

Dairy Dispatch – Winter 1998

Preharvest Research

Geneticist and nutritionist aim to improve composition of milk for cheese manufacturing

The genetic variants of milk proteins play an important role in the composition and cheese-making properties of milk in California dairy cattle, as evidenced by studies conducted by Center investigators Juan Medrano and Edward DePeters, professors of animal science at the University of California, Davis. Their current work involves establishing breeding procedures in cattle that would increase the amount of milk proteins essential for the production of cheese. Through genetic selection, dairy producers will be able to offer cheese manufacturers milk containing the best combination of proteins and solids that increase the amount of cheese produced by 5 to 8 percent over current production levels.

Two types of proteins are found in milk of cattle. Caseins constitute approximately 80 percent of the true protein in milk, and whey proteins contribute to the remaining 20 percent. Several years ago scientists discovered that certain genetic variants of these proteins in milk were associated with improved quality for the manufacture of cheese. For example, cows carrying the kappa-casein B and the beta-lactoglobulin B alleles produced milk of better cheesemaking properties than cows carrying the A allele. Milks of the B type have higher casein and fat concentrations, higher curd firmness and reduced clotting time, resulting in a higher recovery of milk solids as cheese.

In genetic terms, Medrano refers to this research as "marker-assisted selection." In essence, researchers are using genetic markers to identify animals with specific beneficial production traits and selecting mating pairs based on those traits.

Traditionally, genetic selection in dairy cattle focused predominantly on milk production, and milk yield has increased dramatically in the last 50 years. Few efforts have been made to increase the protein components in milk. In cooperation with Phil Tong of the Dairy Products Technology Center at Cal Poly San Luis Obispo, a study was conducted that confirmed clear associations between the milk protein genotype of cows and the yield of cheese. Medrano and his colleagues have developed a system to classify the genotype of a cow based on a sample of DNA. "We can take a blood sample from a cow or a semen sample from a bull and we can genotype them," explained Medrano.

Current methods for determining genetic value of a bull involves the collection of information on the production of milk and milk components by his daughters. It requires about two years before a daughter of a bull enters the milking herd. Using molecular techniques for his genotyping system, Medrano can identify the desirable milk protein genetic makeup of offspring at birth, which could greatly shorten the time needed to identify superior individuals. "It would be an advantage for producers to be able to use molecular markers to help them identify whether an animal has the genetic potential to produce certain economically desirable characteristics," said Medrano.

Medrano and DePeters are engaged in a six-year study applying genetic selection techniques using dairy cows from the UC Davis Dairy Teaching and Research Facility. "We've divided the herd of cows into two groups, and we're selecting for kappa-casein and beta-lactoglobulin genotypes. We're breeding one of the herds with high-performance bulls that have the kappa-casein AA and beta-lactoglobulin AA genotypes. The other herd is being bred with bulls that are kappa-casein AB or BB and beta-lactoglobulin BB. The kappa-casein B variant is found at a

significantly lower frequency than the A variants in the Holstein breed. For beta-lactoglobulin the A and B alleles are found at comparable intermediate frequencies. The objective is to increase the frequency of the B alleles in one herd and A alleles in the other herd," said Medrano. "In cooperation with Ian Garnett, professor of animal science, and Linet Samson, a graduate student, we are also looking at the economic considerations of this type of breeding program, including the costs and benefits of doing marker-assisted selection for the milk protein genotypes."

Milkfat Study

In another similar study, Medrano is working to identify genetic markers associated with milkfat, which will allow the development of breeding programs to modify the composition of milkfat. The animal's diet and genetic makeup affect the fatty acid composition of milkfat. Some breeds tend to exhibit higher concentrations of unsaturated fatty acids than others do. "We'd like to produce a milkfat with a composition more suitable for making butter. We'd also like to identify cattle that produce fat with improved nutritional value for human health. Identification of these animals would allow dairy producers to establish a selection program to improve the quality of milkfat and make it more marketable to the industry," said Medrano.

In early work, Medrano and DePeters examined the milk fatty acid composition in a herd of Northern California dairy cattle consisting of Holstein, Jersey and Brown Swiss cows being fed the same diet. Noticeable differences between breeds were found. The unsaturated fatty acid content of milkfat was highest for Brown Swiss cows and lowest for Jersey cows while Holsteins were intermediate.

These data indicate that genetic differences exist for the fatty acid composition of milkfat. A portion of this genetic difference could be attributed to a desaturase system in the mammary gland responsible for converting stearic acid, an 18-carbon fatty acid with no double bonds, to oleic acid, an 18-carbon fatty acid with one double bond. The desaturase enzyme system increases the monounsaturated fatty acid (oleic acid) content of milkfat, which may change the nutritional value and manufacturing properties of the milkfat.

"We have cloned part of the sequence of the desaturase gene and have examined that gene in cows of different breeds. We are now looking for possible differences or polymorphisms in the gene that could be associated with milkfat composition and used as markers for genetic selection.

Ideally, we will be able to differentiate cows that genetically have a higher or lower desaturase activity."

"In the future, dairy producers will establish breeding programs to produce milk of specific composition to meet the needs of the marketplace. Marker-assisted selection will be one of the tools used by breeders to improve the accuracy and reduce the cost of genetic selection."

Spores in Milk Powder

Cal Poly scientists to improve marketability of milk powder

By Rafael Jiménez-Flores

Powdered milk is beginning to attract new suitors as it shows signs of maturing into a commodity of international importance.

Milk powder is a staple food, offering a shelf-life far greater than fluid milk. It is used extensively as an ingredient in bakery, confectionery and other processed food industries. California is the largest producer of milk powder in the United States, especially skim milk powder. Because microbial quality can easily factor in the decision of the buyer, the microbial quality of California milk powder is an important topic for exploration if California is to remain competitive. An increase in global economies presents the potential for world marketing of California milk powder, and higher quality standards for the international market are fast becoming a marketing reality for the industry. To assist in expanding milk powder markets, Cal Poly's Dairy Products Technology Center developed the Milk Powder Marketability Improvement Program (MiPMIP).

In general, the microbial quality of skim milk powder in California readily meets the specifications of most buyers. However, some industries, especially overseas, have stringent requirements regarding the presence of spores in milk. Most spores do not represent a public health risk but can be a concern in spoilage of reconstituted milk. Baseline data and reductions in spore levels are required to improve the quality and marketability of milk powder.

A collaborative team of Cal Poly scientists is taking a three-pronged approach to address the issue of spores in milk powder. This team is:

1. surveying people about different methodologies they use for counting spores and evaluating milk in identifying the sources of spore contamination in milk;
2. conducting a microbiological evaluation of the most common species of bacteria in the powders produced in California during different seasons of the year in hopes of developing a rapid method for their detection and evaluation; and
3. designing processing procedures that could reduce the spore levels in milk powder.

Accurate measurement of spores in milk and milk powders is important in quality determination and has been the basis for many microbiological studies. Current methodology relies on the ability to induce germination of all of the spores present in a sample, with subsequent aerobic or anaerobic plating and counting to complete the analysis. The total time for analysis ranges from two to five days. Even then, results may be imprecise or skewed. For example, variations of time and temperature of incubation will influence the accuracy of the results. Furthermore, this assay will focus on the finished product prior to the release of the powder for sale.

Current methodology for the detection of pathogens is based on specific determination of the presence of genes using quantitative PCR. As part of the Cal Poly MiPMIP program, investigators are testing the spore count in California milk powders and comparing them with milk powders from other countries. In addition, they are working to develop a rapid assay that could make an accurate determination of spore numbers in milk or milk powder within eight hours.

The three aspects of this project are designed as interactive units toward the same goal. While each aspect has its own specific goals, statistical information generated by each is helpful to the other. For example, investigators are using the survey to analyze the processing plant environment as well as milk, condensed milk and milk powder during an entire production run in several production plants.

Currently, data to pinpoint the sources of spore contamination is insufficient. Researchers hope that samples taken at different times from production runs will clarify what happens microbiologically to the product. Microbiologists will identify the types of microorganisms that are present in the milk. In an approach that mimics ecological studies, three components—environmental samples, raw milk and finished product—are being analyzed for the number of bacterial species present. This synergistic approach strengthens the available information that can be used to reduce the number of spores.

Overall, this program seeks to provide technical and scientific support for the dairy industry, leading to improvement of milk powder quality. Our goal is to develop a better understanding of the types of spore-producing microorganisms and to make available a better description of their biological characteristics, enabling processing plant personnel to incorporate improved practices or new processes to eliminate these bacteria.

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Cal Poly reorganization strengthens dairy research programs

The Cal Poly Dairy Science Department and the Dairy Products Technology Center (DPTC) have been reorganized to streamline efficiency and improve communications within the department. Under the new organizational structure, department and DPTC administrative offices have been consolidated into one location—the Dairy Products Technology Building, DS II. Les Ferreira has assumed responsibilities as department head and DPTC director, and the offices of all three unit supervisors are located in DS I and DS II.

"This move will increase collaboration among the three department units, and improve communication and efficiency within the department," said Ferreira. "DPTC's goal is to become the premier applied dairy products research center in the United States. The excellent dairy production and processing units and modern research facilities, along with a herd of genetically superior cattle, provide unique opportunities for applied research activities."

Cal Poly's graduate and undergraduate students in the dairy sciences are contributing to product development, which will enhance future dairy product research. Together with research scientists, students are working to help meet the dairy industry's applied research needs with their extensive academic training and practical dairy processing experiences.

"The center is committed to meeting the industry's need for technology for new product development in fluid milk, cheese, milk powder, butter and cultured dairy products," explained

Ferreira. "In addition, future research will target ways in which California can become more competitive in the global marketplace."

Spotlight: Leprino Foods

World's largest maker of mozzarella cheese enjoys long-term relationships with Cal Poly and UC Davis

By Bob Boynton

When Mike Leprino Sr., an immigrant from Italy, founded Leprino Foods in 1950, his efforts were based on providing outstanding products and superior service. Nearly 50 years later, the small cheese manufacturing operation that began in Denver as part of a family-owned grocery store is the world's largest manufacturer of mozzarella cheese with seven plants nationwide.

Still family-owned and headquartered at the same Denver location where it was founded, Leprino Foods continues to adhere to its core principles of product quality, customer service and business ethics. Leprino Foods has combined its cheese-making expertise and commitment to research and development to position itself as a leader in the industry. In fact, Leprino's emphasis on research and development has accounted for most of the technological breakthroughs in mozzarella production during the past 30 years, evidenced by the fact that the company has developed more patents relating to mozzarella cheese than anyone else in the industry.

As a result of aggressive research and development efforts, Leprino Foods is a leader in the production of Individually Quick Frozen (IQF) mozzarella. We make IQF mozzarella and pizza cheese blends by shredding or dicing premium quality mozzarella cheese then quick freezing each individual piece to stop the aging process. As a result, our products are easy to use and perform consistently for our customers.

In addition to mozzarella, Leprino produces sweet whey, whey protein concentrate and lactose, all of which are used domestically and internationally in baked goods, confections, infant formula, ice cream, processed cheese, nutritional supplements and animal feed.

Leprino Foods procures nearly 5 percent of the U.S. milk supply through long-term supply agreements with several of the nation's largest dairy cooperatives. The firm operates seven production facilities located in California (Lemoore and Tracy), Colorado, Michigan, New Mexico and New York, including the world's largest mozzarella plant in Roswell, NM. Administrators selected plant locations to efficiently serve Leprino's geographically widespread customer base and to be close to high-quality, long-term and reliable milk supplies.

Leprino, with more than 2,500 employees, conducts comprehensive employee training and development programs that focus on core business skills with an emphasis on continuous improvement. Our employees help us to regularly create new industry benchmarks. For example, employee involvement teams propose and implement ideas to improve our products, services and technology.

Leprino Foods' commitment to research and education extend beyond our organizational boundaries. As part of the cooperative relationship between Leprino Foods and educational

institutions such as UC Davis and Cal Poly San Luis Obispo, members of our research and development department regularly provide data to the research programs supported by the California Dairy Research Foundation and other dairy centers to ensure that these programs meet the highest-priority needs of the dairy industry. Leprino Foods is also a strong supporter of the California Cheese Research and Education Fund (CREF), for which I serve as a member of the board of directors. CREF underwrites educational programs for dairy foods processors that are offered by UC Davis and Cal Poly. CREF helps support continuing education for California's cheese manufacturers by identifying educational priorities and contributing to curriculum development.

Interns and graduates from the UC Davis Food Science and Technology Department and Cal Poly's Dairy Science programs have repeatedly demonstrated that they not only possess a strong educational background but also bring strong practical knowledge that can be quickly applied within the cheesemaking industry. For example, Mike Huyg, who received his Dairy Science degree from Cal Poly in 1992, began his career with Leprino Foods at our Tracy plant soon after graduating. He later moved to our corporate office in Denver as the production supervisor in our technical services department. Since early 1997, Mike has been the manager of the cheese department at our Tracy production facility.

Mike represents just one example of how a focused, relevant curriculum prepares students for effective participation within the cheese industry, and how reciprocal support between industry and education strengthen both sectors.

Bob Boynton is senior vice president of marketing for Leprino Foods and a member of the board of directors of the California Cheese Research and Education Foundation (CREF), which underwrites research and educational programs, including dairy and cheese courses offered by UC Davis and Cal Poly.

Dairy industry well represented at autumn functional foods conference in Cork, Ireland

By Joseph O'Donnell

How many times have you picked up a trade magazine in the past year and found some reference to functional foods? It's difficult to find one without some mention if not a full article on functional foods. While lacking a formal definition, functional foods are described as "foods claimed to have a positive effect on health."

Dairy foods stand as the envy of the food industry in this emerging market. This should be no surprise. The market positioning of many food products often bears little relationship to nutritional value. Milk, in contrast, has only one purpose: to deliver nutrients and health promoters. Unlike any other food product, milk provides the fermentation substrate for probiotic bacteria, making it the ideal role model for functional foods.

With this concept as prologue, an international conference was born. Titled "Functional Foods: Designer Foods for the Future," the conference was held Sept. 30–Oct. 2 in scenic Cork, Ireland. Four expert panels of speakers addressed an array of topics including marketing and legislation, bioactive peptides and milk proteins, food fortification strategies, and pre-probiotics.

Sponsored jointly by the U.S. Department of Agriculture and the Irish Department of Agriculture, Food and Forestry, the conference drew more than 300 people. All sessions were fully attended and stimulated lively discussions. Since the conference focused on business and scientific fundamentals, delegates from commercial food producers and dairy scientific associations composed the majority of the audience.

The proceedings of the conference are expected to be available in March, although abstracts were distributed at the conference.

Copies of the conference agenda or the abstracts may be obtained by contacting the California Dairy Research Foundation at (530) 753-0681 or by sending an e-mail message to CDRF Executive Director Joseph O'Donnell at odonnell@cdrf.org. An announcement of the availability of the proceedings will be made in the next issue of California Dairy Dispatch.

National pilot study aims to track animals from birth to market

Holstein Association USA, Inc. of Brattleboro, Vt., is teaming up with USDA's Animal and Plant Health Inspection Service (APHIS), the National Association of Animal Breeders and the National Dairy Herd Improvement Association to develop and test a pilot animal identification system known as F.A.I.R., Farm Animal Identification and Records. The animals in the pilot study will be identified with plastic ear tags and radio frequency transponders like those used to track endangered species. Herds in New York, Pennsylvania, Wisconsin and California will participate in the three-year project, which is currently funded by APHIS. Once identified, the animals will be entered into a database that will track them throughout their lives. The group's objective is to provide accurate, complete and cost-effective information that meets the needs of the industry for animal health and disease control, food safety, trade and genetic advancement.

Breeders groups aren't the only ones interested in such a system. With Brucellosis eradication program sunsetting, APHIS officials are eager to have a tracking system to fill the upcoming void for disease monitoring and control programs. A national tracking system would aid slaughter and food-processing safety efforts by ensuring "pre-harvest" food safety. A national farm animal identification and tracking system ultimately could prepare the United States for events like England's Mad Cow Disease and prevent those occurrences from devastating the industry, say Holstein Association officials.

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CDRF News & Notes

New telephone area code now in effect for CDRF. The telephone area code for Davis and most of Yolo County has been changed to (530). Callers may continue to reach Davis numbers through the old (916) area code through a grace period ending April 30, 1998.

Milk Composition research conducted at Cal Poly's Dairy Products Technology Center is receiving significant attention from the dairy industry. Watch for more information on industry applications in future issues of California Dairy Dispatch.

Recommended Internet resources:

- * [California Dairy Research Foundation \(CDRF\)](#)
- * [Cal Poly's Dairy Products Technology Center \(DPTC\)](#)
- * [California Milk Advisory Board \(CMAB\)](#)
- * [Dairy Council of California](#)