

Low-Fat Cheese Research

The latest product research, trends and applications



The Low-fat Cheese Challenge

Meeting consumer demand for health, taste and functionality

An increased awareness of the positive impact of healthful foods is leading many Americans to change their eating habits and more carefully consider what they consume. In a January 2009 report from Mintel, 60 percent of survey respondents indicated that they are eating healthier than they did in 2007.¹ Dairy processors have a great opportunity to stay on top of the health and wellness trend, and significantly increase cheese sales through the development of consumer-acceptable low-fat cheese.

To address this demand, Dairy Management Inc.™ (DMI) has launched a major research effort that could yield some low-fat natural and process cheeses with consumer-acceptable flavor, texture and functionality as early as late this year. Read more about the research initiative on Page 2. These low-fat cheeses also will be appropriate to use as ingredients in foodservice and prepared foods, such as entrées, sandwiches and pizzas. Read more about low-fat cheese ingredient opportunities on Page 6.

Unmet consumer demand

“There is a significant demand for great-tasting, low-fat cheese that the dairy industry could be delivering,” says Jim Montel, senior vice president – milk & cheese platforms product innovation with DMI.

DMI conducted research with Taylor Nelson Sofres (TNS) to gain information directly from consumers who restrict their cheese consumption. The research found that 16 percent of adults ages 20

to 54 are “cheese restrictors”; people who eat cheese less often, use smaller portions, or substitute low- or reduced-fat versions. Another 3 percent reject cheese altogether.²

In that same study, 29 percent of cheese restrictors claimed they would change their current cheese consumption if they had access to natural Cheddar cheese with less fat that does not compromise on flavor, texture or meltability. In fact, 50 percent of restrictors said they probably or definitely would buy such a product. If cheese restrictors were able to purchase cheese with less fat, cheese volume could rise substantially.

The importance of taste

Demand for cheese with less fat is growing. Presently, most of the volume among reduced-fat, low-fat and fat-free cheese is sold in the reduced-fat category — the only category that has grown over the past few years.³ But while health is an important purchasing factor, consumers still won't trade off completely for taste. In a December 2008 study, conducted

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by The NPD Group and commissioned by DMI, among adults who bought cheese in the past three months from typical retail channels, only 20 percent thought reduced-fat, low-fat or fat-free cheese tasted as good as regular-fat cheese.⁴

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Great-Tasting, Functional, Low-fat Cheese Becomes a Reality

Dairy Management Inc.™ (DMI) is leading a research effort that is breaking the code on developing low-fat cheeses with the qualities that consumers and food manufacturers want. The research will yield low-fat natural and process cheeses with appealing flavor, texture and functionality that may result in market-ready products as early as the end of this year.

This low-fat cheese research initiative is a first-of-its-kind, coordinated effort that brings together experts from multiple dairy research centers across the United States. It aims to generate results much faster than individual researchers could achieve working alone.

The effort is conducted through DMI's National Dairy Foods Research Center Program (read more below). Directing the effort is an expert panel of low-fat cheese researchers at California Polytechnic State University (San Luis Obispo), North Carolina State University (Raleigh), South Dakota State University (Brookings), Utah State University (Logan) and the University of Wisconsin – Madison.

Growth opportunity

The potential growth opportunity for low-fat cheese is significant. Today, many people who want to reduce fat in their diets choose to eat cheese less often, use smaller portions or substitute other foods. Food manufacturers creating low-fat products and restaurants that want low-fat menu items may simply remove the cheese from the entrée or product. In each case, flavor is compromised and nutritional value is reduced.

“This low-fat cheese research will enable manufacturers to keep the cheese in their formulations and still cut the overall fat content of their products,” says Raj Narasimmon, Ph.D., vice president of product research at DMI. “The challenge

“This low-fat cheese research will enable manufacturers to keep the cheese in their formulations and still cut the overall fat content of their products.”

- Raj Narasimmon, Ph.D., DMI

is to create low-fat cheeses that appeal to consumers, function well in manufacturing processes, and meet Food and Drug Administration regulations for low-fat cheese (containing no more than 6 percent

fat). Those challenges are formidable, but our research initiative is making substantial progress.”

Toward a low-fat future

Researchers are working to develop both natural and process low-fat cheeses:

Natural cheeses. Cheddar and mozzarella are the focus of the low-fat natural cheese research. Researchers are studying various cheese properties, such as microbiology, flavor, texture and chemistry. The research is already yielding low-fat mozzarella with excellent pizza performance that should be market-ready within the next year (read more on Page 4).

The Cheddar research aims to create flavorful yet functional low-fat products in block form that processors can shred or slice. However, reducing fat in Cheddar negatively impacts flavor and texture. Researchers are addressing these issues to create a consumer-acceptable low-fat Cheddar expected to be available within one to two years (read more on Page 3).

Process cheeses. Major growth potential exists in loaf-form and slice-on-slice

National Dairy Foods Research Center Program Research Centers Inspire Innovative Products

The National Dairy Foods Research Center Program is a unified national research program coordinated through Dairy Management Inc.™ (DMI) that provides the industry with the latest developments in dairy products, ingredient research and technical resources. The program includes research centers and applications/technology development labs at universities across the United States that help dairy, food and beverage manufacturers innovate to address unmet consumer demand for dairy and dairy-based products. The low-fat cheese research currently is one of the program's most comprehensive collaborative initiatives.

Research priorities

“The research priorities for the National Dairy Foods Research Center Program align with marketplace needs to provide the science for innovation to address product challenges and bring new product ideas to market,” says Gregory D. Miller, Ph.D., M.A.C.N., executive vice president of research, regulatory and

scientific affairs at DMI. Those research priorities include:

- Technologies and processing methods for extended shelf-life products
- Nutritionally enhanced fluid milks and cheeses
- Dairy ingredients with enhanced functionality and performance
- High-value ingredients from milk and whey
- Products for ethnic and specialized demographic niches
- Safety and confidence in dairy

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Donald J. McMahon, director of the Western Dairy Center, tests the melting characteristics of cheese.

process cheeses. Here, a key focus is on making low-fat formulations that flow well and extrude properly in process machinery.

Researchers have found that the novel approaches developed for low-fat natural mozzarella also can be used to make low-fat process cheese in loaf form that is also lower in sodium and has excellent slice and bake properties. For slice-on-slice process cheese, a major goal is to develop products that can be handled without sticking, tearing or breaking.

To date, the research has yielded promising process cheese formulations that solve the production problems. These products could be ready for market by the end of this year (read more on Page 5).

DMI's low-fat cheese research initiative is making rapid progress toward helping cheese processors develop new low-fat products that meet consumer demands. These low-fat cheeses also will allow food manufacturers to develop healthful, lower-fat products while still delivering the great cheesy taste that consumers demand. ■

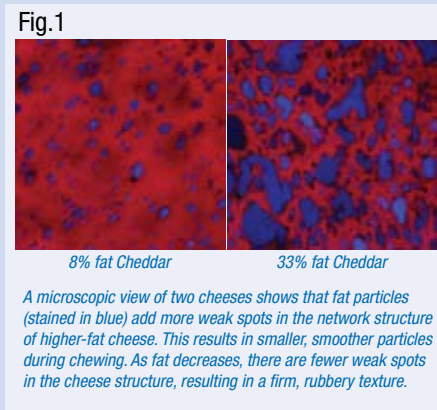
Low-fat Cheddar Cheese: A Matter of Taste and Texture

Although consumers are interested in fat-reduced cheeses, the vast majority are not willing to sacrifice flavor or texture to get a low-fat product. Research from the DMI National Dairy Foods Research Center Program's low-fat cheese initiative may prove crucial for the widespread launch of a successful low-fat Cheddar.

The low-fat Cheddar cheese research has many challenges, including a change in consumer flavor perception as a result of reducing the fat in Cheddar, which causes a reduction of buttery flavor notes and change in texture.

In search of flavor

To date, reduced-fat Cheddar cheeses have been characterized as lacking in flavor, and some have the presence of undesirable flavors, including bitterness. Until recently, researchers thought these differences were solely due to the fat reduction, and changes in flavor thresholds and flavor release during chewing.



"Instead, our research clearly demonstrates that differences in flavor relate to the different biochemistry of the cheese itself, which results in a different balance of flavor-contributing compounds," says MaryAnne Drake, Ph.D., professor at North Carolina State University (Raleigh) and director of the Sensory Applications Laboratory. "Low-fat cheese is a completely different product from full-fat cheese. The biochemical processes that happen in the cheesemaking process are altered, resulting in a product with an entirely different flavor profile."

In particular, there is a distinct change in the volatile compound profile in low-fat Cheddar. Researchers have identified key compounds responsible for the flavor issues, and they are evaluating methods that could be used to control them in the cheesemaking process. Those measures could include using different starter cultures and different process techniques.

"We may look at some nonstarter lactic acid bacteria that potentially have the biochemical characteristics we desire under the conditions encountered in low-fat cheese. We can then replicate the same volatile compounds in low-fat cheese that we normally get in full-fat cheese," Drake says.

Talking texture

Appealing texture also is essential to consumer acceptance of low-fat cheese. Texture encompasses a wide range of sensory perceptions from visual appeal, to feel on contact with the hand or mouth, to behavior during chewing and swallowing.

Historically, low-fat Cheddar cheeses have had unappealing texture: they are firmer, more rubbery and break down less readily in chewing, compared with traditional Cheddar. E. Allen Foegeding, Ph.D., William Neal Reynolds Distinguished Professor of food science at North Carolina State University (Raleigh), and a principal investigator on a number of projects concerning cheese texture at the Southeast Dairy Foods Research Center, describes the experience as "like chewing an eraser." Research has indicated that aging for up to nine months does not improve the texture to a level similar to full-fat cheese.

Fat removal seems to be the direct determinant of texture for low-fat cheese. Looking for the reasons, researchers examined the physical structure of cheeses with fat content from 28 percent to 3 percent. Tests indicated that at lower fat content, protein dominated the network structure (see Fig. 1). At higher fat content, lipids had far more impact on the structure. *(continued on Page 8)*

Low-fat Mozzarella: Ready for Pizza

As consumers continue to demand healthier food options, pizza manufacturers and restaurants can take advantage of that growing market by reducing fat content. One way to address this challenge is to use low-fat mozzarella cheese on pizza.

Coordinated through Dairy Management Inc.™, researchers at the Wisconsin Center for Dairy Research (WCDR), located at the University of Wisconsin – Madison, have made substantial progress in turning a functional base cheese into a low-fat mozzarella already shown to work well on pizza and containing just one gram of fat per serving.

In addition to lacking in desirable flavor, previous lower-fat mozzarella cheeses have been unsatisfactory for multiple reasons:

- Undesirable, translucent color
- Poor melt, flow and stretch properties
- Dries out rapidly when exposed to high-temperature convection ovens
- Scorches and causes a “skinning” effect under baking conditions
- Slices stick together and tear during peeling
- Cracks and breaks during slicing

“As a result of our research, we feel confident that this new low-fat mozzarella approaches the texture, color, flavor and functional properties



that are expected in the regular-fat mozzarella currently used by the pizza industry,” says John Lucey, Ph.D., associate professor of food science at the University of Wisconsin – Madison.

New formula, new cooker

To develop this new low-fat mozzarella, WCDR researchers have combined formulation changes with a different cooking technology.

First, Lucey and his team added mono and diglycerides to the base cheese. FDA regulations allow the use of food-grade ingredients to improve the texture of low-fat mozzarella cheese.

The researchers developed a special procedure for making a direct acid type of skim milk base cheese where sufficient calcium was already removed during the manufacture of the base. This same method of formulation has also been identified as an effective way to develop low-fat process cheese (read more on Page 5).

“When the glycerides are added during processing, the resulting cheese is white and chewy enough, yet not sticky, with a very nice melt and flow — all desirable baking characteristics, especially for pizza. Also, the cheese slices and shreds much like full-fat mozzarella,” Lucey says.

To heat the curd during low-fat mozzarella development, researchers have used a waterless cooker. New-generation waterless cookers prevent the excessive loss of texture-modifying ingredients. Cookers for making traditional mozzarella use water to heat the curd, but there are material losses in the cooker water.

The WCDR researchers have applied for a patent on this process to make low-fat cheese. They expect the results of their work to be ready for market for pizza applications and other products by the end of this year. ■

The Microbial Ecology of Cheese: It's All About Flavor

Past research has established that cheese flavor development requires lactic acid bacteria (LAB). In fact, research on how LAB affects flavor has led to the development of more flavorful cheeses.

However, to date, efforts to extend that knowledge into production of low-fat natural cheeses have been far less successful. As a result, low-fat cheeses still exhibit flavor defects and poor flavor intensity. Current research, as part of DMI's low-fat cheese research initiative, aims to change that.

Research on the microbial ecology of low-fat cheese is being conducted at the Western Dairy Center, led by Jeff R. Broadbent, Ph.D., professor of food science, Department of Nutrition and Food Sciences at Utah State University (Logan); and at the Wisconsin Center for Dairy Research, led by James Steele, Ph.D., professor of food microbiology, Department of Food Science at the University of Wisconsin – Madison. This research aims to discover how fat reduction affects cheese microbial ecology, and LAB in particular.

The researchers have explored scenarios on how microbiology may relate to flavor problems in low-fat cheese. The two most likely scenarios are:

- The physicochemical environment — such as fat, moisture and salt in moisture contents — produces major changes in the gross microbiology of the cheese (bacteria types and numbers).
- The microbiology remains the same, but the micro-environment of low-fat cheese changes bacterial metabolism in ways that affect their production of flavor- and aroma-active metabolites.

To better understand the effects of the cheese micro-environment and cheese make on the sensory properties, flavor chemistry and microbiology of cheese, researchers have investigated the impact of fat content on microbial population dynamics in cheeses made at three different sites during a nine-month ripening.

The key finding is that fat reduction does appear to affect cheese microbiology. Broadbent observes, “Because flavor is produced by bacterial metabolism and enzymes during ripening, our finding underscores the need to develop specialized cultures that are able to produce desirable flavors in a low-fat system.” Research on low-fat cheese's microbial ecology is ongoing. ■

Getting a Handle on Low-fat Process Cheese

Process cheese is popular in sandwiches or prepared foods to add flavor and a creamy texture. However, to reduce fat, manufacturers and restaurants often remove the cheese, which can compromise flavor and nutrition. Soon there will be another option, thanks to a low-fat cheese research initiative conducted through Dairy Management Inc.™ (DMI) and the National Dairy Foods Research Center Program.

The research is focused on developing low-fat process cheese in slice-on-slice and loaf forms, which has the functionality and taste consumers want, and is easy to manufacture.

Sticky issues with slice-on-slice

Slice-on-slice process cheese is ideal for foodservice and prepared food assembly lines because it is pre-sliced with no wrapping, so slices are quickly added to sandwiches or other foods. Researchers at the Midwest Dairy Foods Research Center at South Dakota State University (Brookings) are uncovering best practices for developing low-fat, slice-on-slice process cheese.

The manufacturing process is a significant challenge for low-fat, slice-on-slice process cheese. Removing the fat makes the cheese more viscous and sticky, so it adheres to machinery. Fat removal also makes the cheese more brittle, thus more likely to break and tear during manufacturing.

“To be properly machined on the production line, the cheese should have very specific viscosity and elasticity,” says Lloyd Metzger, Ph.D., director of the Midwest Dairy Foods Research Center. “Also, sticky and brittle slices can be difficult for foodservice workers to handle.”

Substituting for fat

Metzger’s research team found the solution: fat substitutes and processing aids. Protein-based fat substitutes, called

fat mimetics, allow low-fat cheese to perform more like a full-fat product in full-scale manufacturing. Fat substitutes also help keep low-fat process cheese slices from sticking together and provide a smooth, creamy mouthfeel similar to that of fat. Processing aids, such as lecithin, are applied to keep the cheese from sticking as it cools.



According to Metzger, imparting good flavor is as simple as using about 12 percent of high-quality aged Cheddar in the formula.

Lowering fat in loaf cheese

Low-fat process cheese in loaf form presents an entirely different set of challenges. Researchers at the Wisconsin Center for Dairy Research at the University of Wisconsin – Madison have developed a formula for low-fat loaf cheese that is suitable for baking and can be easily sliced and shredded.

Historically, low-fat process loaf cheese has had a tough, chewy texture and dull color. “This new generation of low-fat process cheese could be used in baked products where there is need to retain color, and where suitable melt, stretch and

chewiness are desired,” says John Lucey, Ph.D., associate professor of food science at the University of Wisconsin – Madison.

Reduced sodium is added benefit

Researchers have applied for a patent on a process to make loaf-form, low-fat process cheese using the same basic cheesemaking method used to develop a low-fat mozzarella cheese. This process involves removing sufficient calcium during the manufacture of the cheese base and replacing melting salts normally used in process cheese with emulsifiers like mono and diglycerides. The calcium may be re-added during the cheesemaking process to provide the low-fat, reduced sodium cheese with all the positive nutrients found in full-fat cheese.

“This is important for many people who have been advised to limit their salt intake, including people with high blood pressure, cardiovascular disease, asthma, kidney disease or migraine headaches,” Lucey adds. “Plus, school meal programs will be interested in using a reduced sodium, low-fat cheese.”

The future of process cheese

The DMI research program hopes to create opportunities for a new generation of food products containing low-fat process cheese with a reduced or low sodium content that consumers increasingly demand. ■



Keep the Cheese and Cut the Fat: Low-fat Cheese Ingredients Add Value

Formulators already know that cheese is a versatile ingredient that lends appealing flavor, texture, nutrition and functionality to many foods. Using a low-fat cheese can add further benefit by allowing for low-fat or reduced-fat claims. A research study conducted through North Carolina State University (Raleigh), shows that almost 70 percent of adults want to cut down on fat.¹



But as consumers demand healthier foods, manufacturers are challenged to combine lower fat content with flavor and convenience. Through Dairy Management Inc.™ (DMI) and the National Dairy Foods Research Center Program, researchers are working to develop low-fat cheeses with wide consumer appeal.

“Process and natural low-fat cheeses are value-added ingredients,” says Dean Sommer, cheese and food technologist with the Wisconsin Center for Dairy Research at the University of Wisconsin – Madison. “DMI’s low-fat cheese research initiative will result in improved flavor, texture and functionality that makes these cheeses suitable for a variety of foods.”

Opening up more options

Low-fat cheese gives food manufacturers more options when creating healthier meals and snacks. “It is easier for manufacturers to create low-fat products if they can reduce fat in all the major components —cheese, dough and meat — instead of removing cheese completely,” says Donald J. McMahon, Ph.D., professor in the Department of Nutrition, Dietetics and Food Sciences at Utah State University (Logan), and director of the Western Dairy Center. “Keeping the cheese in the product can create better flavor and value.”

Also, low-fat cheese ingredients improve the nutritional profile of applications by providing additional nutrients like calcium and protein.

Sizing up the market

Some food applications that have high potential for generating consumer interest by adding low-fat cheese include:

Frozen meals. As consumers seek quick meal options on a tight budget, manufacturers must develop new and interesting products to stand out in the ever-expanding frozen food aisle of the grocery store. According to a September 2008 report from Mintel,² there is growth opportunity for frozen meals that meet multiple trends, such as health/wellness and premium/upscale propositions. Adding low-fat cheese to such products can appeal

to health-conscious consumers while still providing a high-quality flavor experience.

Pizza. Pizza is the biggest anticipated use for good-tasting, low-fat mozzarella that functions well. A Mintel report indicates that one obstacle in frozen pizza purchases is low consumer perception of health.³ Lower-fat ingredients, such as low-fat mozzarella, can improve a product’s health perception. Schools are also an attractive market for reduced-fat pizza, as the nation’s lunch programs look for more nutritious menu choices to offer children. Read more about low-fat mozzarella research on Page 4.

Quick-service restaurants. Outlets from sandwich shops to hamburger restaurants face consumer pressure to offer lower-fat alternatives. Low-fat cheese with an appealing taste and mouthfeel can offer consumers a more flavorful sandwich without the added fat. Read more about process cheese for sandwiches on Page 5.

Bakery products.

The versatility of cheese opens up new opportunities for adding flavor and texture to baked goods, especially crackers. Between 2001 and 2006, Cheddar cheese and cheese (other than Cheddar) were two of the most popular flavors of crackers



introduced, according to a Mintel report.⁴ “A reduced-fat cheesy cracker can have higher appeal for consumers driven by the better-for-you trend,” Sommer says.

Other promising applications for low-fat cheese ingredients include salad dressings, cheesecakes and other desserts, breakfast sandwiches, cheese spreads and hot dips.

Plan to use low-fat cheese

The food industry can soon incorporate low-fat cheeses into products that deliver the healthful, good-tasting convenience that today’s consumers demand. Later this year, researchers expect the results of their work on low-fat slice-on-slice process cheese and low-fat mozzarella to be ready for market. In addition, research on low-fat Cheddar for entrée applications should be complete within two years. ■

¹ *Consumer perception of low-fat cheese*, Jessica L. Childs and MaryAnne Drake, Dept. of Food Science, North Carolina State University (Raleigh).

² *Frozen Meals – US – September 2008*, Mintel International Group Ltd.

³ *Pizza – US – January 2007*, Mintel International Group Ltd.

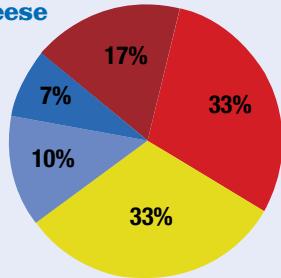
⁴ *Crackers – US – February 2007*, Mintel International Group Ltd.

Low-fat Cheese Challenge (continued from Page 1)

“The key variable is great taste,” Montel says. “Consumers may try new low-fat products but are not likely to stay with them if they don’t taste good.” DMI’s research initiative has already made significant progress in developing low-fat Cheddar, mozzarella and process cheese that has a consumer-appealing taste.

Purchase Interest of Cheese Restrictors to Buy Natural Cheddar Cheese with Less Fat

■ Definitely would buy
■ Probably would buy
■ Might/might not buy
■ Probably would not buy
■ Definitely would not buy



In a 2008 TNS study, 50 percent of cheese restrictors indicated they would probably or definitely buy a natural Cheddar cheese with less fat that does not compromise on flavor, texture or meltability.

Opportunity in schools

Low-fat products can strengthen and possibly expand the role of cheese in school meals. In 2007-08, school meal programs received 133 million pounds of cheese from the U.S. Department of Agriculture (USDA) Food Distribution Program.⁵

In addition to being an excellent source of calcium and a good source of other nutrients, cheese has many virtues for school meals. “Adding it to vegetables, sandwiches and soups helps make foods from the other food groups — like vegetables and whole grains — more appealing to children,” notes Ann Marie Krauthem, MA, RD, senior vice president of nutrition affairs with the National Dairy Council® (NDC). “Most cheese is an excellent source of calcium and a good source of high-quality, easily digestible protein. In fact, cheese is considered a meat/meat alternative by the National School Lunch Program and can be served as an ounce-for-ounce substitute for meat.”

“Schools might find new opportunities for cheese if they had low-fat products as an option.”

- Camellia Patey, vice president of consulting and communication for schools, NDC

Increasing childhood obesity is driving development of nutrition standards — aimed largely at reducing calories and fat — for foods and beverages served in schools.

In recent years, some government, health professional and other nutrition interest groups have proposed standards at the national, state and local levels. “While the Dietary Guidelines for Americans were developed to be applied to the whole diet, many proposed

school nutrition standards apply those guidelines to individual foods, specifically when it comes to single nutrients such as sugar and fat,” Krauthem says. “This approach may reduce the availability of nutrient-rich foods, including some dairy foods that contain key shortfall nutrients in children’s diets.”

The availability of reduced-fat or low-fat cheese for use as an ingredient in school meals or sold as a la carte items (alone or with other foods such as whole-grain crackers) may help to enhance the usage of cheese in schools, particularly if standards are adopted that otherwise may reduce the availability of cheese in schools.

“Schools might find new opportunities for cheese if they had low-fat products as an option,” observes Camellia Patey, the NDC’s vice president of consulting and communication for schools. “For example, pizza is the No. 1 school meal entrée, and appealing low-fat mozzarella that bakes well would help ensure that pizza remains a major menu item. Our main interest is in making sure cheese retains the place it has today as a highly nutritious component of school meals.”



Reducing the risk for dairy processors

Through the low-fat cheese research initiative, DMI’s role is to help dairy processors create innovative products and bring them to market without shouldering all the business risk on their own.

“This research will develop and provide formulations for making high-quality low-fat products so processors don’t have significant R&D investments,” says Mark Johnson, Ph.D., senior scientist with the Wisconsin Center for Dairy Research at the University of Wisconsin – Madison. “Plus, DMI research on consumer responses to low-fat products will help reduce uncertainty about what constitutes acceptable flavor, texture and functionality.”

In short, cheese processors will be well positioned to offer new low-fat products with confidence that they will have consumer appeal and staying power in the marketplace. ■

¹ American Lifestyles – US – January 2009, Mintel International Group Ltd.

² Study of Cheese Consumption Among Cheese Restrictors and Rejecters, Feb. 21, 2008, TNS.

³ Information Resources, Inc., Total U.S. Data (Food, Drug, Mass, Wal-Mart), data ending Nov. 2, 2008.

⁴ Proprietary cheese report, December 2008, The NPD Group.

⁵ Communication with Janet West, Food and Nutrition Service, USDA, Oct. 16, 2008.

Research Centers *(continued from Page 2)*

DMI funds research projects through the National Dairy Foods Research Center Program to meet the needs of business today and tomorrow. To maximize research and development resources, the program partners with research centers, universities and government agencies.

California Dairy Research Center

- California Polytechnic State University (San Luis Obispo)
- University of California – Davis

Midwest Dairy Foods Research Center

- University of Minnesota (St. Paul)
- South Dakota State University (Brookings)
- Iowa State University (Ames)

Southeast Dairy Foods Research Center

- North Carolina State University (Raleigh)
- Mississippi State University (Starkville)

Western Dairy Center

- Utah State University (Logan)

Wisconsin Center for Dairy Research

- University of Wisconsin – Madison

Applications/technology development labs

The dairy applications/technology development labs supported by DMI provide assistance in:

- Prototype/concept development
- Product and process troubleshooting
- Product and process scale-up
- Sensory evaluation

Dairy Products Technology Center

- California Polytechnic State University (San Luis Obispo)

Dairy Technology and Innovations Laboratory

- Utah State University (Logan)

Institute for Dairy Ingredients Processing

- South Dakota State University (Brookings)

Sensory Applications Laboratory

- North Carolina State University (Raleigh)

Wisconsin Center for Dairy Research

- University of Wisconsin – Madison

Low-fat Cheddar *(continued from Page 3)*

Researchers also found that with increasing fat content, fat globules in the structure became larger and more irregular in shape.

“In full-fat cheese, fat functions by adding weak spots in the network structure, so that smaller, smoother particles are created during chewing,” Foegeding observes. “That allows a smooth, creamy texture to develop in the mouth. When fat is reduced beyond 50 percent, there are not enough weak spots in the structure to give the desired texture. This results in an overly firm, rubbery texture that requires more chews before swallowing.”

With those findings in hand, researchers are exploring whether milk protein-based fat replacers can be added to give low-fat Cheddar the desired full-fat texture.



Adjusting the process

Improvements in texture also may come from the cheesemaking process, according to Nana Farkye, Ph.D., professor of dairy science at California Polytechnic State University (San Luis Obispo) who is conducting research through the Dairy Products Technology Center. There are two basic approaches to improving texture. The first is to modify the process with methods such as pre-acidifying the cheesemilk, reducing the cooking temperature, changing the starter culture and including hydrocolloids.

The second approach is to make nonfat cheese curd using the modified methods and then blend it with aged full-fat cheese. A key challenge is to blend the cheeses in a way that creates a product with a homogeneous appearance.

After trying several approaches to blending, the researchers arrived at a wet blending process in which the cheeses are ground and mixed during manufacture and then pressed. The final product has a uniform appearance.

“It also showed a significant reduction of cheese hardness as measured by Texture Profile Analysis,” Farkye reports. “Descriptive sensory analysis showed improved sensory attributes comparable with low-fat control cheese made without modifications of manufacturing protocols and to pilot-scale full-fat cheeses.”

Researchers are still fine-tuning the formulation to determine the best stage at which to blend, and the optimum temperature and pH for blending.

Cheddar’s low-fat future

These developments in flavor, texture and processing represent reason for optimism about creating a marketable low-fat Cheddar cheese within two years. ■

Learn more about Dairy Management Inc.™ and the National Dairy Foods Research Center Program at www.innovatewithdairy.com.