# In Praise of Cheese

**Did Mother Nature know what she was doing when she designed milk? Research reveals a rich source of biological nutrients that science is only beginning to understand.**

*Joseph A. O'Donnell, Contributing Editor*

PHOTO COURTESY OF CALIFORNIA MILK ADVISORY BOARD

Milk is the only product designed by nature for the sole purpose of delivering nutrition and health to mammals. As such, every component of milk plays a role in that goal. Cheese is very much a part of this concept. After all—what is cheese but a concentration of most of the non-carbohydrate solids of milk? Thus, one could say that every component of cheese was designed by nature to deliver nutrition. This may seem obvious, but the science supporting it has taken time. Persistent efforts by the global dairy industry (especially the National Dairy Council [NDC], Rosemont, Ill., which uses farmer check-off money wisely) has clarified milk's role not only in the minds of the industry but also in the minds of most of the general scientific community.

Today, the dairy industry supports a 3-A-Day campaign to encourage consumers to eat daily three servings of any combination of milk, cheese or yogurt. This recommendation is not just based on the dairy industry's desire to sell more products, but rather on science so strong that the expert nutritionists panel that drafted the latest national dietary guidelines also recommends the same.

## A Close-up on Milk

The most radical component, milk fat, is argued by some to be the most complex of all fat sources. P.W. Parodi recently published an outstanding review of milk fat in *The Australian Journal of Dairy Technology* ("Milk Fat in Human Nutrition," vol. 59, no. 1, April, 2004).

**It easily can be argued that cheese complements a balanced diet, and this balance helps contribute to good health.**

Milk fat used to be criticized because it was high in saturated fat. Today, the story has changed to where we see chemically hydrogenated fats linked to heart disease, with some saturated fats, such as stearic acid, considered to be neutral, or perhaps even beneficial.

Milk fat does more than supply energy. The individual fatty acids have specific functional properties related to health. Consider the short-chain fatty acids (SCFAs), one of which (butyric acid) is found almost exclusively in milk fat. They are metabolized in a very different fashion than the more-common longer-chain fatty acids. Although SCFAs are saturated, they are not associated with elevated blood cholesterol and, thus, could be considered to be misrepresented in our nutritional labeling system, in that saturated fats are defined by chemistry rather than by physiological function.

Milk phospholipids also have a composition that is unique to milk fat. Nature has designed them for specific purposes in the human body, which will be a focus of national research. Most of these compounds are associated with the milk fat globule membrane (MFGM). Current animal research suggests the components of MFGM play a role in preventing intestinal cancer by a variety of mechanisms. Also, long-term

**Milk, the key component in many prepared foods, is itself composed of beneficial elements—such as branched chain amino acids to phospholipids. Researchers are investigating the role these may play in functional foods.**

feeding in lab animals shows reduced total blood cholesterol but elevated HDL (healthy cholesterol). More studies will be made public as research ramps up.

Conjugated linoleic acid (CLA) is another component found only in ruminant products (like cheese). This intriguing substance has been studied for years, and results indicate it has benefits from preventing cancer to increasing the lean-to-fat ratio when part of the diet. The mechanism for doing so remains elusive, but will continue to be investigated. Understanding and clarifying the true biological activity of milk and cheese components is a target of the national research agenda.

### Casing Casein

Eighty percent of the protein in milk is casein. It is this protein that finds its way to cheese. Casein's high nutritional value, based on its easy digestibility and excellent amino acid composition, is only the beginning. Bioactive peptides are released from casein during fermentation in cheese-making, and during casein digestion in the gastrointestinal tract. It is fascinating to think that nature custom-made proteins so that, when digested by gut enzymes, useful bioactive peptides result. Several reviews have been published on the subject, notably a 2004 article by Peter J. Huth, Ph.D., et al., in the *Journal of Nutrition* ("The Emerging Role of Dairy Proteins and Bioactive Peptides in Nutrition and Health," vol. 134, no. 4S).

Possibly the greatest impact on our health will be the role these peptides play in maintaining normal blood pressure. Genetics, diet and lifestyle all are factors in the development of hypertension. Finding foods that work to normalize blood pressure would be immensely helpful. Specific peptides derived from casein do just that. As a regular part of the diet, cheese helps to regulate blood pressure in people with normal levels. While one would not claim that cheese or casein-derived peptides cure hypertension, it seems reasonable that cheese delivers nutrients designed to help

## Dairy Ingredients Embody Functionality

For the past six years, the California Dairy Research Foundation (CDRF, Davis, Calif.), the U.S. Dairy Export Council (USDEC, Arlington, Va.) and California Polytechnic State University (Cal Poly) in San Luis Obispo have sponsored the Concentrated and Dried Dairy Ingredients Symposium, a gathering of researchers from throughout the world to examine concentrated and dried dairy ingredients and discuss emerging opportunities, technologies and applications, especially in the functional foods arena.

The following interview with CDRF executive director Joseph O'Donnell—first published in *Dairy Foods*' August 2003 issue—investigates trends that are emerging for dairy ingredients in the functional foods marketplace and beyond.

**Q:** What dairy-derived functional peptides have application in dairy foods, and what structure-function claims can be made?

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**A:** During the symposium, we discussed potential health benefits that could be obtained by using purified peptides as ingredients, including decreasing anxiety, aiding in mineral adsorption, regulating appetite and assisting in liver detoxification. According to my colleague Bruce German at the University of California—Davis, there are a number of milk proteins and peptides currently being used in health-related products throughout the world. Several companies are utilizing certain peptides from bovine casein and whey protein fractions to lower blood pressure. Lactoferrin is being used as an antimicrobial. Casein-glycomacropeptide (CGMP), the kappa-casein peptide released during cheese-making, offers functionality for protecting teeth from cavities. Casein phosphoproteins have been discovered to have similar dental protective properties as CGMP but with the added ability to re-min-

maintain regularity in a number of physiological parameters and thus forestalls the development of abnormal blood pressure. It could be argued that cheese eaten on a regular basis adds balance to the diet and, hence, normality to our physiology. All is fodder for research.

Milk is designed by nature for the sole purpose of delivering nutrition and health to mammals.


### Weighing in on the Big Issue

One could extend the argument to the big issue of the day—weight management. Current research shows that including dairy foods in the diet not only helps to maintain normal weight but also increases body lean-to-fat ratio. Cheese is part of the 3-A-Day campaign, which notes dairy's role in weight management. Although full-fat cheese is criticized for its high-calorie content, this should be put within the context of the full package of dense nutrients it delivers.

A subset of the weight management issue revolves around glycemic index and diabetes. Cheese, which contains little to no carbohydrates, is the original low-carb food. Cheese also is rich in branched chain amino acids (BCAA), known to play a role in insulin regulation and glucose sparing. The detailed mechanisms are the stuff of research papers; however, in general, they appear to proeralize teeth. Milk basic proteins, a crude mixture of proteins from whey, have been shown in studies in Japan to protect adults from bone loss. And, finally, whey proteins have become the darlings of the body building set for their muscle-building properties.

**Q:** What types of functional dairy ingredients are used in other countries, and in what applications? Do you foresee such products entering the U.S. marketplace?

**A:** European manufacturers (and consumers) have always been much more open to the area of functional foods—the popularity of products like Yakult offers a perfect example. USDEC's Veronique LaGrange highlighted at the [2003] symposium a number of international products that are currently utilizing functional dairy ingredients. For example, there are infant formulas in Korea and Japan made with hydrolyzed whey proteins to make them more like breast milk, as well as lactoferrin and lactulose for intestinal health and increased immunity. She also showed a Chinese product made with bovine colostrum that was labeled as a nutritional liquid for toddlers and adults. In dairy beverages, she addressed such trends as combining milk with fruit juices or adding milk minerals, whey proteins or peptides. Functional trends on the horizon include creating products with longevity, wellness, performance and therapeutic properties including flavored milk with bioactive peptides to lower blood pressure, ice cocoa milk drinks with polyphenols to reduce the risk of cancer and weight loss tablets with glycomacropeptides. Products aimed at improving bone and tooth health and those containing pre- and probiotics are also increasing in the market, as are performance or sports products available in a variety of forms—from jelly drinks with whey protein to sport milk candy.

It's hard to tell what products will make it here first. The U.S. is just now waking up to the potential for functional foods. Over the next five years, there will be tremendous growth as our global economy trickles down and American consumers start demanding the products available to their contemporaries throughout the world.

**Q:** What is some dairy ingredient research in progress, and what implications will the findings have for the U.S. marketplace?

**A:** One of the most significant research projects in the works is the use of technology developed to track the human genome to look at the genome system responsible for milk, with the goal of developing milk-derived dietary components that can influence human physiology. The implications for the U.S. dairy market, as well as the consumer are enormous—in a very positive way. Once we understand the roles specific milk proteins play, we can optimize select attributes to address the dietary needs of consumers while—at the same time—increasing our efficiency for separation and formulation. As outrageous as it sounds, the work is under way, and the results are right around the corner.

vide a stable glucose environment, with low insulin responses during energy-restricted periods of the diet. These BCAAs also play a role in weight management and lean/fat body composition.

Finally, there also is a connection between cheese and dental caries prevention. Research in the area has provided impressive results. The mechanism appears to center around casein derivatives in cheese including glycomacropeptide. Some of these have been patented for use in dental hygiene products. While dental caries do not carry the lethal consequences of heart disease or cancer, they are a major source of health expense and patient misery. Dental disease is a "silent epidemic" in the U.S. Cheese could well be part of the solution.

### The Bigger Picture

All proteins result from the genome's dictates, and all milk components have some role in completing milk's mission to deliver nutrition and health. Some components act as carriers of nutrients, others act to compartmentalize nutrients and still others act to stimulate physiological responses—all fertile ground for imagination. The design is there in front of us. The key to understanding the enormous potential benefits lies in first understanding the milk genome. We have the human genome sequenced, but that is merely the beginning. Working through this enormous puzzle requires more effort than any one company or country can commit. A milk genome consortium established at the University of California (Oakland, Calif.) puts all nonproprietary information related to the

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Cheese, which contains little to no carbohydrates, is the original low-carb food and has been used by manufacturers in the production of low-carb products.

milk genome on the Internet. Access by password is granted to those companies and organizations paying relatively modest annual dues. The system includes application of bioinformatics—it is not simply a library but an interpretive tool. From the Internet, any member can keep up to date on the latest findings and use the information to guide product development or (in the case of academic researchers) basic research.

"Bioguided processing" likely will be the driver for tomorrow's product development, according to R.E. Ward, et al. in the May 2005 issue of *Food Technology* ("Bioguided Processing: A Paradigm Change in Food Production," vol. 58, no. 5).

The components of all foods have roles in regards to our diet. Understanding the inherent function of food components will drive product development. In the case of milk, the overall mission to deliver nutrition and health puts milk at the pinnacle of any bioguided process. Nevertheless, this new paradigm will apply to all foods. With cheese being largely protein and fat and made from milk, there will be significant opportunities ahead for inclusion of cheese as a food ingredient in new foods.

### Website Resources:

**www.doitwithdairy.com** — Dairy Management Inc.'s website

**www.ift.org/publications/docshop/ft_shop/05-04/05_04_pdfs/05-04-ward.pdf** — Article: Bioguided Processing: A Paradigm Change in Food Production

**www.DairyFoods.com** — Home page of *Dairy Foods* magazine

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