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Protein and Health

FACT SHEET

APRIL 2011

Protein is the major structural component of all cells in the body. It functions as enzymes and hormones and is needed for the production of neurotransmitters, vitamins, antibodies, and other important molecules. Proteins are made up of chains of nitrogen-containing amino acids, which are generally divided into two categories—essential (or indispensable) and non-essential. The nine essential amino acids (histidine, isoleucine, leucine, lysine, methionine, phenylalanine, threonine, tryptophan, and valine) cannot be produced by the body; it is “essential” that they be consumed in the diet. As the name implies, non-essential amino acids can be produced by the body, making it less necessary to consume them in the diet. If protein intake or the intake of essential amino acids is limited, the body may break down its own protein-containing tissue to fill the gap.

The Recommended Dietary Allowance (RDA) for protein is 0.8 g/kg body weight for adults, set by the Institute of Medicine, and is based on the consumption of good-quality protein, (USDHHS 2010) such as low-fat dairy, lean meats, eggs, and soy. For a 150-pound adult, that translates into 54 grams of high-quality protein per day. The quality of a protein depends on its ability to provide nitrogen and to meet the amino acid requirements necessary for growth, maintenance, and repair, which in turn, is determined by two factors—the protein’s digestibility and its amino acid profile. (Food and Nutrition Board 2005) As calorie intake decreases, as it does during calorie restriction or with aging, the percentage of calories from protein must increase to keep protein intake at RDA levels.

RECOMMENDED DIETARY ALLOWANCES FOR PROTEIN

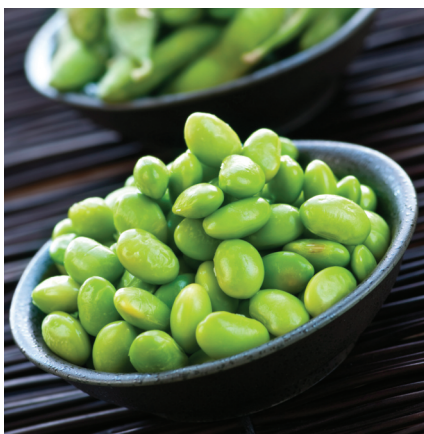
Adults, men and women 19 years and older	0.80 g per kilogram per day
Children ages 1-3 years	1.05 g per kilogram per day
Children ages 4-13 years	0.95 g per kilogram per day
Children ages 14-18 years	0.85 g per kilogram per day
Pregnant women	1.10 g per kilogram per day
Lactating women	1.30 g per kilogram per day

Three ounces (the recommended serving size) of lean meat or poultry contain about 25 grams of protein. One quarter cup of roasted soybeans contains about 10 grams of protein. One cup of cow’s milk, soy milk, or yogurt contains 8 grams of protein. Cereals, grains, nuts, and vegetables contain about 2 grams of protein per serving. (USDHHS 2010)

Protein Consumption

The main protein source in the American diet is animal protein (69 percent). Meat, fish, and poultry protein combined contribute the most to animal protein consumption (42 percent), followed by dairy protein (20 percent). Grains (18 percent) contribute the most to plant protein consumption. (Smit 1999) The most recent NHANES survey data show that women aged 20 and older consume about 67 grams of protein a day. Men 20 and older consume about 98 grams per day. (USDA, ARS 2010) Dietary protein recommendations have traditionally been based on the goal of preventing deficiency, as opposed to promoting optimal health. (Rodriguez 2008) However, research suggests that higher protein intakes may be beneficial for various health outcomes, such as weight management, maintaining muscle mass, preventing osteoporosis, and reducing the risk of cardiovascular disease. (Rodriguez 2008; Fulgoni 2008)

An increased interest in protein is reflected in the fact that, for the first time, the 2010 Dietary Guidelines Advisory Committee report included a chapter focusing solely on the relationship between protein and health. (USDHHS 2010) There is also growing interest in the sources of protein, plant or animal. The 2010 Dietary Guidelines recommend a shift in food patterns to a more plant-based diet and an increase in fat-free and low-fat protein sources. (USDHHS 2010)



Heart Health

Coronary heart disease is still the number one killer in the U.S., responsible for 1 of every 6 deaths in this country. (AHA 2010) Animal protein, with its higher saturated fat content, has been suggested as a contributing factor for an increased risk of cardiovascular disease (CVD). (Bernstein 2010) However, studies show no consistent link between consumption of animal protein (red meat, eggs) and increased risk of CVD. (USDHHS 2010) In fact, studies report that intake of milk and milk products actually may be protective against cardiovascular disease. (Alvarez-Leon 2006; Kontogianni 2006; Elwood 2008) A recent study found that poultry and fish consumption was significantly associated with a reduced risk of coronary heart disease in women. (Bernstein 2010). Many studies have examined the relationship between plant protein intake and risk factors for coronary heart disease. The Food and Drug Administration approved a food-labeling health claim for soy protein-containing foods, which states “25 grams of soy protein per day, as part of a diet low in saturated fat and cholesterol, may reduce the risk of heart disease.” (FDA 1999) Recent opinions suggest a modest effect of soy protein on cholesterol lowering. (Sacks 2006; USDHHS 2010) Other reports have shown significant reductions in cholesterol (Harland 2008; Zhan 2005; Reynolds 2006; Jenkins 2010).

Though some studies have indicated a connection between milk consumption and lower blood pressure, it is not clear if the type of protein (animal or plant) consumed affects blood pressure. (USDHHS 2010) The Dietary Approaches to Stop Hypertension (DASH) diet encourages both plant protein and low-fat and lean sources of animal protein for the management of blood pressure. (USDHHS 2006) A recent review of the research found evidence suggesting a small beneficial effect of higher protein intakes on blood pressure, especially for plant protein. (van der Kuil 2010)

Bone Health

One out of every two women and one in four men over age 50 will experience a fracture in their lifetime due to osteoporosis. (NIAMSD 2010) Protein makes up roughly 50 percent of the volume of bone and about one-third of its mass. (Heaney 2008) Nevertheless, the high-protein content of Western diets has, in the past, generally been



considered detrimental to bone health. (Heaney 2008) The belief that protein could have a negative impact on bone health was the result of studies conducted in populations with insufficient calcium intake.

The belief was based on the theory that a high-protein (especially animal protein) diet creates an increased acid load due to the high sulfur amino acid content. To compensate, the body pulls calcium from the skeleton to buffer the pH of the blood at the expense of bone. Calcium is then excreted in the urine. (Marcason 2010) But expert opinion about the effect of protein on bone health is changing. Recent reviews by leading scientists and authoritative bodies have concluded that in the presence of adequate calcium, protein is beneficial to bone health. (Heaney 2009; EFSA 2010)

Experts now realize that maintenance of adequate bone strength and density during aging is highly dependent on the maintenance of adequate muscle mass and function, which is in turn dependent on adequate intake of high-quality protein. (Wolf 2006) A recent review of 61 studies conducted over the past thirty years found that protein intake does not have a negative effect on bone health. (Darling 2009) In fact, increasing dietary protein had a slightly positive effect, accounting for 1 percent to 2 percent of bone mineral density. A positive effect of protein on bone health was also found in the Framingham Osteoporosis Study. Among a group of seniors, those who were in the lowest 25 percent of dietary protein intake had 50 percent more hip fractures than those who consumed greater amounts of dietary protein. Those who suffered hip fractures consumed less than 46 grams of protein a day. (Misra 2010)

Cancer

According to the most recent statistics from the American Cancer Society, more than 1.5 million new cancer cases are diagnosed annually. (ACS 2010) For decades, researchers have pursued the theory that dietary protein enhances cancerous tumor growth, particularly colon cancer. (Campbell 2006) In 2007, a World Cancer Research Fund/American Institute for Cancer Research report on diet and cancer recommended limiting red meat intake based on limited, but suggestive, evidence that red meat consumption increases the risk of colorectal cancer. (World Cancer Research Fund 2007) Animal studies have found that tumor growth is greatly enhanced by diets that contain more than 10 percent animal protein and is repressed with either 5 percent animal protein or more than 20 percent plant protein. (Dunaif 1987; Youngman 1992) Overall, however, studies on protein and cancer are inconsistent. (USDHHS 2010) A recent study found that increasing dietary protein reduced the risk of the animals developing mammary tumors. (Moulton 2010) In women, soy protein was associated with reduced breast cancer. (Kim 2008) Among women with breast cancer, soy food consumption was significantly related to decreased risk of death and recurrence. (Shu 2009) A recent meta-analysis found no association between animal protein intake and colorectal cancer. (Alexander 2009) One study found that overall cancer incidence was lower among vegetarians; however, more colorectal cancer was reported among the vegetarians compared to meat eaters. (Key 2009)

Aging

Sarcopenia is a progressive loss of muscle tissue that occurs with age, typically resulting in a 3-8 percent reduction in lean muscle mass per decade after the age of 30. However, there is no agreement as to how this affects dietary protein needs with age. (Paddon-Jones 2009) One study found the protein requirements in adult men to be 50 percent higher than current recommendations or 1.4 g/kg. (Paddon-Jones 2009) Another study

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found that providing moderate-size portions (113 g) of high quality protein to elderly subjects increased muscle protein synthesis by 50 percent. The researchers suggested that serving high-quality, protein-rich foods over the course of the day (25-30 g per meal), could optimize potential muscle growth. (Symons 2009; Paddon-Jones 2009)

Weight Management

Both animal and human studies have shown protein consumption to increase satiety more than carbohydrate or fat when total calorie intake remains the same. (Halton 2004; Yancy 2004; Astrup 2005) While all calorie-reduced diets combined with increased physical activity can result in weight loss, body fat loss has also been reported to be greater on diets containing more protein, and higher-protein diets (especially those with high-quality protein), by helping to preserve muscle mass. (Layman 2004; Westerterp-Plantenga 2007; Noakes 2008; Paddon-Jones 2008) As a result, protein intake is important for weight loss and weight maintenance. (Soenen 2008) Few studies have investigated the effects of different protein sources on body weight. (USDHHS 2010) Overall, however, research suggests that meat-containing diets work as well as calorie-controlled vegetarian diets and soy protein in enhancing weight loss. (USDHHA 2010)

Renal Health

The recognition that increased dietary protein consumption is beneficial in weight loss programs has raised concerns that higher levels of protein intake may be detrimental to renal health. The kidney is responsible for urea excretion, a byproduct of protein metabolism. In a review of the literature, (Martin 2005) increased protein intakes were determined not likely to result in any kidney “strain” or damage in people with normal renal function. However, data from the Nurses’ Health Study do suggest that in subjects with mild renal insufficiency, a high intake of nondairy animal protein may accelerate the decline in kidney function. (Knight 2003) A number of other studies have also shown that plant-based protein sources may offer some benefit in slowing renal function decline in diabetic subjects. (Kontessis 1995; Teixeira 2004; Stephenson 2005) This point is particularly important when it is necessary to maintain adequate protein intake to prevent lean mass loss while simultaneously trying to slow the progression of kidney function decline.

Bottom Line

Protein provides essential amino acids, particularly important during growth and development, and is a source of energy. Recent research has begun to focus on the relationship between dietary protein and health outcomes, such as cancer, cardiovascular disease, osteoporosis, sarcopenia, and obesity. While some studies have found that the protein source (animal vs. plant) affects health outcomes, a variety of low-fat and lean protein sources are generally recommended for overall good health.

References

- Alexander D, Cushing C, Lowe K, Scurman B, Roberts M. Meta analysis of animal fat or animal protein intake and colorectal cancer. *Am J Clin Nutr*; 89:1402-1409,2009.
- Alvarez-León EE, Román-Viñas B, Serra-Majem L. Dairy products and health: a review of the epidemiological evidence. *Br J Nutr*; 96 Suppl 1:S94-9,2006.
- American Cancer Society. *Cancer Facts & Figures 2010*. Atlanta: American Cancer Society; 2010.
- American Heart Association Writing Group. Heart disease and stroke statistics 2010 update: a report from the American Heart Association. *Circulation*; 121:e46-e215, 2010.
- Astrup A. The satiating power of protein—a key to obesity prevention? *Am J Clin Nutr*; 82:1-2, 2005.
- Bernstein A, Sun Q, Hu F, Stampfer M, Manson J, Willett W. Major dietary protein sources and risk of coronary heart disease in women. *Circulation*; 122:876-883, 2010.
- Campbell T. Dietary protein, growth factors, and cancer. *Am J Clin Nutr*; 84:1456-1462, 2006.
- Darling A, Millward D, Torgerson D, Hewitt C, Lanham-New S. Dietary protein and bone health: a systematic review and meta-analysis. *Am J Clin Nutr*; 90:1674-1692, 2009.
- Dunaif G, Campbell T. Relative contribution of dietary protein level and aflatoxin B1 dose in generation of presumptive preneoplastic foci in rat liver. *J Natl Cancer Inst*; 78:365-369, 1987.
- Elango R, Humayun M, Ball R, Pencharz P. Evidence that protein requirements have been significantly underestimated. *Curr Opin Clin Nutr Metab Care*; 13(1):52-57, 2010.
- EFSA Panel on Dietetic Products, Nutrition and Allergies (NDA); Scientific Opinion on the substantiation of health claims related to protein and increase in satiety leading to a reduction in energy intake (ID 414, 616, 730), contribution to the maintenance or achievement of a normal body weight (ID 414, 616, 730), maintenance of normal bone (ID 416) and growth or maintenance of muscle mass (ID 415, 417, 593, 594, 595, 715) pursuant to Article 13(1) of Regulation (EC) No 1924/2006. *EFSA Journal* 2010; 8(10): 1811. [24 pp.]. doi:10.2903/j.efsa.2010.1811. Available online: www.efsa.europa.eu/efsajournal.htm
- Elwood PC, Givens DI, Beswick AD, Fehily AM, Pickering JE, Gallacher J. The survival advantage of milk and dairy consumption: an overview of evidence from cohort studies of vascular diseases, diabetes and cancer. *J Am Coll Nutr*; 27(6):723S-34S, 2008.
- Food and Drug Administration, Food labeling: health claims: soy protein and coronary heart disease. Food and Drug Administration, HHS. Final rule. *Fed Regist*; 64:57700-57733, 1999.
- Food and Nutrition Board, Institute of Medicine. Dietary reference intakes for energy, carbohydrate, fiber, fat, fatty acids, cholesterol, protein, and amino acids (macronutrients). Washington, DC: National Academy Press, 2002.
- Fulgoni V. Current protein intake in America: analysis of the National Health and Nutrition Examination Survey, 2003-2004. *Am J Clin Nutr*; 87(suppl):1554S-1557S, 2008.
- Halton T, Hu F. The effects of high protein diets on thermogenesis, satiety and weight loss: a critical review. *J Am Coll Nutr*; 23:373-385, 2004.
- Harland J, Haffner T. Systematic review, meta-analysis and regression of randomized controlled trials reporting an association between an intake of circa 25 g soya protein per day and blood cholesterol. *Atherosclerosis*; 200:13-27, 2008.
- Heaney R, Layman D. Amount and type of protein influences bone health. *Am J Clin Nutr*; 87(suppl):1567S-1570S, 2008.
- Heaney R. Dairy and bone health. *J Am Coll Nutr*; 28:82S-90S, 2009.
- Jenkins, D.J., et al., Soy Protein Reduces Serum Cholesterol by Both Intrinsic and Food Displacement Mechanisms. *J Nutr*; 12:2302S-2311S, 2010.
- Kelemen L, Kushi L, Jacobs D, Cerhan J. Associations of dietary protein with disease and mortality in a prospective study of postmenopausal women. *Am J Epidemiol*; 161:239-249, 2005.
- Kerstetter J, O'Brien K, Insogna K. Dietary protein, calcium metabolism, and skeletal homeostasis revisited. *Am J Clin Nutr*; 78(suppl):S584-592, 2003.
- Key T, Appleby P, Spencer E, Travis R, Roddam A, Allen N. Cancer incidence in vegetarians: results from the European Prospective Investigation into Cancer and Nutrition (EPIC-Oxford). *Am J Clin Nutr*; 89(5):1620S-1626S, 2009. Epub 2009 Mar 11.
- Kim M, Kim J, Nam S, Ryu S, Kong G. Dietary intake of soy protein and tofu in association with breast cancer risk based on a case-control study. *Nutr Cancer*; 60:568-576, 2008.
- Knight EL, Stampfer MJ, Hankinson SE, Spiegelman D, Curhan GC. The impact of protein intake on renal function decline in women with normal renal function or mild renal insufficiency. *Ann Intern Med*; 138(6):460-7, 2003.
- Kontessis PA, Bossinakou I, Sarika L, Iliopoulou E, Papantoniou A, Trevisan R, Roussi D, Stipsanelli K, Grigorakis S, Souvatzoglou A. Renal, metabolic, and hormonal responses to proteins of different origin in normotensive, nonproteinuric type I diabetic patients. *Diabetes Care*; 18(9):1233, 1995.
- Kontogianni MD, Panagiotakos DB, Chrysohoou C, Pitsavos C, Stefanadis C. Modelling dairy intake on the development of acute coronary syndromes: the CARDIO2000 study. *Eur J Cardiovasc Prev Rehabil*; 13(5):791-7,2006.
- Layman D. Protein quantity and quality at levels above the RDA improves adult weight loss. *J Am Coll Nutr*; 23:631S-636S, 2004.
- Marcason W. What is the effect of a high-protein diet on bone health? *J Am Diet Assoc*; 110:812, 2010.
- Martin W, Armstrong L, Rodriguez N. Dietary protein intake and renal function. *Nutr Metab (Lond)*; 2:25, 2005.
- Misra D, Berry S, Broe K, McLean R, Cupples L, Tucker K, Kiel D, Hannan M. Does dietary protein reduce hip fracture risk in elders? The Framingham osteoporosis study. *Osteoporos Int*, published online May 5, 2010.
- Moulton C, Valentine R, Layman D, Devkota S, Singletary K, Wallig M, Donovan S. A high protein moderate carbohydrate diet fed at discrete meals reduces early progression of N-methyl-N-nitrosourea-induced breast tumorigenesis in rats. *Nutrition & Metabolism*; 7:1, 2010.
- National Institute of Arthritis and Musculoskeletal and Skin Diseases. National Institutes of Health. Osteoporosis and Related Bone Diseases National Resources Center. http://www.niams.nih.gov/Health_Info/Bone/Osteoporosis/osteoporosis_ff.asp. Accessed November 25, 2010.
- Noakes M. The role of protein in weight management. *Asia Pac J Clin Nutr*; 17 Suppl 1:169-171, 2008.
- Paddon-Jones D, Westman E, Mattes R, Wolfe R, Astrup A, Westerterp-Plantenga M. Protein, weight management, and satiety. *Am J Clin Nutr*; 87(suppl):1558S-1561S, 2008.
- Paddon-Jones D, Rasmussen B. Dietary protein recommendations and the prevention of sarcopenia: Protein, amino acid metabolism and therapy. *Curr Opin Clin Nutr Metab Care*; 12:86-90, 2009.
- Reynolds K, Chin A, Lees K, Nguyen A, Bujnowski D, He J. A meta-analysis of the effect of soy protein supplementation on

References (continued)

- serum lipids. *Am J Cardiol*; 98:633-640, 2006.
- Rodriguez N, Garlick P. Introduction to Protein Summit 2007: Exploring the impact of high-quality protein on optimal health. *Am J Clin Nutr*; 87(suppl):1551S-1553S, 2008.
- Sacks F, Lichtenstein A, Van Horn L, Harris W, Kris-Etherton P, Winston M for the American Heart Association Nutrition Committee. Soy Protein, isoflavones, and cardiovascular health. An American Heart Association Science Advisory for Professionals From the Nutrition Committee. *Circulation*; 113:1034-1044, 2006.
- Study of Osteoporotic Fractures Research Group. *Am J Clin Nutr*; 73:118-122, 2001.
- Shapses S, Robins S, Schwartz E, Chowdhury H. Short-term changes in calcium but not protein intake alter the rate of bone resorption in healthy subjects as assessed by urinary pyridinium cross-link excretion. *J Nutr*; 125:2814-2821, 1995.
- Shu X, Zheng Y, Cal H, Gu K, Chen Z, Zheng W, Lu W. Soy food intake and breast cancer survival. *J Am Med Assoc*; 30:2437-2443, 2009.
- Smit E, Nieto J, Crespo C, Mitchell P. Estimates of animal and plant protein intake in U.S. adults: Results from the Third National Health and Nutrition Examination Survey, 1988-1991. *J Am Diet Assoc*; 99:813-820, 1999.
- Soenen S, Westterp-Plantenga M. Proteins and satiety: implications for weight management. *Curr Opin Clin Nutr Metab Care*; 11:747-751, 2008.
- Stephenson TJ, Setchell KD, Kendall CW, Jenkins DJ, Anderson JW, Fanti P. Effect of soy protein-rich diet on renal function in young adults with insulin-dependent diabetes mellitus. *Clin Nephrol*; 64:1-11, 2005.
- Symons T, Sheffield-Moore, Wolfe R, Paddon-Jones D. A moderate serving of high-quality protein maximally stimulates skeletal muscle protein synthesis in young and elderly subjects. *J Am Diet Assoc*; 109:1582-1586, 2009.
- Teixeira SR, Tappenden KA, Carson L, Jones R, Prabhudesai M, Marshall WP, Erdman JW, Jr. Isolated soy protein consumption reduces urinary albumin excretion and improves the serum lipid profile in men with type 2 diabetes mellitus and nephropathy. *J Nutr*; 134:1874-80, 2004.
- U.S. Department of Health and Human Services, National Institutes of Health, National Heart, Lung, and Blood Institute. Your Guide to Lowering Your Blood Pressure with DASH. NIH Publication No. 06-4082, 2006. http://www.nhlbi.nih.gov/health/public/heart/hbp/dash/new_dash.pdf
- U.S. Department of Agriculture, Agricultural Research Service, 2010. Nutrient Intakes from Food: Mean Amounts Consumed per Individual, by Gender and Age, *What We Eat in America*, NHANES 2007-2008. Available: www.ars.usda.gov/ba/bhnrc/fsrg. U.S. Department of Health and Human Services and U.S. Department of Agriculture. Dietary Guidelines for Americans Committee Report, 2010. Washington, DC, June, 2010.
- Van der Kuil W, Engberink M, Brink E, van Baak M, Bakker S, Navis G, van't Veer P, Geleijnse J. Dietary protein and blood pressure: A systematic review. *PLoS ONE* 5:e12102, August, 2010.
- Westterp-Plantenga M, Smeets A, Nieuwenhuizen A. Sustained protein intake for body weight management. *Nutr Bull*; 32:22-31, 2007.
- Wolf R. The underappreciated role of muscle in health and disease. *Am J Clin Nutr*; 84:475-482, 2006.
- World Cancer Research Fund/American Institute for Cancer Research. Food, Nutrition, Physical Activity, and the Prevention of Cancer: A Global Perspective. Washington DC: AICR, 2007.
- Yancy W, Olsen M, Guyton J, Bakst R, Westman E. A low-carbohydrate, ketogenic diet versus a low-fat diet to treat obesity and hyperlipidemia: a randomized, controlled trial. *Ann Intern Med*; 140:769-777, 2004.
- Youngman L, Campbell T. Inhibition of aflatoxin B1-induced gamma-glutamyl transpeptidase positive (GGT+) hepatic preneoplastic foci and tumors by low protein diets: evidence that altered GGT+ foci indicate neoplastic potential. *Carcinogenesis*; 13:1607-1613, 1992.
- Zhan S, Ho S. Meta-analysis of the effects of soy protein containing isoflavones on the lipid profile. *Am J Clin Nutr*; 81(2):397-408, 2005.



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