diabetes. In Type 2 or adult onset diabetes, there is a defect in both the secretion and action of insulin in the body. An individual with Syndrome X has hypertension, cardiovascular disease, is usually overweight, and has either insulin resistance or Type 2 diabetes.<sup>6</sup>

A high protein diet is generally not recommended for people with diabetes because it increases the risk of chronic renal failure. However, a protein intake of about 22% of calories (or 2.0 g/kg desirable body weight) has been shown to improve glycemic control with only small changes in renal function in patients with Type 2 diabetes.<sup>9</sup> Well-designed, controlled, clinical studies of high protein, low carbohydrate diets are needed to determine more conclusively whether such diets would be beneficial for individuals with impaired glucose metabolism.

### **Athletic Performance**

Recently, a high protein, low carbohydrate diet consisting of 40% carbohydrate, 30% protein, and 30% fat (the 40/30/30 diet) has been promoted for athletes. Although there is some evidence that athletes may require more protein than the RDA of 0.8 g/kg body weight,<sup>10,11</sup> the increased need for protein is relatively small and generally can be met by athletes' higher calorie intake.

6. National Cattlemen's Beef Association. Beef Facts: Nutrition. Macronutrient Distribution, Diet Plans, and Beef's Role. Chicago: National Cattlemen's Beef Association; 2000.

7. Shiue, H.J.; Sather, C.; Layman, D.K. Reduced carbohydrate/protein ratio enhances metabolic changes associated with weight loss diet. *The FASEB J.* 15(4), Part 1, page, A301, abstract 254.6.2001.

8. Anthony, J.C.; Anthony T.G.; Layman, D.K. Leucine supplementation enhances skeletal muscle recovery in rats following exercise. *J. Nutr.* 129: 1102-1106, 1999.

9. Pomerleau, J.; Verdy, M.; Garrel, D.R.; Nadeau, M.H. Effect of protein intake on glycemic control and renal function in type 2 (non-insulin-dependent) diabetes mellitus. *Diabetologia* 36: 829-834; 1993.

10. Position of the American Dietetic Association, Dietitians of Canada, and the American College of Sports Medicine: Nutrition and athletic performance. *J. Am. Diet. Assoc.* 100: 1543-1556; 2000.

11. Lemon, P.W.R. Effects of exercise on dietary protein requirements. *Int. J. Sport. Nutr.* 8: 426-447; 1999.

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Carbohydrates, in the form of glycogen, are the primary source of energy during physical activity. Since the 40/30/30 diet is lower in carbohydrate than traditional training table meal plans, it may not provide sufficient glycogen stores to sustain the long periods of physical activity required of endurance athletes.<sup>12</sup> Further, there is no scientific evidence that this dietary regime improves performance.<sup>12</sup> Four health professional associations - The American Dietetic Association, the American College of Sports Medicine, the Women's Sports Foundation and the Cooper Institute for Aerobic Research - issued a joint statement indicating that high protein diets do not improve athletic performance.<sup>12</sup> However, recommended (moderate) protein intakes can be used as a source of energy and are important for tissue repair, maintenance, and growth.<sup>13</sup>

12. Anonymous. High-protein diets panned by major health-promoting groups. Tufts Univ Health & Nutrition Letter 15; 6; 1997.

13. McArdle, W.D.; Katch, F.I.; Katch, V.L. Sports & Exercise Nutrition. Philadelphia, PA: Lippincott Williams & Wilkins; 1999.