

Research Leads the Whey

Whey-based ingredients offer benefits ranging from protein enhancement to foam stabilization and more. Ongoing research looks at ways to further improve these functionalities.

Gregory D. Miller, Dairy Management Inc.

The right combination of nutrition research and product manufacturing technology has merged in recent years to create heightened interest in whey protein as an important ingredient for the food and beverage industry. Before there was a full understanding of whey protein's numerous nutritional and functional benefits, whey protein, a by-product of cheese-making, was commonly discarded or used as a food filler ingredient. It later gained notoriety in the world of bodybuilding as a high-quality protein for supplements. Times certainly have changed.

Over 4,100 food and beverage products with whey protein were introduced to the U.S. consumer in the last six years¹. Market data shows the vast majority of U.S. consumers are interested in healthy eating and that nutrition is an issue deemed important by consumers across all age groups². Further, U.S. consumers are interested in higher protein intake to benefit their diets³. Including whey protein in products is an effective way for manufacturers to deliver this nutrition that consumers seek. Research continues to show whey protein's important role in food and beverage formulations, as scientists reveal its nutrition and functionality benefits.

Nutrition Research Reveals Whey Protein's Benefits

Intensive research on the nutritional benefits of whey protein has helped bring this dairy-based protein to the mainstream consumer. Products enhanced with whey protein are easier to find on grocery and convenience store shelves. From oatmeal, smoothies, sports drinks and protein water to yogurt, snack

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A beverage with 10g of whey protein and 21g of carbohydrates — levels easily incorporated into isotonic sports recovery beverages — resulted in a greater stimulation of protein synthesis, as compared to a carbohydrate-only beverage consumed after resistance exercise.

bars and more, whey protein-packed products are gaining exposure and appeal with the health-driven consumer.

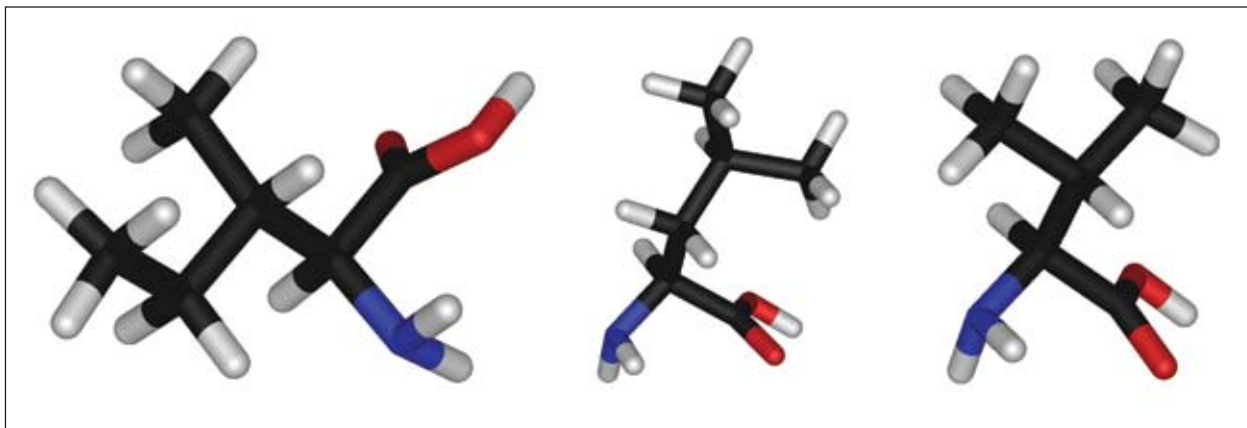
Current nutrition research sponsored by Dairy Management Inc.[™] (DMI) aims to more clearly define whey protein's role in several areas, according

to Matt Pikosky, Ph.D., R.D., director of research transfer at DMI. These research areas include sports nutrition, satiety, body composition and weight management, and healthy aging.

“Whey protein has more of the branched-chain amino acids (BCAAs) leucine, isoleucine and valine than most other protein sources,” Pikosky says. “BCAAs are unique compared to the other amino acids, in that they are almost exclusively taken up and utilized by skeletal muscle to promote muscle protein synthesis, and/or provide fuel for exercising muscles during endurance-type activities. Leucine, in particular, has been identified as a key regulator in these events.”

Because whey protein is a high-quality, complete protein source, it may provide an edge over other protein sources in many areas important to today's consumer.

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Sports Nutrition and Whey Protein

Whey protein, which is rapidly digested and absorbed by the body, has been shown to have a positive effect on muscle recovery following exercise. Research from McMaster University in Hamilton, Ontario, Canada, showed that a whey protein/carbohydrate beverage consumed after resistance exercise resulted in a greater stimulation of protein synthesis, when compared to a carbohydrate-only beverage⁴.

“The benefits of consuming protein after resistance exercise have been shown in a number of research studies. The unique aspect of this particular study was the amount of whey protein shown to have a beneficial effect: 10g of whey protein in combination with 21g of carbohydrate,” Pikosky says. “This is one of the first studies to document this effect in an amount that can be easily incorporated into an isotonic sports recovery beverage.”

Whey protein’s neutral taste makes it ideal for sports product formulations. For beverage applications, whey protein has the unique ability to remain clear in high-acid beverages and is especially compatible with fruit flavors and sweetness, an important feature for beverage manufacturers hoping to capture a larger slice of the active consumer market.

Seniors and Muscle Wasting

Maintaining muscle is important to the quality of life for older adults and a key piece of the puzzle to remaining independent. Sarcopenia, or the age-related loss of muscle mass, strength and function, has received more attention in recent years, as Baby Boomers reach their golden years. It is estimated that at least 30% of those over the age of 60 and 50% of those over 80 experience chronic muscle loss⁵. While research is still investigating the specific underlying mechanisms, the two lifestyle factors that directly contribute to muscle loss with aging are decreased physical activity and inadequate dietary protein intake. A great deal of research today is focusing on the role whey protein and regular resistance exercise can play in helping to preserve muscle in the aging population.

Industry Assists

The DMI-sponsored National Dairy Foods Research Center Program works with manufacturers to find new ways to address unmet consumer demand for dairy and dairy-based products, and provides technical assistance to facilitate innovative uses of dairy foods and ingredients. Each center has a specialized dairy pilot plant and other facilities for research on dairy ingredients and products. Expert resources are available to assist food and beverage manufacturers in product prototype development, product and process troubleshooting, product and process scale-up, and sensory evaluation.

“Researchers are making great advancements to provide a variety of whey protein products for wider use in the marketplace,” says Raj Narasimmon, Ph.D., vice president of product research for DMI. “We are discovering ways to modify the whey protein to exhibit different desired properties for use by manufacturers.” The research is exploring heat stability, ways to improve the flavor of whey protein and different ways of separating the whey proteins out of milk or whey to create whey protein fractions. To view the online National Dairy Foods Research Center Program guide, go to www.innovatewithdairy.com/researchresources.

Foaming Function



An important requirement for application of foam in food and beverage products is its stability characteristics. Products often require highly stable foam, such as whipped toppings, frozen desserts, meringues, cakes and mousses. Research is focusing on how whey proteins function in foaming. Whey proteins contribute to foam stability by several different mechanisms, says North Carolina State University's Foegeding. "First, they absorb at the interface and form an elastic film that resists breakage and shrinking, slowing down the destabilizing process of coalescence. When they absorb at the interface, it lowers interfacial tension, which can be viewed as the resistance of air and water to mix. This allows for smaller bubbles to be produced, which in turn produces more stable foam."

Studies have shown that a higher protein intake can lead to greater preservation of muscle mass in older adults⁶. In addition, there is research that has led some scientists to call for a slight increase in protein requirements in the elderly, to help this population preserve muscle mass and bone mass as they age⁷. The amount of protein consumed at each meal is also an important consideration. A recent review concluded that consuming 25-30g of high-quality protein at each meal is needed to assure older adults hit a threshold level of protein intake to maximize the stimulation of muscle protein synthesis, which, over time, may help preserve skeletal muscle mass in the aging population⁸.

Additionally, DMI-funded research is looking at the impact of whey protein on the diets of older consumers, determining whether it can have a role in maintaining or increasing muscle mass without the presence of exercise—an important factor for seniors with limited mobility. "This will be crucial information for food and beverage innovators to reach the aging consumer," Pikosky says.

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Whey Protein, Satiety and Weight Management

Regularly consuming foods with whey protein can help build a higher protein diet, which has been shown to play a significant role in weight management and body composition. Research has concluded protein is more satiating than carbohydrates or fats, and diets

higher in protein can help curb hunger and, therefore, play an important role in managing weight^{9, 10, 11}.

"We know the issue of weight management is of great concern for many people," says Laura Gottschalk, vice president of U.S. manufacturing and ingredient marketing for DMI. "Offering products that help control hunger can be an appealing message to consumers."

Calorie for calorie, protein can increase the feeling of fullness more than carbohydrates or fat. "This has been shown both following a single meal, as well as following the consumption of an overall diet higher in protein. This feeling of fullness may lead to a subsequent decrease in caloric intake, which, over time, can help with weight management," Pikosky says.

Additional research has shown that, as part of a reduced-calorie diet, diets higher in protein can improve the quality of weight loss by helping to increase the amount of fat loss and/or preserving more lean muscle^{9, 11, 12}.

Food and beverage manufacturers are finding that leveraging the latest research behind whey protein, a low-fat, low-calorie protein source, can help them meet consumer demand for products with a satiety benefit.

Focus on Whey Protein Stability, Beverage Clarity

The functional beverage market is expected to reach \$31 billion by 2010¹³. Functional dairy products, along with fruit juices, are the strongest in terms of market segments, and whey proteins are among the major ingredients used in protein sports drinks.

The nutritional and health benefits of whey protein make it a desirable ingredient for a variety of sports drinks and other beverages. However, the heat treatments that are used in the processing of these beverages have the potential to destabilize the whey proteins. This occurs because proteins change their structure and aggregate into particles when heated. If the heat treatment is successful, the particles are small and soluble, producing a stable, clear beverage. But, if too much aggregation occurs, precipitates are seen at the bottom of the beverage, or it is transformed from a smooth fluid to a clumpy, solid gel, according to E. Allen Foegeding, Ph.D. A William Neal Reynolds distinguished professor of food science at North Carolina State University (Raleigh), Foegeding has directed numerous whey protein research projects at the Southeast Dairy Foods Research Center. Part of his research focuses on determining how to control the aggregation process to produce heat-stable beverages with the desired appearance. One of the ways to do this is by using other molecules to control the aggregation process of whey proteins. Foegeding has been able to show that certain charged polysaccharides can greatly alter whey protein aggregation, creating clear fluid results. "The trick is to get the protein and polysaccharide interacting in a very specific way," Foegeding says. "This requires

close control of how much polysaccharide is added and the beverage's pH level."

Addressing Astringency

Beverage marketers know that beverages containing higher levels of

whey proteins are popular for athletes desiring high-quality protein to build up muscle after a strenuous workout. These beverages require a low pH, generally less than or equal to 3.5, to remain stable. While the low pH improves stability, it also

can sometimes create an astringent, or drying, sensation.

Much research has been done on what contributes to the astringency of tea and red wine, but astringency in whey protein-enhanced beverages has only recently received attention. While the precise reason for astringency has not been established, it appears to be due to a combined effect of the acids used to lower the pH and a direct interaction of whey proteins with saliva proteins. Therefore, astringency may be reduced by lowering the amount of acid used and/or blocking the interactions between whey proteins and saliva proteins. "This is the challenge, because the acids are needed to lower the pH and increase stability, and blocking protein interactions requires very specific chemical properties," Foegeding says. "Our research has shown that there are sugars that react with the amino acid lysine in whey proteins, thereby changing the protein charge and reducing astringency."

This research plays an important role in the growing functional beverage market, as beverage manufacturers look for improved processes to boost the protein content, while still delivering a great flavor in their product innovations.

The Future of Whey Protein

Foods with higher protein content are desirable, but they can be challenging to formulate, because adding protein can change the characteristics of foods. "Our research is focused on how proteins function in foods and beverages, so that protein content can increase in a range of products, while maintaining their quality," Foegeding says. "In other words, foods that are good for you and taste great—what more could consumers want?"

The scientific evidence supporting whey protein's role in a healthy lifestyle will continue to expand, as current research explores the benefits of whey protein consumption on blood pressure, inflammation, immunity, fat loss around the waist and aging muscles of the senior population.

Keeping tabs on the latest in whey protein research could prove part of a winning strategy for product innovators

Hitting the Mark with Flavors in Beverages



MaryAnne Drake, Ph.D., professor at North Carolina State University (Raleigh) and director of the DMI Sensory Applications Lab at the Southeast Dairy Foods Research Center, works directly with manufacturers to design specific sensory and/or volatile component tests to pinpoint and quantitatively and objectively evaluate problems and identify solutions. Part of her research is addressing whey protein and astringency in beverages.

“Flavor and flavor consistency remain critical issues in whey proteins for widespread usage,” she said. “Our research has identified several general whey protein processing steps relevant to food and beverage manufacturers that directly influence flavor and flavor stability of whey protein.” Research has focused on whey protein removal from milk prior to cheese-making, creating what is referred to as native whey proteins. Native whey proteins are not exposed to enzymes or other additives from the cheese-making procedure, leading to a number of potential benefits in formulations, including improved composition, physical properties and improved flavor.

hoping to capture a significant slice of the competitive health and wellness food and beverage market. **PF**

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For the latest information on dairy and dairy ingredient-related research and information, visit www.innovatewithdairy.com. For assistance formulating products with whey proteins or other dairy ingredients, contact techsupport@innovatewithdairy.com.