



# NUTRITIONAL AND HEALTH BENEFITS OF PLANT PROTEINS: A REVIEW

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## Abstract

Daily amino acid consumption in tune with recommended allowance for proper utilization and functioning of the body is imperative. Amino acids (both essential and non-essential) are crucial in the diet to support maximum bioavailability. Many researches have been initiated to elucidate the reason for the need and health benefits of high protein diet especially from plant protein sources. Though, antinutritional factors such as tannins, trypsin inhibitors, phytic acid etc from plant protein sources inhibits the bioavailability of dietary protein but incorporation of proper cooking methods reduces/destroys such factors. Metabolic syndrome such as obesity, Type-2 Diabetes Mellitus, hypertension, dyslipidaemia etc. have been reported to be a major public health concern. The glycemic response as well as the progression of the disease depends upon the source, nature, quantity as well as quality of the macronutrients. GoodPlant quality protein diets have shown to delay the progression as well as the relapse propensity of the diseases. Many evidences have been amassed on the negative impacts of agricultural production and animal rearing on environmental integrity as well as animal welfare. The global impact of rearing, storage and slaughtering of animals are of much extreme concerns.

**Key words:** Amino acid, Protein Quality, Antinutritional factor and Metabolic Syndrome.

## Introduction

Proteins are one of the major macronutrients required for many functions in the body. Over 300 amino acids are known in nature and out of them 20 amino acids are imperative to human existence. Consumption of proteins (both essential as well as non-essential amino acids) determines protein quality. Protein quality is described as the ability of the protein to provide essential amino acids in the required amount and pattern. It also describes characteristics of a protein in relation to its ability to achieve defined metabolic actions. Generally, the concept of protein is mainly thought in maintaining body protein mass and repair. New emerging researches have shown that good quality protein is used for body regulation, composition and bone health, gastrointestinal functional and bacterial flora, glucose homeostasis, cell signalling and satiety etc (Millward *et al.*, 2008). The protein quality of plantsources depends upon the amino acid composition, ratios of essential amino acids to non-essential amino acid, susceptibility to hydrolysis during digestion, source, the effects of processing and cooking method employed (Schaafsma, 2000). Proteins are not consumed in isolation but in a complex food matrix. Cereal, legumes and nuts are vital plant protein sources. Over many decades, researches have been conducted on animal based protein consumption; its impact on health and metabolic syndrome. Though, plant proteinbased nutrition has been less desirable than animal based protein diets due to wide nutritional disparities among both the groups (Friedman, 1996). In recent decades due to the need of sustainable development, animal protection, and environmental safety as well as a huge increase in metabolic

syndrome, people round the globe are shifting to plant based protein diets (David *et al.*, 2014). Approaches such as cell engineering, scalable unit operations for down streaming processing (DSP), bioprocess optimization and detailed cost analysis are employed for innovative product development (Sack *et al.*, 2015). Availability of protein from the consumption of plant protein mix diets in developing countries like India, Brazil and Guatemala was seen to be lower relatively to North American diet *i.e.* 54-78 versus 88-94% respectively. Poor digestibility of protein in the diets of developing countries, which are based on whole cereals, grains and legumes as major sources of protein, is due to the presence of less digestible protein fractions, high levels of insoluble fibre, and/or high concentrations of antinutritional factors present endogenously or/and developed during processing such as Maillard reaction products, oxidized forms of sulphur amino acids, D-amino acids and lysinoalanine (LAL, an unnatural nephrotoxic amino acid derivative (Gilani *et al.*, 2005). Published data on dietary antinutritional factors in plant protein sources have shown to reduce nutritional value. But proper cooking methods employed have shown to decrease such factors and hence, enhance overall nutritional content (Gilani *et al.*, 2012). With changing lifestyle and increase in non-communicable diseases, the research interest in plantprotein is of great interest among many present researchers.

## Antinutritional Compounds

The primary aim of inhibitors in plant food is to protect the plants from various insects and pest infestation. In human physiology, soybean containing protease inhibitors inhibits

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trypsin; sorghum, millets, various types of beans and peas containing tannins; cereals, nuts mainly contain phytates which is considerably present in the protein rich aleuronic layers of monocotyledonous seeds, reduces nutrient bioavailability. But, under proper heat/alkaline treatment such inhibitor are reduced/destroyed and improves the bioavailability of nutrients (Gilani *et al.*, 2012).

### Nutritional Value of Seed Protein

During the development of seeds, the protein is accumulated in the membrane bound organelle in the cotyledon of parenchymal cells. These are termed as storage proteins. These are insoluble in water but are soluble in salt solution, and are also termed as globulins. Apart from storage protein, the seed proteins also constitute minor components such as trypsin inhibitors, lectins, lipoxigenase and urease. These minor components are also important to nutritional quality of seed (Derbyshire *et al.*, 1976). All pulses and legumes are deficient in essential amino acids such as methionine and tryptophan, whereas, they are a rich source of lysine. Cereals on the other hand, are a poor source of lysine and a rich source of methionine. Ampe *et al.*, 1986 stated that the degree of supplementation will also depend upon the second limiting essential amino acids *i.e.* threonine in cereals and tryptophan in pulses. Thus the need of mutual supplementation has risen. Many evidences have stated combination of cereal-legume, cereal-potato, legume-nuts etc which mutually balances the poor amino acid score of an individual protein source and hence, optimizing the protein quality.

Dietary fibre has recently gained great importance. The need for fibre in daily diet is essential for various functions. Indians have many sources for good dietary fibre. But, recent changes in socio-economic status, eating habits and patterns have made it as very important nutrient. Whole grain cereals and whole pulses consumption have been decreased significantly. Ramulu and Udayasekhara, 1997 studied the role of dehusking of pulse. They concluded that total dietary fibre, insoluble dietary fibre and soluble dietary fibre content in green gram dal was increased when pressure cooked. An increase in total dietary fibre and insoluble dietary fibre was noted during cooking. This increase could be due to formation of resistant starch. Plant protein sources are a good source of dietary fibre. Cooking method employed such as germination, fermentation etc have been observed to increase overall nutritional content.

### Health Benefits of Plant Protein

The need for plant based protein is growing evidently. Food is a complex matrix of many nutrients. Consumption of various nutrients with different bioavailability determines the functioning of the body and health. Increase intake of protein rich diet will automatically reduce the intake of other nutrients and hence, it has a huge impact on health outcomes. Many researches have been conducted in order to explore beneficial and adverse effects of various protein sources on health (Friedman, 1996). Some evidences states that the consumption of good plant protein quality diets aids to achieve optimal health outcomes.

A brief review by Phillips *et al.*, 2016, on high protein quality diet consumption states that protein intake more than recommended dietary allowance helps to promote healthy ageing, appetite regulation, weight management and goals aligned with athletic performance as well as it may help in preventing age related sarcopenia. Progressive muscle mass loss is an evident feature in the process of aging. A study conducted by Paddon-Jones *et al.*, 2015 studied on young and middle aged adults with adequate diet pattern especially adequate protein consumption in combination with physical activity. They observed and concluded that adequate protein consumption with physical activity reduces the chances of sarcopenia.

Epidemiological and interventional researches have been conducted to evaluate the complexities of both plant and animal based protein diets. Researchers have documented that the diets based on plant and animal protein have different effects on cardiovascular diseases. A review done by Richter *et al.*, 2015 have highlighted the need for plant based protein diet in an American dietary pattern along with unprocessed and low saturated fat containing animal based products. Developed countries have shown to have high rate of obesity with very low consumption of pulses and legumes, even less than the recommended values. A systematic review and meta-analysis of 21 randomized controlled clinical trials conducted by Thompson *et al.*, 2017 showed that the increase consumption of pulse [*Phaseolus vulgaris* L.] is associated with improved weight controls and reduced adiposity. Iwase *et al.*, 2015 conducted a study comparing two diets of low carbohydrate; one with animal sources and the latter with plant based sources on Type-2 diabetic patients. Their conclusions in support with other research evidences were gathered to state that the diet in low carbohydrate content with high plant protein diets have shown to result in weight reduction. Also, intake of dietary plant protein have improved metabolic features and reduced pro-inflammatory status in obese subjects (Hermsdorff *et al.*, 2011).

A research was conducted on postmenopausal women that showed an inverse association of the gall bladder risk with Plant protein intake. But the researchers mentioned that intake of plant protein can be used in weight reduction management and hence promote lower risk of gall bladder disease. Dietary habits and patterns influence the structure and activity of gut microflora. Studies have shown protein from plant sources improve gut microflora and keeps them healthy. Depending on the quantity and quality of protein intake, proportionately urinary calcium excretion increases by its effect on both glomerular filtration rate and production of acid. Many researches have associated animal and plant protein with human bone health. Increase in dietary animal protein have been systematically investigated and attributed to increase in frequent osteoporotic fractures. Whereas, plant protein diet tend to reduce the tendency of such fractures. Consumption of either animal protein or plant protein have a severe effect on bone health but the effect will be modified by the total diet matrix due to the presence of many more component in the food systems such as isoflavones, antinutritional factors etc (Massey, 2003).

### Future of Plant based Protein

Worldwide researches are focusing towards sustainable development. Many researches have been concluded that a shift from animal based protein sources to plant based protein sources are of high importance as they use fewer natural resources and are less taxing on the environment. Many surveys suggest that with an increase in population size as well as income, the demand of animal origin food have been increased. Due to this there is a huge burden on both renewable and non-renewable resources. In 2010, FAO defined the concept of sustainable diets as “Those diets with low environmental impacts which contributes to food and nutrition security and to healthy life for present and future generations” (Sabate and Soret, 2014). The global impact of rearing, storage and slaughtering of animals are of much extreme concerns. The U.S. Department of Agriculture (USDA 2004) has noted that “Greenhouse gas (GHG) missions from livestock are inherently tied to livestock population sizes because the livestock are either directly or indirectly the source for the emissions.” Detectable greenhouse gases such as carbon-di-oxide, methane and nitrogen dioxide are of major global concern and numbers of its effects are irreversible in nature. Food safety involved in animal care, slaughtering and cooking preparations requires utmost vigilance. Thus, a shift from animal based to plant based food is of global and public health concern as well as requirement. Negative impacts of increased agricultural production on environmental integrity as well as animal welfare are raising many queries towards sustainable development. Time has arrived for the next green revolution with updated scientific data and advancement to meet the growing needs of the increasing population size and their requirement for food. Thus, a major shift in feed and fodder production for animals reared specially for human meat consumption is of an alarming necessity.

### Conclusion

As population growth increases tremendously and the main sources of food (farms and oceans) are approaching towards their maximum per capita output, the burden requires a shift in order to protect exhausting natural resources. Many current researches on the nutritional as well as health impacts of plant protein consumptions are highly promising and support the need for sustainable development. To further establish more vivid results, the concept of plant protein requires intense research with a holistic approach towards health, environmental concern as well as animal care.

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