

Whey Protein Supplement: An Exclusive Food or Need of Hour: Review

Sonia Sangwan*, Raman Seth

Department of Dairy Chemistry, National Dairy Research Institute, Karnal, India

ABSTRACT

Background: Protein is essential portion of food which exerts beneficial effects on body composition and metabolism. But protein rich foods are very expensive and are scarcely available in developing country and protein deficiency is one of the major public health concerns. In this situation, searching for additional sources of dietary protein is of utmost importance due to decreasing resources because of global growing population. Current review of literature is about a cheapest, easily available unused protein source.

Methods: Milk is formed of two proteins, casein and whey. Whey protein is often separated from the casein in milk or formed as a by-product of cheese making. Whey (the liquid left after milk curdling) was deemed a waste by the dairy industry for decades but it proved a cheapest source of protein for poor growing population in developing countries. Whey protein is taken into account an entire protein because it contains all 9 essential amino acids. It is low in lactose content.

Conclusion: Human body cannot make essential amino acids, so it's important to get enough of them from diet. Due to availability of carbohydrates, fat, immunoglobulin, lactose and minerals including essential amino acids in whey protein, it is an important source of energy provided by domesticated animals. There are many benefits related to the consumption of whey protein such as muscle building and loss of fat. Researchers are constantly finding new possible therapeutic properties.

Keywords: Whey protein; Milk; Casein; Cheapest protein

INTRODUCTION

Milk is one of the important sources of nutrition that is widely consumed for human consumption and this can be obtained from a number of domesticated animals (sheep, goat, buffalo and cow) e.g. fresh cow milk containing approximately 3.5% total protein, out of which 80% casein, 15% whey protein, also it as vitamins, and lipids that gives necessary ingredients for growth [1]. In other words, energy (carbohydrate) obtained from milk within the sort of lactose (sugar), nitrogen (protein; subcomponents of micro fractions) and rich source of calcium (for bones) [2]. The dairy industry was treating Whey (the liquids left after milk curdling) waste for decades. As whey liquid is highly organic with high biological oxygen demand, its disposal is very difficult. On the other hand, Whey is full of the biologically active components e.g. lactoferrin, lactoperoxidase, lysozyme, and immunoglobulins etc. and are having

antimicrobial properties [3]. Milk is formed of two proteins, casein and whey. Whey protein is often separated from the casein in milk or formed as a by-product of cheese making. It is very useful in wound healing due to high protein contents, in weight loss as no fat, in infant health as full of amino acids. It is one of the excellent proteins for all age groups especially for marasmus children and helps in maintain of their health [2]. Human body cannot make essential amino acids, so it's important to get enough of them from diet. Due to availability of carbohydrates, fat, immunoglobulin, lactose and minerals including essential amino acids in whey protein, it is an important source of energy provided by domesticated animals [4].

Whey protein may be a popular fitness and dietary supplement. It is prepared from whey, which is the liquid that separates from milk during the cheese-making process. Whey protein powder

Corresponding Author: Sonia Sangwan, Department of Dairy Chemistry, National Dairy Research Institute, Karnal, India, Tel no: 9810000000; E-mail: soniasangwanera03@gmail.com

Received: June 28, 2021; **Accepted:** July 12, 2021; **Published:** July 19, 2021

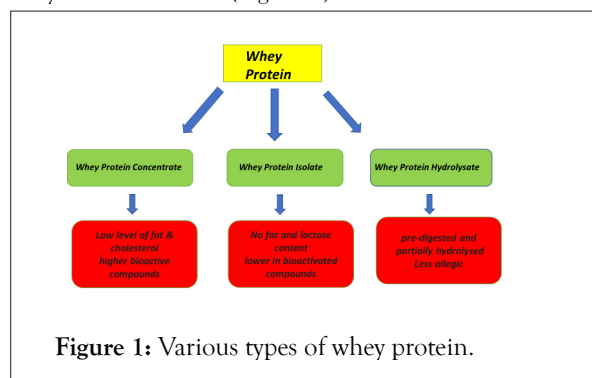
Citation: Sangwan S, Seth R (2021) Whey Protein Supplement: An Exclusive Food or Need of Hour: Review. J Proteomics Bioinform. 14:542

Copyright: © 2021 Sangwan S, et al. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

can be prepared by drying filtered whey liquid. Whey protein may be a popular choice among athletes, fitness enthusiasts and other people eager to build muscle or to reduce fat. Studies show it can help you recover from exercise, build muscle and strength and even lose weight by reducing your appetite and boosting your metabolism [5]. You can take whey protein just by mixing it with water or a liquid of your choice. Despite its health benefits, some people are concerned about its safety. Concentration of whey protein is different in different animals as sheep and goat have similar concentration but higher than that of bovine (cow) whey.

LITERATURE REVIEW

These days Industries are presenting whey protein as health supplement in place of various health food and beverages. Actually, these proteins are used for medicinal purpose and also to improve the health status of all age groups of humans. One of the most familiar examples is reported in Type 2 diabetes where this protein is generally involved in controlling or maintaining the blood glucose levels and also provides additional benefits including weight management [6]. Whey liquid is obtained from the milk of different domesticated animals and then whey liquid is purified by removal of a number of constituents. There are three types of whey i.e. Whey Protein Concentrate (WPC; low at still significant level of fat and cholesterol; higher bioactive compounds), Whey Protein Isolate (WPI; remove fat and lactose content but lower in bioactivated compounds) and whey protein hydrolysate (WPH; pre-digested and partially hydrolysed; highly hydrolysed whey could also be less allergenic). In addition, there are many immunological components in whey protein [7]. Despite its health benefits, some people are concerned about its safety and side effects (Figure 1).



Amino acid content is one of the most important factors in bovine milk proteins especially caseins and whey protein whereas milk proteins is a potential source of immunobiologically active peptides full of nutritional value. Whey protein provide all those essential amino acids which a human can't produce itself within the body. These amino acids are nine in number with different function. These amino acids fulfil all body requirements and keep body fit with lean muscle mass [8]. Branched chain amino acids e.g. leucine, isoleucine and valine are also present in Whey. These branched chain amino acids help in protein synthesis and thus cover up to one-third of muscle protein. In addition, only these amino acids are not degraded in the liver but other amino acids are normally regulated by gut and liver. Consuming these branched chain

amino acids before training can increase uptake into the muscle tissue and showed many benefits e.g. increase growth hormone circulation; lower lactate levels and improve muscular oxidation; decrease serum concentrations of intramuscular enzymes creatine kinase and lactate dehydrogenase etc. In other words, branched amino acids are continuously released from the liver and other internal organs to skeletal muscle so that these branched amino acids can assist in maintaining blood sugar levels. Thus about 40%-50 % of blood sugar during exercise is produced with the help of branched amino acids. Cysteine and methionine which help to grow immune function through intracellular conversion to glutathione, are present in high concentration in whey protein. Lactoferrin (iron binding glycoprotein) consists of approximately 689 amino acid residues and its concentration in human milk (2 mg/ml) and colostrums (7 mg/ml) respectively; while in bovine milk (0.2 mg/ml) and is colostrums (1.5 mg/ml) respectively [9]. According to the amino literature, lactoferrin is reported as anti-microbial and anti-inflammatory agent and also have the capability to induce the activity of natural killer cells and colony stimulating factor including the activation of macrophages. In human, lactoferrin is one of the most significant content or diet for children through breast milk for less than two years of age. Now a day, bovine lactoferrin including recombinant human lactoferrin are available commercially and is normally added to various food products including milk which is beneficial for our immune system and showed antibacterial and antiviral activities in the intestine against various pathogens. In addition, it may regulate the iron content of infants and also in pregnant women antiviral receptor-mediated pathway.

Whey protein also contains immunoglobulins (blood group proteins) is useful for enhancing the immunity. The highest concentration of these immunoglobulins is present in colostrum (first milk after birth). As per the literature, Immunoglobulins are useful for various bacterial infections and exists in the form of antibodies. These immunoglobulins provide passive maternal immunity to infants through breast milk and help to maintain our immune system. These immunoglobulins are about 10%-15% of total whey proteins from bovine milk. The colostrum of cow, sheep and bovine is full of lactoferrin. Bovine milk contains enzyme lactoperoxidase which has anti-bacterial properties against many pathogens. This enzyme in combination with hydrogen peroxide (H₂O₂) and thiocyanate (SCN⁻) work as antimicrobial agent in raw milk samples. Whey contains lactalbumin one of the major milk serum proteins i.e. alpha-lactalbumin which has got antiproliferative effects in human cell lines especially in case of adenocarcinoma such as Caco-2 and HT29. The content of alpha-lactalbumin is much higher in cow's milk and may cause allergic reaction in some cases [10]. Goat milk free of allergic reaction thus is useful in young children. The concentration of alpha lactalbumin is different in different animals eg. cow (52.9%-53.6%); sheep (8.97%-17%) and goat (13.31%-34.7%) [10].

Various health benefits of whey proteins

Whey protein is a cheap and easily available protein source in developing countries like India. It is full of many benefits to

human beings in its various derivative forms (concentrate, isolate and hydrolysate) (Figure 2).

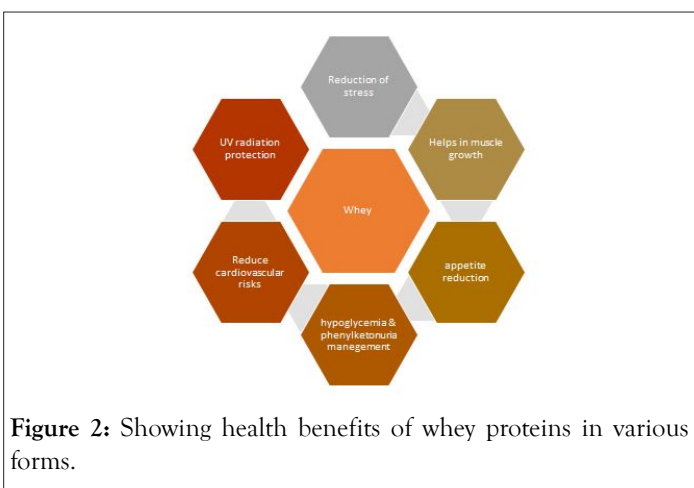


Figure 2: Showing health benefits of whey proteins in various forms.

Gut and prebiotic action

In seriously-ill patients, gut does not function appropriately and becomes unable to absorb even light diet. This affects the health of patients. Due to high cost, it is difficult to give parenteral nutrition to all such patients. In these patients, whey protein protection might impart inflammation and enhance tolerance towards enteral nutrition [11]. In order to exert its therapeutic property, lactic acid bacteria and yeast need to be viable. Prebiotic action of whey on gut may be not that effective due to hostile gastrointestinal environment and storage of whey. Whey protein gels can encapsulate the protecting the microbes and thus its efficacy is increased against the adverse conditions. The encapsulating *Lactococcus rhamnosus* CRL 1505 in whey protein and pectin survive better at low pH. Similarly, pectin antibiotic beads with a whey protein layer could be used as probiotic carrier in acidic functional foods [12]. *Lactococcus acidophilus* and *Bifidobacterium* in yogurt beverages are proteins of the cystic stabilized with high-methoxyl pectin and whey protein concentrate. This proves the role of whey as probiotics and prebiotics stabilizer. Whey protein isolate and alginate microparticles have showed appropriateness as oral delivery systems for probiotic yeast *Saccharomyces boulardii* [10].

Muscle strengthening

All eccentric and concentric skeletal muscle exercises result in muscle damage and produce inflammatory markers (muscle proteins in blood). The anabolic protein hydrolysates and amino acid supplements accelerate the repair. Leucine-derived metabolite β -hydroxy- β -methylbutyrate ingestion result in healing of muscle injury. Resistance exercise such as weight-lifting raises oxidation products in plasma, disturbs leukocyte redistribution and leukocyte functionality. The whey protein diet promoted a faster recovery from injury sustained due to isometric as well as concentric exercise in comparison to the casein diet. The low-protein (6.25 g) beverage can be as effective as a high-protein dose (25 g) at stimulating myofibrillar protein synthesis rates when supplemented with a high (5 g) leucine content. Leucine a amino acid (10% of the total whey amino acid) is important for muscle hypertrophy. Health parameters, performance and body composition effects produced by 12 week intake of hydrolysed

whey protein were compared in players. Ingestion of the hydrolysed whey protein helped in drop in the muscle damage markers (creatine kinase and lactate dehydrogenase). Lean body mass gains is significantly high in whey protein consumers than soy protein and the remarkable response was correlated with the elevated levels of leucine and faster absorption [2-4].

Immunomodular action

Whey protein concentrates enhance essential mucosal immunity during early life and have a protective role in some immune disorders. The incidence of atopic dermatitis (a chronic skin disease characterized by swollen, scaly and itchy rashes) is increasing worldwide, infants being a major vulnerable group. A meta-analysis of systematic review revealed that incidence of atopic dermatitis was considerably lower among infants in the partially hydrolyzed whey-based formula group compared to the bovine milk group. The finding suggested that whey-based formula might protect infants from atopic dermatitis. Psoriasis is chronic autoimmune disease-causing thick skin, dry scales and red patches. Bioactive whey protein isolate can decrease systemic inflammation due to psoriasis by increasing glutathione levels. The intake of 20 g/day whey protein isolate improved the conditions of the Psoriatic patients [3].

Antioxidant action

Inflammatory or oxidative stress can cause cystic fibrosis, pneumonia, diabetes, cancer, atherosclerosis, myocardial infarction, aging and a number of other degenerative diseases. Whey is full of antioxidant glutathione, and can eradicate the adverse effects of the stressors. Hyperbaric treatment of whey protein accelerated the release of bioactive peptides, raised intracellular glutathione level and decreased the bacteria and lact generation of interleukin IL-8, a cytokine responsible respiratory tract diseases. The dietary supplementation of pressurized whey (20 g/day) in cystic fibrosis patients decrease serum C-reactive protein level significantly [5]. The antioxidant and anti-inflammatory effects of pressurized whey protein isolate and native hydrolysate in human epithelial colorectal adenocarcinoma Caco-2 cells exposed pneumonia, cancer, cystics compared. The results suggested that whey protein isolate cystics hydrolysates can alleviate inflammation and oxidative stress in intestinal cells exposed to oxidative injury, which is further enhanced by their hyperbaric treatment. The consumption of whey protein hydrolysate boosts HSP70 expression. Thus the whey protein hydrolysate can enhance cell survival factors such as HSP90 and Vascular Endothelial Growth Factor (VEGF) cells. Pressurized whey protein can decreased level of inflammatory response, oxidative stress, and lung damage. Thus whey protein subjected to hyperbaric treatment has superior biological attributes. It protects the airway proteins from oxidation and stimulating leukocytes to kill the pathogens and save from *Pseudomonas aeruginosa*. Whey protein hydrolysate has the antioxidant effect against paracetamol-induced hepatonephrotoxicity [7].

Anticancer action

Several studies have suggested that whey protein hydrolysate may help in treating cancer patients and thus improve the anticancer efficacy in cancer of colon. A 48-year-old female patient with increased serum levels of leucine, isoleucine, valine, lysine, threonine was administered with whey protein (10 g thrice daily) and a weekly intra-muscular injection of testosterone enanthate before and during the Standard-Of-Care (SOC) chemotherapy. As a result of the combination therapy, improvement of lean body mass, physical activity, and overall quality of life was observed in recurrent cervical cancer [9].

Cardioprotective

Whey protein intake reduces cardiovascular disease (ischemic stroke) risk. Whey-derived extract (NOP47) ingestion increased impaired brachial artery flow-mediated dilation (improved endothelial function). Postprandial plasma amino acids level increased. The improvement in arterial dilation was found to be independent of the circulating vasoactive compounds such as nitric oxide, prostacyclin and endothelium-derived hyperpolarizing factor [3]. The cardiovascular risk might be lessened by using rapid-absorbable extracts derived from whey.

Antidiabetic action

Diabetes effects of all human organs accompanied by many complications such as loss of vision, angiopathy, reduced blood flow leading to tissue hypoxia and nonhealing ulcers. Type-2 diabetes is managed by diet control and hypoglycaemic drugs. Whey protein have been demonstrated to reduce serum glucose level in healthy individuals, maintain muscle mass, boost the release of satiety hormones (cholecystokinin, leptin, and Glucagon Like-Peptide 1 (GLP-1) and lower the secretion of there hunger hormone ghrelin. For ancillary therapy in glycaemia and vascular inflammation control in the diabetics, cysteine in whey proteins is quiet effective.

The whey protein helps in diabetic wound healing by restricting the access of inflammatory cytokines by maintaining normal IL-10, TNF- α , IL-1 β and IL-6 levels. Increased serum levels of leucine, isoleucine, valine, lysine, threonine helps in Insulin secretion in body [9].

Whey protein fractions (whey isolate and whey hydrolysate) added to a fat-rich meal lowered postprandial triglyceride responses in type 2 diabetic subjects. Both components provoked a higher insulin response. A hydrolyzed whey protein-based supplement may result in a higher leucine level followed by increased insulin level.

Obesity management

Whey protein helps in reduction of obesity. The ameliorating effects of the protein-rich diet on metabolic disorders are exactly due to modulation of satiety mediated by liver lipogenesis attenuation. The whey protein concentrate employs stronger beneficial effects than that of soy protein isolate on appetite, calorie intake, anthropometry (body mass index and waist

circumference), and body composition (body fat mass and lean muscle) of obese men and thus reduce obesity [11].

Side effects of whey protein

Whey protein is very useful nutritional food and there is no other natural protein equivalent to this. But still there can be risks from nutritionally refined foods such as whey as it is a heavy protein. Acne can develop if a person takes whey protein for a long time. Most of whey protein's side effects are related to digestion and may experience symptoms such as bloating, gas, stomach cramps and diarrhea. But most of these side effects are due to lactose intolerance due lack of the enzyme lactase, which body needs to digest lactose. Moreover, lactose intolerance is quiet common and about 75% of people are affected worldwide. In such cases, whey protein isolate powder can be used as whey protein isolate is more refined [12]. It contains smaller amount of fat and lactose than whey protein concentrate.

People with a cow's milk allergy may be allergic to whey protein. Cow milk allergy exists up to initial three years age and after that 90% of people out grow with cow's milk allergies. Symptoms of a cow's milk allergy are hives, rashes, facial swelling, throat and tongue swelling and a runny or stuffy nose and rarely anaphylaxis, a severe, life-threatening allergic reaction.

Conclusion

Whey protein is very important and cheap source of protein which is full of nine amino acids along with branched amino acids. So, it is a first-rate nutrient. Only whey protein can fulfil the increasing demand of an economical protein source for humans in developing nations. Various forms of whey protein can be used as health supplement. Excess of everything is bad so is of whey protein. Whey protein is full of immunoglobulins and can challenge cancer as an immune-nutrient. Still whey is an underutilized resource and new strategies should be planned to increase its the utility for human welfare.

REFERENCES

1. Abrahao V. Nourishing the dysfunctional gut and whey protein. *Curr Opin Clin Nutr Metab Care*. 2012;15(5):480-484.
2. Alexander DD, Schmitt DF, Tran NL, Barraj LM, Cushing CA, et al. Partially hydrolyzed 100 % whey protein infant formula and atopic dermatitis risk reduction: A systematic review of the literature. *Nutr Rev*. 2010;68(4):232-245.
3. Athira S, Mann B, Sharma R, Kumar R. Ameliorative potential of whey protein hydrolysate against paracetamol-induced oxidative stress. *J Dairy Sci*. 2013;96(3):1431-1437.
4. Attaallah W, Yilmaz AM, Erdoğan N. Whey protein versus whey protein hydrolysate for the protection of azoxymethane and dextran sodium sulfate induced colonic tumors in rats. *Pathol Oncol Res*. 2012;18(4):817-822.
5. Badr G, Badr BM, Mahmoud MH, Mohany M, Rabah DM, et al. Treatment of diabetic mice with undenatured whey protein accelerates the wound healing process by enhancing the expression of MIP-1 α , MIP-2, KC, CX3CL1 and TGF- β in wounded tissue. *BMC Immunol*. 2012;13:32.
6. Ballard KD, Kupchak BR, Volk BM, Mah E, Shkreta A, Liptak C, et al. Acute effects of ingestion of a novel whey-derived extract on

- vascular endothelial function in overweight, middle-aged men and women. *Br J Nutr.* 2012;109(5):882-893.
7. Bell SJ. Whey protein concentrates with and without immunoglobulins: A review. *J Med Food.* 2000;3(1):1-13.
 8. Bjorck L, Rosen CG, Marshall V, Reiter B. Antibacterial activity of lactoperoxidase system in milk against pseudomonas and other gram negative bacteria. *Appl Microbiol.* 1975;30(2):199-204.
 9. Blome RM, Drackley JK, McKeith FK, Hutjens MF, McCoy GC. Growth, nutrient utilization, and body composition of dairy calves fed milk replacers containing different amounts of protein. *J Anim Sci.* 2003;81(6):1641-1655.
 10. Burd NA, West DW, Moore DR, Atherton PJ, Staples AW, Prior T, et al. Enhanced amino acid sensitivity of myofibrillar protein synthesis persists for up to 24 h after resistance exercise in young men. *J Nutr.* 2011;141(4):568-573.
 11. Castro GA, Maria DA, Bouhallab S, Sgarbieri VC. *In vitro* impact of a whey protein isolate (WPI) and collagen hydrolysates (CHs) on B16F10 melanoma cells proliferation. *J Dermatol Sci.* 2009;56(1):51-57.
 12. Casqueiro J, Casqueiro J, Alves C. Infections in patients with diabetes mellitus: A review of pathogenesis. *Indian J Endocrinol Metab.* 2012;16(1):S27-S36.