

# CALIFORNIA Dairy Dispatch

RESEARCH, EDUCATION AND SERVICE TO SUPPORT THE DAIRY INDUSTRY

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## The Milk Genome: Using Science to Mine the Benefits of Our Most Nutritious Food

By J. Bruce German, Ph.D.

**G**ood health and good food go hand-in-hand. Today, new scientific research at the University of California, Davis, is addressing how we can prevent disease with foods that actually improve health. Milk is one such food that researchers are investigating. While we've always known the health benefits of milk for infants, the new Davis research is using genomics—the study of genetic material—to determine the lifelong health benefits of milk for adults.

### Understanding Milk's Health Benefits Through Genomics

Genomics is a new field in which scientists are analyzing the entire genetic sequence of a typical human or literally hundreds of other organisms to understand for example, health and disease. For today's food scientist using genomics, an obvious question is: Did evolution design the organisms that we use as foods to make us healthier? In general, the

answer is no. Plants evolved to avoid being eaten by animals. Even though plants may contain the essential nutrients that animals must consume to stay healthy, these are there to enrich the plant, rather than the animal.

But the new research is indicating that one food—milk—did in fact evolve to nourish and make healthy [\(Milk Genome on page 2\)](#)



## National Research Consortium Formed to Support Whey Protein Health Claims

**W**hey, the milk protein byproduct of cheese production, was once thought to have little use in the food industry. Over the years, as scientists began investigating whey they found it contains a variety of factors and compounds capable of improving health and preventing disease. Now the U.S. is the world's single largest producer of whey proteins and the world's largest market for higher-value whey

protein concentrates. Whey proteins also play a major role in the country's \$53 billion functional foods market.

Numerous scientific studies linking whey protein to health have been published over the years. Now a unique national consortium has been formed to provide the scientific support necessary for specific, government-approved health claims for whey proteins.

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## Milk Genome *from front page*

mammals healthier.

Milk evolved to produce ingredients that provided infants a greater probability of surviving to reproduction age. From this logic, milk should contain biologically active ingredients that also make adults healthier. Scientists have already found dozens of biomolecules within milk that act in exactly this way:

- ▶ Milk protects gastrointestinal health by warding off pathogens, toxins and inflammation.
- ▶ Milk supports the growth of beneficial intestinal bacteria while at the same time discouraging the growth of



detrimental bacteria.

- ▶ Milk supports metabolic health by regulating energy, including glucose and insulin.

While much previous research has been done confirming the benefits of milk for infant health, we also have many examples of milk providing nutrients essential to lifelong health.

### Milk's Benefits—Beyond the Basics

Today, we have a new strategy for discovering even broader nutritional benefits of milk: the study of genomics allows us to go beyond simply understanding that milk is beneficial and challenges us to discover precisely how and why. Along these lines, we ask: which molecules act on which targets through which mechanisms of actions provide which benefits?

The composition of milk varies with each mammalian species, the time of lactation, the diet of the lactating mother, the physiological state of the mother and even various aspects of the infant. As nutrition is

beginning to discover that food recommendations cannot be made without taking into account the variation in humans and their environment, milk provides a building example of how to customize diet to the specific needs of a single consumer.

### The Milk Genome

A project now underway at UC Davis is working to coordinate scientific researchers around the world to study milk and its benefits in these new ways. Scientists and organizations from the United States, New Zealand, Australia, Ireland, Canada, Switzerland and the Netherlands are coming together to build databanks containing the genes from milk. They have begun building the tools to mine these databanks to discover how these genes work, how they produce milk and how the milk provides its unusual benefits. An international conference is being planned in Davis this year to finalize the project.

We know milk does a body good. Soon we'll discover how and why.

*J. Bruce German, Ph.D. is currently a professor in the Department of Food Science and Technology at UC Davis' College of Agriculture and Environmental Sciences. His current research interests include the role of dietary fat in the structure and function of biological lipids, the role of milk components in food structures and health and the use of metabolic assessment to personalize health. He is also a senior scientific advisor for the Nestle Research Center in Lausanne, Switzerland.*

This article originally appeared in the Summer 2004 issue of the *CMAB Update*.

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# New Uses of Whey Can Increase Dairy Industry Income

In Miss Muffet's day, whey was eaten along with curds. But until recently many commercial cheese manufacturers in the United States have treated whey as sewage or animal feed.

Now, new uses for the cheesemaking by-product are being developed at the UC Davis Department of Food Science and Technology aimed at giving whey added value and providing dairies a needed economic boost.

The UC Agricultural Issues Center (AIC) has published an AIC Issues Brief that reports the potential gains to producers from new uses of whey. Economists calculated the cost of research and development, which began at UC Davis in 1990 and was estimated through 2005, to be \$4.9 million. Financial support flows from the dairy industry and consumers through producer and processor assessments. Support also comes from grants and overhead paid by the University of California.

"Even with our narrow measure of research benefits, the return on investment in research may be significant if the new technologies are adopted by industry for only a few years," say the authors, AIC policy analyst Fiona Hutchinson, AIC postgraduate researcher Joseph Balagtas, UC Davis food science professor John Krochta and AIC Director Daniel Sumner.

To make cheese, manufacturers add an enzyme to milk, causing it to curdle. The curds are processed into cheese. The watery liquid leftover is whey.

Due to the development of new refinement techniques, as well as

increasing awareness of the environmental and financial costs of whey disposal, manufacturers have found it profitable to process whey into high-protein products for use as food ingredients. For example, whey protein is used in bakery products, infant formulas and energy bars. Nevertheless, currently about 30 percent of whey is not sold. In addition, as cheese production grows to meet increased consumer demand, more whey is produced.



A UC Davis food science graduate student places peanuts into a pilot-scale confectioners pan for coating with a whey protein-based, oxygen-barrier coating formulation. The coating protects the peanuts from oxidative rancidity and thus extends shelf life of peanut-containing products.

UC Davis scientists developed and hold patents on processes in which whey can be made into films and coatings for food products and plastics. The researchers believe that three new uses for whey could be implemented by industry in 2004:

*Oxygen-barrier coatings on food.* For example, coating snack peanuts and nuts to be used in candy with the refined and processed whey film. The coating protects nuts from oxygen that causes rancidity and therefore extends the shelf life of the nuts or confection.

*Gloss coatings on candy.* Candy manufacturers are looking for an alternative to food-grade shellac, an

imported glaze made from the resinous secretions of the lac insect. The whey alternative will be a domestic product and will not have shellac's tight environmental regulations.

*Oxygen-barrier coatings on plastics.* Most plastics that are good moisture barriers are poor oxygen barriers. Whey coating for plastic developed by UC Davis research provides an oxygen barrier and may substitute for current technologies that make plastic non-recyclable.

"We see this as a win-win-win situation," said Krochta, in whose lab these innovations were developed. "Farmers would benefit from the increased market for whey, food processors benefit with less expensive and more environmentally sound products, and consumers benefit from higher food quality. There is also an overall benefit to the state's economy."

Research on applications for the new technologies is continuing in Krochta's lab, even as scientists are working with the food industry to commercialize the first three applications. Three additional potential applications of whey are being investigated at the UC Davis lab: moisture barriers for food, anti-microbial coatings on cheese, and edible or biodegradable films and containers.

The AIC Issues Brief concludes that higher whey demand will result in higher whey prices, which would be offset in part by lower cheese prices as cheese manufacturing increases to meet whey demand. The likely increase in U.S. demand for whey from

(See **New Uses** on page 6)

## Using Whey Protein to Combat Obesity, Diabetes

**W**ith obesity and diabetes at the forefront of health issues affecting the U.S. population, finding ways to effectively reduce weight while countering insulin resistance is key in the battle to good health. A UC Davis researcher is applying knowledge of the health benefits of whey protein into a new project aimed at both.

Dr. Sidika Kasim-Karakas, professor of internal medicine at the UC Davis School of Medicine, is leading a two-year study on the effects of whey protein on weight loss, glucose and lipid metabolism in obese women with insulin resistance and polycystic ovary syndrome (PCOS). The study is being funded by the California Dairy Research Foundation and the Dairy Council of California.

At the heart of Dr. Kasim-Karakas' research is recent evidence indicating that relatively small amounts of weight loss can significantly decrease insulin resistance and protect against diabetes. Protein's role in preserving lean body mass and sports medicine research suggest that whey

protein might be uniquely beneficial in protecting muscle mass because of its high branched chain amino acid content. The goal of this project is to investigate the potential benefits of whey protein on glucose and lipid metabolism and gonadal function during weight loss.

To do so, she will target a group of women who are particularly susceptible to obesity, insulin resistance and diabetes—women who suffer from PCOS—by comparing two whey protein enriched energy-restricted diets, one containing 30 percent protein and the other 15 percent protein. The project will utilize a randomized, crossover, single-blinded intervention.

For patient populations suffering from insulin resistance, this research could have an immediate application and affect. With 40 million obese adults and 17 million diabetic patients in the United States alone, the therapeutic use of whey protein also will have a positive affect on the dairy industry. *ODD*

### Whey Protein *from front page*

Initially launched in 2003 as an ad-hoc taskforce by members of the U.S. Dairy Export Council (USDEC), the newly formed U.S. Whey Protein Research Consortium is a group of producers, processors, food manufacturers, trade associations, scientific organizations and governmental groups working together to investigate/substantiate scientific support of an FDA approved health claim or claims for whey proteins in the areas of lean body mass optimization, weight management and/or cardiovascular health.

"We know whey protein has a number of positive health benefits," said Marc A.H. Beck of USDEC. "The consortium grew out of our need to take this knowledge a step further with the actual science and clinical trials to substantiate a health claim the industry can use to help grow its markets."

Clinical trials take time and money—much more than most manufacturers and processors can afford. The Consortium's model is unique in that it integrates the financial and intellectual resources of its members for a common goal. The structure also allows the Consortium to maximize its relationships with multinational end-users, domestic end-users and international scientific and trade associations as well as international suppliers and research entities to leverage resources, coordinate efforts and minimize duplication of research.

The Agricultural Research Services unit of the U.S. Department of Agriculture (USDA), the organization



USDA-ARS photo

involved in cardiovascular research for the soy industry in the 1980s, has been enlisted to conduct the research and clinical trials.

Initial funding for the project is \$500,000 and comes from Consortium members. Clinical trials are expected to take three years to execute. Consortium members hope to have the first research findings by fourth quarter 2004.

Information about the U.S. Whey Protein Research Consortium can be obtained by contacting Marc A. H. Beck, senior vice president, or Veronique LaGrange, vice president, Strategic Research and Business Development, U.S. Dairy Export Council (703) 528-3049, or [mbeck@usdec.org](mailto:mbeck@usdec.org) or [vlgrange@usdec.org](mailto:vlgrange@usdec.org). For more information about the health benefits of whey, visit [www.healthywhey.org](http://www.healthywhey.org) or download the USDEC's monograph, "Whey Ingredients and Weight Management" at [www.usdec.org/Files/Publications/13WEIGHTw.pdf](http://www.usdec.org/Files/Publications/13WEIGHTw.pdf). *ODD*

# News and Notes

## Nominations Sought for the William C. Haines Dairy Science Award

The “William C. Haines Dairy Science Award” was created by the California Dairy Research Foundation to recognize individuals who, through their accomplishments in research and development in the field of chemistry, biochemistry, microbiology, technology, nutrition, and/or engineering, have made a significant contribution to dairy science and the betterment of the dairy industry and consumers of dairy products.

The award, named for William Haines, former Vice President of Product Innovation for Dairy Management Inc., includes an engraved plaque, \$1,000 in cash and travel expenses to present at an annual dairy industry event co-sponsored by the CDRF. A committee of dairy personnel representing the producer, processor, manufacturing and research side of business will make the final selection. Nomination forms for the 2005 award, which are **due by September 24, 2004**, are available at [www.cdrf.org](http://www.cdrf.org) under “Awards/Giving.” The winner will be announced in early 2005.

## Sweet is the ‘Whey’ to Go in Eastern Europe

Feb. 24, 2004 ([foodnavigator.com](http://foodnavigator.com))—As manufacturers and ingredients companies look to new income sources, dairy companies are fast turning whey into value-added food ingredients for the food industry. According to the report from UK company Zenith International, Eastern Europe is already being developed by local and international companies, but opportunities are still very much out there, with sweet whey demand on the top of the list.

“Compared with established West European markets, demand for whey products in the East European accession states remains underdeveloped. However, the rate of progress over the past three years has been impressive, particularly in the production of sweet whey powder, which has increased by 30 percent since 2000 to nearly 111,000 tons in 2003,” explained Zenith market consulting manager John Meropoulos.

The new report, “Whey Products in East Europe,” examined four main whey product sectors—sweet whey, demineralized whey, whey protein concentrates and whey

protein isolates—analyzing both the supply and demand for these throughout the EU accession countries of Poland, the Czech Republic, the Baltic States, Hungary, Slovakia and Slovenia.

The whey processing sector in Eastern Europe is expected to undergo significant changes over the next few years as local companies begin to expand their product offering, writes the report. A notable drive into functional food ingredients with added-value, such as whey protein isolates, is likely to be a major part of the landscape.

A report published by Zenith last year clearly showed sweet whey powder to be the largest sector in Western Europe, responsible for three quarters of total volume. This was followed by demineralized whey, an important ingredient in both chocolate confectionery and infant formula.

## Fat-Burning Whey Drink to Be Launched in Germany

Feb. 20, 2004 ([DairyReporter.com](http://DairyReporter.com))—A “fat-burning” whey drink was launched into the German functional foods market this spring. Nordmilch, the company behind the product, hopes that the drink will have a positive impact on the sector, which is one of the largest in Europe.

Body-Fit, the drink that was launched, will be part of Nordmilch’s Milram health drink range, which already includes low-fat buttermilk and whey products. The zero fat beverage uses the ingredient L. cartin to help to speed up metabolism, and in turn help consumers to lose weight, the company claims. L.cartin (previously known as vitamin BT) is a nutrient that once digested attaches itself to fat within the body to speed up the reaction of fat-burning.

According to Datamonitor, the industry analyst group, the functional foods market is growing by 16 percent per year. It is the dairy sector that is driving growth, and in Europe the sector is expanding at 6.8 percent annually.

According to a report released this year by the market report agency (ZMP), almost half of those questioned about their diets said that they included whey drinks in their eating and drinking habits. A similar survey carried out two years ago revealed that only 34 percent of the population consumed whey drinks.

*ODD*

## UC Davis Program Trains Future Dairy Veterinarians

**D**airy veterinarians are the first line of defense against livestock disease that can threaten the overall health of a herd. Only about 100 dairy veterinarians work with most commercial herds in the state of California, with perhaps 200 more providing service to dairies on a part-time basis. As the need for qualified dairy veterinarians increases in response to the complex health problems seen on ever-larger dairies as well as the growing threat of John's Disease, BSE, and other devastating diseases, the number of veterinary students choosing a career in dairy are failing to keep pace with the demand.

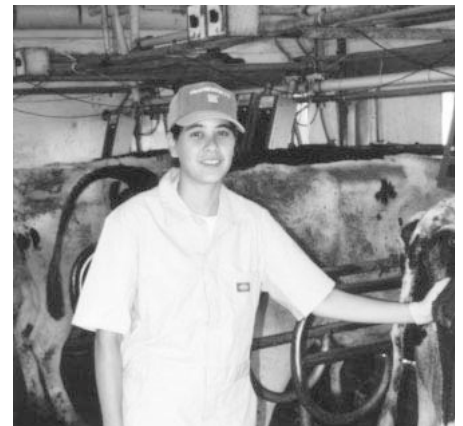
Between 2001 and 2005, the percentage of seniors at UC Davis selecting the small-animal track is at 58 percent, with the percentage of students seeking a path of food animal, large animal or combined at only 11 percent. Today, the American Veterinary Medical Association (AVMA) reports that half of the 67,459 North American veterinarians are in

small-animal practice with 14 percent in exclusively or principally large animal practice (including equine), and just 1 percent are identified as exclusively practicing on cattle.

UC Davis School of Veterinary Medicine is countering that trend with a unique student internship program that provides training, contacts and experience to train the next generation of dairy veterinarians. Launched in 2000 with funding from the California Dairy Research Foundation, Pharmacia (now part of Pfizer) and UC Davis, the Early Veterinary Student Dairy Experience Program (EVSDEP) introduces students to the field of dairy practice as an option and, in the words of program coordinator, Dr. Brad Smith, "gets them hooked early."

The EVSDEP is a scholarship program designed to expose first- and second-year veterinary students to dairying and dairy practice and then offer them a mentor relationship with a practicing food animal veterinarian

to enhance the experience and help direct and encourage them to pursue a career in dairy production. Dairy practice was selected because it is the area of food production that employs the largest number of food animal veterinarians in California.



Jill Mercado, class of 2005

For students not coming from a dairy background, the first part of the program places them for six weeks on a small- to medium-sized dairy during the summer before entering their freshman year. Some students with more experience are placed on a larger dairy. Dairies are selected based on their willingness to participate and whether they are modern facilities that utilize veterinary services. Onsite housing also is a factor in facility selection, as many students do not live in an area close to a dairy. Participating students receive a stipend of \$2,000 for the summer.

"The stipend is an important part of the internship," said Smith. "As with all areas of study, the cost of a veterinary education has risen steadily over the last decade. Without financial support, students often find themselves unable to take advantage of programs like this and miss out on a great opportunity."

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### New Uses *from page 3*

these new innovations is 3 percent, according to the study's authors. Ultimately, the researchers estimate in the AIC Issues Brief that conservative implementation of just the three new uses for whey would increase annual U.S. dairy farm revenue \$10 million and California dairy farm revenue \$1.9 million. Adoption of other concepts being developed by the Krochta lab would further increase revenue. The new uses for whey also reduce the costs of manufacturing candy and plastic products.

Additional data from the study are in the AIC Issues Brief titled

"Potential Gains to Producers from New Uses for Whey," which is available by calling the UC Agricultural Issues Center at (530) 752-2320, or online at <http://aic.ucdavis.edu> (click "Issues Briefs").

The UC Agricultural Issues Center, based at UC Davis, conducts research and outreach programs on issues central to maintaining California agriculture's competitive edge. The center provides broadly based and objective information about these issues and their significance for California's economy and natural resources. *edd*

Incoming veterinary students receive information outlining the program and an application with their letter of acceptance. Faculty members with food animal interests review applications and identify an appropriate number of incoming freshmen to participate during the summer before their first year. While this requires immediate turnaround, it puts students in a unique position to gain initial training before starting veterinary school in the fall.

Participating dairymen understand that the student is to be a worker-in-training and is expected to rotate and experience training in all areas, including calf delivery, calf raising, milking, feeding, breeding, treating sick cows, record keeping, preventive medical programs, and assisting the veterinarian during visits to the farm. After the first year, EVSDEP students interested in continuing are placed with a practicing veterinarian for mentoring during the following summer.

Comments and feedback from participating dairies and veterinarians has been very positive. Some dairies have



Harmony McPherson, class of 2005

committed to hosting a student each year and 100 percent of the veterinarians want to continue as mentors.

The effect on students also has been positive. One student who grew up in Los Angeles and joined the program in its inaugural year had never worked with cows. It was love at first sight! After graduation two years later he began working as a dairy veterinarian. Another student from the first program is in mixed practice doing one half small animal and one half dairy.

“I honestly feel as though not only my direction but also my experience was shaped directly by the

EVSDEP experience,” said student Sarah Lien, class of 2004. “It helped me more than anything else during my time at UC Davis.”

Fellow student, Frank Martin (class of 2004) agrees. “EVSDEP was a great program. My vet school experience was enriched and improved by my summer experiences. I would love to be a host veterinarian in the future.”

The program, which started with seven students, has grown to support 18 veterinary student scholarships each summer. Current funding comes from Pfizer and a privately endowed scholarship fund at the UC Davis School of Veterinary Medicine.

If your dairy is interested in hosting a UC Davis veterinary medicine student for the summer, call program coordinator Brad Smith, D.V.M., professor at the UC Davis School of Veterinary Medicine at (530) 752-2957 or send an e-mail message to [bpsmith@ucdavis.edu](mailto:bpsmith@ucdavis.edu). There is no charge to participate. Dairies with housing are especially desirable.

*ODD*

## DFSL Collaborates on Food Security Program for California

Researchers from the Dairy Food Safety Lab (DFSL) at the UC Davis Veterinary Medicine Training and Research Center in Tulare will be working with investigators from the Western Institute for Food Safety and Security (WIFSS), Stanford University, the Monterey Institute and local law enforcement offices on a program for statewide food security.

According to Director James Cullor, D.V.M., the DFSL, which is funded by the California Dairy Research Foundation, will collaborate with these organizations on the four

important elements for food safety and food security—prevention, detection, response and recovery.

“With the big picture now focused on security of all kinds—from personal security to the security of the food supply—we need to be ready for an intentional introduction of an organism that might threaten the lives of humans and/or livestock as well as posing a threat to the agricultural economy in California,” said Cullor.

The program will explore food security issues on the farm, in

transportation and at the processing plant. This news comes on the heels of an announcement of a collaboration between Texas A&M University, UC Davis, the University of Texas Medical Branch in Galveston, and the University of Southern California for the development of a national center to enhance national security against animal-disease and zoonotic-disease threats.

The \$18 million project is being funded by the U.S. Department of Homeland Security.

*ODD*

**Address Service Requested**

*Calendar of* **EVENTS**

**July 12-16, 2004**

**Institute of Food Technologists Annual Meeting and Food Expo.** Location: Las Vegas, Nevada. For more information, call IFT at (312) 782-8424, send an e-mail message to [info@ift.org](mailto:info@ift.org), or visit [www.ift.org](http://www.ift.org) on the Web.

**August 8-11, 2004**

**International Association for Food Protection (IAFP) 91st Annual Meeting.** CDRF is sponsoring a session on safety of raw milk cheeses. Location: JW Marriott Desert Ridge Resort, Phoenix, Arizona. For more information, visit [www.foodprotection.org](http://www.foodprotection.org).

**September 28-October 1, 2004**

**6th Dairy Science and Technology Basics for the Farmstead/Artisan Cheesemaker.** Includes 1 day of hands-on cheese making activities, cheese sensory evaluations, and other considerations in starting a small scale cheese making business. Location: Cal Poly Dairy Products Technology Center, San Luis Obispo, CA. For more information, please call Laurie Jacobson at (805) 756-6097 or send an e-mail message to [ljacobso@calpoly.edu](mailto:ljacobso@calpoly.edu).

**October 19-20, 2004**

**9th Annual Dairy Cleaning and Sanitation Short Course.** Designed to provide basics of plant and equipment cleaning and sanitation, as well as personal hygiene, and introduction to HACCP.

Location: Cal Poly Dairy Products Technology Center, San Luis Obispo, CA. For more information, please call Laurie Jacobson at (805) 756-6097 or send an e-mail message to [ljacobso@calpoly.edu](mailto:ljacobso@calpoly.edu)

**October 23-27, 2004**

**National Frozen & Refrigerated Foods Convention.** Washington, D.C. Call 717-657-8601, e-mail [info@nfraweb.org](mailto:info@nfraweb.org), or visit [www.nfraweb.org](http://www.nfraweb.org)

**October 24-28, 2004**

**National Dairy Board/National Milk Producers Federation/United Dairy Industry Association Joint Annual Meeting,** Reno, NV. Call National Milk Producers Federation at (703) 243-6111.

**November 16-18, 2004**

**Health Ingredients Europe (HiE).** The Netherlands. The U.S.A. and Canadian Pavilions are organized by IFT. For information on the U.S.A. and Canadian Pavilions, call Jack Cacciabondo at (312) 782-8424 or e-mail [jcacciabondo@ift.org](mailto:jcacciabondo@ift.org). For HiE general information or registration information, send an e-mail to [ahagenstein@cmpinformation.com](mailto:ahagenstein@cmpinformation.com), or visit [www.hi-events.com](http://www.hi-events.com) on the Web.

**November 14-17, 2004**

**Dairy Institute of California 2004 Fall Meeting,** Ojai Valley Inn & Spa, Ojai, CA. Call (916) 441-6921.