

Bioactive Proteins and Peptides

Essential, functional and beneficial



Protein is needed to build and maintain muscles, repair muscle damage, maintain fluid and electrolyte balance, provide energy, boost the immune system and maintain hair, fingernails and skin. It is also required for production of red blood cells, enzymes and hormones.¹

Proteins act as functional ingredients in food formulations by contributing properties such as whippability, emulsification, foaming, stabilizing, water binding, gelation and texturization. Proteins and their hydrolysates also contribute to flavour generation and browning in foods.

Moving beyond conventional nutritional benefits and functionality is the discovery that bioactive proteins and peptides derived from many food proteins have a positive impact on the health of cardiovascular, immune, nervous and gastrointestinal systems.

Bovine milk and eggs are the most important sources of protein and bioactive peptides in human diets. They can also be derived from fish and plants such as soy beans, peas, chickpeas, flax, brown rice, corn, wheat, oats and potatoes. This wide array of protein sources enables industry to reduce the potential allergenicity of a food.

Health Benefits

Many proteins and peptides have anti-hypertensive properties, opioid activities, immunomodulatory activities, mineral sequestering properties, and antioxidant and antimicrobial activities.² Soy protein plays a role in reducing the risk of coronary heart disease by lowering plasma cholesterol and triglycerides.³ Soy and pea protein can aid in controlling insulin fluctuations.⁴

Some proteins found in milk, soy and peas have positive effects in the areas of satiety, weight management and sustained energy.⁵ These effects are likely due to the slow digestion of proteins which prolongs the feeling of fullness.

Whey proteins such as alpha-lactalbumin and bovine serum albumin have been researched extensively in the prevention and treatment of cancer. Whey protein supplementation has also shown benefits in exercise performance and enhancement.⁶

Proteins and Peptides—Activity and Source⁴⁻¹⁷

Biological Activity	Proteins and Peptides (Source)
Antihypertensive ACE-inhibitory peptides	Casein and whey peptides (bovine milk); ovalbumin (egg white); fish muscle peptides (bonito, salmon, sardine, tuna); α-zein (maize), vegetable protein hydrolysates (pea, chickpea, soy, potato, flaxseed, lupins); pork and chicken peptides
Antimicrobial	Lactoferrin and its hydrolysis product, lactoferricin (milk); β-lactoglobulin (milk), thionin peptides (wheat, barley, rye and oats), fish peptides (mudfish, salmon, catfish and sole); avidin, ovalbumin, ovotransferrin, ovomucin, lysozyme (egg)
Antioxidant	Soybean peptides; hydrolyzed potato protein peptides; gelatin (skin of Alaska Pollack); flaxseed protein hydrolysates
Anticarcinogenic	α-lactalbumin, bovine serum albumin (milk); lunasin peptide (soy); ovomucin, lysozyme, cystatin and avidin (egg white)
Antiobesity	Soy protein, peptides and associated isoflavones, whey proteins and peptides, pea protein and hydrolysates
Cardiovascular health (cholesterol lowering)	Soy protein, lupin protein
Immunomodulatory	Oryzatenin (rice protein); immunoglobulins (milk and egg yolk)
Mineral sequestering	Caseinophosphopeptides and lactoferrin (milk)
Opioid (regulation of nervous system)	Gluten and gliadin (wheat); β-casomorphins (milk)

Canadian Research Expertise

Acadia University

Wolfville, NS

- Interfacial behaviour of proteins, lipids and carbohydrates (**S. Roscoe**)

Agriculture and Agri-Food Canada

Eastern Cereal and Oilseed Research Centre

Ottawa, ON

- Hypoallergenic soybeans, allergen identification, proteomics, protein content, protein composition (**S. Gleddie**)

Food Research and Development Centre

St. Hyacinthe, QC

- Extraction and structure-function interrelationship of plant proteins, peptides and other biomolecules (**J. Boye**)

- Fractionation and functional properties of milk components and by-products (**M. Britten**)
- Production of plant protein concentrates/isolates using membrane technologies (**F. LaMarche, M. Mondor**)

Guelph Food Research Centre

Guelph, ON

- Structure and functional properties of soy proteins and fibres (**S. Cui**)

Saskatoon Research Centre

Saskatoon, SK

- Biological, chemical and physico-chemical properties of *Cruciferae* (canola and mustards) and other oilseed proteins (**J. Wanasundara**)

Pacific-Agri-Food Research Centre

Summerland, BC

- Extraction, recovery and characterization of flaxseed proteins (**G. Mazza, D. Oomah**)

McGill University

Montreal, QC

- Preparation and structure-stability-functionality relationships of homogenous food protein (**A. Inteaz**)

University of Alberta

Edmonton, AB

- Fractionation and bioprocessing of novel bioactive egg components (**J. Wu**)
- Membrane-protein interactions (**M. Gänzle**)
- Properties and reactions of whey and whey components (**P. Jelen**)

Applications

Proteins are added to foods because of their functional properties or to enhance nutritional and health qualities of a food product. Protein ingredients are available as isolates (>90% protein), concentrates (30-80% protein), and hydrolysates.

Milk proteins are commonly used to fortify foods for infants and the elderly. Alpha-lactalbumin is used in infant formulas for those infants requiring higher protein levels. Glycomacropptides can be used to prepare specialty foods for individuals with phenylketonuria who must limit intake of phenylalanine. Milk protein is used in nutritional applications such as bars, pastas and nutraceuticals. Bioactive peptides, such as caseinophosphopeptides, are used in toothpaste formulations.

Egg protein is used for its functional characteristics. Egg yolks provide emulsifying properties and egg whites excel at binding and foaming. Egg whites have application in the diet of aging populations because they are easily digested and release essential amino acids. Lysozyme, from egg

whites, is used as a natural food preservative and is added to toothpaste, mouthwash and chewing gum to prevent gum infections.

New plant proteins from traditional crops have applications in food, animal feed and non-food products. For instance, Burcon NutraScience Corporation, MCN Bioproducts and BioExtraction produce canola protein concentrates and isolates. Natunola Health Ingredients extracts flax proteins for use in cosmetic, hair and skin formulations. Pea protein concentrates and isolates, derived through air classification (Parrheim Foods) and wet fractionation (Nutripea Inc.), have applications in food, nutritional supplements, cosmetics, and animal feed.



University of British Columbia

Vancouver, BC

- Production and characterization of functional peptides from food proteins (**E. LiChan**)
- Antioxidant activity of bioactive proteins in milk (**D. Kitts**)

University of Guelph

Guelph, ON

- Bioactivity of milk and egg proteins for intestinal health (**Y. Mine**)
- Protein interactions with charged polysaccharides (**M. Corredig**)
- Microstructural and functional changes in milk proteins (**D. Dalgleish**)
- Structure-function of aspartic proteinases (**R. Yada**)

Université Laval

Quebec, QC

- Separation of peptide mixtures by nanofiltration (**Y. Pouliot**)
- Isolation of bioactive molecules for biopolymers; maize proteins (**M.C. Bouffard**)

Canada Research Chair in Protein, Biosystems and Functional Foods

- Food protein-based materials as nutraceutical delivery systems (**M. Subirade**)

University of Manitoba

Winnipeg, MB

- Isolation, characterization and biological activity of peptides derived from enzymatic hydrolysis of food proteins (**R. Aluko**)
- Structure and function of pulse and oilseed proteins (**S. Arntfield**)

University of Saskatchewan

Saskatoon, SK

- Protein-polysaccharide interactions and functionality (**M. Nickerson**)
- Functionality of meat muscle and plant protein systems (**P. Shand**)

University of Toronto

Toronto, ON

- Edible oilseed processing (canola, mustard seed) protein isolation and purification, and recovery (**L.L. Diosady**)
- Pulse proteins and satiety (**H. Anderson**)

Canadian Suppliers

Quality
is in our **nature**

Milk Protein

- **Advitech**
Québec, QC | www.advitech.com
- **Agropur**
Longueuil, QC | www.agropur.com
- **AM Ingredients Corp.**
Burlington, ON | www.amicanada.com
- **Dealers Ingredients**
Brampton, ON | www.dealersingredients.com
- **M. Larivée International**
Montreal, QC | www.mlilinc.com
- **Parmalat Canada**
New Dundee, ON | www.parmalat.ca
- **Ronald A. Chisholm Ltd
Optimal Ingredients Division**
Toronto, ON | www.rachisholm.com
- **Sloan Valley Dairies Ltd**
Victoria, BC | www.sloanvalley.com

Egg Proteins

- **Inovatech Egg Products**
Abbotsford, BC | www.inovatech.com

Plant Proteins

- **Burcon Nutrascience Corporation**
Vancouver, BC | www.burcon.ca
- **Bio-Extraction Inc. (BioExx)**
Toronto, ON | www.bioexx.com
- **MCN Bioproducts Inc.**
Saskatoon, SK | www.mcnbioproducts.com
- **Natunola Health Inc.**
Ottawa, ON | www.natunola.com
- **Nutripea Inc.**
Portage La Prairie, MB | www.nutripea.com
- **Parrheim Foods**
Saskatoon, SK | www.parrheim.com

To learn more about Canada's functional food and natural health products industry, visit: www.agr.gc.ca

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The Pathfinders Research & Management Ltd.

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