



# U.S. Dairy Proteins



Value-Added, High-Quality Nutrition Solutions

Global demand for dairy proteins is growing as awareness of protein benefits expands. 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 type and content and offer a wide range of functional and nutritional benefits.

## U.S. Dairy Protein Industry

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 concentrate production in recent years. With one of the world's largest sustainably produced 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.



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- The United States is the leading single-country producer of whey ingredients, exporting more than 70% of the 767,000 metric tons manufactured in 2018.
- U.S. production of whey ingredients is increasingly shifting to value-added products. In 2018, combined production of WPC and WPI rose 5% vs. 2017 and 9% over 2013 to reach 288,000 metric tons, accounting for about 38% of total whey production.
- U.S. MPC production is on the rise, reaching 66,000 metric tons in 2018, up 5% from 2017 and 3% from 2013.

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	
Color/opacity	
Precipitation by Ca <sup>++</sup>	

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 casein-rich fraction 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 expanded ingredient offerings 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	34-36	48-55	3-4.5	6.5-8	3-5
WPC 80	80-82	4-10	4-8	3-5	3.5-5
WPI	90-92	0.5-1	0.5-1	2-3	4-5
MPC 42	42	<51	<1.25	<10	<5
MPC 70	70	<20	<2.5	<10	<5
MPC 85	85	<8	<2.5	<8	<6
MPI	>89.5	<5	<2.5	<8	<6

Source: Industry Sources.

## MICELLAR CASEIN CONCENTRATE

Micellar Casein Concentrate (MCC), a type of microfiltered milk protein (MMP), is produced by microfiltration of skim milk. MMPs differ from other concentrates of milk protein because the casein to whey protein ratio is adjusted to be between 82:18 and 95:5 compared to milk's typical ratio of 80% casein to 20% whey protein. Within MMPs the name micellar casein is suggested for commercially available products with the higher ratio (95:5). Additionally, the casein remains in its native, soluble (micellar) form.

MCC provides notable nutritional benefits; offers functional benefits such as emulsification, wetting, dispersibility, heat stability at a neutral pH and solubility. It also allows for the addition of minerals in soluble form. These are applicable for:

- 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: MCC 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

The composition of milk-derived whey protein ingredients is unique compared with those derived from cheese whey. The protein composition of cheese whey differs from MDW because it contains glycomacropptide, which is cleaved from  $\kappa$ -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% (compared to 6 to 7% in cheese-whey-derived WPC), even after further concentration to 80% protein.<sup>1,2</sup>

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 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 nutrition bars, sports nutrition and infant formula for milk protein allergenicity.

## DAIRY VS. OTHER PROTEINS: WHAT'S THE ADVANTAGE?

Food and beverage formulators have an array of choices for protein ingredients, including animal, plant, insect and single cell proteins. With so many options, choosing the right protein ingredient is imperative to deliver on key attributes that appeal to consumers. Dairy proteins—made from wholesome and sustainably produced U.S. milk—offer formulators the complete package of a high-quality, complete protein, together with multifaceted functionality, wide usage versatility, a neutral flavor profile and supply security. Access [ThinkUSAdairy.org](https://www.thinkusadairy.org) for the technical report *A New Era for Protein: Why U.S. Dairy Delivers in the Crowded Protein Marketplace* for further information on the distinctive, research-backed advantages of proteins from milk vs. alternative sources.

<sup>1</sup> 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.

<sup>2</sup> 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 HIGH-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. Research has shown that whey proteins, as part of a higher-protein diet, can help in key areas such as:

- **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](https://www.usdaairy.org) at [ThinkUSADairy.org](https://www.usdaairy.org).

To learn more and find a USDEC representative near you, go to [ThinkUSADairy.org/global-presence](https://www.usdaairy.org/global-presence).

