

CALIFORNIA Dairy Dispatch

RESEARCH, EDUCATION AND SERVICE TO SUPPORT THE DAIRY INDUSTRY

VOL. 12, NO. 2 • FALL 2002

CREDIBILITY FOR PROBIOTICS

ISAPP supports research investigating beneficial microorganisms

Microorganisms now have a support group. The International Scientific Association for Probiotics and Prebiotics (ISAPP) has been established to help advance the scientific understanding of beneficial microorganisms in dairy foods and other food products. ISAPP is an international association of academic and industrial scientists working on fundamental and applied aspects of probiotics and prebiotics.

The organization has been established to promote scientific advances in the area of probiotics and prebiotics. These findings are important to the food, dairy, and dietary supplement industries and regulatory agencies involved in the marketing or regulation of probiotics and prebiotics.

For decades, probiotics have been incorporated into dairy products, which are the most common delivery vehicle for probiotics in the USA. Probiotics are live microorganisms that offer certain health benefits and are found in about 80 percent of yogurts sold in the USA. Scientific studies have demonstrated the ability of

(See "ISAPP" on page 2)



Marschall Cheese Seminar makes the grade

The 39th annual Marschall Cheese Seminar hosted hundreds of cheesemakers, dairy industry personnel, suppliers and leading researchers for three days of education and networking. The event kicked off Tuesday, Oct 1, with pre-seminar events including an open scramble golf outing in nearby Friant and a membrane separation technology short course at the Visalia Convention Center conducted by Phillip Tong, professor of dairy science at Cal Poly San Luis Obispo. An afternoon trade show on Oct. 2 featured a "teaser" cheese reception that drew attendees into the exhibit hall. In addition to visiting with industry suppliers, guests were encouraged to try their hand at cheese grading in the 3rd Annual Cheddar Cheese Grading contest. The day's events wrapped up with a wine and cheese reception that spotlighted award-winning cheeses from throughout the United States including many from California manufacturers. (The above photo shows Jalapeno Brie from Marin French Cheese Co., and Smoked Mozzarella from Belviore Cheese Co., being served at the reception.) Cheese grading contest winners included first place winner, Kyle Jensen of Hilmar Cheese Co. in Hilmar, Calif.; second place went to Ron Thompson of California Dairies, Inc. in Visalia; and third place winner was Dale Schmidt of Stoelting, Inc. in Kiel, Wisc. The Marschall Cheese Seminar is held every September/October in Visalia, Calif. For additional information, visit www.marschallcheeseseminar.org.

INSIDE

3

CDRF SEEKS

DAIRY-DELIVERED VACCINE

Researchers working to develop vaccine to combat RSV.

4

DEVELOPING A BETTER SMOOTHIE

Cal Poly grad key researcher for Yoplait's newest product.

6

CSU AG RESEARCH INITIATIVE FUNDS 11 DAIRY PROJECTS

Cal Poly dairy research projects awarded \$1 million in ARI funds.

8

CALENDAR OF SHORT COURSES AND EVENTS

2003 schedule of upcoming events.

probiotics to help in managing symptoms of diarrhea, aiding lactose digestion and enhancing the immune response. But the public and many food processors remain unaware of the potential benefits of microorganisms. Most people believe that bacteria are bad for you, observes Mary Ellen Sanders, Ph.D., president of the new organization. Until that impression changes, marketing probiotics as beneficial will be a challenge.

"ISAPP is important to the dairy industry because it supports the science behind probiotics," said Sanders, a Colorado-based independent consultant who operates a business called Dairy and Food Culture Technologies.



Mary Ellen Sanders (above) is president of ISAPP.

"There was a great need to have an organization of scientists that could provide some objective perspective on the field, with an aim to 'raising the bar' for the science in the field. ISAPP is serving that role, for both probiotics and prebiotics. The dairy industry will benefit from the coordinated efforts of these international scientists focused on what is needed to improve our level of understanding about these important dairy ingredients."

A group of microbiologists, dairy scientists, geneticists, immunologists, and gastroenterologists who met at the Fermented Foods and Health meeting in New York in May 1999 subsequently formed ISAPP. CDRF is a major supporter of ISAPP, providing funding to cover legal costs associated with its incorporation.

CDRF also provides administrative assistance and leadership, with CDRF head Joe O'Donnell serving as ISAPP's executive director. ISAPP was incorporated as a non-profit, tax-exempt 501(c)(3) corporation in California this past August 28.

CDR

ISAPP Investigative Topics

ISAPP has announced its interest in advancing probiotic and prebiotic research related to several specific areas, including:

- **Immunology:** mechanisms, allergy (milk allergy, eczema, asthma), non-specific immune enhancement;
- **Cancer research:** epidemiology, animal and human studies, mechanisms, role in genotoxicity, role as antioxidants;
- **Gastrointestinal changes induced by probiotic and prebiotic feeding:** genetic-based tracking methods, microbiological, physiological and biochemical changes;
- **Role in the functional food concept:** comparison with other dietary approaches;
- **GI tract disease:** acute gastroenteritis, lactose intolerance, diarrhea, ulcerative colitis, Crohn's disease, pseudomembranous colitis, irritable bowel syndrome, necrotizing enterocolitis;
- **Emerging areas:** wellness, wound healing, urogenital, vaccine delivery, skin microbiology, dental health;

- **Genetics of probiotic microbes:** status of genome sequencing, application of the technology, role of proteomics and transcriptomics;

Safety

- **Microbiological issues:** taxonomy, shelf-stability, quality assurance approach, dose, delivery vehicle (foods and supplements), antibiotic resistance;
- **Testing efficacy:** laboratory models, animal studies, human trials, clinical situation;
- **Future requirements:** symbiotics, new product developments, distal colon activities, low dosage forms, application of robust but useable monitoring tools.

"A responsible, science-based approach will result in higher quality products and the potential for the dairy industry to develop healthful probiotic and prebiotic products with consumer appeal for the marketplace," asserts Sanders. "The industry benefits, the dairy farmer benefits and the consumer benefits."

For more information, visit <http://www.fp.rdg.ac.uk/isapp/> or call CDRF at (530) 753-0681.

CDRF seeks dairy-delivered vaccine for infant disorder

Biotech firm working with UC Davis research team to combat RSV

The California Dairy Research Foundation (CDRF) is helping to fund development of a dairy-based oral vaccine to combat a serious childhood disorder. CDRF and RZ Syntopical Technologies, a biotechnology firm, are working in collaboration to support research investigating Respiratory Syncytial Virus (RSV), the most common cause of infant hospitalizations in developed nations.

RSV is one of the most serious childhood respiratory pathogens, responsible for about 50 percent of all cases of bronchiolitis and 25 percent of all cases of pneumonia during the first few months of life. The word “syncytial” (pronounced sin-SISH-e-ul) relates to syncytium, the name for a mass of protoplasm such as a slime mold resulting from fusion of cells.

Complications from RSV infection constitute the most common source of fatal acute respiratory tract infections in infants and young children.

Its ill effects are not limited to infants and toddlers. RSV lower respiratory tract illnesses in early childhood can lead to subsequent development of wheezing in children up to age 11. And RSV is now regarded as a significant cause of morbidity and mortality among elderly persons and children, and adults with impaired immune systems. No vaccine against the disease currently exists.

CDRF and RZ Syntopical have leveraged their funds with the University of California (UC) Discovery Grants program for a four-year



David A. Mills (above) is an assistant professor of viticulture and enology at UC Davis, specializing in the genetics of lactic acid bacteria.

total of \$1.1 million to help fund research into an RSV vaccine. UC Discovery Grants is a matching-grants program that links business to basic research conducted in the UC system. The RSV investigation will be conducted by a research team at the University of California at Davis under the direction of microbiologist David A. Mills, an assistant professor of viticulture and enology specializing in the genetics of lactic acid bacteria. Collaborators in the research project are David Block, an associate professor in viticulture and enology, and in the department of chemical engineering and materials science, who offers expertise in bioprocess engineering; Karen McDonald, a professor of chemical engineering and materials science with expertise in biochemical engineering; veterinary biologist Laurel Gershwin, professor of veterinary pathology, microbiology and immunology; and Bo Lönnerdal, a professor of nutrition with expertise in infant and pediatric nutrition and nutri-

(See “Vaccine” page 5)

Probiotics and Prebiotics

Foods and dietary supplements containing probiotic compounds include yogurt, fermented milk, capsules and powders. Together, they account for hundreds of millions of dollars in sales per year. Giract, a Swiss market-research firm, has identified more than two dozen strains of bacteria—most in the genera *Lactobacillus* and *Bifidobacterium*—as principal components in dietary supplements. Prebiotics, which are normally indigestible alone but fuel the growth of a select number of beneficial colonic microbes—have equally important economic implications.

These products have been denied the respect of the dairy industry and consumers partly because of unsupported and improbable health claims that some producers have made. Consequently, mainstream medical researchers have been reluctant to embrace these microbe-containing products. ISAPP activities provide an independent forum for scientists with a common interest in probiotics and prebiotics to come together to discuss the limitations in the science and to discuss how best to fill the knowledge gaps. As a multidisciplinary organization, ISAPP will provide opportunity for medical researchers to interact with scientists in other related disciplines resulting in a better understanding of current knowledge and potential avenues of research for probiotics and prebiotics.

Yoplait brings a food phenomenon to the dairy case

The smoothie has gone portable. Ever since the creation of the first commercial smoothie fruit-and-protein beverage by a New Orleans health food store owner in the 1960s, the concoction has grown in popularity, today drawing crowds to specialized smoothie shops. Once a novelty item, the smoothie has become a staple among nutrition-conscious consumers.

In response, last spring General Mills premiered its latest Yoplait product, Nouriche, an 11-ounce non-fat yogurt smoothie containing 20 vitamins and minerals. The product was developed for busy people interested in a quick, nourishing breakfast drink that they can take with them. Tonya Schoenfuss, who attended Cal Poly San Luis Obispo as an undergraduate student from 1985 to 1989, played a role in the research and development of the new product.

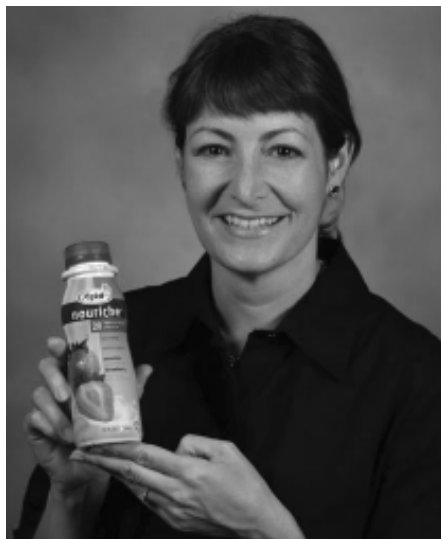
Schoenfuss recalls, "I worked in Cal Poly's pilot plant for two years doing jobs like making butter, running the filler, and driving the milk tanker to pick up milk at the Foundation dairy.

In 1988 she took a year's leave from Cal Poly to study in the food technology program at Massey University in New Zealand, which was offered through California State University's exchange program.

"When I returned to Cal Poly, our dry ingredients warehouse had become the new Dairy Products Technology Center," said Schoenfuss. "I was employed by the center as a student worker, and got to do my senior project through the center with Phil Tong as my adviser. We investigated low-temperature ultrafiltration [UF]

of milk to remove beta-casein. We didn't get the experiment to work while I was there. We had trouble keeping the temperatures low enough because all the pumping through the UF would warm it up, and low temperatures caused high pressures that caused problems for the UF filters."

Based on Tonya's initial studies, subsequent students successfully frac-



Tonya Schoenfuss holds bottle of Yoplait's newest product, Nouriche, that she helped to develop.

tionated beta casein in small bench scale systems. Cal Poly Professor Phillip Tong recalls, "As a brand new young faculty member fresh out of graduate school back in 1986, I was immediately impressed with Tonya's interest in science and desire to learn. After almost 20 years at Cal Poly, I can still say she is one of the best students I ever had the privilege to teach/mentor. I am happy that she is doing so well at General Mills, but I am not surprised at all!"

Schoenfuss went on to study animal drug residue detection methods in milk at Virginia Polytechnic Insti-

tute and State University in Blacksburg, Va., where she earned her master's degree in food science in 1992. She continued her dairy education at Louisiana State University, earning her Ph.D. in dairy science in 1997. Schoenfuss joined General Mills that fall, shortly after completing her Ph.D.

"When I started in the dairy products technology program, I thought I wanted to be in plant management, most likely in quality assurance. After doing internships for two summers at a dairy plant, I decided I'd rather get into R&D. Phil Tong was the person who sat me down and suggested graduate school. Most large food companies require at least a master's degree for food scientists. So he was responsible for steering me that way, and also suggested that I send a resumé to General Mills after I completed my Ph.D. So I have a lot to thank him for because I really love my job."

Schoenfuss says she also learned dairy product evaluation from Cal Poly Dairy Science Professor William Gillis, who has directed the collegiate dairy product judging teams since 1979, and she remains involved with the annual Dairy Product Evaluation Contest as an industry judge.

"General Mills sponsors my involvement, and it's great catching up with students from my former universities after the contest. The ability to identify off-flavors in dairy products and develop a vocabulary of tasting terms is helpful in my everyday work."

Schoenfuss was involved with development of Nouriche from the concept stage through to commercialization. "That is one of the reasons it is so great to work at General Mills.

The R&D function is not just a service for the marketing group," she explained. "We worked together as a team that involved all the different functions to develop the concept, package and product. The R&D team worked on the product and the process, and started up the plant on this product. I was responsible for the product, and we had engineers who worked on the process."

She credits her training in college for giving her the practical experience

that paved the way for her advancement at General Mills.

"One of the great things about Cal Poly was that I was able to get a lot of plant experience as an undergraduate. This has carried me through my career and definitely has helped me on start-ups. You can't learn everything from a book and knowing what the equipment looks like inside and how it affects your product is extremely important."

edd

compounds within dairy formulations. The research proposal contained Hagie's vision for application of genetic techniques for development and commercialization of a vaccine.

"Engineered probiotic formulations delivering high-value recombinant nutritional and therapeutic molecules will be priced on the value of the target molecules, thereby giving the California dairy industry additional and higher value uses of dairy products," Hagie wrote.

"Frank deserves kudos," said Mills. "This is such an appropriate use of UC Discovery Grants funds because it is truly a cooperative effort involving commercial enterprise with academic researchers." Hagie acknowledges the inability of others to develop an RSV vaccine, but believes technological advances in research procedures are now encouraging.

"CDRF and the University of California are ideal partners for us to work with on this project," Hagie said. "We welcome the challenge and opportunity. CDRF's knowledge of dairy products combined with the University of California's state-of-the-art facilities and experienced scientists offer the best environment to develop an RSV vaccine in a timely fashion, and are strong first steps towards the realization of an RSV vaccine."

O'Donnell agrees, observing, "The infrastructure of the California dairy industry could be commercially accessed to make this product as currently envisioned available globally. We look forward to accelerating the movement of technology that will increase the benefits to consumers using dairy products."

edd

Vaccine *from page 3*

ent formulation. CDRF and RZ Syntopical Technologies will jointly oversee campus research. RZ Syntopical, established earlier this year in Sacramento, will produce any viable RSV vaccine product that is developed through the research.

Probiotics play key role

Mills will focus his attention on probiotic lactic acid bacteria (LAB). Introduction of bioactive antigens into the gastrointestinal tract using LAB hosts presents a potentially effective means to stimulate the human immune system. Probiotics are microbial cell preparations—or foods containing viable microbial cultures or components thereof—that have beneficial health effects beyond their normal nutritional value. Dairy foods make an ideal delivery system for probiotics because they protect the cultures and promote stability. The delivery of RSV antigen genes into the genomes of target probiotic bacteria will employ novel genetic tools developed by Mills and molecular biologist Alan Lambowitz, director of the Institute of Cellular and Molecular Biology at the University of Texas at Austin.

"We are excited to be partnering with RZ Syntopical in this endeavor," said Joseph O'Donnell, executive director of CDRF. "As a result of long-term and ongoing research sponsored by the CDRF and others, we believe the California dairy industry offers a safe and wholesome product platform for an RSV vaccine, production facilities and technical know-how for scale-up of the product, and established marketing and sales channels that can be easily modified to include this medical product opportunity, should it come to fruition."

Mills and his research colleagues hope to initially develop and test an oral RSV vaccine delivered in a dairy-based probiotic formulation that would be administered to a rhesus monkey. The vaccine would be intended to stimulate antibody production in the respiratory tract to protect against RSV infection. Success in research and development and subsequent regulatory approval could enable RZ Syntopical to release a commercial RSV vaccine in about eight years.

Mills credits Frank Hagie Jr., president and CEO of RZ Syntopical, with recognizing the potential of the technique to "piggyback" beneficial

CSU Agricultural Research Initiative funds more than \$1 million in dairy research projects at Cal Poly SLO

The California State University Agricultural Research Initiative (CSU/ARI), a matching-funds program, has succeeded in generating primary funding for more than 70 faculty research projects at California Polytechnic State University, San Luis Obispo (Cal Poly SLO), since 1999. Those projects, encompassing agribusiness, horticulture, crop sciences, agricultural engineering, irrigation, earth and soil sciences, food science and nutrition, and natural resources management, **included 11 dairy-related projects that were awarded a combined total of \$1.07 million in ARI funds.**

The CSU/ARI, established in 1999, is a multiple-campus collaborative partnership involving California State University (CSU), Fresno; California State Polytechnic University, Pomona (Cal Poly Pomona); CSU Chico; and Cal Poly SLO, as well as the state's agriculture and natural resources industries and allied business communities. An important proviso is that ARI research project funding must be matched at least dollar-for-dollar by funds from non-CSU sources. The program has enabled dairy researchers at Cal Poly SLO to reinforce research dollars contributed by dairy processors and producers by matching them with ARI "seed" funding. The initiative also offers potential opportunities for researchers in CSU colleges of agriculture to collaborate with University of California investigators and to complement the basic and applied research undertaken by UC.

The researchers benefiting from ARI support include Rafael Jiménez-Flores, a professor in the DPTC at Cal Poly SLO. Logistically, he works with ARI in either of two ways. "I

propose to one agency—say CDRF or DMI—a project to solve a determined problem, according to their research plan priorities. At the conclusion of that process or even before I know the outcome, depending on timing required, I also apply to ARI with complementary objectives. For example, more local California focus or deeper understanding of a subject that may not be of primary importance to DMI or CDRF, but that is fundamental for advancement of the project," explains Jiménez-Flores.

More often, he applies to ARI to support ongoing research projects in which he has identified the need for additional related avenues of research. "That approach is the one that I have used the most and more successfully." He values the program because he says it has created new options for him. "Research funds are always a means to answer questions and ultimately to solve problems. ARI is fundamentally important to researchers because it enhances the emphasis on the confidence that an institution has in its scientist by respecting their ideas."

Research projects offering practical applications to support California's agricultural industries and bolster consumer confidence are the best candidates for ARI funding. ARI is administered by the California Agricultural Technology Institute (CATI), a non-profit educational institution created in 1984 by a mandate of the state Legislature to develop and evaluate new and promising technologies that could have the potential for improving the economic performance of California agriculture. Based at CSU Fresno, CATI operates under a permanent research mandate from CSU and the Legislature. Each campus is

responsible for designating a campus coordinator and working cooperatively and collaboratively with the CSU/ARI executive director and the CATI administrative office. At Cal Poly SLO, the ARI coordinator is Mark D. Shelton, Ph.D., associate dean and graduate coordinator in the College of Agriculture.

"The Agricultural Research Initiative has helped our faculty establish research programs and has broadened the base of active researchers in the College of Agriculture. This program has helped connect our faculty to California's ag industry in a very meaningful way," said Shelton, who administers the campus farm, as well as research and graduate programs in the College of Agriculture. Shelton, an entomologist, has expertise in integrated pest management, apiculture and insect control methodology. He observes that Cal Poly SLO places strong emphasis on application of ARI funding to introduce undergraduate and postgraduate students to the research discipline.

The governor initially authorized \$5 million per year to be set aside from the state budget for agricultural research and extension under the ARI. When the state began to encounter fiscal difficulties last year, Gov. Davis used his line-item veto power in August to reduce ARI's budget to \$4 million annually. As it now stands, ARI designates \$1.24 million to be dispersed among the four CSU agricultural colleges for competitive research projects; another \$800,000 is pooled for competitive research projects at the system-wide level; \$1.53 million for individual campus "capacity-building" funds; and \$424,000 for central and campus ARI program administration. The

“capacity-building” allocations are intended to support technology transfer objectives by funding research scientist and technician positions, graduate and undergraduate assistantships and purchase of scientific equipment for research.

The ARI budget cut is endemic of funding reductions affecting all research, in the view of ARI Board of Governors member W. R. “Reg” Gomes, who is the University of California Vice President—Agriculture and Natural Resources.

“Research has been taking hard hits, and budget cuts have had a devastating effect on all research efforts,” said Gomes. He is director of the California Agricultural Experiment

Station and California Cooperative Extension. He is responsible for research and extension efforts in agricultural, human and natural resources on three campuses (Berkeley, Davis, Riverside), at nine field stations, and in extension offices serving California’s 58 counties. Gomes is disturbed by the implications of the recent budget reductions. “We simply cannot continue to cut research funding and allow the quality of research to slide to mediocrity. The Agricultural Research Initiative is an important program that extends and expands academic research and adds one more arrow into the quiver of California agriculture.”

Jiménez-Flores says that ARI warrants restoration of funding because it is living up to its expectations as a means through which to leverage private-sector support.

“The program is designed to promote research in agriculture, and to motivate faculty at the CSU system to do so. In my particular case, I am totally devoted to further understanding of milk and dairy products, and to application of this knowledge to innovation, health and improvement of products and processes,” he said. “If these goals are aligned with some other funding agencies, such as CDRF, then that is a nice symbiosis.”

ODD

For information about ARI, contact:

Cal Poly ARI on the Web at <http://agriculture.calpoly.edu/cagr/ARI/> or by phone at (805) 756-7241

CSU Agricultural Research Institute on the Web at <http://ari.calstate.edu/>

California Agricultural Technology Institute on the Web at <http://cati.csufresno.edu/> or by phone at (559) 278-2361

Dairy-related projects funded through ARI

The title of each research project is followed by the name of the principal investigator, the amount awarded by ARI, and the time period of the funded study.

The contribution of dairy foods to nutrient intakes and health in the U.S.

Louise Berner, \$64,287 (2000–2002)

Development of a line of smoked cheeses for Cal Poly Creamery

Nana Farkye, \$20,000 (2000–2001)

Studies on the ripening of cheddar cheese: Identification of nonstarter lactic acid bacteria isolated from cheese and their role in flavor development, and the formation of calcium lactate crystals

Nana Farkye, \$116,760 (2002–2004)

Genetic, nutrition and processing factors affecting the lipid and protein composition of buttermilk

Rafael Jiménez-Flores, \$302,455 (2001–2004)

Isolation and characterization of minor lipids from buttermilk

Rafael Jiménez-Flores, \$149,244 (2000–2002)

Mucinase activity of probiotic bacteria

Rafael Jiménez-Flores, \$54,050 (2000–2002)

Organic acid determination by capillary electrophoresis as quality parameter of buttermilk

Rafael Jiménez-Flores, \$107,950 (2001–2003)

Program for microbial quality improvement of milk powder produced in California

Rafael Jiménez-Flores, \$121,534 (2000–2002)

Evaluation of factors influencing cell count of probiotic bacteria

Mary Ellen Sanders, \$21,700 (2000–2002)

Process improvement for fresh mozzarella cheese

Phil Tong, \$20,000 (2002–2003)

Treatment of a flushed dairy manure and energy production in an anaerobic/aerobic lagoon system

Douglas Williams, \$94,339 (2000–2002)



Board of Directors

William Ahlem Jr.

Nat. Dairy Promotion & Research Board

Stan Andre

California Milk Advisory Board

Peggy Biltz

Dairy Council of California

Rachel Kaldor

Dairy Institute of California

Randy Mouw

California Milk Advisory Board

Rick Pacheco

California Creamery Operators Association

Tony Souza

California Milk Advisory Board

California Dairy Dispatch is a quarterly publication of the California Dairy Research Foundation.

© 2002 California Dairy Research Foundation

For more information, contact:

Joseph O'Donnell, Executive Director

California Dairy Research Foundation

502 Mace Blvd., Suite 12

Davis, CA 95616

Phone (530) 753-0681

Fax (530) 753-1453

E-mail: odonnell@cdrf.org

Editor: Corinne Esser, CDRF, (530) 753-0681

Produced by EditPros, Davis, CA (530) 759-2000

Change Service Requested

Calendar of **EVENTS**

January 28-31, 2003

Frozen Dairy Desserts Manufacturing Short Course. This four-day course will emphasize ingredients function and usage, mix formulation, equipment and processes in frozen dessert manufacture. Hands-on sessions for products quality evaluation and product manufacture included. Location: Cal Poly Dairy Products Technology Center (DPTC), San Luis Obispo, CA.

February 18-20, 2003

Dairy Industry Conference. Location: Sacramento, CA. Contact: John Bruhn jcb Bruhn@ucdavis.edu

February 24-25, 2003

5th Dairy Ingredients Symposium. This two-day symposium, sponsored by Cal Poly DTPC, is designed to provide an overview and update on the latest trends in the marketing, science, manufacturing technology and application of dairy ingredients, including whey-derived and milk-derived concentrates and powders. Location: The Cliff's at Shell Beach, Shell Beach, CA.

March 18-21, 2003

Cal Poly/ UC Davis 15th Annual Cheese Short Course I. This four-day course (including one day of hands-on cheesemaking) will teach participants the basic scientific information and practical skills needed to understand and manufacture cheese. Location: Cal Poly DPTC, San Luis Obispo, CA.

May 20-23, 2003

7th Annual Cal Poly/UC Davis Cheese Short Course II. This course provides details on factors influencing development of quality attributes of cheese and their measurement, as well as advanced techniques in the manufacture of cheese. Completion or familiarity with material covered in Cal Poly/UC Davis Cheese Short Course I or equivalent recommended. Location: Cal Poly DPTC, San Luis Obispo, CA.

For more information on Cal Poly-sponsored events, please contact Laurie Jacobson at (805) 756-6097 or by e-mail: ljacobso@calpoly.edu.