

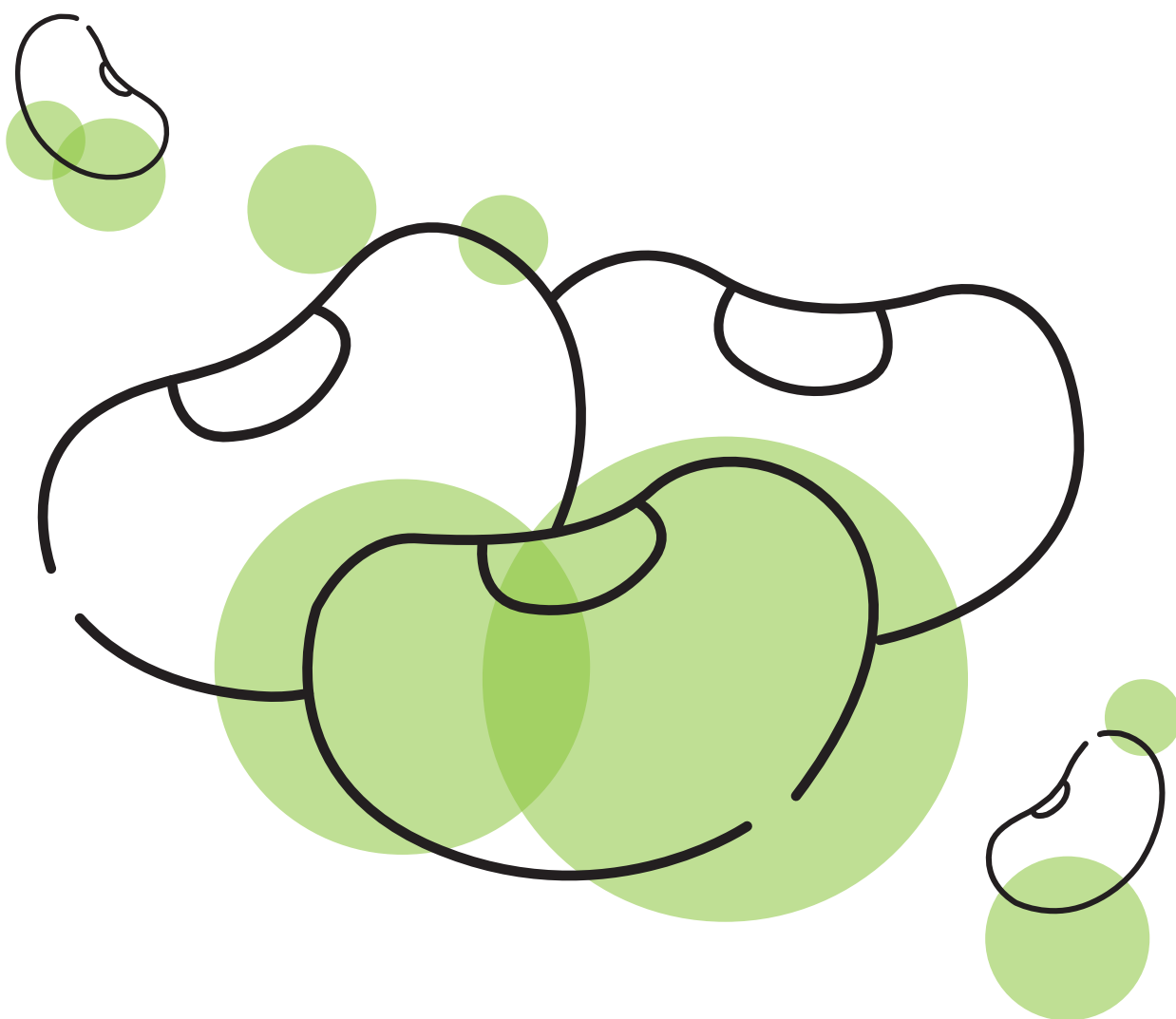
# Soy

## A Superfood & Wonderbean

A study by



‘Addressing the Protein Challenges of the Indian Diet with Soy Protein’



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## EXECUTIVE SUMMARY

Protein is an important macronutrient that is critical to the optimal health and vitality of individuals of all ages and stages of life. For decades, protein deficiency has been a concern relative to the traditional Indian diet, contributing to developmental delays in children and negative health impacts more broadly in the population. Soy protein, a high-quality, plant-based protein, provides promise as a protein source that can be used to fortify traditional Indian foods and enable the development of new, innovative high-protein foods and beverages. Many soy-based foods and soy protein ingredients exist to help address the protein opportunity in India.

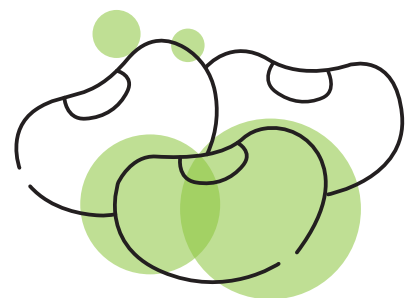
Food innovation, as well as continued consumer education on the importance of protein, and more specifically the benefits of soy protein, will be key in improving the protein status of India's population.



**Dr. Jagadish Pai**  
Executive Director, PFNDAI



"For decades, protein deficiency has been a concern relative to the traditional Indian diet, contributing to developmental delays in children and negative health impacts more broadly in the population. In this recent work, we have explored how soy protein, a high-quality, plant-based protein, can help improve the low protein consumption in India. Food innovation, as well as continued consumer education on the importance of protein, and more specifically the benefits of soy protein by busting common myths, will be key in improving the protein status of India's population."



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# The Importance of Protein in a Healthy Diet

PROTEIN IS AN IMPORTANT MACRONUTRIENT IN THE DIET, NEEDED AT ALL STAGES OF LIFE



Essential for the proper growth and development of children



Critical for the maintenance of body tissues and overall health in adults

As part of every living cell in the body, protein has an important role to play in the functioning of all key body systems. It is key for maintaining a strong skeletal and muscular system, and a healthy immune system. Proteins, like haemoglobin, are carriers of oxygen in the blood to all parts of the body. Proteins are part of important hormones, enzymes, and antibodies – all of which are critical in maintaining overall health and vitality.

Getting the proper type and amount of protein through diet is vitally important in maintaining good health. When we consume protein through food, it is digested and transformed into body proteins, essential in supporting key body functions. If we consume more protein than is required, excess protein is converted and used as energy or stored as body fat. If we consume less than what is required, then stored body proteins are broken down to support daily needs, leaving our bodies in a deficient state, resulting in muscle loss and compromised health. In children, insufficient protein can result in stunting, which can have negative long-term consequences on both cognitive and physical growth and development.

## Age and Life Stage Impact Protein Requirements

The daily requirement for protein differs by age and life stage. Adults need about 0.8 -1.0 grams of protein per kilogram of body weight per day. Therefore, an adult who weighs 60 kilograms will need to ingest approximately 60 grams of protein daily. Pregnant or lactating women need slightly more to support fetal growth or breastfeeding after birth. Children, on a body weight basis, also require more protein, to support proper growth and development. Physically active individuals, such as athletes, require more protein, as do ageing individuals and convalescing patients recovering from illness, surgery or injury.



# India Faces Unique Protein Challenges

Protein deficiency has been a concern relative to the traditional Indian diet for decades. In its 2021 report, the National Nutrition Monitoring Board concluded that average household consumption of protein was only 90 per cent of the Recommended Dietary Allowance (RDA) in urban areas, based on dietary monitoring of over 170,000 individuals. Rural populations fared worse, consuming on average, only 83 per cent of the RDA for protein. Additionally, a large percentage of children under 5 years of age were found to be deficient in protein, with stunting and thinness common among them.

The traditional Indian diet relies mostly on cereals and pulses for protein and is generally lacking in leafy green vegetables, milk and milk products. A high percentage of Indians practice vegetarianism and thus do not consume traditional animal-based sources of protein, like meat. Although milk production in India has increased substantially over time, milk consumption has not changed. Even among populations who are not committed vegetarians, consumption of animal products is often meagre.

While the problem of protein deficiency in the traditional Indian diet is well recognized, implementing change to reverse these trends has proven to be challenging. Indians, like many populations, find it difficult to embrace dietary change. Thus, it is difficult to quickly implement changes necessary to substantially increase protein intake. Additionally, more work is needed to increase consumer awareness of the problem and provide meaningful solutions that fit with traditional Indian eating habits and food culture.

## Addressing the Protein Challenge with Soy Protein

One of the protein sources that provides particular promise in addressing India's protein deficiency challenge is soy protein. Derived from the soybean, soy protein is a source of high-quality, plant-based protein. As such, it fits a vegetarian diet, favoured by many Indian consumers today, as well as the growing global movement toward plant-based eating. In addition to nutrition, protein derived from soybeans provides several advantages. Soybeans are widely available, and thus are a reliable and sustainable raw material for producing soy protein ingredients that, in turn, are highly nutritious, economic and functional. Soy proteins have proven to be quite versatile as ingredients that can add protein nutrition to a wide range of food and beverage products, as well as traditional Indian foods.

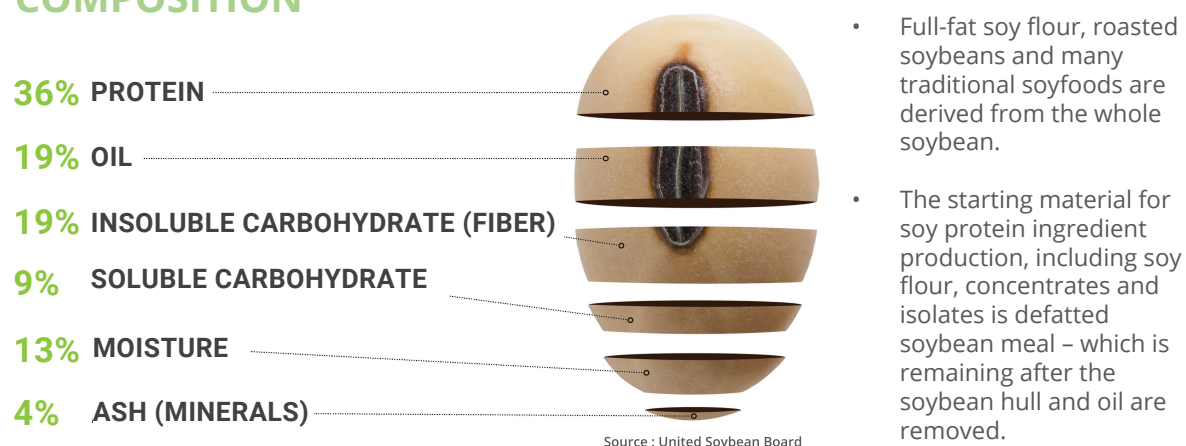
# A Closer look at the Nutrition and Health Benefits of Soy Protein

Soy protein is unique among plant proteins for its protein quality and health benefits. It is the most widely available plant protein source that is considered high quality, similar in quality to meat, milk and eggs.

The Protein Digestibility-Corrected Amino Acid Score, or PDCAAS, is a globally accepted method of measuring and comparing the quality of various food protein sources. In calculating PDCAAS, the amount and presence of essential amino acids - the building blocks of proteins - as well as the digestibility of the protein source are considered. Using this methodology, the PDCAAS of soy protein isolate is 1.0, the highest score attainable and comparable to milk and egg protein<sup>1</sup>.

FIGURE 1: TYPICAL SOYBEAN COMPOSITION

## SOYBEAN COMPOSITION



Most plant-based sources, including grains, seeds and nuts are lacking in one or more of the essential amino acids, and thus are considered lower-quality proteins.

In addressing India's protein challenge, both protein content and quality are important. High-quality proteins, like soy protein, provide all of the essential amino acids in the proper ratios, required to support the healthy growth, development and maintenance of body tissues. Soy protein also supports long-term health and is well researched for heart health, linking its consumption to reduced cardiovascular disease risk.

# Soy Protein Benefits for Infants and Children

Early life consumption of soy protein, as part of sole source or supplemental nutrition, supports normal, healthy growth in infants and children. Infant formula based on soy meets the nutrient requirements of a growing infant, supporting healthy growth and normal development. Soy-based infant formulas are often recommended for infants displaying symptoms of cow's milk allergy or lactose intolerance as well as for those mothers preferring vegetarian feeding options<sup>2</sup>.

As a child ages, soymilk can play a distinctive role in the diet, especially when compared to other plant-based milk products. Typically, soy-based milk alternatives deliver levels of protein and key micronutrients, including calcium and vitamin D, comparable to dairy milk<sup>3</sup>, making them a great option for children or adults who are lactose intolerant, allergic to dairy or seek a nutritious plant-based beverage.

## Soy Protein Benefits in Adulthood

Good nutrition and exercise are considered key to good health. Increasing soy protein intake paired with exercise has been shown to help maintain or increase muscle mass in a range of populations, including high-performance athletes as well as ageing individuals.



Replacing carbohydrates – especially refined carbohydrates – with protein sources low in saturated fat is an effective strategy for maintaining a healthy weight. Soy protein, as part of a calorie-controlled diet, can help manage weight by helping one feel fuller for longer<sup>4</sup>. Numerous clinical studies have demonstrated the efficacy of soy protein for promoting fat loss, including abdominal fat while preserving muscle mass<sup>5,6,7</sup>.

Research supports that energy-restricted diets containing soy protein are equivalent to energy-restricted diets containing similar intakes of other high-quality protein sources for reducing weight and body fat<sup>4,8,9,10</sup>.

In addition to aiding in weight management, soy protein offers a clinically demonstrated cardio-metabolic advantage over animal-based proteins, namely reducing LDL-cholesterol while potentially improving blood glucose control<sup>4,9,10</sup>. As the global population ages, management of risk factors for cardiovascular disease, the leading cause of death globally, becomes increasingly important.

Finally, a large body of evidence, including multiple meta-analyses, confirm the cholesterol-lowering effects of soy protein<sup>11,12</sup>.



Consuming soy protein as part of a diet low in cholesterol and saturated fat has been found to reduce the risk of heart disease and have a favourable impact on blood lipids, lowering LDL-cholesterol, total cholesterol, and triglycerides, without lowering cardio-protective HDL-cholesterol<sup>15</sup>.

The outcomes described above are all specific to the protein fraction of soy. There are other components derived from the soybean that may be present in various soy ingredients and soy foods. For example, isoflavones are natural, bioactive plant compounds found in legumes, including soybeans<sup>16</sup>. Soybeans contain isoflavones at a concentration of 0.2-4.2 mg/g seed dry weight<sup>17</sup>. A significant portion of isoflavones is lost in the processing of soy foods and soy protein ingredients. Soy protein isolates contain between 1-3 mg isoflavones/g soy protein.

Consumption of foods containing isoflavones increases the body's level of antioxidants and may help support cellular health. Isoflavones have been the focus of many clinical trials, which suggest consumption may help maintain blood vessel health<sup>18</sup>, provide support during menopause<sup>19</sup> and have modest effects on maintaining bone density<sup>20</sup>. In addition, a thorough scientific review underscores the safety of isoflavone exposure through soy consumption. The European Food Safety Authority (EFSA) published a Scientific Opinion on food supplements containing isolated isoflavones and concluded that there was no association between exposure to isoflavone-containing food supplements and adverse effects in the mammary gland (breast), uterus or thyroid in peri- and post-menopausal women<sup>21</sup>.

# OPTIONS FOR ADDING SOY PROTEIN TO THE DIET

Protein from the soybean can be added to the traditional India diet in several ways. Some of the most common options are summarized in the table below.

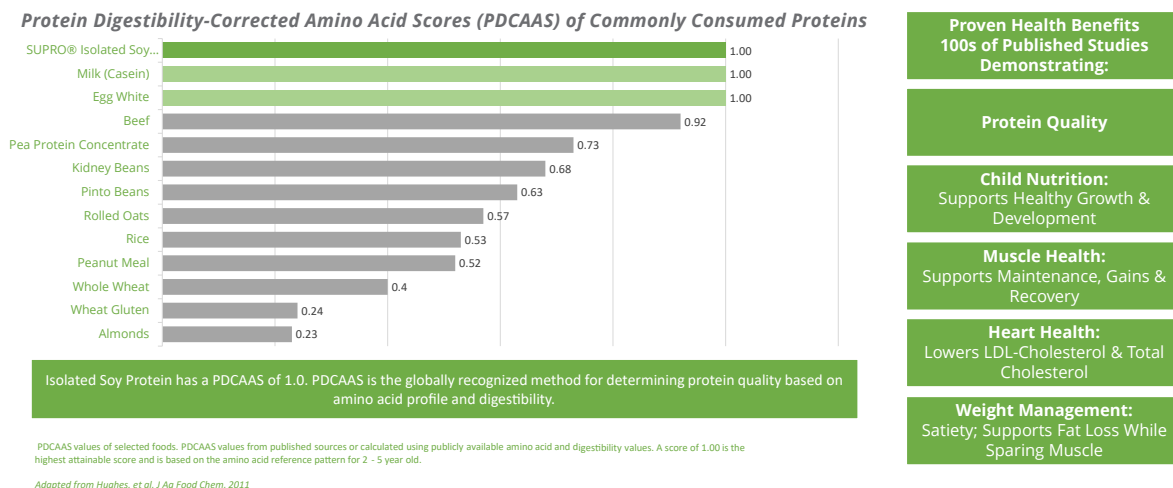
**TABLE 1: AN OVERVIEW OF TRADITIONAL SOYFOODS AND SOY PROTEIN INGREDIENTS – RAW MATERIAL, PROTEIN QUALITY AND USE**

	WHOLE SOYBEAN PRODUCTS Whole Green Soybeans, Baked Soybeans, Seeds, Soy Sprouts, Stock Feeds			DEFATTED SOYBEAN MEAL PRODUCTS Grits, Flour, Concentrates, Isolates		
Ingredients:	Full Fat Flour	Roasted Soybeans	Traditional Soy foods	Defatted Soy Flour	Soy Protein Concentrate	Soy Protein Isolate
% Protein	36%	43%	Varies	50% (dry basis)	65% (dry basis)	90% (dry basis)
Protein Quality (PDCAAS)	0.70	0.85	0.60-0.90	0.80	1.00	1.00
Application opportunities	Bread, confection, doughnut mix, pan grease extender, pie crust, sweet goods, frozen desserts, Instant milk drinks, low-cost gruels, pancake flour	Soy nuts, soy nut butter, candy ingredient, cookie topping, cookie inclusion, confection	Miso, soymilk, soy sauce, natto, tofu, tempeh. Consider convenience packaging of traditional products to enable expanded use and eating occasions	Textured vegetable protein, baked products, sweet baked goods, extruded snacks	Beverages, processed meat products, plant-based meat alternatives, cereals, snacks	Infant formula, baby foods, powdered and liquid beverages, processed meat products, plant based meat and dairy alternatives, dietary supplements, hospital feeding, cereals and snacks

Many dishes can be made by using soy products and added in your day-to-day meals like soy milk, roasted soybeans, soy protein bars, soya pancakes etc for breakfast, soya kebabs, soya cutlet, soya burgers and soya Manchurian as starters, soya chunk curry, soya chap curry, soya pulao, soya bhurji as main course and soy yogurt as desert. These are just examples there are so many other varieties of soy products than you can incorporate and experience the benefit of soy protein.

Traditional soy foods, such as soymilk, tofu, roasted soybeans and tempeh are typically manufactured from the whole soybean. The whole soybean, in its natural state, is about 36 per cent protein but also contains significant amounts of fat in the form of soybean oil, as well as carbohydrates.

**FIGURE 2: SOY PROTEIN IS A HIGH-QUALITY, PLANT-BASED PROTEIN, COMPARABLE IN PROTEIN QUALITY TO MILK AND EGG PROTEIN**



Soybean oil is typically extracted from the bean and sold as a common oil source for food, fuel and other industrial uses. Defatted soybean meal remains after the soy oil is removed. This highly versatile feed and food source can then be processed into soy protein ingredients for human food use, such as soy flour, soy protein concentrate and soy protein isolate.

## THE VALUE AND USE OF SOY PROTEIN INGREDIENTS

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Food manufacturers have several options when considering soy protein ingredients. Considered individually, these ingredients will differ in protein level, quality, functionality and typical use in food and beverage products.

**Soy flour**, is approximately 50 per cent protein (dry basis), and well suited for protein fortification of bakery and cereal products. It is also available as textured vegetable protein or TVP, which is used extensively as a meat substitute or extension in home recipes and food manufacturing.

**Soy protein concentrate**, approximately 65 per cent protein (dry basis) and a source of dietary fibre, is available in powdered or textured formats. It is used extensively to provide meat-like texture and as water or a fat-binding ingredient in processed meat and plant-based meat alternatives. It can also be incorporated into cereal and snack products to increase protein content.

**Soy protein isolates**, 90 per cent protein (dry basis), are highly versatile, protein-enhancing ingredients used in a wide range of food and beverage applications. They are considered high-quality proteins and have been the focus of much of the clinical research supporting the health benefits of soy. Soy protein isolates display a wide range of functionality, a bland flavour and are precisely designed to work optimally in specific end applications. They are used extensively to boost the protein content of a variety of beverages, nutritional bars, snacks, cereals, and plant-based meat and dairy alternatives. In addition, they are used as functional protein ingredients in processed meat products as well as for fat emulsification in products such as soups and coffee creamers.

With a wide range of options to choose from, food manufacturers can use soy proteins to boost the protein content and quality of traditional Indian foods and recipes. Soy proteins can also provide the basis for innovating new nutritional foods and beverages targeting the precise protein needs of different segments of the population, from children to adulthood. As awareness of the importance of protein expands, and demand for protein-enhanced foods grows, soy protein provides food manufacturers and consumers an important source of high-quality, plant-based complete protein that can improve the protein status of India's population.

# Consumer Education, Food Innovation Needed to Address India's Protein Challenges

Recent efforts to educate consumers in India about the benefits of protein, specifically plant protein, appear to be making a difference in attitudes and food choices. According to a recent consumer study published by Health Focus International, 63 per cent of primary household shoppers in India (n≥500) indicated that they had increased their consumption of protein in the past 2 years, and 53 per cent increased their use of plant protein<sup>22</sup>. When asked to indicate the most important benefits of protein, 69 per cent rate daily health as the top benefit, followed by physical energy (67 per cent).

Considering attitudes more specific to soy protein, a consumer study conducted by IFF in 2021 found that 77 per cent of India consumers surveyed (n=504) were interested in trying foods containing soy protein<sup>23</sup>. While the perception of soy protein in India is already favourable, this study reinforced the importance of consumer education, by assessing the perception of soy protein, before and after exposure to messages related to soy protein's benefits.

**TABLE 2: SOY PROTEIN MESSAGES PRESENTED TO ASSESS IMPACT OF CONSUMER EDUCATION ON PERCEPTION**

<b>1</b>	<b>Soy protein is plant-based</b> - Soy protein comes from the soybean, so is naturally cholesterol and lactose free. It has been part of the food supply for over 5,000 years.	<b>4</b>	<b>Soy protein is heart healthy</b> - Soy protein is low in fat and cholesterol free. Clinical studies show it can help lower cholesterol levels, reducing the risk of cardiovascular disease.
<b>2</b>	<b>Soy protein is a high-quality protein</b> - Soy protein provides all the benefits you expect protein to deliver. Being high quality means that it delivers all the amino acids the building blocks of protein that your body needs to stay healthy, just like milk and egg proteins do.	<b>5</b>	<b>Soy protein supports healthy weight loss</b> - Soy protein can help satisfy hunger, which makes it a great choice if you're trying to watch your weight. And if you are actively trying to lose weight, it can help ensure that you lose fat and not muscle.
<b>3</b>	<b>Soy protein helps build and maintain muscle mass</b> - Soy protein can help you build muscle in conjunction with exercise. As you age, it can help you maintain your muscle mass.	<b>6</b>	<b>Soy protein is environmentally friendly</b> - Soy protein has a low carbon footprint and is very efficient to produce, requiring less water, energy and land than animal-based proteins like milk and meat.

Pre-messaging, 65 per cent of consumers indicated a positive perception of soy protein; post-messaging, positive perception climbed to 78 per cent. Only 1 per cent of consumers in India indicate a negative perception, pre- or post-messaging. While consumer education appears to be making inroads in increasing awareness of the importance of protein and encouraging consumption, additional effort is still needed. Events like the annual "Protein Day", celebrated in India for in-office the last three years, help to reinforce the importance of protein and educate consumers on how to act on that message through practical food selections. In addition, continued efforts to reach consumers and health professionals through traditional news, electronic and social media, as well as professional meetings, are important. Recruiting, developing and leveraging prominent, trusted and respected health and wellness spokespersons who can help deliver those messages effectively is key.



Food innovation is also an area of continued opportunity. Consumers in India, like most populations, have a strong food culture defined by many traditional Indian foods. Opportunities exist to use soy protein and other plant proteins to enhance the protein content of these foods, without sacrificing traditional eating quality and experience. In many cases, soy protein added to traditional Indian foods can increase their protein content and improve overall protein quality, by complementing the essential amino acids already present.

In addition, opportunities exist to develop innovative higher protein foods and beverages that appeal to the protein interests of particular populations, including sports and fitness enthusiasts and ageing individuals, as well as products geared more toward the specific protein needs of children and pregnant women. Delivering the benefits of protein in products offering convenience and portability, such as protein-enhanced beverages, snacks, and nutrition bars, are also certain to appeal to the growing number of health-conscious Indian consumers with busy, active lifestyles. Finally, as consumers in India become more aware of the benefits of plant-based diets, and vegetarian diets remain an important part of India's food culture, opportunities for plant-based meat and dairy alternatives are certain to expand.

## SUSTAINABILITY

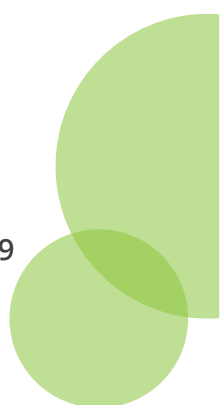
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The global soybean production has been around 350 million tonnes with the 2020 figure being over 353 MT. Two countries the US and Brazil produce about 60% of global production and with Argentina, China, and India, produce together over 90% of the total.

Indian efforts at the sustainability of soy have been nudged by Indian Standards for Sustainable Soy prepared by the Indian Institute of Soybean Research. Along with good agricultural methods and increasing yields, the pressure on the soil will reduce if agricultural land is used for many different crops<sup>(28, 29)</sup>.

India makes an excellent case for using soy for food. There is a deficiency in protein intake and most vegetarian protein is of lower quality (incomplete) than animal protein except soy, which is equal to animal protein in quality. It is also not expensive so it would solve a large problem of deficiency if more soy is consumed by people.

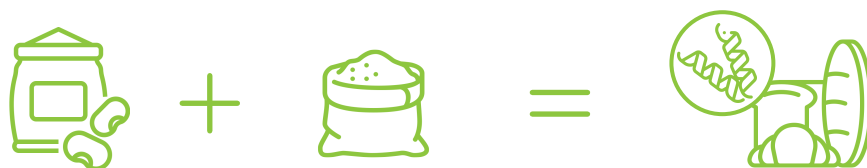
Soy can be used to make a large number of high-protein food products that will be in appearance and taste similar to many animal-based products as well as vegetarian food products. Thus, acceptability will not be a problem.





# SOY IS A WONDER-BEAN

Soyabean has been used for centuries for preparing many different food products <sup>(30)</sup>. Early applications were from Japan and China for making mostly tofu and soymilk. However, when the bean travelled to many countries newer applications were explored. It was converted to texturized vegetable protein to make meat analogues. As the health benefits became known to many, various products including egg substitutes, and sophisticated meat-like products like burgers, nuggets, sausages etc. started being prepared. Even dairy products are simulated such as milk, cheese, paneer, ice creams, whiteners, and spreads. Soymilk-based beverages and mixes are prepared for vegans or those allergic to milk proteins.



Soy flour is quite versatile it can be used in combination with other flour

To increase the protein content of brad, roti's and many baked and dried snack items

Granules and chunks can be used in many curried preparations prepared across India. Thus soybean has been used to prepare a large number of products that people have started calling it a wonder-bean. It is extremely versatile and also very healthy <sup>(31)</sup>.

## MARKETING

With the increase in awareness of protein, soy protein is becoming very popular. It is a high-quality source of protein and it can help clear the deficiency of protein in India. Products like soybean wadi, granules, soy flour, etc. are good and affordable sources of protein and are also readily available in markets across the country. You can incorporate them into your daily diet by just changing the variations in several ways. Even though many Indians are non-vegetarian, still according to several reports 80% of Indians are deficient in protein. Many vegetarians consume only pulses and grains to meet their protein requirements, but that is not enough. Soy protein being the powerhouse of vegetarian protein can be a great source for protein consumption for individuals following any type of diet. So, including this in our daily diet will be a great step towards solving the problem of protein deficiency.

There are various health benefits of soy protein, which makes it the powerhouse of protein like daily consumption of soya proteins can reduce the breakdown of lean muscles and boost the growth of healthy muscles. Another benefit of soya protein is that it lowers the LDL cholesterol level without impacting the level of good cholesterol. Soy proteins are rich in essential amino acids, which can be incorporated into our diets in the form of tofu, soy flour, soymilk, soybeans, soy granules, and also any soy meat substitutes. Adequate consumption of soy can also help in reducing the risk of cancer, especially breast cancer in women.

As soy protein makes your skin look healthy, various cosmetics companies use soy protein in their products that helps to moisturize the skin. It also helps in reducing pigmentation, enhances circulation, improves sleep, gives a kick to your digestive system, reduces post-menopausal symptoms, prevents heart diseases, controls obesity & diabetes etc. <sup>(32)</sup>

As we all know Indians are fond of snacks and foods, be it a festive season, occasion, meetings, get together etc snacks is the main item we look for. Many dishes can be made by using soy products and added to your day-to-day meals like soy milk, roasted soybeans, soy protein bars, soya pancakes etc for breakfast, soya kebabs, soya cutlet, soya burgers and soya Manchurian as starters, soya chunk curry, soya chap curry, soya pulao, soya bhurji as a main course and soy yogurt as dessert. These are just examples there are so many other varieties of soy products that you can incorporate and experience the benefit of soy.

Though the product is healthy, full of nutrition, protein-rich, or famous there are chances that those products might have several myths. Even soy has several myths like it is said phytoestrogens have adverse effects on men, however, there are no such findings that prove this. People do believe such myths and it is very important to debunk such myths. <sup>(33, 34)</sup>

There are several ways in which such myths can be debunked, like reaching the public through proper channels like various print media, news media, electronic media, etc so that these people can guide others about the importance of soy. Even training of health care professionals will be helpful to eradicate such myths and to clear doubts regarding soy proteins. These health professionals and various industry experts can come forward to dispel fears and help increase protein intake through various dietary means including meals, snacks, liquid refreshments etc. Today's generation believes and trusts their favourite influencers and tries to follow what they promote. Taking help from social media influencers to create awareness about soy will bring a lot more recognition.

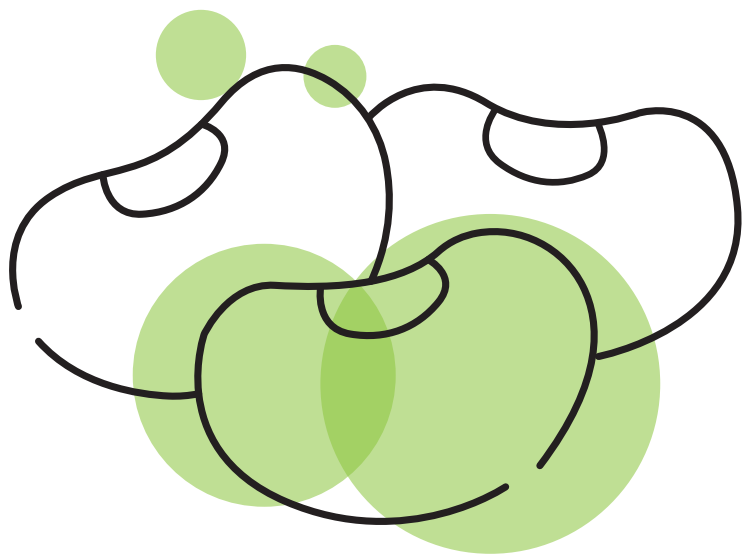
Another way in which we can create awareness about soy and its health benefits <sup>(35, 36)</sup> is by organising webinars and also nutrition awareness activities in colleges, as students are the future of the world if we try to educate them about soy and its various aspects will boost in some or the other way. Giving advertising, creating social media ads, organising contests, taking up blogs from experts, distributing free samples, creating different content, partnering with different companies and associations for awareness, and offline campaigns like posters, brochures, billboards, etc are all good options to create the awareness around soy and soy-based products. Some conferences and expos are also very useful in creating awareness. <sup>(37)</sup>

The problem of protein deficiency is going around for a long time now, most of the people are aware of it, they are talking about it but just talking and discussing the problem is not enough. It is high time now when we must work on it. Industries will keep going on developing new products with high protein content and launch them but what after that? How are people going to get aware of all these products? Half of India's population is not aware of protein, deficiency of protein is the least that they would be knowing. So, to reach out to people with the problem and solution, creating the buzz about the deficiency, solutions, availability, usage, and consumption is critical.

There is a lot of interest among consumers about plant-based meat and dairy substitutes. Some consumers are vegetarian and would love to eat burgers and nuggets

nuggets and other products which have become quite popular but because of their beliefs, they can't enjoy them. Soy-based substitutes have been prepared which are quite similar in taste and texture to animal-based products. Some people are sensitive to milk protein, and some consider milk as an animal product and because of some personal reasons they would not like to consume milk protein but they would love to enjoy similar products like fluid milk, shakes, cheese, paneer, spreads, coffee whitener etc. These are also made from soya and other plant-based materials, which maintain the sensory properties with keeping their faith and belief as well as health intact. Thus soy protein has come a long way and can do even more for health of people as well as the planet. It can make serious efforts in bridging the protein gap in India.<sup>(38)</sup>

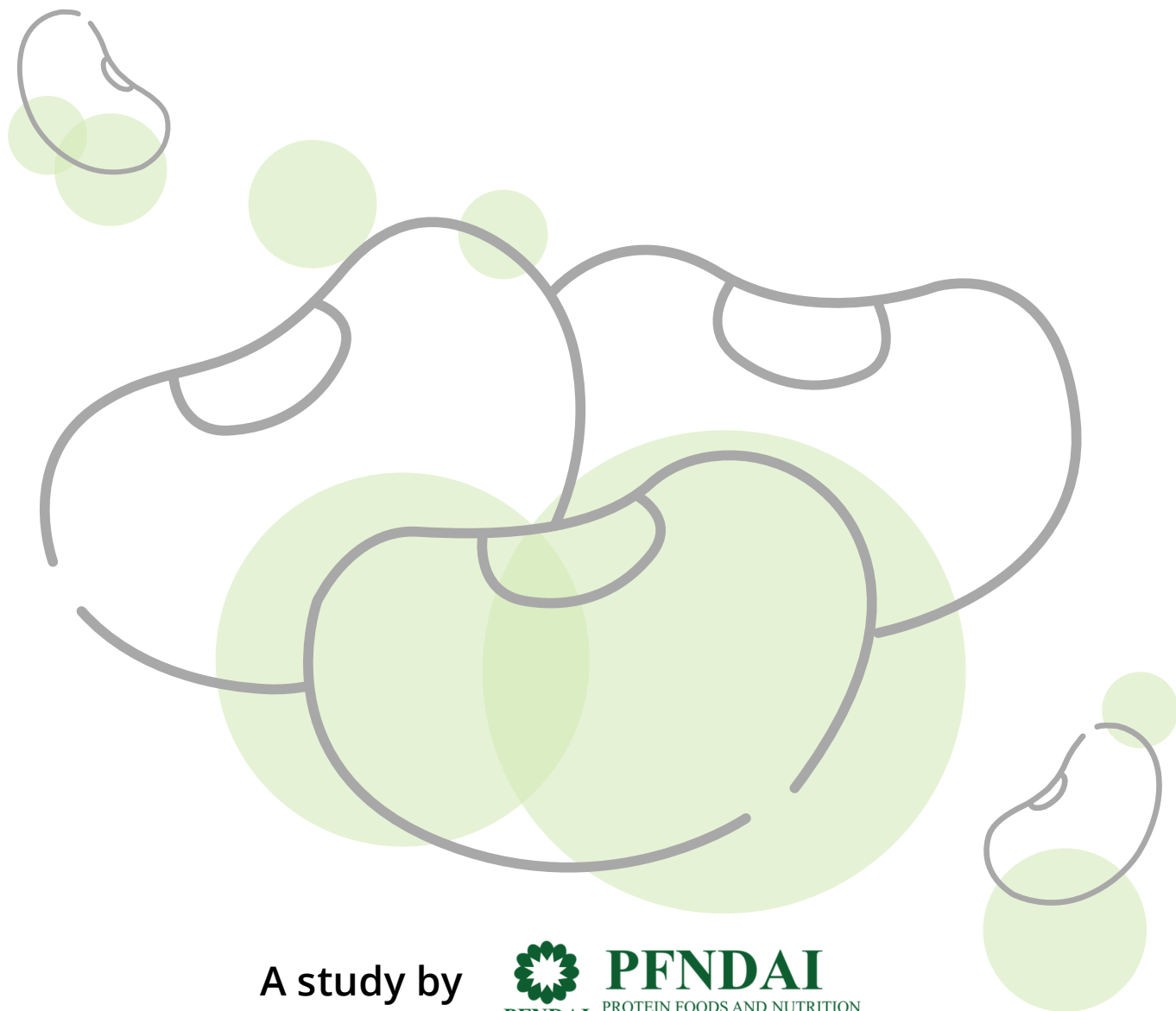
**Reviewed by:** Dr Jagadish Pai, Executive Director, PFNDAI



# ANNEXURE

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