

Common Bean (*Phaseolus vulgaris* L.): Nutritional Composition, Bioactive Compounds and Health Benefits

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Common bean (*Phaseolus vulgaris* L.) is one of the most widely consumed grain legumes worldwide and serves as a major source of plant-based protein, dietary fiber, complex carbohydrates, essential minerals, vitamins, and diverse bioactive compounds. Beyond its nutritional significance, common bean has been increasingly recognized as a functional food due to its protective role against chronic non-communicable diseases, including cardiovascular diseases, diabetes mellitus, obesity, and certain types of cancer. The health-promoting properties of beans are primarily attributed to their high content of resistant starch, soluble and insoluble fiber, polyphenols (anthocyanins, flavonoids, proanthocyanidins), lectins, phytic acid, and bioactive peptides. Epidemiological, experimental, and clinical evidence indicates that regular bean consumption improves lipid profiles, lowers glycemic response, enhances gut microbiota composition, reduces oxidative stress, and modulates inflammatory pathways. This review comprehensively discusses the nutritional composition of common beans, their major phytochemical constituents, and the underlying biochemical mechanisms responsible for their disease-preventive effects, highlighting their importance in sustainable and preventive nutrition strategies.

Keywords: *Phaseolus vulgaris*, common bean, dietary fiber, polyphenols, cardiovascular disease, diabetes, obesity, functional food



Figure 1. Common bean (*Phaseolus vulgaris* L.) grains

Introduction

Common bean (*Phaseolus vulgaris* L.) originated in the Americas and was domesticated approximately 7000–8000 years ago in Mesoamerica and the Andean regions. It is currently cultivated in tropical, subtropical, and temperate regions worldwide and represents a staple food in Latin America, Africa, and parts of Asia. In many developing countries, beans are often referred to as the 'poor man's meat' due to their affordability and high protein content. However, in recent decades, beans have gained renewed scientific interest not only for their macronutrient density but also for their functional properties that contribute to disease prevention. Nutritionally, common beans contain 17–30% protein, 50–65% carbohydrates, 1–2% fat, and 20–30 g of dietary fiber per 100 g dry weight. They are also rich sources of iron, zinc, magnesium, potassium, calcium, and B-group vitamins. Importantly, beans contain significant levels of bioactive compounds such as flavonoids, phenolic acids, anthocyanins, proanthocyanidins, resistant starch, oligosaccharides, and lectins. These compounds exert antioxidant, anti-inflammatory, antidiabetic, and cardioprotective activities.

Nutritional Composition of Common Bean

Protein and Amino Acid Profile: Common bean is an excellent plant-based protein source, containing predominantly globulins and albumins. The protein quality of beans is enhanced by their high lysine content, an essential amino acid deficient in cereals. Therefore, combining beans with cereals results in complementary amino acid profiles, improving overall dietary protein quality. Although sulfur-containing amino acids such as methionine and cysteine are relatively low, proper cooking improves protein digestibility by inactivating antinutritional factors such as trypsin inhibitors.

Carbohydrates and Resistant Starch: Carbohydrates constitute the major portion of beans and include starch, resistant starch, and non-starch polysaccharides. Resistant starch escapes digestion in the small intestine and undergoes fermentation in the colon, producing short-chain fatty acids (SCFAs) such as acetate, propionate, and butyrate. These SCFAs play essential roles in maintaining gut health, regulating glucose metabolism, and reducing systemic inflammation.

Dietary Fiber: Common beans are particularly rich in dietary fiber, providing both soluble and insoluble fractions. Soluble fiber forms viscous gels in the gastrointestinal tract, slowing glucose absorption and reducing serum cholesterol levels. Insoluble fiber enhances intestinal motility and prevents constipation. The high fiber content contributes significantly to the low glycemic index of beans and their protective role against metabolic disorders.

Minerals and Micronutrients: Beans are rich in iron, zinc, magnesium, potassium, and calcium. Iron-rich biofortified bean varieties have demonstrated improvements in iron status and cognitive performance in human populations. Magnesium and potassium contribute to blood pressure regulation, while zinc plays a crucial role in immune function and enzymatic activities.

Bioactive Compounds in Common Beans

Polyphenols: Polyphenols are major phytochemicals in common beans and include flavonoids, anthocyanins, proanthocyanidins, and phenolic acids. Dark-colored beans such as black and red varieties contain higher concentrations of anthocyanins, which possess strong antioxidant capacity. Polyphenols scavenge free radicals, inhibit lipid peroxidation, modulate gene expression, and suppress inflammatory signaling pathways.

Lectins and Protease Inhibitors: Lectins and protease inhibitors, once considered solely antinutritional factors, exhibit potential anticancer and immunomodulatory activities. Proper cooking significantly reduces their antinutritional effects while retaining certain beneficial bioactivities.

Phytic Acid and Oligosaccharides: Phytic acid exhibits antioxidant and potential anticancer properties. Oligosaccharides act as prebiotics, promoting beneficial gut microbiota such as Bifidobacteria and Lactobacilli, thereby enhancing intestinal health and immune modulation.

Health Benefits of Common Bean Consumption

Cardiovascular Protection: Regular bean consumption has been associated with reduced LDL cholesterol, improved HDL levels, and decreased risk of cardiovascular diseases. Mechanisms include soluble fiber-mediated cholesterol reduction, inhibition of LDL oxidation by polyphenols, antiplatelet activity, and regulation of blood pressure through mineral balance.

Anti-Diabetic Effects: Beans have a low glycemic index due to resistant starch and fiber content. Clinical studies demonstrate lower postprandial glucose levels following bean consumption. Polyphenols enhance insulin sensitivity and regulate carbohydrate metabolism through modulation of key enzymes.

Anti-Obesity Potential: The high fiber and protein content of beans increases satiety and reduces overall caloric intake. Their low energy density supports weight management and reduces adiposity-related metabolic risk.

Anti-Cancer Properties: Experimental studies suggest that bean consumption reduces colon tumor incidence and inhibits cancer cell proliferation. Butyrate produced from fiber fermentation exerts protective effects on colonocytes by regulating apoptosis and cell differentiation.

Gut Microbiota and Immune Modulation: Fermentation of bean fiber and resistant starch improves gut microbial diversity, enhances SCFA production, and reduces intestinal inflammation. Improved gut integrity contributes to systemic metabolic and immune health.

Conclusion

Common bean (*Phaseolus vulgaris* L.) is a nutritionally dense and functionally significant legume with substantial health benefits. Its balanced protein profile, high dietary fiber, resistant starch, essential minerals, and diverse phytochemicals contribute to protection against cardiovascular diseases, diabetes, obesity, and certain cancers. Promoting regular bean consumption represents a sustainable, economical, and evidence-based strategy for improving public health worldwide.

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