



# A REVIEW: BENEFITS AND RISK ASSESSMENT OF PROTEIN POWDER SUPPLEMENTS IN HUMAN BODY

<sup>1</sup>Patel Megha Sunilbhai, <sup>2</sup>Dr. Alisha Patel

<sup>1</sup> Research scholar, Department of Pharmaceutical Quality Assurance, ROFEL Shri G.M. Bilakhia College of Pharmacy, Namdha, vapi, 396191

<sup>2</sup> Associate Professor, Department of Pharmaceutical Quality Assurance, ROFEL Shri G.M. Bilakhia College of Pharmacy, Namdha, vapi, 396191

**Abstract:** Protein powder is a powdered form of protein (concentrated) that comes from milk (casein or whey), egg white powder, or plant sources (soy, pea, rice, pumpkin seed and hemp). Dietary protein provides the amino acids your body needs to build and repair muscles, heal wounds and injuries, synthesize hormones and enzymes, and even store and carry oxygen throughout the body. Protein powders often contain other ingredients—like artificial sweeteners and/or flavorings, thickening agents, vitamins, minerals, and other functional ingredients. Protein powders can be helpful for individuals who struggle to meet their daily protein needs through whole foods alone. However, it's important to note that protein powder supplements are not necessary for everyone, it's essential to be mindful of potential risks. Some protein powders may contain additives, fillers, or artificial sweeteners that could be problematic for certain individuals. Additionally, excessive protein intake from supplements can put a strain on the kidneys and may lead to digestive issues. However, it's important to be aware of potential risks. Overconsumption of protein powder may lead to metabolic diseases risk, cardiovascular risk and impact on kidney function. The American Heart Association has suggested that high protein diets may have detrimental effects on liver function. It also contains Heavy metals that extent of renal damage by heavy metals depends on the nature, the dose, route and duration of exposure. Additionally, excessive protein intake from supplements can strain the kidneys and may cause digestive issues such as bloating or discomfort. To ensure the best use of protein powder supplements, it's always a good idea to consult with a healthcare professional or a registered dietitian. They can provide personalized guidance based on your individual needs, goals, and any existing health conditions.

**Index Terms** - Protein Powder, Whey Protein, Protein intake.

## INTRODUCTION

Protein powders are concentrated sources of protein from animal or plant foods, such as dairy, eggs, rice, or peas. Protein is an essential macronutrient composed of 20 different amino acids, nine of which must be obtained from the diet because the body can't produce them on its own. Amino acids are considered the primary building blocks of your body because they are found in muscles, tendons, bone, skin, hormones, tissue, enzymes, red blood cells, and more. Dietary protein provides the amino acids your body needs to build and repair muscles, heal wounds and injuries, synthesize hormones and enzymes, and even store and carry oxygen throughout the body. Good protein sources include eggs, dairy, lean meat, poultry, fish, beans, lentils, soybeans, tofu, and supplements (such as protein powder) or protein-fortified foods. Proteins are nitrogen-containing substances that are formed by amino acids. They serve as the major structural component of muscle and other tissues in the body. In addition, they are used to produce hormones, enzymes and hemoglobin. Proteins can also be used as energy; however, they are not the primary choice as an energy source. For proteins to be used by the body they need to be metabolized into their simplest form, amino acids. There have been 20 amino acids identified that are needed for human growth and metabolism.

## 1. WHAT IS PROTEIN POWDER?

Protein powder is a powdered form of protein that comes from milk (casein or whey), egg white powder, or plant sources (soy, pea, rice, pumpkin seed and hemp). Protein powders often contain other ingredients—like artificial sweeteners and/or flavorings, thickening agents, vitamins and minerals, and other functional ingredients—and vary in protein content depending on the type used. For instance, whey protein offers 25 grams of protein/serving, whereas pea protein contains 15 grams of protein/serving. The U.S. Food and Drug Administration (FDA) considers protein powder a dietary supplement. The FDA doesn't regulate supplements like other products, such as drugs or medical treatments. The FDA doesn't ensure what's in the container is the same as what's on the label or that health claims are accurate. However, not everyone benefits from these powders. If your diet is already rich in high quality protein, you likely won't see much difference in your quality of life by adding protein powder. However, athletes and people who regularly lift weights may find that taking protein powder helps maximize muscle gain and fat loss (Trusted Source, Trusted Source). Protein powders can also aid individuals who have difficulties meeting their protein needs with food alone, such as people who are ill, older adults, and some vegetarians or vegans.

## 2. TYPES OF PROTEIN POWDER

**2.1 Animal protein:** Eating enough protein daily is important for your overall health. Protein is necessary for critical processes such as immune function, cellular processes, cell structure, and growth, among others. Thus, it's essential to consume enough protein on a daily basis. Generally, animal protein sources also supply other important nutrients, including vitamin B12 and a type of iron called heme iron. Heme iron is more readily absorbed than the iron found in plant foods, which is known as non-heme iron.

**2.2 plant protein:** plant protein sources, such as beans, nuts, legumes, wheat, and wild rice, are too low in or missing one or more essential amino acids. However, because plant foods contain varying amounts of different amino acids, getting all the essential amino acids on an exclusively plant-based diet is still manageable it may just take a little more effort.

**2.3 Whey protein:** Whey protein comes from milk. It is the liquid that separates from the curds during the cheesemaking process. It's high in protein but also contains lactose, a milk sugar that many people have difficulty digesting. Whey protein can help build muscle mass and strength and enhance post-workout recovery. It may also help improve body composition, reduce appetite, decrease inflammation, and support heart health. While whey protein concentrate retains some lactose, the isolate version contains very little because most of this milk sugar is lost during processing.

**2.4 Casein protein:** Casein is a type of protein found in milk that is digested and absorbed more slowly than whey protein, which can reduce the rate of muscle protein breakdown. It may be also more effective at increasing muscle growth than some other types of protein, including soy and wheat. Like whey, casein is a protein found in milk. However, casein is digested and absorbed much more slowly. Casein forms a gel when it interacts with stomach acid, slowing down stomach emptying and delaying your bloodstream's absorption of amino acids. This results in a gradual, steadier exposure of your muscles to amino acids, reducing the rate of muscle protein breakdown. Research indicates that casein may be slightly more effective at increasing MPS and strength than soy and wheat protein — but less than whey protein. It may also be a better protein supplement choice when taken before bed.

**2.5 Egg protein:** Eggs are an excellent source of high-quality protein. Egg white protein is a good source of essential amino acids and is rich in leucine. Though more research is needed on the potential benefits, egg white protein supplements may be a good alternative to whey or casein for those with dairy allergies. Of all whole foods, eggs have the highest protein digestibility-corrected amino acid score (PDCAAS), which is used to measure a protein's quality and digestibility. Eggs are also one of the best foods for decreasing appetite and helping you stay full for longer, especially when combined with fiber. However, egg protein powders are typically made from egg whites rather than whole eggs. Although the protein quality remains excellent, you may experience less fullness because the high fat yolks have been removed. Like all animal products, eggs are a complete protein source. That means they provide all nine essential amino acids that your body can't make itself.

**2.6 Pea protein:** Pea protein powder is especially popular among vegetarians, vegans, and people with allergies or sensitivities to dairy or eggs. Pea protein is a good source of BCAAs and contains all nine essential amino acids. It may also be comparable to whey protein in terms of its ability to increase fullness hormones and improve body composition, strength, and performance when combined with exercise.

**2.7 Hemp protein:** Hemp protein powder is another plant-based supplement that is gaining popularity. Hemp protein is rich in omega-3 fatty acids and several essential amino acids. Some research suggests that it may also be well-digested, but more studies are needed. Although hemp is related to cannabis, it only contains trace amounts of the psychoactive component, tetrahydrocannabinol (THC).

**2.8 Brown rice protein:** Protein powders made from brown rice have been around for some time, but they are generally considered inferior to whey protein for building muscle. Rice protein contains all essential amino acids but is not considered a complete protein. Though research is limited, one 8-week study found that rice protein and whey protein were similarly effective at improving body composition and performance when paired with resistance training.

## 3. HOW TO USE PROTEIN POWDER:

Protein powder is versatile. It comes in an array of tastes and textures, from unflavored to chocolate, vanilla, or splashier choices like red velvet cake and snickerdoodle. You can choose plant-based powders made with hemp, soy, nuts, or peas. You can also select powders with whey or egg protein. Each protein powder has a nutrition label with a suggested serving size. In general, a serving is one to two scoops with the scoop that comes with the powder. It supplies 20-40 grams of protein.

## 4. HEALTH BENEFITS OF PROTEIN POWDER:

**4.1 Aiding weight loss:** In one study of 158 people, published in Nutrition & Metabolism Trusted Source, those who were given whey “lost significantly more body fat and showed a greater preservation of lean muscle compared to subjects consuming the control beverage.

**4.2 Anti-cancer properties:** Promising results were published in the journal Anticancer Research Trusted Source for the use of whey protein concentrate in cancer treatment. More research is needed.

**4.3 Lowering cholesterol:** A study, published in The British Journal of Nutrition Trusted Source, gave whey supplements to 70 overweight men and women for 12 weeks and measured a number of parameters, such as lipid and insulin levels. They found that “there was a significant decrease in total cholesterol and LDL cholesterol at week 12 in the whey group compared with the casein (group).”

**4.4 Asthma:** Whey protein could improve the immune response in children with asthma. One small study involving 11 children, published in the International Journal of Food Science and Nutrition Trusted Source, found that children with asthma who were supplemented with 10 gram whey protein twice daily for 1 month had an improved immune response.

**4.5 Blood pressure and cardiovascular disease:** Research published in the International Dairy Journal found that beverages that were supplemented with whey protein significantly reduced blood pressure in patients with hypertension; their risk of developing heart disease or stroke was also lower.

**4.6 Reducing weight loss in people with HIV:** A study published in the journal Clinical and Investigative Medicine found that whey protein may help reduce weight loss among HIVpositive patients.



## 5. HEALTH RISK ASSESSMENT OF HIGH PROTEIN INTAKE ON HUMAN HEALTH

Long-term consumption of any nutrients (including water, protein, and vitamin A at high amounts may have adverse effects on human health. Protein intake greater than its safe upper limits in different age groups can exceed the ability of the liver, intestine, and kidneys to detoxify ammonia and should be avoided. Adverse effects of high protein intake include intestinal discomfort, hypoketotic hypoglycemia, hyperammonemia, hyperinsulinemia, dehydration, irritation, nausea, diarrhea, liver and kidney injuries, fatigue, headache, seizures, high risk for cardiovascular disease, or even death. Increased protein intakes and supplementation have generally been focused on athletic populations. However, over the past few years high protein diets have become a method used by the general population to enhance weight reduction. In strength/power athletes who consume high protein diets, a major concern was the amount of food being consumed that was high in saturated fats. However, through better awareness and nutritional education many of these athletes are able to obtain their protein from sources that minimizes the amount of fat consumed. For instance, removing the skin from chicken breast, consuming fish and lean beef, and egg whites. In addition, many protein supplements are available that contain little to no fat. It should be acknowledged though that if elevated protein does come primarily from meats, dairy products and eggs, without regard to fat intake, there likely would be an increase in the consumption of saturated fat and cholesterol. Problems of high protein intake can be exacerbated by low intake of carbohydrate because of additional burdens on the liver and kidney to produce large amounts of glucose from AA. Calorie content: Whey protein may be low fat and low carb, but it still has calories. "Too many calories from anything, including protein, leads to weight gain," Smith explains. Extra sugar or processed ingredients: Many protein powders and shakes contain processed ingredients like artificial flavors, sweeteners or added sugar. "It's better to get your protein from whole foods and a varied diet, rather than a supplement, bar or shake," says Smith. "If you use a supplement, look for one that lists whey protein as the only ingredient."

There is also such a thing as too much protein. Taking in more than 2 grams per kilogram of body weight per day over a long period is associated with vascular, digestive, and kidney problems. Taking too much over a long period can also hurt your kidneys or liver and possibly aggravate acne, especially if you are sedentary. If you're taking any of them, talk with your healthcare provider about whether to continue using whey protein powder with your medication.

### 5.1 A human health risk assessment of heavy metal ingestion among consumers of protein powder supplements:

Concerns have recently been raised about the presence of heavy metals in protein powder supplements following a Consumer Reports analysis of 15 protein powder products. The Consumer Reports study found that the average amounts of heavy metals in three servings of protein powder per day exceeded the maximum limits in dietary supplements proposed by U.S. Pharmacopeia. In a follow up to the Consumer Reports analysis, another study reported that 40 % of the 133 protein powder products they tested had elevated levels of heavy metals. The objective of this analysis was to determine whether the heavy metal concentrations reported in protein powder supplements posed any human health risks, based on the reported concentrations of arsenic (As), cadmium (Cd), mercury (Hg), and lead (Pb) in the protein powder.

We noted that the protein powder HI was mainly driven by the As or Cd content in each product. Interestingly, the highest HI levels (which approached 1) were found in 'mass gain' type protein powder supplements, whereas the lowest calculated HI levels were in whey protein powders.

### 5.2 Determination of heavy metal content in whey protein sample in different country's: A probabilistic risk assessment study:

Whey protein is a by-product obtained from cheese manufacturing, contains high amounts of essential metals and amino acids. We assessed levels and health risk of Co, Ni, Sn, Cr, Cu, Mn, Zn, Fe, Al, Na, Ca, Mg, Pb, Cd, and Hg in different whey protein samples collected in Egypt using inductively coupled plasma optical emission spectrometry (ICP OES) and graphite furnace atomic absorption spectrometry (GF AAS). Large differences were found between the measured and defined values for some metals (such as Na, Mn, Cr, Cu, and Mg), whereas others showed only minor variation (Fe and Zn). The maximum concentration of Ca, Na, Mg, Zn, Fe, Cu, Al, Mn, Ni, Cr, and Sn was 12860, 5336, 3248, 66.11, 40.14, 16.78, 16.26, 14.37, 0.927, 0.685, and 0.502 mg/kg, respectively. The health risk assessment was evaluated for estimated daily intake (EDI), average body weight (70 kg), hazard quotient (HQ), and hazard index (HI) using the FAO/WHO and US EPA recommendations. Among the samples, only two brands had HI > 1, indicates that there is some possibility that non-cancer effects may occur through consumption in the future.

### 5.3 Effect of Heavy Metals on, and Handling by, the Kidney:

Heavy metals such as cadmium (Cd), mercury (Hg), lead (Pb), chromium (Cr) and platinum (Pt) are a major environmental and occupational hazard. Unfortunately, these non-essential elements are toxic at very low doses and non-biodegradable with a very long biological half-life. Thus, exposure to heavy metals is potentially harmful. Because of its ability to reabsorb and accumulate divalent metals, the kidney is the first target organ of heavy metal toxicity. The extent of renal damage by heavy metals depends on the nature, the dose, route and duration of exposure. Both acute and chronic intoxication have been demonstrated to cause nephropathies, with various levels of severity ranging from tubular dysfunctions like acquired Fanconi syndrome to severe renal failure leading occasionally to death. Very varied pathways are involved in uptake of heavy metals by the epithelium, depending on the form (free or bound) of the metal and the segment of the nephron where reabsorption occurs (proximal tubule, loop of Henle, distal tubule and terminal segments). It addresses the putative uptake pathways involved along the nephron, the mechanisms of intracellular sequestration and detoxification and the nephropathies caused by heavy metals.

### 5.4 Acute kidney injury associated with androgenic steroids and nutritional supplements in bodybuilders:

Anabolic steroids, also known as anabolic-androgenic steroids, are synthetic substances that mimic the effects of testosterone, the male sex hormone. They are used to increase muscle size, strength, and performance and are commonly associated with athletic performance enhancement and bodybuilding. Four bodybuilders who injected anabolic steroids and ingested commercial protein (78–104 g/day) and creatine (15 g/day) products presented with serum creatinine levels between 229.84 and 335.92 µmol/L (2.6–3.8 mg/dL). Renal biopsies revealed acute tubular necrosis. Four weeks after discontinuing injections and supplements, serum creatinine was in the normal range and estimated glomerular filtration rate > 1.00 mL/s (60 mL/min), including two patients with

biopsies showing >30% interstitial fibrosis and tubular atrophy. The findings highlight a risk for acute and potentially chronic kidney injury among young men abusing anabolic steroids and using excessive amounts of nutritional supplements.

#### **5.6 Dietary Protein and Cardiovascular Disease Risk:**

High protein diets have also been suggested to have negative effects on blood lipid profiles and blood pressure, causing an increased risk for cardiovascular disease. This is primarily due to the higher fat intakes associated with these diets. However, this has not been proven in any scientifically controlled studies. Hu et al., (1999) have reported an inverse relationship between dietary protein (animal and vegetable) and risk of cardiovascular disease in women, and Jenkins and colleagues (2001) reported a decrease in lipid profiles in individuals consuming a high protein diet. Furthermore, protein intake has been shown to often have a negative relationship with blood pressure. Thus, the concern for elevated risk for cardiovascular disease from high protein diets appears to be without merit. Likely, the reduced body weight associated with this type of diet is facilitating these changes. Excessive intake of protein is known to cause gastrointestinal discomfort due to a high rate of NO synthesis by mucosal cells. Likewise, elevated levels of homocysteine (a metabolite of methionine) in the plasma decrease NO bioavailability in endothelial cells by inhibiting NO synthesis and oxidizing NO, thereby causing vascular dysfunction.

#### **5.7 Dietary Protein and Renal Function:**

The major concern associated with renal function was the role that the kidneys have in nitrogen excretion and the potential for a high protein diet to over-stress the kidneys. In healthy individuals there does not appear to be any adverse effects of a high protein diet. In a study on bodybuilders consuming a high protein (2.8 g·kg<sup>-1</sup>) diet no negative changes were seen in any kidney function tests. However, in individuals with existing kidney disease it is recommended that they limit their protein intake to approximately half of the normal RDA level for daily protein intake (0.8 g·kg<sup>-1</sup>·day<sup>-1</sup>). Lowering protein intake is thought to reduce the progression of renal disease by decreasing hyperfiltration.

#### **5.8 Protein Intake and Liver Disease Risk:**

The American Heart Association has suggested that high protein diets may have detrimental effects on liver function. This is primarily the result of a concern that the liver will be stressed through metabolizing the greater protein intakes. However, there is no scientific evidence to support this contention. Jorda and colleagues (1988) did show that high protein intakes in rats produce morphological changes in liver mitochondria. However, they also suggested that these changes were not pathological, but represented a positive hepatocyte adaptation to a metabolic stress. Protein is important for the liver not only in promoting tissue repair, but to provide lipotropic agents such as methionine and choline for the conversion of fats to lipoprotein for removal from the liver. The importance of high protein diets has also been acknowledged for individuals with liver disease and who are alcoholics. High protein diets may offset the elevated protein catabolism seen with liver disease, while a high protein diet has been shown to improve hepatic function in individuals suffering from alcoholic liver disease.

#### **5.9 Cancer and diabetes risk:**

Recent epidemiological studies suggested that consumption of large quantities of protein (particularly animal protein) could be linked to an increase in risks for cancer and diabetes. Although some epidemiological research revealed a correlation between consumption of animal-based protein (e.g., red meats) and certain diseases (e.g., colon cancer and hypertension), it should be borne in mind that: (1) there is a clear difference between correlation and causation; and (2) results of the epidemiological studies do not establish a role for adequate consumption of animal-source protein (e.g., lean meat) in causing chronic diseases in humans. • There are no rigorous long-term clinical trials involving meat-less diets for adults or children. Likewise, there is limited evidence in human beings for the carcinogenicity of adequate intake of animal protein. Lean meat is a major source of high-quality protein for human consumption. Recent studies from large cohorts such as the Nurse's Health Study, the Health Professional Follow-up Study, and the Multiethnic Cohort showed non-significant associations and even inverse associations between consumption of unprocessed red meat and colorectal cancer.

### **CONCLUSION**

Protein powder supplements can provide benefits like helping with muscle recovery after workouts and supporting muscle growth. They are typically made from different protein sources such as whey, casein, or plant-based proteins like soy or pea. But, it's important to be cautious about added ingredients and excessive intake. Reading labels and consulting with a healthcare professional can help you find the right one for you. Some protein powders may contain additives, fillers, or artificial sweeteners that could be problematic for certain individuals. Additionally, excessive protein intake from supplements can put a strain on the kidneys and may lead to digestive issues. Protein powder supplements can be beneficial for muscle recovery and growth, but it's important to consult a healthcare professional to assess any risks. They provide a convenient source of protein, but whole foods should still be the main focus. Seek personalized advice for safe and effective use.

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