U.S. Dairy Proteins

Value-Added, High-Quality Nutrition Solutions

Global demand for dairy proteins is growing due to increased awareness of protein benefits. U.S. suppliers have become increasingly specialized in the production of dairy proteins to meet varying protein levels, functional properties and other specifications. Applications vary depending on the protein content and offer a wide-range of functional and nutritional benefits.

Research-Driven Portfolio

Advances in technology and investments in research and development have enabled the United States to expand its portfolio for these value-added dairy proteins. The United States is the largest producer and exporter of whey in the world and has also been increasing milk protein production in recent years. With one of the world's largest milk supplies, an abundance of land, and investments in research and development, the U.S. dairy industry is capable of answering the call for increased global customer demand.

Dairy protein ingredients are divided into two basic categories: whey protein ingredients and milk protein ingredients. The whey protein ingredients include whey protein concentrates (WPC) and isolates (WPI), which range in protein from 34 to 89% for a WPC to a minimum of 90% for a WPI. The milk protein ingredients include milk protein concentrates (MPC) and isolates (MPI) with similar ranges in protein as whey protein ingredients. MPC contains the typical 80% casein and 20% whey protein found in milk, whereas the protein in a WPC is all whey protein. Differences in functional properties between WPCs and MPCs can be attributed to the predominant type of protein making up each ingredient.

DID YOU KNOW

- The United States is the leading single-country producer of whey ingredients, exporting more than 60% of the 711,000 metric tons manufactured in 2015.
- U.S. production of whey ingredients is increasingly shifting away from sweet whey to value-added products. In 2015, WPC and WPI together accounted for 38% of production, up from 31% in 2010.
- U.S. MPC production is on the rise, reaching a new record of 71,300 metric tons in 2015, up 25% from 2014 and 78% from 2010.

Source: U.S. Department of Agriculture

Wide Ranging Food Applications

Whey products improve texture, enhance flavor and color, emulsify and stabilize, improve flow properties and dispersibility in dry mixes, help extend shelf-life and exhibit a range of additional properties that increase food product quality.

Functional properties are affected by several factors within a food application, including protein level, quality of the whey protein, pH, ionic environment, preheat and heat treatments, and the presence of lipids. High solubility over a wide pH range makes WPI and WPC well-suited for sports beverage or meal replacement applications. Water-binding capabilities make them suitable for processed meats, cakes and breads.

Milk protein ingredients are used for their nutritional and functional properties with higher-protein MPCs providing protein enhancement and a clean dairy flavor without adding significant levels of lactose to food and beverage formulations. MPCs also contribute valuable minerals such as calcium, magnesium and phosphorus to formulations, which may reduce the need for additional sources of these minerals.

FIG. 1: FUNCTIONAL PROPERTIES OF THE PROTEINS IN MILK

CASEINS	WHEY PROTEINS
Fat emulsification	Gelation
Foaming	Foaming
Soluble at pH>6	Soluble at any pH
Heat stable	Heat sensitive
Water binding	
Precipitation by chymosin	
Precipitation by Ca++	

Source: Early. The Technology of Dairy Products. 1992.

Next Generation U.S. Dairy Proteins

The U.S. dairy industry is continually adopting new technologies to create more value-added ingredients with diverse applications for food manufacturers. Recent research has examined different microfiltration systems to separate caseins and whey proteins directly from milk. The fraction containing casein is commonly referred to as "micellar casein," while the fraction containing mainly whey proteins is referred to by many names in the literature, such as "native whey," "serum proteins," and "milk-derived whey (MDW)." These next generation ingredients provide an opportunity for food and beverage companies to create new products benefiting consumers.

FIG. 2: COMPOSITION OF WHEY AND MILK PROTEIN INGREDIENTS

	PROTEIN (%)	LACTOSE (%)	FAT (%)	ASH (%)	MOISTURE (%)
WPC 34	33	52	4	7	4
WPC 55	53	31	6	6	4
WPC 80	77	9	6	4	4
WPI	89	2	1	3	5
MPC 56	54.4	31.7	1.2	7.6	5.0
MPC 70	68.3	18.2	1.2	7.3	5.0
MPC 80	78.1	8.4	1.5	7.0	5.0
MPI	87.1	0.5	1.5	5.9	5.0

Source: Smith K. Dried Dairy Ingredients. Wisconsin Center for Dairy Research. May 15, 2008.

MICELLAR CASEIN CONCENTRATE

Micellar casein concentrates (MCC) produce a range of compositions depending on the amount of whey protein removed. Further concentration and diafiltration can increase the total protein and decrease the amount of lactose in the final ingredient.

MCC provides notable nutritional benefits and is an excellent source of all essential amino acids and calcium and offers functional benefits in:

- Retort applications – Because of MCC's heat stability, it's a good choice for neutral pH ultra-high-temperature (UHT) or retort-processed ready-to-eat (RTE) meals, soups, sauces and nutritional drinks.

- Cheese milk standardization – Typically improves yield and produces cheese with a consistent composition; the ideal ingredient would contain predominantly casein protein, as that is the primary protein in cheese.

MILK-DERIVED WHEY

Composition of milk-derived whey protein ingredients are unique compared with those derived from cheese whey. The protein composition of cheese whey differs from MDW because it contains glycomacropeptide, which is cleaved from κ-casein through the action of chymosin in cheese making. One of the key differences between cheese whey and MDW is fat content. MDW is essentially free of fat, typically less than 0.3 percent (compared to 6 to 7 percent in cheese-whey-derived WPC), even after further concentration to 80 percent protein.[1,2]

Functional benefits include:

- Like traditional WPC, milk-derived WPC has foaming, gel strength, solubility and emulsification capacity.

- The use of milk-derived WPC will produce a clear, high-acid beverage (pH 3.4) that will have similar heat stability and clarity to a commercial whey protein isolate (WPI).

WHEY PROTEIN HYDROLYSATES

Whey protein hydrolysates are another emerging U.S. dairy ingredient, made from whey protein concentrates or isolates that are further processed using enzymes. The enzymes cleave the protein chains into smaller amino acid chains thus changing the functionality of the protein ingredient. The amino acid chains are hydrolyzed or broken down at specific points in order to impart desired characteristics. There can be considerable variation in the product profile as the specific enzymes used, sequence of enzymes, reaction time, reaction temperature, etc. can affect the type of protein fragments produced.

While traditional whey protein concentrates tend to have better foaming properties and emulsifying capacity, whey protein hydrolysates offer:

- Highly functional ingredients that are well-suited for a variety of applications, including but not limited to sports nutrition and infant formula for milk-allergic infants.

- High biologic value and superior taste and smell, compared to casein hydrolysates when dealing with milk protein allergies.

SWEET WHEY POWDER: WHAT'S ON THE HORIZON?

The United States continues to be a significant supplier of sweet whey powder, which is commonly used as a source of dairy solids for bakery, snack, confectionery and other food products. Production was 445,000 metric tons in 2015, down about 15,000 metric tons from 2010 and more than 70,000 metric tons below the peak of production. This trend is anticipated to accelerate, as the result of processing shifts to higher-value ingredients. In turn, availability of whey permeate, a co-product to WPC/WPI production, is on the rise and can be used as a reformulation option in several applications.

[1] Evans J, Zulewska J, Newbold M, Drake MA, Barbano DM. Comparison of composition, sensory, and volatile components of thirty-four percent whey protein and milk serum protein concentrates. *J Dairy Sci.* 2009;92:4773-4791.

[2] Evans J, Zulewska J, Newbold M, Drake MA, Barbano DM. Comparison of composition and sensory properties of 80% whey protein and milk serum protein concentrates. *J Dairy Sci.* 2010;93:1824-1843.

U.S. DAIRY PROTEINS ARE A QUALITY PROTEIN SOURCE WITH SUPPORTING HEALTH AND WELLNESS BENEFITS

VERSATILITY

U.S. dairy proteins can be added to a variety of foods and beverages, not just for athletes but also weight conscious consumers, active adults and seniors. Its neutral flavor complements the taste of foods to which it is added.

QUALITY

Protein quality matters. U.S. dairy proteins are an easily digestible, high-quality complete protein containing all essential and non-essential amino acids and high levels of branched-chain amino acids (BCAA).

TIMING

Beyond the total intake quantity of protein, the timing of protein intake also matters in order to help build and maintain muscle. Emerging research suggests a balanced intake of 25-30g of protein per meal as optimal.

Nutritional Powerhouse

Published nutrition research on the health and nutritional benefits of dairy proteins continues to multiply each year, supporting the benefits of incorporating whey and milk proteins into the daily diet. Protein is an essential nutrient the body needs to build and maintain muscle. Notably, while all animal and most plant foods contain some amount of protein, not all proteins are created equal.

Whey and milk proteins are a high quality, complete source of essential and non-essential amino acids naturally found in dairy foods. Whey proteins notably stand out as among the best sources of branched-chain amino acids (BCAA), including leucine, which has been shown to stimulate muscle protein synthesis. Concentrated whey protein contains minimal lactose compared to most milk powders or less concentrated whey powders. Highlights of key areas where research has shown that whey proteins, as part of a higher-protein diet, can help are:

- Maintain a healthy weight – A reduced calorie, higher protein diet including whey protein may improve the quality of weight loss by helping people lose more fat and/or maintain more lean muscle.
- Curb hunger – Calorie for calorie, whey protein can help people feel fuller longer than carbohydrates or fats.
- Get lean – Consuming whey protein and performing regular resistance exercise can help build more lean muscle compared to resistance training alone, or resistance training combined with carbohydrate consumption.
- Enhance exercise recovery – Consuming whey protein in proximity to exercise helps to build and repair muscle.
- Help maintain muscle – Consuming more high-quality protein and engaging in regular exercise can help people maintain muscle mass as they age, which may allow for a more active lifestyle.

GET IN TOUCH

Looking to buy dairy proteins?

While USDEC does not manufacture or sell dairy products, we proudly support the people who do. Search the **U.S. Dairy Supplier Directory** at **ThinkUSAdairy.org.**

To learn more and find a USDEC representative near you, go to **ThinkUSAdairy.org/global-presence**.