

Whey Protein's Star is Rising

Whey protein is quickly becoming the ingredient of choice for many formulators. The ingredient's résumé contains an impressive list of functional and nutritional properties—a neutral, mild taste chief among them—leading to its inclusion in formulations that span every aisle in the supermarket.

Bill Haines, Dairy Management Inc.

New research funded by America's dairy farmers continually is reinventing whey, developing new varieties of this popular ingredient to increase its versatility and add value to a wider range of foods and beverages, from processed meats and crunchy snacks to sports drinks, both in the U.S. and abroad.

For the food technologist brushing up on dairy ingredients, this primer on whey protein ingredients provides a good background to begin investigating the benefits whey protein can add to almost any formulation.

Ingredient Innovations

Whey is produced during cheesemaking. Sweet whey is most common, resulting from the making of hard cheeses such as Cheddar or Swiss. Acid whey results from the manufacture of cottage or cream cheese. Most whey ingredients come in powdered form obtained by drying liquid whey.

Whey ingredients are rich in proteins and also contain lactose, minerals, vitamins and traces of milkfat. To make whey protein concentrate (WPC), a protein-packed powder, some non-protein constituents are removed in the manufacturing process so that the end result contains 34% to 80% protein. Whey protein isolate (WPI), typically featuring 90% protein or more, is a powder that contains less than 1% lactose and fat.



A wide variety of innovative whey protein products are available to solve food manufacturers' formulation challenges.

Researchers have developed other forms of this versatile dairy ingredient to present new uses to product developers. One is a recently introduced crunchy, textured whey product developed by the Western Dairy

Center at Utah State University (Logan) with funding from Dairy Management Inc.™ (DMI, Rosemont, Ill.) and licensed by an independent ingredient supplier. The patented product combines whey protein and an edible polysaccharide—such as cornstarch—and is formed using twin-screw extrusion.

Currently, the product is available in four sizes and contains a standard 50% protein. However, custom protein levels up to 70% are available. This ingredient possesses a clean dairy flavor and excellent protein profile, suitable for applications such as cereal, nutrition bars, trail mix, frozen dessert toppings and crunchy snacks.

In DMI-funded research conducted at the University of California-Davis, scientists discovered the properties of WPI as an edible coating for nuts, produce and confectionery applications. WPI makes excellent films and has the advantage of being very water-soluble across a



wide pH range. These edible films can bar oxygen, aroma and oil at low to intermediate relative humidity, serving as an alternative to options such as guar gum. They can help make foods spoilage-resistant, minimizing the necessary packaging.

The Way to Better Health

A complete protein, whey protein contains all of the essential amino acids in the appropriate proportions the body requires for growth and development. Amino acids, protein's "building blocks," not only help strengthen and build muscles, they also facilitate central nervous system and brain functions and perform other tasks.

Whey protein provides about 26g per 100g of protein of the branched chain amino acids (BCAAs) leucine, isoleucine and valine. BCAAs are unique among amino acids in their ability to provide an energy source during endurance exercise.

Whey protein has the highest biological value of any protein, which means the human body can use this type of protein very efficiently. As a comparison, the biological value of whey protein is 104, while the value is 100 for eggs, 74 for soy protein and 54 for wheat.

New discoveries related to whey's health benefits continue to emerge from in vitro, experimental animal and limited human studies probing the bioactivities of whey and its component proteins and peptides, such as beta-lactoglobulin, alpha-lactalbumin, immunoglobulins, bovine serum albumin, lactoferrin, lactoperoxidase and glycomacropeptide.

Some whey protein products offer a broad spectrum of flavor, viscosity and gelation properties, functional in cold- and heat activated systems.

For instance, preliminary studies show that the peptides in specially processed whey proteins may offer advantages in cardiovascular health by lowering high blood pressure. Research also sug-

gests that whey protein may help protect against microbial and viral infections.

Even long-held empirical beliefs are receiving initial scientific validation in new research findings. Body builders, for example, have long touted whey protein's benefits in products designed to help repair or build muscles after a workout. Recent studies by a University of Illinois (Urbana-Champaign) researcher took this a step further by investigating the role of the essential amino acid leucine found in whey protein in improving body composition.

This research suggests that higher daily intakes of leucine may help people on a reduced-calorie diet lose more fat while preserving lean muscle mass than those who cut calories while consuming lower amounts of protein. Whey protein contains more leucine than egg protein or soy protein.

Versatility Plus

It is clear that whey protein provides great nutrition, an impressive health profile and a clean dairy flavor. But how does it behave functionally? Whey proteins fulfill functional roles running the gamut from emulsification and fortification to binding, texturizing and more.

■ **Lower-carb, higher-protein products.** It seems that just as a dietary trend is evident almost everywhere, it begins to wane. Such is the case with "low-carb" lifestyles, now followed by an estimated 4% to 5% of American adults, compared with 8% to 9% at the trend's peak. However, the eternal quest remains: to formulate higher-protein, low-fat, nutritious foods that taste good.

Here, whey proteins fit the bill nicely, offering a wide range of protein possibilities for products from sweet to savory. Any number of food and beverage product formulators seeking a higher protein profile can turn to whey ingredients for a natural source of great-tasting protein.

■ **Beverages.** Predicting that protein will be an excellent platform for innovation in the beverage aisle, the Beverage Marketing Corporation (New York) recently reported that by 2008, whey proteins and other dairy ingredients have the potential to appear in products in which one would not expect to find dairy, such as energy drinks, isotonic, enhanced waters and fruit drinks. Dairy also is projected to remain strong in more expected areas such as sports nutrition drinks, yogurt drinks/smoothies and meal replacement beverages.



WPI is the ingredient of choice to make a clear sports nutrition beverage because it contains less than 1% fat, the main contributor to cloudiness. For an optimal clear drink, “drop the pH of the drink to between 3.0 and 3.2 for a ready-to-drink beverage,” advises Kimberlee “K.J.” Burrington, whey applications program coordinator at the DMI-supported Wisconsin Center for Dairy Research at the University of Wisconsin-Madison. Formulators can achieve about a 7% protein level before running into issues with gelation or cloudiness.

■ **Baked goods.** Carolyn Podgurski, dairy ingredients applications specialist at the DMI-supported applications program at the Dairy Products Technology Center at California Polytechnic State University (San Luis Obispo, Calif.), advises that whey proteins, in general, can help reduce cooking and baking losses to improve yield. Whey helps improve shelflife by increasing moisture and water retention. This also will enhance mouthfeel and improve the texture of the end product. “Don’t forget that whey products help with browning, or the Maillard reaction,” says Podgurski.

Acid whey, a small percentage of the total amount of whey produced, makes an appearance in some baked goods such as sourdough.

Podgurski notes that her applications lab has received multiple requests to replace some of the flour in bakery formulations and reduce total carbohydrates. She has achieved success in removing as much as 25% of total carbohydrates in various formulations, replacing much of the sugar with sucralose and a portion of the flour

WPC in patented crisps delivers protein, clean dairy flavor and a unique crunchy texture.

with whey protein, resulting in nutritious breads, cookies, muffins and brownies.

■ **Snacks.** New whey products such as the textured whey ingredient not only serve as great additions to certain snack

products, but also can be formulated to stand alone as high-protein snack items. Whey ingredients appear in many seasoning blends, such as those used in flavored potato or corn chips. The lactose content can help bind the seasoning to the chip.

■ **Nutrition bars.** Nutrition bars continue to be a growing category. And with whey, formulators packing them with proteins can achieve a reasonable 30% protein in a bar and still have a product that will not harden over time. In a formulation, says Burrington, it is best to mix WPI or WPC80 with some hydrolyzed WPC or WPI. “The hydrolyzed protein doesn’t bind water the same way as a regular isolate,” contributing to a softer product shelflife, says Burrington.

■ **Meat/seafood.** WPC appears in surimi-type products and some luncheon meats. However, an area of huge potential for meat processors is whey protein as an ingredient to manufacture low-fat, high-protein sausages. DMI-funded research at Ohio State University (Columbus, Ohio) used a form of WPC80 to create a breakfast patty with only 20% of the fat and one-third fewer calories than traditional sausage. Consumer panelists rated the taste and texture as equal or superior to regular sausage.

In addition, whey proteins’ water-binding capacity helps reduce shrinkage, preserving the sausage patty’s original size and shape, and giving consumers the perception of a better value for the money. Additional research at the DMI-supported Western Dairy Center at Utah State University also suggests that textured whey protein has a promising application as a meat extender.

■ **Prepared foods.** Ready-to-eat (RTE) meals require dozens of different components. A WPC34, for example, helps provide thickening and a smooth mouthfeel to sauces, an essential component of many RTE meals. The clean dairy taste adds good flavor and, in the case of a gravy-type of brown sauce, helps promote the Maillard reaction for brown flavor and color. And the seasoning packets that lend a distinctive flavor to many prepared meals use whey ingredients.

Sauce and dressing formulators, already using whey ingredients for such functionalities as browning and mouthfeel, might someday soon be able to incorporate a low-pH WPC gel for a more tailored texture. Research at the DMI-supported Southeast Dairy Foods Research Center at North Carolina State University (Raleigh, N.C.) recently revealed that enzyme-treated whey protein gels have superior fracture/yield properties, com-



pared with gels without this treatment. This also applies to cold-set gels.

■ **Dairy foods.** Acid whey ingredients appear in some dairy applications such as dips. New DMI-funded research at the Minnesota-South Dakota Dairy Foods Research Center (St. Paul, Minn.) also shows that acid whey can be used to add protein, calcium and prebiotics to yogurt while still retaining consumer acceptability.

The time is now to use whey protein in foods and beverages. Get answers to specific application questions or

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find a whey supplier by using the DMI Technical Support Hotline. DMI technical support staff can help resolve either basic or complex

dairy-related project challenges. DMI offers the resources of two applications labs, six dairy research centers and more than 100 experts in applications, research, technology, marketing and nutrition to help food and beverage manufacturers develop successful products from concept to market.

It is not enough to be satisfied with just reading about whey protein's functional properties: great taste, functionality, nutrition and versatility. Formulators should try hooking up that protein power source for future food or beverage applications. **PF**

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Website Resources:

www.grandecig.com — Click on "Why Whey"

www.PreparedFoods.com — Type "whey proteins" into the LINX search field

www.extraordinarydairy.com — Home page of DMI

www.DairyFoods.com — Type "whey proteins" into the search field for several articles