

New Plant Proteins to Challenge Soy

Alternative choices to soy protein may have preferential benefits like superior flavor, hypoallergenicity, gluten free, positive name association, and preferred consumer labeling.

by Henk W. Hoogenkamp

Once you have seen one protein, does not mean that you have seen them all. Not all proteins are equal – some are digested and absorbed more rapidly, while others may favorably impact metabolism and glucose control. The organoleptic and application performances are also typically different, with each type having specific characteristics.

Consumers have no problem paying premium prices for specially formulated food and beverage products. It is expected that emerging protein sources such as pea protein, algae protein, rice protein and even hemp protein will succeed in market penetration, including the lucrative market for nutraceutical and therapeutic foods.

Soy protein has dominated the vegetable protein category for many years. As a matter of fact, in 1995 the decision was made to change the name of soy to “vegetable protein” to reduce the negative consumer perception of soy. Although the market domina-

tion by soy protein use in terms of quantity will not change anytime soon, soy must increasingly share the limelight with new and emerging protein solutions.

The Ingredient Angle

Besides the health benefits of many protein ingredients, proteins are also in demand for their ability to emulsify, gel, foam, stabilize and give structure. Specific knowledge of how to utilize protein to reach the optimum performance is necessary for food formulators. Innovative protein ingredients, usually the result of separation and purification from their original native source, are often additionally treated with enzymes to influence or modify specific amino acid sequences to obtain certain characteristics. All proteins are composed of a sequence or building blocks of amino acids and these determine a protein’s physical properties including molecular size and charge, solubility, as well as isoelectric point. The specific protein’s isoelectric point is the pH at which the molecule charge

is neutral and therefore no longer soluble in water-based solutions.

Evaluating Alternatives

The demarcation lines between the various protein sources such as those made from pea, rice, hemp, canola, quinoa, potato and dairy are disappearing. Segmentation and positioning of these ingredients will determine the ingredient most likely to be chosen or used as an alternative back up.

Alternative choices to soy protein may have preferential benefits like superior flavor, hypoallergenicity, gluten free, positive name association, and preferred consumer labeling. It is logical that much of these ingredients’ positioning is aimed to replace soy and dairy protein ingredients. This makes sense, considering that soy protein and dairy protein are the world’s largest and most dominant sources of protein.

The Potential of Hemp

In the plant kingdom, hemp is second only to soy in protein content. Compared to soy, hemp

is typically non-GMO. For years, hemp and hemp proteins have raised eyebrows because of its association with cannabis. Way back in the roaring 1970s, hemp derived ingredients were only used in very specific foods and preliminary sold to a small number of people belonging to the “hippy generation.” All that is now a thing of the past, especially because a number of US States, such as California and Colorado, have relaxed the rules and now allow the use of marijuana (*Cannabis sativa L.*).

Hemp protein originates from the hemp plant, a member of the cannabis family. And as such, hemp protein comes from the same plant species as marijuana, though the protein is derived from a special plant species that contains virtually no THC (tetrahydrocannabinol), the specific chemical that triggers marijuana’s psychoactive effects. Most hemp is grown in Canada.

Besides an above average content of essential amino acids, hemp protein is a quality source of arginine and histidine, as well as the sulphur-containing amino acids cysteine and methionine. Arginine and histidine are especially important for growth during childhood, while cysteine and methionine are essential for the production of vital enzymes. Compared to other plant proteins, hemp protein also contains relatively high levels of branched-chain amino acids that are important in repair and growth of lean body mass. About 65 percent of hemp protein is made up of edestin, a type of globulin protein exclusively found in hemp seeds. The remaining portion is albumen, similar to what is present in egg whites.

Hemp protein is considered to be a complete protein source

Table 1: Allergy Response of Selected Alternative Proteins

Ingredient	Allergy Response	Main Application
Hemp Protein	No	- Raw plant protein powder - Organic whole foods
Rice Protein	No	- Dry-blended nutrti-drinks - Gluten-free foods - Nutri-bars, incl. rice crisps
Pea Protein	Low risk/yes	- Universal soy protein substitute



› Hemp protein is rich in branched-chain amino acids.

and is arguably the only plant food capable of sustaining life in the absence of other foods. While soy has a higher overall protein content, hemp protein is easier to digest due to its lack of trypsin inhibitors and oligosaccharides, not to mention that soy is considered a major source for causing allergic symptoms. Hemp protein is gluten free and has a rather unique nutty flavor. This restricts the protein of universal inclusion in flavor sensitive foods and beverages.

The Pulse on Pea Protein

Most probably because of the negative name association of soy protein in relation to allergenic response, the use of pea protein ingredients is rapidly increasing in the US, Canada and the UK. As a matter of fact, 2013 symbolizes a shortage of pea protein isolate, which will last until new manufacturing units are constructed. Cosucra has already committed to building a new protein plant for pea (see box), and Roquette is expected to make the same decision before the end of the year. If these plans push through, these two manufacturing units will have a combined additional capacity of some 16,000mt. In the meantime, China now has three pea protein plants in operation. These plants were actually initially built as soy protein manufacturing units but mothballed because of the severe

overcapacity. With some adjustments, these plants can be reconfigured into modern pea protein production units.

The pea plant is considered an autogamous species like wheat, because it does not need external pollen to be fertilized. Since the pea plant can draw nitrogen from air, the crop does not require nitrogenous fertilizers, which is very beneficial for sustainable and ecological sound agriculture. When used in rotation with wheat crop, significantly less greenhouse gases are expelled, which will ultimately reduce global warming.

In terms of a soy protein alternative, pea protein is probably the furthest ahead on the curve, offering excellent water-lipid linkage properties. Unlike soy protein, the yellow pea grown in northern Europe and North America is not genetically modified and it is not on the list of major allergens requiring label warnings. Pea protein isolate has an amino acid profile close to that recommended by the FAO and WHO, not only because of its high levels of branched amino acids, glutamic acid and arginine, but also because it is rich in lysine. The little yellow round pea is highly digestible because of the elimination of anti-nutritional factors during its manufacturing process. All in all, pea protein isolate is an environmentally-friendly source of food protein and, sub-

sequently, ideal for sustainable or "green" food production.

Up until recently, the main restriction of the use of pea and lupin protein was their taste difference depending on the botanical origin, as well as inadequate processing methods to clean up persistent odor and sensory notes. Recently-introduced pulse protein ingredients, including blends with microalgae protein, rice bran protein as well as hemp protein, have made major organoleptic improvements possible, including nutritional value, superior digestibility, and technological functionality. Pea protein is ideal for combining with other plant protein ingredients, such as rice bran protein, although when non-plant proteins are an option, whey or egg protein is a better solution to maximize nutrition profiles. Together, these combined proteins provide superior, easily digestible nutrition at attractive price points. Especially in the US and Canada, many new formulated foods, including nutribars, weight management, and dry-blended beverages, are based on a combination of whey protein, pea protein and rice bran protein.

The main projected use of pea protein is the inclusion in extruded high-protein pea crisps for use in nutrition bars, as well as in the production of extruded meat analog protein fibers. Extruded intermediate plant proteins structured fibers containing pea protein, which are available in semi-moist or dehydrated forms, are increasingly used as an alternative for soy and have shown properties that mimic meat.

Rice Bran Protein Potential

Rice has been the staple of billions of people for many centuries. This grain is much more than a vehicle to deliver carbohydrate calories. Being one of the oldest grains, rice protein has not been explored to the same extent as wheat, corn and soy. The reason is probably due to the available funding of US driven agricultural interests. However, since the beginning of the 21st century, science and food technology are quickly unraveling this grain's potential and formulators have started to incorporate rice bran and its many fractions to

provide functionality, health and taste contributions, as well as cost efficiency.

About 90% of all the nutrients of rice are embedded in the rice bran and germ. Being an inherent part of the whole grain, it also contains phytonutrients like tocopherols, tocotrienols, oryzanols and phytosterols. Stabilization technology has made it possible to recoup a range of highly nutritional ingredients from rice bran; including protein, fibers, and oil.

Unfortunately there is some market confusion about the name definitions of the various types of rice protein. Especially in the US and Canada "sprouted whole grain brown rice protein" is popular and recognized by pro-active consumers seeking out health benefits. Sprouted whole grain brown rice is usually a bio-fermented a concentration of protein. Typically, the highest rice protein yields are obtained from germinated brown rice at 42°C for 2 hours, using a solid to solvent ration of 1:10 at pH 8.5. These yields are about 20 percent higher than that from non-germinated brown rice. This fact alone, explains the price

› Cosucra Invests in Pea Protein Facilities

Active for more than twenty years in research and development in natural food ingredients, Cosucra is strengthening its industrial and commercial leadership by investing €30 million in its Belgian pea protein production unit. In a market still dominated by soy protein, pea protein is recording rapid growth, especially in the North American and European markets. Asian markets keep a close eye on the development of this product, aware of its value as a non-allergenic nutritional supplement. Cosucra is today reaping the benefits of its industrial and commercial investment and is recording an annual growth of over 20% of its Pisane sales in the market segments of sport, medical nutrition, seniors, vegetarians and diet nutrition.

This investment will expand production capacity for its Pisane product, by the creation of a second pea protein refining line. The investment project has already been endorsed by the company's board of directors and is due to start in October 2013. The extension of its Warcoing production site will be operational at the beginning of 2015. The project will also include the construction of a second drying tower as well as an additional packaging line.



› This Zeal product contains whey, pea and rice bran protein.

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differences compared to the premium rice protein ingredients derived from non-sprouted brown rice.

Explaining the Difference

Protein derived from germinated or sprouted brown rice is therefore quite different from storage proteins extracted from non-germinated rice. There is little doubt that the collective rice industry should put special emphasis to explain the differences between true storage protein and vegetative protein. In a way, it is misleading to say that germinated brown rice protein is the same as rice protein derived from whole grain rice kernel and its bran that have not been subjected to the process of germination. The message is clear; once storage proteins are converted to vegetative proteins by means of synthesis, it is questionable to claim that the proteins still have the same nutritional benefits as whole rice grains. Obviously, part of the sprouting process may be the breakdown of the natural storage proteins, resulting in the synthesis of vegetative proteins found in impurities such as rice leaves, i.e. Rubisco (Ribulose), the most abundant protein on earth. Most of the sprouted brown rice protein ingredients originate from China, while the premium rice bran protein ingredients originate from the US and Thailand.

On September 6, 2013, the US Food and Drug Administration (FDA) ruled that the amount of detectable arsenic is too low in rice and rice products. Rice protein ingredients, including the soluble fractions such as California grown and extracted RiSolubles, are quickly making inroads and have become the poster child for many formulated foods, typically sold through Whole Foods and Multi-Level-Marketing (MLM) channels. Especially MLM nutraceutical foods and gluten free selections have become hugely popular.

Gold of the Incas

Quinoa is a recently rediscovered ancient grain, also known as "The Gold of the Incas." Quinoa is a gluten free amino-acid rich seed with a slightly crunchy texture and a note of nutty flavor when cooked. Modern processing allows

the removal of the bitter saponin coating that naturally covers the cylindrical seed. Much similar to rice, this process involves a mechanical abrasion followed by a thorough washing and dry/thermalization process to manufacturer whole grain, flour, starch, flakes or protein components.

Quinoa is a promising, highly nutritious yet "old-age" cereal-like crop that is rich in protein and micronutrients. This grain, which originated from the Andes region in Peru, has a wide ability to adapt to different ecological climate environments. Traditionally, quinoa grains are roasted and then used as flour in bread. However, quinoa has presently branched into applications such as pasta, cereals, and as a fermentation medium for beer. The almost forgotten protein-rich grain is now quickly recovering and frequently used in organic foods, including high moisture extruded meatfree options. Quinoa is now also cultivated and harvested in the US, Canada, UK, Scandinavia and India.

Others to Watch

Canola or rapeseed protein and oat protein are also potentially viable plant proteins options, just like potato protein and sorghum. The commercialization of canola, oat, and potato protein isolate will offer food formulators with additional options. Expect these vegetable proteins to be positioned at the semi-high end of the application spectrum, somewhere between soy proteins isolate and dairy protein prices. ▼

Henk W. Hoogenkamp is a protein expert and the author of the new book "Rice Protein & Beyond."

