

# PLANT-BASED PROTEIN FAQ

A WHITE PAPER FROM OSAGE FOOD PRODUCTS



# SECTION I: Defining Proteins

## What's Protein?

From a food science perspective, proteins are vital macronutrients composed of long chains of amino acids. These amino acids serve as the building blocks for various structures within the human body, including muscles, tissues, enzymes and hormones.

### THE NINE ESSENTIAL AMINO ACIDS ARE:

**HISTIDINE**  
**ISOLEUCINE**  
**LEUCINE**

**LYSINE**  
**METHIONINE**  
**PHENYLALANINE**

**THREONINE**  
**TRYPTOPHAN**  
**VALINE**

## Why is Protein Important?

Proteins play critical roles in virtually every aspect of bodily function and health. For example:

- Proteins build and repair tissues
- Proteins are essential for metabolic processes
- Proteins are hormones and signaling molecules
- Proteins improve our immune system
- Proteins improve the body's transportation of oxygen and storage of nutrients
- Proteins maintain fluid balance
- Proteins regulate the body's pH
- Proteins are responsible for muscle contractions and movement

Because the body cannot synthesize all the necessary amino acids required for protein synthesis, it relies on dietary sources to obtain essential amino acids. Thus, consuming an adequate amount of protein is vital for overall health, growth, development and maintenance of bodily functions.



## That's Impressive. But Why is Protein Important to the Food Industry?

Great question. In the food industry, proteins serve various functional roles beyond their nutritional value. They contribute to the texture, mouthfeel and structural integrity of foods while also enhancing flavor and supporting product stability. As such, proteins are a key focus for food manufacturers seeking to create nutritious, appealing and innovative food and beverage products.

## How Much Protein Should We Eat?

The recommended daily intake of protein for humans varies depending on factors such as age, sex, body weight, level of physical activity and overall health status. According to the Dietary Guidelines for Americans, which are established by the U.S. Department of Agriculture (USDA) and the Department of Health and Human Services (HHS), the Recommended Dietary Allowance (RDA) for protein for adults is 0.36 grams of protein per pound of body weight per day. This means that a sedentary adult weighing 150 pounds would require about 55 grams of protein per day.

It's important to note that these are general recommendations, and individual protein needs may vary. Athletes, individuals recovering from illness or injury, pregnant or lactating women and older adults have higher protein requirements.

Additionally, the distribution of protein intake throughout the day is also important for optimizing muscle protein synthesis and overall health. It's often recommended to evenly distribute protein intake across meals and snacks rather than consuming a large amount of protein in one meal.

## SECTION II:

# Animal Versus Plant Protein

### What's the Difference Between Animal and Plant Proteins?

It depends on who you ask! While there are many strong opinions of nutritional profile and environmental impact of animal versus plant proteins, there are a few definitive things we know. Animal proteins (meat, poultry, fish, eggs, dairy products, seafood) typically contain all nine essential amino acids in balanced proportions. Animal proteins are considered complete proteins. Plant proteins (legumes, nuts, seeds, grains, etc.) usually lack one or more essential amino acids. Additional differences include:

- **Animal Protein:** Generally higher in saturated fat and cholesterol compared to plant-based proteins. Animal proteins are also significant sources of certain vitamins and minerals, such as vitamin B12, iron, zinc and calcium.
- **Plant Protein:** Lower in saturated fat and cholesterol, and higher in fiber, antioxidants, vitamins, and minerals such as magnesium and potassium. Plant proteins also contain phytonutrients with potential health benefits.

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### What Has Mainly Been Used as a Protein Source in the Food Industry?

For food and beverage formulations targeting specific protein targets, dairy proteins are the gold standard. Whey protein is a complete protein, containing all nine essential amino acids. It's easily digested and efficiently utilized by the body for protein synthesis and muscle repair.

Even better, whey protein is easy to add to a wide variety of food and beverage products, including protein bars, shakes, smoothies, baked goods, dairy products, sports drinks and nutritional supplements. Its neutral taste and excellent solubility make it easy to blend into various formulations without altering the flavor or texture significantly.

Whey protein also offers functional properties that improve the texture, mouthfeel and stability of food and beverage products. It can enhance viscosity, water-binding capacity, emulsification, foaming and gelation properties.

### What More Could You Ask For? It Sounds Like Whey Protein is Perfect for Food and Beverage Formulations!

If you're a vegan, you're going to have concerns with consuming products with whey protein. There also are some potential allergen concerns with whey protein being a dairy-based milk allergen, which is one of the Food & Drug Administration's top nine allergens that have to be declared and labeled on food products. These factors, along with growing environmental and sustainability concerns, have led many consumers to seek alternative protein options, with plant-based proteins having a very high amount of interest and activity in new product development efforts.

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### So, What's the Best Plant Protein Source?

That's a really tough question to answer without knowing the specific product application and the consumer's specific desires and needs. However, in general, it's not one specific plant protein that's best to use. It's a blend of plant proteins that together meet all of a product's nutritional and functional attributes.

Simply put, not all plant proteins are created equal, and it's important for product developers to select a "quality" plant-based protein blend that delivers the nutritional benefits consumers desire while still being functionally usable in product formulations.



### How Do You Determine if a Plant Protein System is "High Quality?"

Great question. For starters, we're going to look at the nutritional attributes that determine whether a plant protein blend is of high quality or not.

[Read on ...](#)



# SECTION III: Protein Quality and PDCAAS

## Why is Protein Quality Important?

When it comes to protein, the number of grams per serving tells only half the story. As we mentioned above, many plant proteins are deficient in one or more essential amino acids. For example:

- **Legumes** are typically low in methionine and cysteine but are rich in lysine.
- **Grains** are generally low in lysine but contain more methionine than legumes.
- **Nuts** and seeds often lack lysine but are abundant in methionine and cysteine.

Sourcing one plant protein for a formula is most likely not going to deliver a high quality optimal protein. In most cases, you have to use a blend of plant proteins to achieve a complete, quality protein.

## How Does the Food Industry Measure Protein Quality?

Now we're getting to the good science and acronyms! The food industry measures the quality of a protein by its PDCAAS score. PDCAAS stands for Protein Digestibility Corrected Amino Acid Score, and it measures the quality of dietary proteins based on their amino acid composition and digestibility (and thus bioavailability).

The PDCAAS was developed in 1991 by the Food and Agriculture Organization (FAO) of the United Nations in collaboration with the World Health Organization (WHO). The development of the PDCAAS was a significant advancement in the field of nutrition and food science, providing a standardized and widely accepted method for evaluating and comparing protein quality across different protein sources.

Since amino acid requirements differ for humans at different ages (see chart), there are different "reference standards" for various age groups that the FAO/WHO have developed and that the FDA and CFR use to determine the PDCAAS for a specific age group. The current FDA mandate is that the reference standard to be used for all protein claims made on food (other than for infants) is for the 2-5 year old category. In dietary supplements, including most sports nutrition products, this mandate does not exist so the reference standard for the specific age category that the products are being developed for, and marketed to, can be used.

## 1991 Reference Standard - Amino Acid Requirements by Age Category

Amino Acid (g/100 g)	1991 Reference Standard Infants (birth-6 months)	1991 Reference Standard (1-2 yr olds)	1991 Reference Standard (2-5 yr olds)	1991 Reference Standard (3-14 yr olds)	1991 Reference Standard (15-18 yr olds)	1991 Reference Standard Adults (>18 Years)
Histidine*	26.00	20.00	19.00	16.00	16.00	15.00
Isoleucine*	46.00	32.00	28.00	30.00	30.00	30.00
Leucine*	93.00	66.00	66.00	61.00	60.00	59.00
Lysine*	66.00	57.00	58.00	48.00	47.00	45.00
Methionine* +Cystine (SAA)	42.00	27.00	25.00	23.00	23.00	22.00
Phenylalanine* +Tyrosine (AAA)	72.00	52.00	63.00	47.60	40.00	38.00
Threonine*	43.00	31.00	34.00	25.00	24.00	23.00
Tryptophan*	17.00	8.50	11.00	6.60	6.30	6.00
Valine*	55.00	43.00	35.00	40.00	40.00	39.00

\*9 Essential Amino Acids

## How Does it Work?

### The PDCAAS takes into account two key factors:

- **Amino acid profile:** Proteins that contain all nine essential amino acids in proportions similar to those required by the human body receive a higher score.
- **Digestibility:** Proteins that are easily digested and absorbed by the body receive a higher score

A protein's PDCAAS score is calculated by dividing the amino acid content of a protein by the amino acid content of a reference protein, typically the amino acid requirements of a 2- to 5-year-old child, and then multiplying by a digestibility factor. The resulting score ranges from 0 to 1, with 1 being the highest score possible.

## How Do Food and Beverage Manufacturers Use PDCAAS?

Product developers use the PDCAAS to develop functional foods and dietary supplements that provide targeted nutritional benefits. By selecting protein sources with high PDCAAS scores and optimizing formulations for digestibility and bioavailability, companies can create products that support specific health goals, such as muscle recovery, weight management and athletic performance.

## SECTION IV:

# Profiles of Common Plant Proteins

Osage Food Products' SolvPro plant protein line consists of a variety of options that can be used on their own or blended with other sources.

### ALMOND PROTEIN

Derived from almonds, the edible seeds of the almond tree.

- **Protein Level:** 50-70%
- **Flavor:** Mild, nutty
- **Color:** Off-white to beige
- **Applications:** Protein bars, snacks
- **PDCAAS Score:** .22 to .48
- **Allergens:** Tree Nut

### BROWN RICE PROTEIN

Derived from brown rice, a whole grain rice variety that retains its outer bran layer and germ.

- **Protein Level:** 65->90%
- **Flavor:** Grainy, mild
- **Color:** Light beige
- **Applications:** Meat analogs, dairy alternatives, bakery
- **PDCAAS Score:** .61
- **Allergens:** None

### CANOLA PROTEIN

Derived from canola seeds, which is a type of rapeseed that has been bred for human consumption.

- **Protein Level:** >90%
- **Flavor:** Clean mild, slight astringency
- **Color:** Light to dark beige
- **Applications:** Meat analogs, soups, sauces, bakery
- **PDCAAS Score:** .86
- **Allergens:** None

### FABA BEAN PROTEIN

Derived from fava beans, also known as broad beans or Vicia faba.

- **Protein Level:** 85%
- **Flavor:** Mild, slightly earthy
- **Color:** Light beige to cream
- **Applications:** Meat analogs, bakery foods, beverages
- **PDCAAS Score:** .63 to .68
- **Allergens:** None

### HEMP PROTEIN

Derived from hemp seeds, which come from the Cannabis sativa plant species.

- **Protein Level:** 43-95%
- **Flavor:** Nutty, grassy
- **Color:** Greenish beige to light tan
- **Applications:** Ready-to-mix powders and beverages, snacks and protein bars
- **PDCAAS Score:** .66
- **Allergens:** None

### MUNG BEAN PROTEIN

Derived from mung beans, which are small, green legumes commonly cultivated in Asia.

- **Protein Level:** 65->90%
- **Flavor:** Mild, nutty, slightly savory
- **Color:** Light yellow
- **Applications:** Meat analogs, egg alternatives, pasta, bakery
- **PDCAAS Score:** .65
- **Allergens:** None

### PEA PROTEIN

Derived from yellow peas, also known as Pisum sativum

- **Protein Level:** 65->95%
- **Flavor:** Beany, earthy
- **Color:** Light yellow
- **Applications:** Meat analog, beverages, extruded snacks, bars
- **PDCAAS Score:** .89
- **Allergens:** None

### WHITE RICE PROTEIN

Derived from white rice, which has been milled to remove the bran and germ layers.

- **Protein Level:** 80-90%
- **Flavor:** Mild, clean
- **Color:** Cream, off-white
- **Applications:** Meat analogs, dairy alternatives, pasta, bakery
- **PDCAAS Score:** .60
- **Allergens:** None

### SOY PROTEIN

Derived from soybeans.

- **Protein Level:** 65->90%
- **Flavor:** Earthy, bitter, astringency
- **Color:** Cream, off-white
- **Applications:** Meat analogs, ready-to-mix powders, drinks, soups, dressings
- **PDCAAS Score:** .91
- **Allergens:** Soy

### SUNFLOWER PROTEIN

Derived from sunflower seeds, the edible seeds of the sunflower plant.

- **Protein Level:** 45-60%
- **Flavor:** Slightly nutty, sweet
- **Color:** Light beige
- **Applications:** Ready-to-mix powders, sports nutrition, bars, snacks, cereals
- **PDCAAS Score:** .6
- **Allergens:** None

### WHEAT PROTEIN

Derived from wheat grains and also known as wheat gluten or wheat protein isolate.

- **Protein Level:** 65->90%
- **Flavor:** Grainy
- **Color:** Creamy, off-white
- **Applications:** Bakery, meat extender, snacks
- **PDCAAS Score:** .42
- **Allergens:** Wheat

Want to know the current markets and costs of these various protein sources and their functionality in specific food and beverage products?

**Contact our SolvPro experts.**

## SECTION V: Formulating Plant Protein Blends

### It Seems Most Plant Proteins Are Not Complete Proteins. Can I Blend Them to Achieve A Complete Protein Profile?

Yes, blending different plant protein sources together is a common and effective way to create a complete protein. It's also a great way to reach a color, flavor and functionality profile that is optimized for specific applications.

### What Should I Think About When Reviewing Blended Protein Systems?

There are two areas a product developer should think about as they evaluate what blended protein systems work best in a formula.

- **Nutritional Considerations:** What macro and micro nutrient targets are you trying to hit?
  - » Protein Concentration
  - » Nutritional Profile
  - » PDCAAS Score
  - » Allergen Risk
- **Sensory Considerations:** What's the product application, usage level and impact on key sensory attributes listed below?
  - » Flavor
  - » Color
  - » Functionality
  - » Processability
- **Market Considerations:** Is the protein blend readily available and will it meet the cost targets for a specific product?
  - » Crop and product availability
  - » Pricing



### Can You Give Me An Example Of A Blended Protein System?

Osage Food Products' SolvPro team has developed many optimized plant protein blends designed for easy incorporation into a variety of applications. One of our most popular is SolvPro 012, which is a pea protein isolate/barley-rice protein isolate blend that has a PDCAAS score of 1.00. A couple interesting notes on this blend:

- It's made with a new barley-rice protein made from spent brewers grains (upcycled barley) from the brewing process, so it is considered sustainable and environmentally friendly.
- The blend delivers superior solubility and a clean flavor and smooth mouthfeel, especially in ready-to-mix (RTM) powdered beverages.
- It has an exceptional amino acid profile and a PDCAAS of 1.0 delivering optimized nutritional attributes.
- It is available in a flavor masked version for a balanced and clean flavor profile.

### That Sounds Great. Can I Use This In Any Application?

That's the wonderful thing about protein blends. Protein experts, like our SolvPro team, can develop blends for specific applications. The above blend is fantastic, but it has a slightly darker color and contains barley gluten, so it may be inappropriate for some applications that require a lighter color and gluten free claims. It also may not be ideal for extruded snacks due to its high solubility characteristics.

### What Protein Blend Works Well For Extruded Snacks?

Our SolvPro024 is a blend of a functionally larger mesh pea protein isolate and brown rice protein concentrate that are designed specifically for bakery and extruded snack systems yet still delivers a complete protein and a PDCAAS of 1.0. Plus, it's allergen-free so it can be used in allergen-free products.





## When Selecting The Protein Blend For My Application, What Formulation Challenges May I Encounter?

Plant proteins operate differently than dairy proteins, and formulating with plant protein ingredients can pose challenges. Here are the main things that your R&D team should be focused on when selecting plant protein blends and formulating with these ingredients.

- **Solubility and Dispersion:** Some plant proteins have poor solubility or dispersion properties, which can lead to issues with texture, product uniformity and stability. Formulators may need to experiment with different processing methods, emulsifiers, stabilizers and pH adjustments to improve the solubility and dispersion of plant-based proteins in food and beverage applications. It's also important to choose the best type and mesh size of each protein component.
- **Texture and Mouthfeel:** Plant proteins often have different textures and mouthfeels compared to animal proteins. Due to some of the insoluble matter that comes along with the protein isolation, they may be gritty, chalky or have a beany taste or off flavor that can be undesirable to consumers. Formulators need to work to optimize the texture and mouthfeel of products containing plant-based proteins through ingredient selection, processing techniques, formulation adjustments and flavor systems.
- **Flavor Profile:** Plant proteins can have strong flavors or off-flavors that need to be masked or balanced in finished products. Formulators must carefully select flavoring agents and ingredients that complement or neutralize the taste of plant proteins without overpowering the overall flavor profile of the product. Given this challenge, the SolvPro team also leverages its expertise in flavor masking technology to offer a flavor optimized version of each of the SolvPro systems (when applicable and desired).
- **Allergen Considerations:** Many plant proteins, such as soy, wheat and nuts, are common allergens that can pose challenges for consumers with food allergies or sensitivities. Formulators need to carefully label products containing allergenic ingredients and take precautions to prevent cross-contamination during manufacturing to ensure product safety.
- **Nutritional Profile:** Plant proteins vary in their nutritional composition and amino acid profiles compared to animal-based proteins. Formulators need to consider the nutritional requirements of the target consumer market and ensure that products containing plant proteins provide adequate protein content and essential amino acids for optimal nutrition.
- **Cost and Supply Chain Considerations:** Some plant proteins may be more expensive or less readily available than traditional animal-based proteins, depending on factors such as crop yields, processing methods and market demand. Formulators need to consider the cost and availability of plant protein ingredients and explore opportunities for sourcing partnerships, supply chain optimization and ingredient substitution to manage costs and ensure product availability.

Overall, plant proteins can be challenging to work with.

A collaboration between food scientists, product developers and ingredient suppliers is essential to overcome formulation challenges and create successful product applications with desired protein levels. There is also a very wide range of quality across the global supply chain and various suppliers of plant proteins, so finding a high quality source with consistent product quality is a key challenge.



## SECTION VI: SolvPro Plant Protein Blends

Osage Food Products' SolvPro systems are optimized for functionality and nutritional properties in a variety of applications.

PRODUCT	INGREDIENTS	PDCAAS	ALLERGEN	DESCRIPTION
<b>SolvPro 010</b>	Pea protein isolate, EverPro Neutral barley-rice protein isolate	0.83	Gluten (barley)	Made with the a lighter colored barley-rice protein isolate and a high functionality North American produced pea protein isolate (various grades available depending on the end-use application), delivering superior mouthfeel and optimized nutrition in RTE systems. The lighter color allows this blend to be used in color-sensitive applications like vanilla RTM sports powders. This product is non-GMO, but is not available in an organic format.
<b>SolvPro 012</b>	Pea protein isolate, barley-rice protein isolate	1	Gluten (barley)	Made with the a slightly darker colored barley-rice with a superior amino acid profile, and a high functionality North American produced pea protein isolate (various grades available depending on the end-use application), delivering superior mouthfeel and optimized nutrition. This product is non-GMO, but is not available in an organic format. The darker color makes this version useful for darker colored recipes like chocolate-based RTM powders.
<b>SolvPro 018</b>	Pea protein isolate, canola protein isolate	1	None	Allergen-free blend made with a highly functional combination of canola protein isolate and pea protein isolate (various grades available depending on end-use application), delivering a very clean flavor profile with a neutral color and excellent functionality. This product is non-GMO, but is not available in an organic format.
<b>SolvPro 024</b>	Pea protein isolate, brown rice protein concentrate	1	None	Allergen-free combination of pea protein isolate and brown rice protein concentrate. The brown rice is sourced from China and is combined with a NA-produced pea protein isolate made specifically for extruded snack type systems. The dispersibility and solubility characteristics are different than the finer mesh beverage systems (see below, SolvPro 028), but this product works very well in extruded crisps, snacks and pasta systems.
<b>SolvPro 028</b>	Pea protein isolate, brown rice protein concentrate	1	None	Allergen-free combination of pea protein isolate and brown rice protein concentrate. The extra fine brown rice is sourced from China and is combined with an extra fine NA-produced pea protein isolate specifically for RTM beverage powder systems and higher moisture applications. With the finer mesh protein forms, the solubility of this optimized blend is greatly improved and the mouthfeel is about as smooth as you can get with vegan proteins; very close to the quality of milk proteins and with an equivalent PDCAAS.
<b>SolvPro 030</b>	Pea protein isolate, mung bean protein, brown rice protein concentrate	1	None	Allergen-free combination of pea protein isolate, brown rice protein concentrate, and mung bean protein. The brown rice and mung bean are sourced from China and are combined with a fine NA-produced pea protein isolate. The mung bean adds a unique creamy type character to this blend and by combining these three different components you get a nice functionality and a rounded clean flavor.

\*PDCAAS values are specific to the reference standard for 2-5 year olds that the FDA mandates through the CFR, this MUST be used for any food product making any protein claim marketed to any older age group; if used in a dietary supplement product and marketed as such, the PDCAAS values are much higher because they can be marketed specifically to the age group that the product is targeting, unlike the FDA food regulations. *NOTE: All of the above systems are available in an optimized flavor-masked version too for flavor sensitive applications or where the finished process processing allows for this (ie RTM drinks).*

These initial systems have been developed for specific applications and product development requirements. Please bring us your specific application requirements and the SolvPro® team can help you to navigate these difficult formulation challenges and help develop and deliver a SolvPro® system to meet your specific needs.







## **CONTACT US TODAY**

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Our customer service team is waiting to hear how we can help provide you with high-quality ingredients for your food and nutritional products.