

CHAPTER

5

Proteins

LEARNING OBJECTIVES

After completing this chapter, you should be able to:

- Describe the structure and functions of protein
- Explain how the body uses protein
- Discuss the quality and quantity of protein necessary in the diet
- Give examples of complementary proteins
- Describe the unique nutritional benefits of legumes
- Distinguish between animal and plant proteins
- Plan diets with proteins coming from animal and vegetable sources
- Identify appropriate portions of protein foods per serving and for daily consumption

The word “protein” comes from the Greek *proteios*, meaning “of prime importance.” Protein is essential for life because it is needed to build and maintain the body. All living cells and most body fluids contain protein. Most Americans, however, eat more protein than the body requires and, along with it, an excess of saturated fat and cholesterol that come from many foods rich in protein.

Functions of Protein

The cells in muscles, organs, blood, bones, nails, hair and skin are made primarily of protein. Worn out cells are replaced constantly in the body so protein is required daily. Proteins in blood help transport iron, fat, minerals and oxygen throughout the body. Antibodies, enzymes and hormones are composed of proteins. Protein is also necessary for blood to clot normally and to maintain the body’s acid-base balance.

Like fat and carbohydrates, protein is an energy nutrient. It provides 4 calories per gram. When the diet lacks sufficient calories from carbohydrates and fat, protein that is circulating in the bloodstream will be used for fuel. If more calories are needed, protein will be taken from muscles and other body tissues, which is why people who are dieting may lose lean

Proteins in the Body

Antibodies - Large proteins generally found in the blood that detect and destroy invaders such as bacteria and viruses, thus protecting the body from infection and disease.

Enzymes - Specialized protein substances that help regulate the speed of the many chemical reactions within cells. Enzymes assist in breaking food down during digestion, help build substances such as bone, and help change one substance to another as needed by the body. Although enzymes regulate many reactions, they are not changed in the process. Cells of plants contain enzymes that cause them to grow and ripen.

Hormones - Chemical messenger proteins that regulate body functions to maintain normal levels of essential substances. For example, the hormone insulin regulates blood sugar levels by moving sugar from the blood into and out of cells. Other hormones regulate growth, reproduction and behavior.

tissue as well as body fat. Loss of muscle mass also can occur with prolonged physical activity, high fever, severe burns or in diseases that alter metabolism.

Protein Structure

Amino acids are the building blocks of protein and are linked together in protein strands connected by peptide bonds. **Proteins** are large, complex chemical structures containing many amino acids, each composed of carbon, hydrogen, oxygen and nitrogen. Some amino acids also contain sulfur or phosphorus.

There are 20 distinct amino acids. They are divided into two categories, essential and nonessential.

Essential amino acids are those that cannot be produced by the body and must be provided by food.

Nonessential amino acids are those that can be made by the body, primarily in the liver. Histidine is essential for children and pregnant women but is nonessential for all others. Consumption of amino acids as supplements is not required when a variety of foods and adequate calories are included in the diet

Each protein differs in the specific amino acids it contains and the order in which they are linked. Because there are so many ways 20 different amino acids can combine and twist into structures creating protein chains, there is almost an infinite number of possible proteins. Each of the 20 amino acids can appear many times in a protein at various places within the chemical structure. The protein component of hemoglobin, a protein in blood that carries oxygen through the body, contains a total of 574 amino acids; while myosin, a muscle protein, is formed from the linkage of more than 4,500 amino acids. The hormone insulin contains 51 amino acids.

Amino Acids

Essential Amino Acids	Nonessential Amino Acids
Isoleucine	Alanine
Leucine	Arginine
Lysine	Asparagine
Methionine	Aspartic acid
Phenylalanine	Cysteine
Threonine	Glutamic acid
Tryptophan	Glutamine
Valine	Glycine
Histidine (<i>essential only for children and pregnant women</i>)	Histidine
	Proline
	Serine
	Tyrosine

Digestion and Metabolism

Because proteins are very large, they must be broken down into smaller units. The process of digestion breaks dietary protein into separate amino acids, which then circulate through the bloodstream and are available to form proteins the body needs. The body does not store amino acids the way it stores fat, so people must eat protein daily or the body will break down muscle tissue to get the protein it needs.

The digestion and metabolism of dietary protein is the ultimate recycling project, creating the approximately 50,000 different proteins the body needs to function properly. Protein beyond the amount needed by the body and any amino acids that do not form complete proteins are used to provide energy.

Protein digestion begins in the stomach where enzymes called **proteases** break the protein's peptide bonds. The enzyme **pepsin** breaks proteins down into smaller chains of amino acids. Protein digestion continues in the small intestine where more proteases break protein down into individual amino acids, which are absorbed through the surface of the intestinal lining. The amino acids are then released into the bloodstream where they are available to be absorbed by various cells to build the many proteins the body needs.

If an essential amino acid is not available to produce a particular protein, the building of that protein will be halted. Because the body cannot make essential amino acids, it is important that the diet supply a variety of protein-rich foods to ensure that all the essential amino acids are available.

Complete or Incomplete Proteins

Sometimes proteins are classified as complete or incomplete. **Complete proteins** are foods that provide all the essential amino acids in sufficient amounts to support the growth and maintenance of body tissues; therefore, complete proteins have what is called **high biological value**. The biological value of protein refers to the amount, type and proportion of amino acids present in a food to meet bodily needs. The egg is used as the standard by which all other protein quality values are based. The egg has a perfect score – a biological value of 100. All the essential amino acids are present in perfect amounts.

Foods that contain complete protein include meat, fish, poultry, cheese, eggs, milk and isolated soy protein. In short, animal and some soy products contain complete proteins. Animal products can also contain abundant amounts of fat, particularly saturated fat, and cholesterol. That is why high-fat, high-cholesterol animal products should be consumed in moderation.

Incomplete proteins lack one or more of the essential amino acids in sufficient quantity to support growth and maintenance of body tissues. Foods that contain incomplete protein provide a lower quality (lower biologic value score) of protein. Examples include grains, legumes, nuts and seeds, and vegetables. Most plant products contain incomplete proteins, which have some, but not all, essential amino acids. Cereal and legume combinations help people around the world meet their protein needs. Plant products are also abundant in fiber, vitamins, minerals and phytochemicals, making them excellent food choices.

While most people choose to include some animal protein in their diets, it is important to note that all of the essential amino acids can be obtained by consuming a variety of plant foods, each with different types and quantities of amino acids. Plant sources of protein can easily meet nutritional needs for protein if a sufficient variety of foods (vegetables, grains, cereals, legumes, nuts and seeds) are included in the diet to provide all the essential amino acids necessary to form complete protein.

Amino acids that are absent or low in number are called **limiting amino acids**, meaning that they limit complete protein formation. By including foods in the diet that complement limiting amino acids, complete proteins are formed. These are called **complementary proteins**, and the process is called mutual supplementation.

Making incomplete proteins complete is as simple as eating a peanut butter sandwich or baked beans and brown bread. For example, bread is rich in the amino acid methionine, but low in lysine. Legumes (peanuts and beans) are rich in lysine, but poor in methionine. When both foods are eaten, they complement each other, together providing the amino acids to form a new complete protein. A small amount of complete protein with a larger amount

of incomplete protein will make all of the protein complete. For example, in macaroni and cheese, the cheese completes the amino acids missing in the macaroni, even though there is less cheese than macaroni in the mixture. We used to think that foods with complementary proteins had to be eaten at the same meal. It now appears that all necessary amino acids need to be available in the bloodstream or to cells daily, but that eating them at the same meal is not necessary.

Civilizations throughout history have combined foods to make complete proteins. Examples include rice and beans (Mexican), tofu and rice (Asian), pasta and beans (Italian), corn and lima beans (American Indian), and hummus and pita bread (Middle East). It is interesting to theorize whether this “natural” combining of foods to make complete proteins was by accident, belief or a factor of cultural survival.

Protein Needs

The Food and Nutrition Board of the National Academy of Sciences has established protein requirements based on an individual's age and weight. For adults, the Recommended Dietary Allowance (RDA) is 0.80 grams of protein for each kilogram (2.2 pounds) of body weight. This amount assumes that an individual eats a mixed diet of proteins – some complete, some incomplete. For vegetarians who consume mainly incomplete or plant proteins, protein requirements increase by approximately 15%. Individuals consuming mainly complete or animal proteins actually need about 15% less protein because it is used more efficiently. Most Americans, particularly men, eat more protein than needed, especially if they eat large portions of meat.

Protein requirements increase during pregnancy and lactation, at the onset of certain illness, and while healing or recovering from surgery. Increased exercise may also increase the need for protein. Children under 18 need additional protein to facilitate growth; the younger they are, the more protein they need per pound of body weight.

The World Health Organization has set 40 grams of protein daily as an adequate intake. The *Dietary Guidelines* do not specify an ideal protein intake, but say that 10% to 35% of calories should come from

protein. In the typical American diet, about 20% of calories come from protein. A very high protein intake can decrease calcium absorption and increase the metabolic workload of the liver and the kidneys. The main problem with protein, however, is the company it keeps. Most protein sources also contain fat; consequently, excess protein consumption increases total and saturated fat intake as well. Most sources of animal protein also contain cholesterol.

The *Dietary Guidelines* recommend choosing proteins that are low in total fat and saturated fat. Eating legumes, which contain protein, is encouraged. The availability of protein in legumes, however, is somewhat limited because legumes are not easy to digest. For example, soybeans must be treated to break down their chemical structure. Making soybeans into tofu through the processes of soaking, grinding and fermenting makes the protein more available. Soaking and cooking legumes allows the protein to be digested. Textured vegetable protein and isolated soy protein are also digestible and particularly useful as a protein source for vegans.

Protein and Health

Escalation in portion sizes over the last decade, particularly in casual and fast food restaurants, may have provided dollar value but has not enhanced the health of diners. Oversized portions have contributed to weight gain and various health risks. Downsizing portions, particularly of protein- and fat-rich foods, should be a goal for chefs interested in healthful cooking.

Eating more than the recommended amount of protein has no real health benefits. The fat (particularly saturated fat), cholesterol and calories consumed with fat can raise the risk of heart disease, some cancers and the many diseases associated with obesity. Not many people can sustain high-protein, low-fat diets because there are relatively few foods rich in protein that have no or little fat.

While adequate protein is important for health, a diet very high in protein can cause calcium loss through the kidneys, which can lead to osteoporosis. Regular consumption of fat-free (skim) milk can reduce risk by supplying calcium, but many adults do not get the recommended 3 servings of low-fat milk equivalents

daily. When children are given sugary beverages in place of milk, calcium and protein intake is greatly reduced, thus lowering diet quality.

Contrary to wishful thinking and sales pitches, eating excessive protein does not build bigger muscles, increase immunity or make stronger bones. In fact, studies also show that very high-protein diets increase the workload of the kidneys, which must process nitrogen waste. This extra work can worsen problems for individuals with kidney disease.

It is true that a high-protein, low-calorie diet can cause weight loss. Food choices are limited on this regimen so dieters become bored and eat fewer calories. In addition, eliminating carbohydrates (like bread and potatoes) reduces the intake of the fats that accompany them, thus lowering calories (no French fries, no butter, etc.). Much of the “science” of low-carbohydrate (and thus high-protein) diets is based on unproven claims from testimonials and uncontrolled studies rather than from validated scientific research. Not much long-term data exist on safety or adherence to high-protein, low-calorie diets. We do know, however, that these diets are not nutritionally adequate without major supplementation. Many vitamins and minerals, fiber, and phytochemicals come from foods that contain carbohydrates.

Recommended Dietary Allowance for Protein

	Grams of Protein needed Daily
Children ages 1 to 3	13
Children ages 4 to 8	19
Children ages 9 to 13	34
Girls ages 14 to 18	46
Boys ages 14 to 18	52
Women ages 19 to 70 +	46
Men ages 19 to 70 +	56

Source: Center for Disease Control and Prevention. Nutrition for Everyone: Protein. www.cdc.gov/nutrition/everyone/basics/protein.html.

The Scourge of Malnutrition

Economics is an influential factor in food availability and how food choices are made. Protein foods tend to be expensive; many hungry Americans cannot afford enough food, much less costly protein. Experts predict that malnutrition in America will increase; it is not a problem for Third World countries only.

When feeding people with limited funds to buy adequate foods, providing protein is a priority. This is why school lunch, feeding programs for older Americans and other government programs must provide protein foods plus milk at each meal.

Unlike carbohydrates and fat, protein contains nitrogen in its molecular structure. Nitrogen equilibrium – when nitrogen intake equals output – is a measure of protein adequacy. In times of rapid growth, such as infancy, childhood and pregnancy, positive nitrogen balance is desirable so that new tissues can be formed. Negative nitrogen balance, in which loss of protein exceeds intake, can occur in illness, with injury or due to inadequate food intake. A severe protein deficit can lead to protein-calorie malnutrition.

Two diseases are caused by too little protein in the diet. Starving children suffer from **marasmus**, a severe form of protein-calorie malnutrition. **Kwashiorkor** is a disease in which protein is absent but calories, usually from starchy foods, may be adequate. Both of these protein-deficiency diseases are common in developing countries but are also seen in very low-income populations in developed countries. Some individuals who get most of their calories from alcoholic beverages, and generally eat poorly, also develop protein-deficiency diseases.

Protein Is Satisfying

According to a 2007 *Journal of Nutrition* study, when it comes to satiety, protein has more staying power than carbohydrates and fat. Eating a moderately high-protein diet (at least at the Recommended Dietary Allowance) can curb hunger and the body's desire to eat. [1] In addition, a 2004 study in the *Journal of Nutrition* tested a moderately high-protein, low-fat diet compared with a higher-carbohydrate, low-fat diet. Researchers found that those on the moderately high-protein diet did not complain of hunger and were much more satisfied than those on the higher-carbohydrate diet. [2]

Where's the Protein?

Protein is found in meat, poultry, fish, eggs, dairy products, dry beans, nuts, seeds and grains. In general, 1 ounce of meat, poultry or fish, ¼ cup cooked dry beans, 1 egg, 1 tablespoon of peanut butter, or ½ ounce of nuts or seeds can be considered 1 ounce equivalent from the meat and beans group in *MyPlate*.

Slow Roasted Glazed Salmon

Chef Sarah Stegner, Prairie Grass Cafe, Northbrook, Illinois

Yield: 10 servings

Be sure the salmon is well trimmed and free of bones and brown fat. This simple method and presentation requires excellent quality salmon. The butter enhances flavor and texture. Some butter is released on the pan as the salmon roasts. This salmon dish is both very easy and versatile. Serve it hot or chilled atop a spinach salad.

Honey	2 tablespoons
Unsalted butter, at room temperature	2 tablespoons
Lemon zest, grated	1 teaspoon
White pepper	1 teaspoon
Dijon mustard	2 teaspoons
Thyme, fresh, chopped	1 tablespoon
Kosher salt	½ teaspoon
Salmon fillets, skinned, cleaned, boned, ¾ to 1 inch thick	(10) 5 - 6 ounces each

1. Preheat oven to 225° F.
2. In a small bowl combine honey, butter, mustard, lemon zest, white pepper, thyme and salt. Mix well.
3. Arrange salmon on a shallow roasting pan. With the back of a spoon, spread honey-butter mixture to coat the top of each fillet.
4. Slow roast the salmon at 225° F for 25 minutes.
5. Remove any white drippings that may be released from salmon before serving.

Per Serving

Calories	200	Cholesterol	70 mg
Fat	7 g	Sodium	190 mg
Saturated Fat	2.5 g	Carbohydrates	4 mg
Trans Fat	0 g	Dietary Fiber	0 mg
Sugar	3 g	Protein	28 g



Meat

Meat includes a variety of animals: beef, lamb, pork, veal, goat, bison, buffalo, beefalo, rabbit, venison and other game. The leanest beef cuts include round steaks and roasts (round eye, top round, bottom round, round tip), top loin, top sirloin, and chuck shoulder and arm roasts. The leanest pork choices include pork loin, tenderloin, center loin and ham. In choosing ground meat, the most healthful choice is extra lean ground meat. The label should say at least “90% lean.” You may be able to find ground beef that is 93% or 95% lean and ground chicken and turkey that is 97% lean.

Worldwide, goat is the most consumed meat. It is a staple of, among others, Mexican, Indian, Greek, southern Italian, Lebanese, African and Korean cuisines. Sometimes goat meat is called chevon, capretto or cabrito. The meat of a young goat is flavorful and lower in fat than chicken but higher in protein than beef. It is lower in total fat, saturated fat, calories and cholesterol than most meat. Because goat meat is so lean, it requires low-heat slow cookers to preserve tenderness and moisture.

Nutrient Content of Meats

This table lists the nutrient content of commonly eaten meats. All values are for a **3½-ounce cooked edible portion**.

	Calories	Protein (grams)	Fat (grams)	Saturated Fat (grams)	Cholesterol (milligrams)
Beef tenderloin	220	27	11	4	85
Beef, top round steak	210	35	6	2	90
Beefalo	190	35	6	2.5	60
Bison, top round steak	170	30	5	2	85
Buffalo, top round steak	170	25	2	0.5	60
Goat, average of all cuts	124	25	2.6	0.8	64
Ground beef, 20% fat	270	26	18	7	90
Ground lamb, 20% fat	280	25	19	8	95
Ground beef, 10% fat	220	26	12	4.5	85
Ground beef, 5% fat	240	26	14	5	90
Lamb, average of all cuts	175	24	8	3	80
Pork tenderloin	140	26	4	2	60
Pork chop	210	25	11	3.5	75
Pork sausage	230	15	18	6	80
Spare ribs	360	21	31	9	105
Ham	160	16	9	3	60
Rabbit	200	29	8	2.5	80
Veal, average of all cuts	190	32	7	2	115
Venison	160	30	3	1	110

Source: U.S. Department of Agriculture, Agricultural Research Service. 2009. USDA National Nutrient Database for Standard Reference, Release 24. Nutrient Data Laboratory, www.ars.usda.gov/services/docs.htm?docid=8964

Nutrient Content of Various Cuts of Beef

This table lists the protein and fat content of different cuts of beef from the same animal. All values are for a **3½-ounce cooked edible portion**.

	Calories	Protein (grams)	Fat (grams)	Saturated Fat (grams)	Cholesterol (milligrams)
Flank steak	190	27	8	3.5	80
Strip steak	210	29	9	4	85
Top round steak	190	31	6	2	65
Top sirloin steak	210	29	10	4	90
Tenderloin or filet mignon	220	27	11	4.5	85
Ground beef, 10% fat	220	26	12	4.5	85
Ground beef, 15% fat	250	26	16	6	90
Rib eye steak	250	27	15	6	110
T-bone steak	250	24	16	6	60
Ground beef, 20% fat	270	26	18	7	90
Brisket	290	27	19	7	90

Source: U.S. Department of Agriculture, Agricultural Research Service. 2009. USDA National Nutrient Database for Standard Reference, Release 24. Nutrient Data Laboratory, www.ars.usda.gov/services/docs.htm?docid=8964

Poultry

Chicken, turkey, duck, goose, guinea hen, pigeon, partridge, pheasant and quail are common birds used on menus today. Most poultry is high in good-quality protein and low in fat. The lighter meat is lower in fat than the darker meat. Because fat is

deposited under the skin of poultry, consuming poultry without the skin will lower the fat by about 5 grams per 3½-ounce serving. The fat content of the meat is similar whether the skin is removed before or after cooking, as long as the skin is not eaten.

Nutrient Comparison of Poultry

This table lists the nutrient content of various poultry. All values are for a **3½-ounce cooked edible portion**.

	Calories	Protein (grams)	Fat (grams)	Saturated Fat (grams)	Cholesterol (milligrams)
Turkey breast, w/o skin, roasted	135	30	0.5	0.5	85
Guinea hen, w/o skin, raw	110	21	2.5	0.5	65
Duck breast, w/o skin, broiled	140	28	2.5	1.0	145
Emu, full rump, broiled	170	34	2.5	1.0	130
Chicken breast, w/o skin, roasted	165	31	3.5	1.0	85
Chicken thigh, w/o skin, roasted	180	24	8	2.5	135
Cornish game hen, w/o skin, roasted	130	23	4.0	1.0	105
Ostrich, top loin, cooked	150	28	4.0	1.5	95
Pheasant, cooked	240	32	12.0	4.0	90
Squab, cooked	210	24	13.0	3.5	115
Goose, w/o skin, roasted	240	29	13.0	4.5	95
Quail, cooked, with skin	230	25	14.0	4.0	85

Source: U.S. Department of Agriculture, Agricultural Research Service. 2009. USDA National Nutrient Database for Standard Reference, Release 24. Nutrient Data Laboratory, www.ars.usda.gov/services/docs.htm?docid=8964

Words Used to Describe Chicken

Understanding the labeling used on chicken can be confusing because processors use different terms.

Free Range: The animals were given access to a fenced area or pen outside the chicken house. Chickens often stay close to the water and chicken feed, which is usually located within the house, so they may or may not utilize the pen.

Organic: The Department of Agriculture (USDA) defines organic production and prohibits the use of antibiotics in feed or treatment of animals. Feed must be made from organic ingredients, so no pesticides or chemical fertilizers can be used on the corn and soybeans used to make poultry feed. There are other requirements as well.

Retained Water: A “retained water” statement, such as “May contain up to 6% retained water,” is found on most packages of fresh poultry. This statement indicates the amount of water retained in the product as a result of essential food safety procedures, such as chilling processed chickens in ice-cold water to reduce their temperature and retard the growth of spoilage bacteria and other microorganisms. Single-ingredient chicken is not allowed to retain any water beyond the minimum required by these essential food safety procedures.

Farm-Raised: All chickens are raised on farms. So the label “farm-raised” can refer to any chicken. When this term is used on menus, it usually means chickens were raised on a local farm.

Natural: Under USDA regulations, a “natural” product has no artificial ingredients, coloring ingredients or chemical preservatives and is processed just enough to get it ready to be cooked. Most ready-to-cook chicken can be labeled “natural,” if processors choose to do so.

Produced without Hormones: Food and Drug Administration regulations prohibit the use of artificial or added hormones in the production of poultry in the United States.

Raised without Antibiotics or Antibiotic-Free: The flock was raised without the use of products classified as antibiotics for animal health maintenance, disease prevention or treatment of disease. “Antibiotic free” is not allowed to be used on a label but is sometimes found in marketing materials not regulated by the USDA.

Enhanced Chicken Products: Some uncooked chicken products are enhanced with chicken broth or a similar solution. The presence and amount of broth or other solution must be stated clearly and the actual ingredients used in the enhancing solution must be listed on the label. Salt is used in some enhanced products.

Fresh: Use of the word “fresh” on a label indicates that the product has never been chilled – that is, cooled or held below 26° F.

Kosher: Chicken have been killed and processed according to kosher food rules, which require salting plus supervision by rabbis.

Source: National Chicken Council, www.nationalchickencouncil.com

Seafood

Fish and shellfish are valuable sources of high-quality protein. Most seafood is also low in fat. Some fish, such as salmon, trout and herring, are high in omega-3 fatty acids. The specific omega-3 fatty acids

in fish are commonly called EPA and DHA. Eating fish rich in EPA and DHA may reduce the risks for cardiovascular disease. The current *Dietary Guidelines* recommend at least 2 servings of fish per week.

Nutrient Comparison of Various Seafood

This table lists the nutrient content of various types of seafood. All values are for a **3½-ounce cooked (baked, broiled or steamed) edible portion**.

	Calories	Protein (grams)	Fat (grams)	Saturated Fat (grams)	Cholesterol (milligrams)
Cod, Atlantic	100	23	1	0	55
Flounder	90	16	2.5	0.5	55
Haddock	90	20	0.5	0	65
Halibut	110	23	2	0	60
Snapper	130	26	1.5	0	45
Salmon, coho	180	27	7.5	1.5	55
Salmon, Atlantic	180	25	3	1	70
Salmon, chinook	180	20	10	3	50
Salmon, sockeye	170	25	7	1	65
Mackerel, Atlantic	260	24	18	4	75
Shad, American	250	22	18	--	95
Trout, mixed species	190	26	8	1.5	75
Walleye	110	24	1.5	0	90
Catfish, farmed	150	19	8	1.5	65
Shrimp	120	23	2	0.5	210
Lobster	90	20	1	0	140
Crab, Alaska king	100	19	1.5	0	55
Crab, blue	90	18	1	0	100
Crab, Dungeness	110	22	1	0	75
Clams, mixed species	150	25	2	0	65
Oysters	80	7	2	0.5	40
Mussels	170	24	4.5	1	55
Squid	170	18	7.5	2	260
Octopus	160	30	2	0	95

-- denotes value is not available

Source: U.S. Department of Agriculture, Agricultural Research Service. 2009. USDA National Nutrient Database for Standard Reference, Release 24. Nutrient Data Laboratory, www.ars.usda.gov/services/docs.htm?docid=8964

Eggs

Few ingredients are as useful and versatile as eggs. Even though they are part of the same package, egg whites and yolks are very different. The yolk contains some protein and all of the fat and cholesterol. Egg whites are mainly protein. The protein in eggs is of excellent quality.



Nutrient Comparison of Eggs

This table lists the nutrient content of various eggs. **All values are for a 3½-ounce (100 grams) edible portion.** Egg sizes vary according to the bird. The color of the shell does not influence nutrient values.

	Calories	Protein (grams)	Fat (grams)	Saturated Fat (grams)	Cholesterol (milligrams)
Chicken eggs, whole (1 large egg = 50 grams)	140	12	10	3	420
Chicken egg yolks	310	16	26	9	1225
Chicken egg whites	50	11	0	0	0
Duck eggs (1 egg = 70 grams)	180	13	14	3.5	875
Goose eggs (1 egg = 144 grams)	180	14	13	3.5	845
Quail eggs (1 egg = 9 grams)	160	13	11	3.5	835
Turkey eggs (1 egg = 79 grams)	170	14	12	3.5	925

Source: U.S. Department of Agriculture, Agricultural Research Service. 2009. USDA National Nutrient Database for Standard Reference, Release 24. Nutrient Data Laboratory, www.ars.usda.gov/services/docs.htm?docid=8964

The Incredible Egg

Eggs are excellent sources of protein, versatile and easily digested. For many years, mainstream advice was that eggs contained a lot of cholesterol and should be limited to promote heart health. Thirty years of research have shown, however, that eating an egg a day does not significantly impact the LDL-HDL cholesterol ratio that is a predictor of heart disease. Current American Heart Association guidelines and *Dietary Guidelines for Americans 2010* allow 1 egg a day rather than limiting eggs to 3 to 4 a week as previously advised. This recommendation is for people without cardiovascular disease, congestive heart failure or diabetes. For people with these conditions, egg yolk consumption should be limited to 2 per week. Foodservice operators may want to offer egg white omelets with vegetable fillings.

Part of the issue with eggs is the company they keep. Eggs are frequently served with bacon, sausage, cheese and other high-fat, high-cholesterol foods. While eggs themselves are high in cholesterol (a large egg contains about 185 milligrams of cholesterol in the yolk), they are also a very rich source of protein and many vitamins and minerals. Some chickens

are given special feeds that make their eggs rich in omega-3 fatty acids and lower in cholesterol than other eggs.

Eggs also provide lecithin, a fatty molecule that transports and metabolizes fats in the body. As one of the least expensive sources of high-quality protein and other nutrients, eggs also help to control food costs.

Unfortunately, the nutrients that make eggs a high quality food for humans are also a good growth medium for salmonella bacteria. Fortunately, however, on average across the United States, only one of every 20,000 eggs might contain the bacteria. You can reduce this risk by proper chilling and eliminate it by proper cooking. The potential for salmonella is present only with raw or partially cooked eggs that may be used in Caesar salad dressings, soft-cooked eggs, eggnogs, soft meringues, etc. Pasteurized-in-the-shell as well as pasteurized liquid eggs are available. Both are very useful because they pose no threat of salmonella. These eggs are well worth the extra cost when making food that will be held over a period of time or when feeding vulnerable individuals.

Source: American Egg Board. Eggs & Food Safety, www.incredibleegg.org/egg-facts/egg-safety/eggs-and-food-safety#2

Dairy Products

Milk from cows, buffalos and goats is used as a beverage and in various dairy products such as ice cream, yogurt and cheese. The *Dietary Guidelines* recommend that people should choose low-fat or nonfat dairy products. *MyPlate* recommends that anyone over the age of 9 should consume 3 cups (or

the equivalent) of dairy products daily. In addition to protein, dairy products provide calcium, potassium and vitamin D. Dairy products, particularly milk and yogurt, are the best sources of calcium and vitamin D. For a list of calories and fat in dairy products see Chapter 4.

Protein in Dairy Products

Item	Amount	Protein (grams)
Cottage cheese	1 cup	25
Ricotta cheese	1 cup	28
Milk (all types, including chocolate milk)	1 cup	8
Evaporated milk	1 cup	18
Yogurt	1 cup	9
Greek yogurt	1 cup	20
Cheese, firm	1 ounce	7
Cream cheese	1 ounce	2
Ice cream	½ cup	4
Pudding (made with milk)	½ cup	2



When Milk Is Not Milk

The standard of identity for milk is that it is obtained from cows. **Standards of identity** are minimum quality specifications for food defined by the Food and Drug Administration, including permitted ingredients and processing requirements. Standards of identity emphasize food composition (the ingredients or components) or processing requirements (how the food is manufactured). Milk from other mammals (for example, sheep, goats and water buffalo) must include the source animal in the product name (for example goat's milk).

Beverages designed to mimic cow's milk have a place in the diet for those who are allergic to milk or who follow a strict vegan diet but desire the taste and function of this familiar beverage. Milk-substitute beverages, however, do not necessarily supply the valuable nutrients milk provides and should not be treated as equal to milk.

Plant-based milks, such as soy, rice and almond milk, are non-dairy beverages that have their own distinct texture, color and taste. They are used as a beverage, poured on cereals, or used in cooking or baking. These beverages vary in calorie and nutrient content. While plant-based milks have little saturated fat and no cholesterol, they may also lack the protein, calcium and vitamin content of dairy milk. Unfortified plant-based milk products are low in several key nutrients, such as calcium and vitamin D. Read labels carefully.

- **Soy milk.** Many brands of soymilk have about the same or slightly less protein than cow's milk. Lower-fat or light varieties may be lower in protein, calcium, vitamin D, and/or vitamin B₁₂, depending on the brand. Unfortified soymilk contains little absorbable calcium; most manufacturers enrich their products with calcium carbonate, an easily absorbed form of calcium.
- **Nut milk.** Various types of nuts can be used to make nut milk, including Brazil nuts, hazelnuts and almonds. Nut milk is made from ground nuts that have been strained, liquified and sweetened. Nut milk has a creamy consistency and a nutty taste good for creamy drinks and desserts. The nutrient content of nut milk varies depending on the manufacturer and the nut used. Many nut milks have added sweeteners to balance out their bitter taste. Most nut milks available have very little protein.
- **Grain milk.** Made from fermented grain or flour, most grain milks contain less than 4 grams of protein per 8-ounce serving. The most common types of grain milk come from rice and oats. These milks have the added benefit of fiber infused into the drink during manufacturing. Rice milk, however, is processed from brown rice and usually contains rice syrup, evaporated cane juice or some other natural sweetener. It is typically fortified with calcium, vitamin D and/or vitamin B₁₂.

Types of "Milk" and Nutrient Content

Milk	Calories (cup)	Protein (grams)	Fat (grams)	Sat Fat (grams)	Carbs (grams)	Calcium (milligrams)
Cow, nonfat	90	9	0	0	12	316
Buttermilk, low-fat	98	8	2	1	12	284
Goat	168	9	10	7	11	327
Water buffalo	237	9	17	11	13	412
Sheep	265	15	17	11	13	473
Almond	60	1	2	0	8	200
Hemp, fortified	130	4	3	1	20	460
Oat	107	1	0	0	26	7
Rice, enriched	100	1	2	0	10	250
Soy milk	131	8	4	0	15	61
Coconut	552	5	57	51	13	38

Legumes (Dry Beans and Peas)

All varieties of beans are rich sources of fiber, vitamins, minerals and protein, including the essential amino acid lysine, but most are low in the amino acid methionine. Lysine is missing from most grains, which is why the combination “rice and beans”

makes a complete protein. The *Dietary Guidelines* suggest a shift in food-intake patterns toward a more plant-based diet that emphasizes cooked dry beans and peas, among other plant foods.

Nutrient Comparison of Cooked Dry Beans and Forms of Soybeans

This table lists the nutrient content of various cooked dry beans and soybeans. All values are for a **1-cup cooked edible portion**. Beans contain no cholesterol and are an excellent source of fiber.

	Calories (grams)	Protein (grams)	Fat (grams)	Carbohydrate (grams)	Fiber (grams)
Adzuki beans	290	17	0	57	17
Baby lima beans	190	12	0.5	35	11
Black beans	230	15	1	41	15
Black-eyed peas	200	13	1	36	11
Butter beans	200	10	0	36	8
Cranberry beans	240	17	1	43	18
Edamame, shelled	200	16	6	18	8
Fava beans	180	14	0.5	32	9
Garbanzo beans	270	15	4	45	12
Great northern beans	210	15	1	37	12
Kidney beans	220	15	1	40	11
Lentils	230	18	1	40	16
Lentils, black beluga	200	12	0	32	8
Navy beans	250	15	1	47	19
Pinto beans	240	15	1	45	15
Scarlet runner beans	200	12	0	40	14
Split green peas	230	16	1	41	16
Tempeh	320	31	18	16	--
Tofu, firm	180	21	11	4	2
Trout beans	200	14	0	36	12

-- denotes value is not available

Source: U.S. Department of Agriculture, Agricultural Research Service. USDA National Nutrient Database for Standard Reference, Release 24. Nutrient Data Laboratory, www.ars.usda.gov/services/docs.htm?docid=8964

Nuts and Seeds

Nuts, nut butters and seeds are a good source of plant protein, providing approximately 10 to 20 grams of protein per 100 grams, with almonds and pistachios providing the highest levels of protein among tree nuts. Peanuts are used as nuts but are really legumes. Dry-roasted, oil-roasted and raw peanuts have similar nutrient values. Nuts rich in

monounsaturated fats include macadamias, cashews, almonds, pistachios and pecans. Walnuts, pecans, pine nuts and Brazil nuts are rich in polyunsaturated fats. Some nuts and seeds (flax, walnuts) are excellent sources of essential fatty acids, and some (sunflower seeds, almonds, hazelnuts) are good sources of vitamin E.

Nutrient Comparison of Nuts and Seeds per Ounce

This table lists the nutrient content of various nuts and seeds. All values are for a **1-ounce edible portion**. Nuts and seeds contain no cholesterol and are a good source of fiber. Two tablespoons of peanut butter is about 1 ounce; three tablespoons of flax seeds is about 1 ounce.

	Calories (grams)	Protein (grams)	Fat (grams)	Carbohydrate (grams)	Fiber (grams)
Almond butter	180	4	17	6	1
Brazil nut butter	170	4	17	4	2
Cashew butter	170	5	14	8	1
Hazelnut butter	160	4	14	4	4
Peanut butter	190	8	16	6	2
Sesame seed butter	170	5	15	6	1
Soy nut butter	170	8	13	5	4
Sunflower seed butter	160	6	14	8	4
Walnut butter	180	4	18	4	2
Almonds	160	6	14	6	3
Brazil nuts	190	4	19	3	2
Cashews	160	5	12	9	1
Chestnuts	60	0	0	13	--
Hazelnuts or filberts	180	4	17	5	3
Macadamia nuts	200	2	21	4	2
Peanuts	160	7	14	5	2
Pecans	200	3	20	4	3
Pine nuts or pignolia	190	4	19	4	1
Pistachio	160	6	13	8	3
Walnuts, English	190	4	18	4	2
Walnuts, black	180	7	17	3	2
Sunflower seeds	170	6	15	6	2
Sesame seeds	160	5	14	7	3
Flax seeds	150	5	12	8	8
Pumpkin seeds	160	9	14	3	2

-- denotes value is not available

Source: U.S. Department of Agriculture, Agricultural Research Service. USDA National Nutrient Database for Standard Reference, Release 24. Nutrient Data Laboratory, www.ars.usda.gov/services/docs.htm?docid=8964

Grains

Grains provide protein, carbohydrate and fiber, in addition to vitamins, minerals and phytochemicals. Most grains, including rice and wheat, are deficient in the essential amino acid lysine but provide the amino acid methionine, which legumes lack. That is why in order to get sufficient amino acids to form usable protein, many vegetarians combine grains with legumes. Common examples of such combinations

are dal with rice, beans with corn tortillas, tofu with rice, and peanut butter with wheat bread.

Pseudograins are actually seeds that are cooked and used like grains. Quinoa and amaranth are pseudograins. Quinoa, while used like a grain, contains all of the essential amino acids and, like soybeans, is a vegetable source of complete protein.

Nutrient Comparison of Grains and Pseudograins

This table lists the nutrient content of various grains. All values are for a **1-cup cooked edible portion**. Grains contain no cholesterol and are a good source of fiber.

	Calories (grams)	Protein (grams)	Fat (grams)	Carbohydrate (grams)	Fiber (grams)
Amaranth	250	9	4	46	5
Barley, pearled	190	4	0.5	44	6
Bulgur	150	6	0	34	8
Kamut	250	11	1.5	52	7
Millet	210	6	1.5	41	2
Oatmeal	170	6	3.5	28	4
Quinoa	220	8	3.5	39	5
Rice, brown	220	5	2	45	4
Rice, white	210	4	0	45	1
Rice, wild	170	7	0.5	35	3
Teff	250	10	1.5	50	6
Wheat berries	210	8	0.5	45	8

Source: U.S. Department of Agriculture, Agricultural Research Service. USDA National Nutrient Database for Standard Reference, Release 24. Nutrient Data Laboratory, www.ars.usda.gov/services/docs.htm?docid=8964



Protein in Cooking

Susceptibility to **denaturation** – changes in the structure by chemical or physical means – is an important characteristic of protein. The most common ways to denature protein are through the addition of salt (as in curing meat), acid (cold poaching as in ceviche), whipping (as in meringues) and heat (as in cooking eggs).

With the application of heat or chemicals, protein strands are broken apart and are then available to link with other protein strands. In this bonding process, known as **coagulation**, protein fragments release water, which is why proteins lose moisture during cooking and when marinated.

Wheat flours contain varying amounts of protein. Hard wheat has a high protein content. When mixed

with liquid, the protein in hard wheat forms **gluten**, a firm but elastic substance that affects the texture of baked goods such as bread and pizza dough. Soft wheat flour, such as cake flour, comes from wheat kernels with lower protein content; thus, it produces a product that is more tender and has less gluten.

The food industry uses some amino acids as ingredients. L-glutamic acid and its salt form, monosodium glutamate, are used as flavor enhancers. Aspartame, a food sweetener, is made from the amino acid aspartic acid. Amino acids are sometimes added to processed vegan foods to improve nutrient values. Collagen, a protein component of connective tissue, is used to make gelatin. All of these ingredients can be found on ingredient lists of packaged foods.

casebycase

Healthworks at Hallmark

In the wake of health care reform legislation and the influence of various anti-obesity initiatives, increasing numbers of employers are helping their workers pursue healthier lifestyles. There's no better place to begin this effort than in the corporate cafeteria.

In Kansas City, Missouri, Hallmark Cards, Inc., is way ahead of the curve on healthful dining. The company has been providing meals for its employees since 1923 and has had a healthful dining program in place for more than 30 years.

"The program has evolved over time," says Christine Rankin, Hallmark's manager of foodservices, fitness and work-life. "Our employees can choose cafeteria items that help them achieve their personal goals. We also discount the healthiest foods in our foodservice and vending operations by 25%." Over the past two years, Hallmark's Health Rewards program has offered employees an incentive in the form of gift cards or paycheck credits for healthy habits, including healthy dining. "We've had excellent, steadily increasing participation in the program," notes Christine.

Foods such as Asian salmon, grilled vegetable manicotti, and chicken with wine sauce are part of Hallmark's branded menu known as Healthworks. In addition, the company has significantly increased its snack-packs and "grab 'n go" fare, which offer great value and ideal portion sizes.

Healthful dining is part of more than 50 wellness-related programs Hallmark offers its employees. It's no surprise that Business Week has recognized the company for having one of the nation's most innovative corporate cafeterias. In fact, healthful dining is so ingrained in Hallmark's corporate culture that employees don't need signs or table tents to tell them what their best choices are.

"People go through what they know is the 'healthy serving line,'" says Christine, "and they are confident they can find a great-tasting, lower-calorie lunch there. A half-dozen of our chefs are culinary school graduates with restaurant experience."

Not long ago, Christine doubled the size of the healthy serving line in the Crown Room, the company's largest dining facility. All told, Hallmark's foodservice boasts an 80% to 85% participation rate, meaning that four meals are dished up each day for every five workers in the building.

Turning Dietary Guidance into Meals

Chefs often overemphasize the importance of protein in the diet and make it the central focus of every meal. The *Dietary Guidelines* encourage **lean**, **low-fat** and **fat-free** choices from the meat and milk groups. Less than 7% of calories should come from saturated fatty acids, and most fat should come from polyunsaturated and monounsaturated sources. For meal planning, this guideline means that protein sources such as fish, legumes and nuts are preferred.

Protein-rich skim or low-fat milk should be available both as a beverage on menus and as an ingredient in cooking. Most Americans do not consume the 3 servings per day of low-fat/non-fat milk products recommended for a nutritionally adequate diet.

MyPlate suggests 5 to 7 ounces of meat equivalents per day. This 5 to 7 ounces is a cooked, edible portion. Assuming people eat three meals per day, food portions from the meat group should be far smaller than typical restaurant portions are today. An entree-sized portion of animal protein of 4 ounces raw weight (100 to 120 grams) and an appetizer-sized protein portion of approximately 2 ounces raw weight (60 grams) are sufficient. The protein can be presented so that a relatively small portion appears larger.

In a restaurant setting, it may be impractical to begin by making such a drastic change in the amount of protein served. Restaurants need to introduce healthier dishes slowly. A restaurant that typically serves a 10-ounce porterhouse steak and decides to change to a 4-ounce sirloin is likely to meet with instant resistance from kitchen personnel as well as customers. It is important to step back and rethink the concept of the main course, shifting the balance on the plate to less meat, fish or poultry and more vegetables and grains.

Old plating methods that place meat at 6 o'clock, vegetable at 10 o'clock and starch at 2 o'clock should be reexamined. When reducing the entree protein portion, the chef needs to find "volume" elsewhere. Whole grains, legumes, vegetables and even fruit can assume a greater supporting role and should be included in the menu description – for example, Caesar Salad with Charred Flank Steak or Shrimp Pad Thai.

It is also important to pay close attention to the quality of ingredients used and to the integrity of the desired product. One cannot expect a 4-ounce portion of meat to hide a plain baked potato and green beans. The same ingredients can be made enjoyable and satisfying. A roasted potato and crisp green bean salad tossed with vinaigrette and served with a 4-ounce portion of sliced grilled beef fanned attractively and garnished with fresh herbs can make a significant difference in quality and presentation, as can thinly sliced grilled marinated lamb mixed with a saute of Vidalia onions and served on a toasted herb roll. The key in these examples is making every ingredient count.



Vegetarian Choices

Many Americans, particularly teens and young adults on college campuses, are choosing to reduce their consumption of animal protein and adopt a vegetarian lifestyle. Some popular books espouse an eating philosophy in which meat is used as a condiment rather than an entree. Vegetarian options should be available on all menus for strict as well as “sometimes” vegetarians. If interesting and delicious, these menu options will be attractive to people who avoid meat for health, environmental or religious reasons. Vegetarian diets typically combine different types of foods and styles of cooking from diverse cultures. (For more information on vegetarianism, see Chapter 12.)



A Word from the Chef

A Healthy Portion of Local and Sustainable

Two-time James Beard award-winning chef Sarah Stegner is co-owner/chef at suburban Chicago's Prairie Grass Café. Sarah is known for her commitment to local foods and sustainability. “I'm not focused on being nutritious, but I do believe you have to offer choices and be open to serving nutritious food,” she says. “It's a skill to take what's in season and showcase it – without relying on a fryer to add flavor.

“Some people think nutrition means no fat, no oil, no flavor. But that's simply not true,” Sarah explains. “Nutrition is about balance and moderation. That's a key point for aspiring chefs to understand.” Not one to rely on lists of substitutes to make a recipe healthier, Sarah says she makes dishes that are what they are: “You need to preserve the food's integrity.”

Sarah's fresh tenderloin, sirloin and meat for ground beef come from 100% grass-fed, hormone- and antibiotic-free cattle. The meat is leaner, higher in protein, and higher in vitamins A and E than grain-fed beef. The fish served at the restaurant is line-caught; no nets catch other sea creatures or disturb the sea floor. In addition, Sarah's restaurant partners with Chicago's Shedd Aquarium in its sustainable seafood program, which promotes making environmentally responsible buying decisions by supporting fish species (like tilapia, salmon, halibut and local whitefish) that are abundant while giving those that aren't a chance to recover.

Sarah is also a fan of small, regional family farms and Chicago's year-round Green City Market, which she helped establish in 1999. “Sustainable, locally raised produce is much more important to me than organic,” she explains. “Much of the organic food available here is imported from China. We don't know how fresh it is and how it's been handled.” Sarah always has a vegan choice on her menus. “All I ask is that the customer let me prepare it my way – isn't that why they came to my restaurant?”

Opportunities for Chefs

Protein, a key part of a healthful diet, can be found in a variety of plant and animal foods. A balanced diet contains a good mix of proteins from various sources. Culinary professionals should choose nutrient-rich, lean protein, including products from plant sources. Foods high in protein are often high in fat and saturated fat. Thus planning appropriate portion sizes is particularly important when developing main course items that are high in protein.

Learning Activities

1. Purchase cow's milk and a selection of milk substitutes (soymilk, rice milk, almond milk, etc.). Compare color, flavor and mouthfeel. Compare the nutrition and culinary applications for each.
2. Compare the protein and fat content of a 6-ounce portion of four different cuts of beef, lamb and pork.
3. Identify five common main entrees and the typical portion size of meat, fish, or poultry served. Calculate the amount of protein provided. Compare the amount typically served in a restaurant with the serving size recommended by *MyPlate*.
4. Develop four vegetarian main courses suitable for college foodservice.

For More Information

- Alaska Seafood Marketing Institute (ASMI), www.alaskaseafood.org
- American Egg Board, www.aeb.org/foodservice-professionals
- *Dietary Guidelines for Americans, 2010*, www.dietaryguidelines.gov
- *MyPlate*, www.choosemyplate.gov
- National Cattlemen's Beef Association, Beef for Foodservice, www.beeffoodservice.com
- National Chicken Council and US Poultry and Egg Association, www.eatchicken.com
- National Dairy Council, www.nationaldairycouncil.org
- National Peanut Board, Foodservice, <http://nationalpeanutboard.org/foodservice.php>
- National Pork Board, Foodservice Professionals, www.porkfoodservice.org
- The Tri-Lamb Group, www.leanonlamb.com
- US Dry Bean Council, www.usdrybeans.com