

What Are Milk Protein Concentrates?

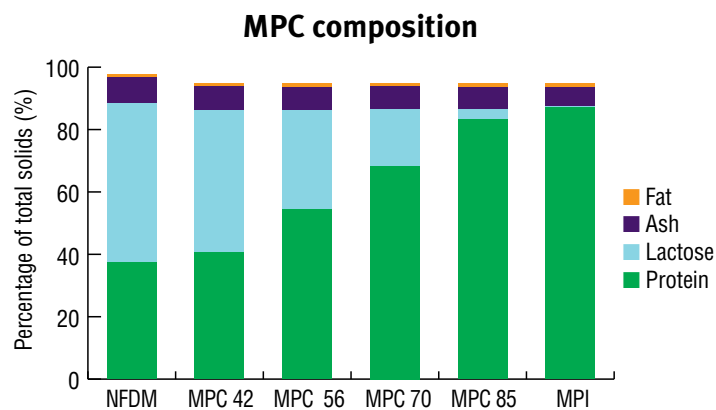
Milk protein concentrates (MPCs) are complete dairy proteins (containing both caseins and whey proteins) that are available in protein concentrations ranging from 40 to 89 percent. As the protein content of MPCs increases, the lactose levels decrease. For example, MPC₄₂ contains 42 percent protein and 46 percent lactose, while MPC₈₀ contains 80 percent protein and 4 percent lactose. Typical MPCs offered are MPC₄₂, MPC₇₀, MPC₇₅, MPC₈₀, MPC₈₅ and milk protein isolate (MPI). MPCs are produced by ultrafiltration or by blending different dairy ingredients. Although ultrafiltration is the preferred method for producing MPCs, they also can be produced by precipitating the proteins out of milk or by dry-blending the milk proteins with other milk components. Presently, there is no standard of identity for MPCs in the United States. Costs may vary and, more important, functionality may differ depending on how MPCs are produced. For comparison, skim milk powder (SMP) contains about 35 percent protein and 52 percent lactose.

Benefits of Milk Protein Concentrates

MPCs are used for their nutritional and functional properties. For example, MPC is high in protein content and averages approximately 365kcal/100g. Higher-protein MPCs provide 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. MPCs are multifunctional ingredients and provide benefits such as water binding, gelling, foaming, emulsification and heat stability.

Application of Milk Protein Concentrates

MPCs are currently used for manufacturing products including: process cheese, cream cheese, ice cream, yogurt/fermented dairy and meal replacement beverages. Application and formulation dictate the type of MPC used. Typically, lower-protein MPCs are used as ingredients in cheese applications, while higher-protein MPCs are used in beverage and bar applications. They are used as an ingredient in the kinds of applications that rely on nonfat dry milk/skim milk powder but



Source: Smith K. *Dried Dairy Ingredients*. Wisconsin Center for Dairy Research. Available at: http://www.cdr.wisc.edu/programs/dairyingredients/pdf/dried_dairy_ingredients.pdf. Accessed May 18, 2012.

require a higher level of protein where casein and caseinate are used traditionally. Use of MPCs as an ingredient is growing at the expense of casein and caseinate, due to their improved flavor profile. Common applications include infant formulas, desserts, baked goods, toppings, low-fat spreads, dairy-based dry mixes, dairy-based beverages, sports and nutrition beverages/foods, geriatric nutritional products, weight loss beverages/foods and some process cheese products. However, MPCs cannot be used in federal standard of identity cheeses (e.g., Cheddar).

Some of the common functional characteristics that MPCs offer in various food and beverage applications include:

- **Solubility** — MPCs that are stored at ambient to cool temperatures (40 to 70 F) and low humidity retain good solubility for six to eight months. Solubility of higher-protein milk protein concentrate, when stored at elevated temperatures, can decrease over time. Researchers investigated what causes differences in solubility in MPCs during production and storage, as well as the impact of manipulating mineral content on the solubility of MPC80 powder. A new technique to improve dissolvability of MPCs by increasing the sodium or potassium content was discovered, which makes MPCs more suitable for use in specific food and beverage applications such as meal replacement beverages and process cheese. This research shows that certain minerals such as calcium, magnesium and phosphorus interfere with protein solubility. This study also provides food manufacturers with techniques to control and customize the mineral content of their dairy powders for use in specific food and beverage applications. (Research conducted by Dr. Philip Tong and Dr. John Lucey.)
- **Emulsification/Foaming/Whipping** — Researchers are working on enhancing the functional properties of MPCs by modifying the processing conditions to manufacture MPC80 powders. They are studying various whey protein denaturation levels, different types of casein-whey protein complexes, various levels of casein-bound calcium and soluble casein, and manipulating casein micelle size to achieve improved MPC functionality. This research is focused on enhancing the emulsions (oil/water interface) and whipping (air/water interface) of MPCs for applications such as sausages, processed meats, dairy drinks, soups, vinaigrettes, sauces and bakery products. Researchers also are investigating the process to form a consistent film of air bubbles to stabilize meringues, mousses, cakes, ice creams, whipped cream and soufflés. (Research conducted by Dr. John Lucey and Dr. Federico Harte.)
- **Water Binding/Viscosity** — Researchers are working on enhancing the functionality of MPCs to improve water binding and viscosity similar to rennet casein and are planning to functionalize milk proteins by using an enzymatic process before spray-drying. The functionalized MPCs enhance the viscosity of a food product and will be applicable in products such as cheeses, firm yogurts, sauces, milk-based drinks and creams for desserts and bakery products. (Research conducted by Dr. Lloyd Metzger.)



Food and beverage processors should be aware of several best practices while using MPCs/MPI to ensure proper hydration of proteins prior to heat processing. Kimberlee J. Burrington, dairy ingredient applications coordinator at Wisconsin Center for Dairy Research, recommends using water or milk at temperatures of 90 to 140 F for at least 60 minutes, as this helps milk protein rehydrate and allows higher-protein MPCs/MPI to deliver similar functional benefits as milk. Processors should use a high-speed mixer like a tri-blender or liquifier to get MPCs into a solution. Once in solution, processors should avoid foaming by not agitating the mix at high speed and

using slow agitation or intermittent agitation, as foaming can be a big issue (use anti-foaming agents as needed). While the proteins are hydrating, processors can mix in other ingredients with the MPC solution but should avoid pH-adjusting ingredients. Depending on protein levels, processors may choose from various stabilizers, emulsifying salts and buffers. Homogenization is recommended for higher levels of protein, for ultra high temperature processing (UHT) and for retort processing.

Researchers at the Wisconsin Center for Dairy Research are currently evaluating various commercial MPCs for application in beverages and nutritional bars. These key learnings will help researchers determine the gaps between quality attributes desired by end users of these ingredients and develop strategies to improve existing commercial products.

MPCs are now widely used in a variety of protein-enhanced foods, but primarily in meal replacements, nutritional beverages and bars. It is common to find both milk and whey protein ingredients used alone or in combination with other proteins in these two key applications. Research funded by the Dairy Research Institute® is designed to address knowledge gap in areas related to quality and functional performance of MPCs. A body of work funded by the Dairy Research Institute, the National Dairy Foods Research Centers and the U.S. Dairy Export Council® is addressing processing technology/fundamentals and their impact on low-protein powders (SMP) and high-protein powders (MPCs) for food use.

The Dairy Research Institute, in partnership with the U.S. Dairy Export Council, is sponsoring a symposium titled “Maximizing value of milk proteins — Manufacture, applications and market opportunities for milk protein concentrate” at the American Dairy Science Annual Meeting. This symposium will cover market opportunities and an overview of various processing technologies such as separation, concentration and drying of MPCs, as well as functionality and applications. For more information, contact TechSupport@InnovateWithDairy.com.



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