Dairy Farmers of America

INGREDIENT SOLUTIONS

Not All Proteins Are Created Equal

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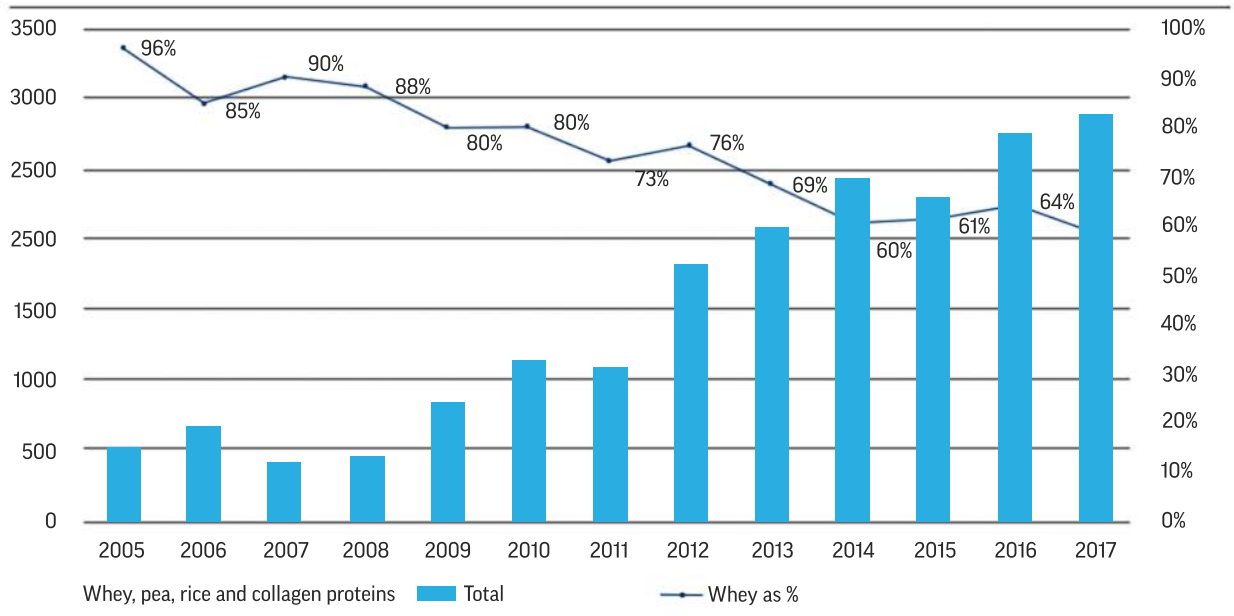
We know that all fats are not the same, and there are both simple and complex sugars. But how much do we know about proteins? Is a protein... just a protein? Many of us probably think of meat when we think protein, but as consumers are becoming seemingly more interested in plant-alternatives, we have to take a deep dive into dairy proteins vs plant proteins.

Sixty-four percent of Americans want to consume more proteins, and protein product introductions have increased by a factor of five in the United States in the past 10 years. Food and beverage products featuring a plant-based claim posted an average annual growth rate of 68% over the past five years.[1] Why is this? Because dietary proteins deliver many health benefits: they provide energy throughout the day, make people feel fuller for longer, help with weight loss and reduced waist size, help manage blood sugar, support cardiovascular health, and can prevent muscle loss that comes with age. In short, proteins fit perfectly into consumers active and busy lifestyles – at any age.

Pea, rice and collagen proteins capture growing market share

(New product introductions, 5 year comparison, USA 2018P based on 8 months data)



Milk-Based Proteins

It is estimated that over 85% of the research documenting the benefits of proteins has actually been done with proteins from milk: whey, milk protein, and casein. Hundreds of high-quality clinical trials have been conducted over the past 15 years, offering a formidable body of scientific evidence.

Some of the most researched benefits of dairy-based proteins, which are also top-of-mind for today's consumer, include:

- Desirable changes in body composition, improving tone, fat loss, and weight loss; [2,3,4,5,6]
- Satiety, reducing hunger and reducing subsequent energy intake and increasing energy throughout the day; [7,8,9,10,11]
- Improved sports performance and workout recovery; [12,13,14,15,16]
- Blood sugar management;
- And "anti-aging": managing muscle loss that comes with age, overcoming reduced anabolic response to food intake in the elderly. [17,18,19]

Plant-Based Proteins

There are many plant-based proteins options available to food formulators and consumers these days. Many are positioned as more sustainable or lower in cost, but how much protein do they contain? And perhaps most importantly, what is the quality of this protein, and are they effective? The evidence shows that not all proteins are created equal.

Protein Contents Vary Across Sources

Plant-based protein sources range between 40% (almond protein powder)[20] and ~90% (pea or soy isolates). In comparison, whey protein concentrate 80 (WPC80) contains ~80% proteins, and whey protein isolates over 90%. Milk protein concentrates typically range between 70 and 85%, and isolates contain over 85%.

The table below displays the typical protein content of plant-based products[21]

Type of Protein	Typical Protein Content
Almond protein powder	40%
Hemp	51%
Lupin	61%
Oat	64%
Corn	65%
Rice	79%
Pea	80%
Potato	80%
Wheat (gluten)	81%
Soy concentrates/isolates	61%-91%

Protein Quality

Beyond the basic content in protein, a factor to consider is the quality of the proteins themselves – essentially the amino-acid content, its balance, and its "fit" with human needs. In other words, dietary protein quality is assessed based on the essential amino-acids composition of a protein as it relates to human needs and the ability of the protein to be digested, absorbed, and retained by the body.

The value of a protein is related to the bioavailability of its amino acids and depends on the efficiency of their metabolic utilization. This is measured by a score called the PDCAAS (Protein Digestibility Corrected Amino-Acid) score, and in 2013, the Food and Agriculture Organization (FAO) proposed a new, more accurate quality score called DIAAS (Digestible Indispensable Amino Acids Score.

The following table presents protein quality scores based on various protein sources[22]

Type of Protein	PDCAAS	DIAAS
Milk	100	114
Whey	100	
Casein	100	
Soy flour	93	89
Chick pea	74	83
Pea protein concentrate	89	82
Yellow split pea	64	73
Cooked rice	62	60
Wheat	51	45

The current body of evidence suggests[23]

- That plant-based protein investigated so far are characterized by a DIAAS score below 100%, which is lower than animal proteins, in particular proteins from milk;
- Overall plant-based proteins are less digestible than animal proteins, and they are deficient in certain amino-acids for the human body's needs;
- The availability of amino-acids derived from plant-based proteins is lower than that of animal proteins;
- And plant-based proteins have less of a capacity to improve lean and skeletal muscle mass than proteins from milk and other animal proteins.

What Type of Protein Produces Higher Efficacy?

Studies investigating the anabolic properties of plant-based proteins have shown that the muscle protein synthetic response to the ingestion of soy and wheat protein is lower when compared to dairy proteins. The lesser anabolic properties of plant-based proteins have been attributed to lower essential amino-acid content and/or shortage of specific amino-acids such as leucine, lysine, and/or methionine.[24] Even when doses are increased to 40g vs. 20g for soy, or 60g vs. 35g for wheat (matching the leucine content of 35g from whey), researchers were not able to induce a greater stimulation of muscle protein synthesis.[25] Therefore, in order to "compensate" for lower amounts of essential amino-acids, it is necessary to consume much larger amounts of plant-based proteins.

Furthermore, according to recent research, "the low lysine and methionine content of corn, hemp, brown rice, soy, and pea protein can be compensated for by ingesting two to four times more protein," and "oat, lupin and wheat protein are both low in lysine and methionine, which could be compensated for by ingesting three to eight times more protein." [26]

As using much larger quantities of protein is not always practical, desirable, or cost-effective, a solution for product developers is to create blends of proteins, or simply complement plant- based proteins with proteins to form milk to compensate for plant-protein's deficiencies in specific amino-acids. Combinations of milk-based and plant proteins may provide characteristics that closely reflect the typical composition of higher quality milk-based protein sources.

Proteins are valued for their anabolic properties, but according to recent research[27] , "plant-based proteins have less of an anabolic effect than animal proteins due to their lower digestibility, lower essential amino-acid content (especially leucine), and deficiency in other amino acids." To compensate for this lower quality, nutritional strategies include increasing quantities consumed (not always desirable from a cost, caloric intake, or formulation standpoint) and blending plants with milk-based proteins.

The Numbers Set You Free: Is It Just About Grams of Protein?

The benefits of milk-based proteins for a healthy lifestyle are well documented. Notably, health benefits can be achieved with consumption of lower amounts of milk-based proteins (see previous section) vs. alternative proteins. It's not just "grams" – it's quality and efficacy which counts.

Beyond the specific benefits (reduction of body fat, increases in lean body mass,[28] Section II.2), of milk-based proteins, such as whey proteins, caseins, and milk protein concentrates/isolates, recent systematic reviews and meta-analysis support adequate milk consumption at various stages of life in the prevention/control of various non-communicable diseases. This includes diabetes and cardiovascular health, which are a concern to millions of individuals worldwide.[29] As populations are aging in most industrialized countries, it is also important to note that the consumption of proteins from milk may reduce the risk of frailty, and that skeletal muscle mass may improve with the addition of milk protein to the diet and reduce the risk for sarcopenia – key to quality of life as we age.

Dairy Flavor vs. Plant Flavor Profiling

Demand for plant-based proteins is increasing, but there are still serious functional and sensory issues the industry needs to solve. According to trade sources, "plant protein products are continuously launching, but many simply do not measure up when it comes to taste, solubility, and purity. Many plant protein ingredients still contain large amounts of starches and fibers, as well as undesirable tastes and flavors that do not offer high functionality."[30]

Despite the strong consumer interest in plant proteins, formulators have challenges in that most of the plant proteins have intrinsic flavor and texture problems. Pea protein, for example, has been described as "earthy," "grassy," "beany," and "hay-like" due to residual volatile compounds. Naturally occurring saponins in pea flours and protein products cause bitterness, with some metallic and astringent notes also described. Legumes, which include pulses like yellow peas, may bring off-flavors like bitterness and grassy notes.[31]

One of the challenges that product developers face when working with plant-based ingredients such as pulses is the natural, beany flavor profile which is objectionable to most consumers and requires either masking or the use of intensive technologies and at times solvents (hexanes, alcohol) or other chemicals, to treat the raw material.

Rice and chia are also sources of plant-derived proteins, but they all have unique, inherent off- tastes, bitter notes, and vegetative aftertastes. According to trade sources "As much as consumers are interested in protein-rich foods and beverages, the unpleasant taste of proteins derived from plant sources is often hard to endure. Reducing the earthy, bitter, and often chalky off-notes of different plant proteins is more complicated than it seems."[32]

Dairy Flavor vs. Plant Flavor Profiling (cont.)

Flavoring and masking agents are key tools for suppressing these desirable off-flavors. Yet, one of the major challenges in flavor masking is finding solutions that maintain the natural, clean-label positioning of a brand or product. Natural or organic solutions are difficult to find compared to artificial flavoring options.

In contrast, proteins from milk are minimally processed through simple filtration techniques and air dried – offering a clear advantage for clean label. Not only do milk proteins not impact off- flavors, but they contribute to the desirability and appeal of the products they are incorporated in.

Aside from flavor, a major challenge is solubility and suspension, and most plant-based beverages contain added gums, carrageenan, and other additives which is not desirable from a clean label perspective. On the other hand, proteins from milk are highly soluble, and isolates can be formulated in crystal-clear beverages. Proteins from milk can be incorporated into a very wide range of applications without the need for chemicals or additives.

Not All Proteins are Created Equal

Proteins from milk are the most complete, highest quality proteins and rank on top of all dietary proteins. When selecting a protein, think beyond "grams" – only proteins from milk deliver proven benefits even at low doses of 20-25g. What's more, there is no need for flavor-masking when using proteins from milk in most food formulations, and milk protein ingredients are manufactured through simple processes, without additives or harsh chemicals. Highly functional and soluble, milk protein ingredients are a perfect solution for clean labels. They can be incorporated into drinks, supplements and hundreds of applications without the addition of stabilizers, masking agents and other additives. The latest studies show that proteins from milk are sustainable and the best choice for diets with low global warming potential. Proteins from milk are suitable for vegetarian and fit well a sustainable lacto-ovovegetarian diet.

Not all proteins are created equal; only milk-based proteins have been proven to have specific health benefits, which are based on extensive evidence gathered through hundreds of high-quality clinical trials. From reducing hunger to improving body composition, reducing fat to maintaining muscle as we age, proteins from milk face no competition.

DAIRICONCEPTS®

DFA INGREDIENT SOLUTIONS
Dairy Farmers of America

DairiConcepts, DFA Ingredient Solutions' taste and flavor product line, provides award-winning dairy-based ingredients for the global food industry, producing specialty cheese and dairy powders, concentrates, seasoning blends, flavor enhancers, and dairy-type flavors. Catering to food manufacturing and foodservice companies, the DairiConcepts product line is supported by eight manufacturing plants in the U.S., two development laboratories, and a pilot testing plant. Facilities are SQF Certified and recognized by the Global Food Safety Initiative.

DFA INGREDIENT SOLUTIONS
Dairy Farmers of America

DFA Ingredient Solutions is a division of Dairy Farmers of America, a national, farmer-owned dairy cooperative focusing on quality, innovation and the future of family dairies. DFA Ingredient Solutions delivers essential ingredients in exceptional ways – from versatile dairy powders and butter products to award-winning cheeses. We work with some of the world's largest food companies to develop ingredients that satisfy their customers' cravings, all while being part of our network of 14,000 family farm-owners who stay committed to social responsibility and ethical farming. For more information, please visit DFAingredients.com.

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