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Protein Properties

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Introduction to Food Proteins

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The word protein was coined by Jons J. Berzelius in 1838, and is derived from the Greek word *proteios* which refers to being "of the first rank." Over the past 100 years proteins were studied extensively and food proteins have been of much interest not only because of their importance nutritionally and for their functionality in foods, but also for their detrimental effects. Food proteins include proteins from milk, meats (including fish and poultry), eggs, cereals, legumes, and oilseeds. Although these have been the traditional sources of protein in the human diet, potentially any proteins from a biological source could serve as a food protein. However, a food protein must be nontoxic, nutritionally adequate, digestible, have functionality desirable in foods, be readily available, and agriculturally sustainable.

The primary role of proteins in the diet is to provide the building materials for synthesis of muscle and other tissues. Proteins play a critical role in many biological processes. For example, proteins such as myoglobin and ferritin are involved in the transport of important biological molecules; oxygen and iron, respectively. Proteins are also major components of muscle and skin, and are essential for providing mechanical support in the body. Antibodies are highly specific proteins, important in immune defenses. Nerve cell responses to specific stimuli are mediated by protein receptors. Growth and differentiation of cells are also controlled by growth factors that are often proteins. Enzymes are proteins with catalytic activity which stimulate many chemical reactions in biological systems. Recently, there has been much interest in proteins due to the satiety they provide, as well as the bioactive peptides derived from them because of their potential as neutraceuticals. Proteins and bioactive peptides have the potential to improve health and reduce risk of various diseases.

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The nutritional value of a protein is determined by its amino acid composition. A protein containing all of the essential amino acids in life and growth sustaining proportions is considered a complete protein and will have a high biological value. Many animal proteins generally have high biological value, whereas plant proteins generally are not as high in biological value due to their deficiency in some of the essential amino acids. However, incomplete proteins can be supplemented with the missing essential amino acids. This has been an important practice in improving world's food sources. The body's daily protein requirements vary by person, with typical demand being greatest during growth, pregnancy, and lactation. Protein malnutrition can be reversed by proper diet. However, when protein intake is inadequate for too long the recovery may not be complete and the damage is irreversible, possibly leading to mental retardation.

Food proteins are responsible for texture, color, and flavor. Today they are extracted, modified, and incorporated into processed foods to impart specific functional properties. For example, proteins can function as buffering agents, emulsifiers, and fat mimetics in foods. Certain proteins can also form gels and foams. Because proteins contain both hydrophilic and hydrophobic characteristics they can orient themselves at the oil–water interface and can stabilize emulsions, which is important for the stability of foods such as salad dressings, sauces and mayonnaise. Foams are colloidal dispersion of gas in liquid. The protein orients itself at the air–water interface to trap air, similarly as emulsions. Foams are important in foods such as dessert toppings and ice creams. Egg and milk proteins are good foaming agents. Proteins can also form a well-ordered protein matrix or a gel which then traps water, fat, and other food components. Food products like yogurt, tofu, and gelatin dessert rely on the gelation properties of proteins.

Enzymes in food can be desirable or undesirable. Enzymes may serve as processing aids in food processing. For example, lactose-free (or lactose-reduced) milk and lactose-free dairy products are produced from milk where lactose has been hydrolyzed through a controlled enzymatic process. Enzymes also have undesirable aspects including their involvement in deteriorative reactions in foods. For example, polyphenoloxidase catalyzes browning reactions in fruits like apples in the presence of oxygen, and lipoxygenase is involved in lipid oxidation of polyunsaturated oils.

Food proteins can also have adverse effects in the diet. Food proteins can be powerful allergens for some people. Peanut, various tree nuts (such as walnuts, pecans, almonds, and cashews), soybean, wheat, milk, egg, crustacean, and fish proteins have been demonstrated to induce immunoglobulin E (IgE)-mediated food allergies. These eight foods account for approximately 90% of the food allergy reactions in the United States and are sometimes referred to as the "big eight." There are also some proteins that have antinutritional properties. Trypsin inhibitors (which reduce digestibility of protein) and avidin (which binds biotin, a B vitamin) are common examples. There are also proteins, or amino acids that may react to form toxins. For example, acrylamide in fried potatoes is formed from the reaction of amino acid asparagine with a reducing sugar.

It is important to note that food processing can alter the nutritional value and functional properties of proteins, along with enzyme activity.

This book will review the properties of food proteins, and provide in-depth information on important plant and animal proteins consumed around the world.