

CHARACTERISTICS AND BIOLOGICAL PROPERTIES OF WHEY PROTEINS

Whey is a reliable source of high quality and biologically active proteins, carbohydrates and minerals. Whey proteins are easily digested and contain an amino acid profile that meets all the essential amino acid requirements set by the Food and Agriculture Organization/World Health Organization (FAO/WHO). Individual whey proteins contain a variety of functional and nutritional attributes, which are related to the structure and biological functions of these proteins.

□ *β-lactoglobulin*

β -lactoglobulin is approximately 50% of the total whey protein content. This protein has numerous binding sites for minerals, fat soluble vitamins and lipids, and acts as a transport protein for desirable lipophilic compounds such as tocopherol and vitamin A.^{1,2} Modification of β -lactoglobulin results in products that have strong antiviral activity against human immunodeficiency virus types 1 and 2.³

□ *α-lactalbumin*

α -lactalbumin comprises about 25% of the total whey protein content. This protein possesses an excellent amino acid profile, which is rich in lysine, leucine, threonine, tryptophan and cystine. The main known biological function of α -lactalbumin is to modulate the synthesis of lactose in the mammary gland.⁴ Addition of this protein is strongly advocated in the formulation of "humanized" infant formulas and to create other products for people with limited or restricted protein intakes. Limited work has suggested that α -lactalbumin may be effective as an anti-cancer agent in several different types of cancer.⁵

□ *Immunoglobulins*

Immunoglobulins are a complex group of proteins that make a significant contribution to the protein content as well as exerting an important immunological function. They are well recognized to provide disease protection to newborns through

passive immunity and there is evidence that the immunoglobulins also may have a role in disease control in adults. It is known that whey protein concentrates from mixed milk supplies generally contain sufficient antibody to *E. coli* K-99 to meet the requirements of the USDA to serve as a colostrum supplement.

□ *Bovine serum albumin*

Bovine serum albumin (BSA) has a good essential amino acid profile. BSA binds free fatty acids, other lipids and flavor compounds.⁶ BSA's primary function has been associated with its lipid binding properties.⁷ It may play a role in mediating lipid oxidation.^{8,9} Denatured BSA might reduce the probability of a person acquiring certain diseases, such as insulin dependant diabetes or auto-immune disease.¹⁰

□ *Lactoferrin*

Lactoferrin is an iron binding protein and has the potential capability of acting as an antimicrobial agent related to its iron chelating ability, thus depriving microorganisms of a source of iron. Most recently, it has been shown to have a number of other physiological and biological functions. The biological activities of lactoferrin include iron transport,¹¹ antimicrobial activity,¹² antifungal activity,¹³ antiviral activity,¹⁴ anticancer activity,^{15,16} toxin binding properties,¹⁷ immunomodulating effects,¹⁸ wound and wound healing,¹⁹ and anti-inflammatory activity.²⁰

□ *Lactoperoxidase*

Lactoperoxidase has been identified as an antimicrobial agent in milk, saliva and tears.²¹ The lactoperoxidase system has been proven to be both bactericidal and bacteriostatic to a wide variety of microorganisms, while having no effect on the proteins and enzymes of the organisms producing it.²² Clinical studies have supported the possibility that plaque accumulation, gingivitis and early onset caries may be reduced by appropriate lactoperoxidase preparations.

□ *Glycomacropeptide*

Glycomacropeptide (GMP), the glycosylated portion of caseinomacropeptide (CMP), is present in sweet whey formed following the κ -casein cleavage and casein precipitation by rennin; it is absent from acid whey. The biological and physiological properties that have been attributed to GMP or peptides derived from it include: reduction in gastric secretion, dental plaque and dental caries inhibition, growth promoting activity

for Bifidobacteria, product for control of phenylketonuria, inhibition of platelet aggregation and others.^{23,24}

GMP can suppress appetite via stimulation of the pancreatic hormone cholecystikinin (CCK) release. It alters pigment production in melanocytes, acts as prebiotic and has immunomodulatory actions. Physiologic activity of GMP depends on its glycosylation.

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