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A Technical Resource for Dairy Manufacturers

SUCCESSFUL CHEESEMAKING: GETTING BACK TO BASICS

Kerry Henning, Henning's Cheese, Inc.

Each and every cheesemaker desires to create a well-made, safe and delicious product. Manufacturing such a cheese takes skill and knowledge but truly, the cornerstone of successful cheesemaking relies on reaching three main goals:

1. Produce cheese with the desired composition.
2. Produce cheese with the desired initial flavor and physical characteristics.
3. For aged cheeses, develop the desired flavor and texture in the cheese by aging it with the appropriate microorganisms and enzymes under the correct conditions.

These three items probably seem very basic, especially to the experienced cheesemaker, but the importance of these fundamental points is sometimes not fully understood or appreciated. When they are not followed, serious and even disastrous cheese quality issues can occur. So this article is aimed at reviewing some very basic cheesemaking and evaluation practices to help the industry to manufacture the best cheese possible.

Desired Composition

Every cheese has a unique optimal composition. Knowing this information for the specific cheese you want to manufacture is the first step in obtaining that desired composition. For example, if the desire is to produce a one year sharp Cheddar cheese, then producing a Cheddar at 38.5 percent moisture and/or with a 1.1 percent salt is likely to lead to disappointment. Experienced Cheddar cheesemakers would instantly recognize that this composition results in a soft bodied, flat tasting and likely bitter piece of one year old sharp Cheddar.

To set the proper compositional ranges for any cheese and discover a desirable make procedure, an inexperienced cheesemaker or marketer would do well to either hold a discussion with people experienced in making similar cheeses or to collect and analyze commercial samples of competitive cheeses in the marketplace that display the desired "gold standard" characteristics.

Certainly, to produce cheese with the desired composition one needs to start with the "correct" milk composition,

namely the proper fat and protein contents of the starting milk. These starting milk fat and protein contents along with an appropiate make procedure, enzyme and starter will ultimately help to determine the final composition of the cheese. It is critical to test the finished piece of cheese for basic compositional parameters to verify that your target ranges have been hit. The basic compositional tests for virtually any cheese include moisture, fat, pH and salt. These cheese compositional factors will collectively determine the characteristics of your cheese both when produced and after aging. Lack of verifying these compositional parameters on every vat of cheese produced is a fundamental oversight that CDR commonly sees with inexperienced cheese manufacturers and marketers. This oversight often leads to disappointing cheese quality and inconsistency, which are magnified if you happen to be making a cheese that is going to be further aged.

Producing cheese with the desired initial flavor as well as physical characteristics, such as firmness, smoothness, pliability or even melt and stretch when heated, is fundamental to successful cheese manufacture. Each of these characteristics will be heavily influenced by the composition of the cheese but also the ability of the cheesemaker to develop the correct amount of acid at each step in the cheesemaking process.

Ultimately, determining whether these desirable characteristics have been achieved will be the critical role of the cheese grader. Every vat of cheese should be graded and evaluated at a young age by an experienced cheese grader to determine if the cheese exhibits the desired flavor and physical characteristics at that initial point in time of the cheese's life. This is another step where lack of verification is all too common with inexperienced cheesemakers and marketers; missing this step can lead to customer dissatisfaction. There needs to be a tight communication and feedback loop in place between the cheese grader and the cheesemaker (assuming they are not the same person) so that the cheesemaker knows as soon as possible if they are on target.

Dealing with Aged Cheese

Lastly, in order to develop the desired flavor and texture for cheeses that are going to be aged for any period of time, the cheese must be made with the appropriate microorganisms (starters, adjuncts, natural contaminants), enzymes and aged for the correct length of time under the proper temperature and humidity conditions. The most common mistake CDR observes with inexperienced cheesemakers, marketers and agers is that they store the cheese in an aging room for long periods of time (many months or even over a year) without periodically grading and evaluating the cheese to verify that the cheese is maturing well. Lack of periodic evaluation and grading of aged cheeses during a lengthy aging process can lead to catastrophic disappointment. Based on experience, CDR would recommend looking at cheese during aging at least once every two to three months to verify that all is going well.

Conclusion

To review and summarize, the following basic steps will go a long way towards helping an inexperienced cheesemaker or marketer achieve success with their cheese:

1. Determine what the optimal composition ranges are for the type and age of cheese you want to produce.

✘ OPTIMAL COMPOSITION

2. Verify with testing the moisture, fat, pH and salt content of every vat of cheese you produce.

✘ MOISTURE, FAT, pH & SALT

3. Have an experienced cheese grader evaluate every vat of cheese you produce for flavor, body and texture at an initial time point (less than one week old).

✘ FLAVOR, BODY & TEXTURE

4. If you are making a cheese for aging, have an experienced cheese grader evaluate the maturation process of every vat of cheese being aged once every two to three months during the aging process.

✘ EVALUATE THE MATURATION

Following these simple steps will go a long ways in helping you achieve the cheese quality, consistency and customer satisfaction that your business needs for long term success.

Contributed by: Dean Sommer, CDR

Gary Grossen, Master Cheeesemaker, UW Food Science (R) discusses cheesemaking with Mark Johnson, CDR.

CDR TO LAUNCH NEW DAIRY PLANT WORKER TRAINING PROGRAM

CDR has a steep tradition of providing quality education and outreach to the dairy industry. As a part of our continued efforts to serve the industry in this way, CDR, the Wisconsin Cheese Makers Association (WCMA) and the Wisconsin Department of Agriculture, Trade and Consumer Protection (DATCP) have partnered in developing a new dairy training program for dairy plant workers which will be launched this fall.

Focused on providing a practical understanding of the key aspects of dairy processing, this online course will consist of 10 modules supported by important resources such as regulatory standards, reference guides and videos. "We chose to offer this course online to accommodate the various schedules of dairy plant workers," shares Marianne Smukowski, co-coordinator of the course development.

Dairy plant workers will be awarded a certificate for completing the program. Please note that all candidates applying for the program should have a General Educational Development (GED) or high school diploma and basic computer skills. Once enrollment is open, priority will be given to Wisconsin manufacturers and WCMA member plants.

CDR is currently working to find a qualified person to serve as the Dairy Training Facilitator who will manage this course as part of their responsibilities. In the interim, we have contracted with Ranee May, retired from UW-River Falls, to develop teaching materials for this online certificate program.

For more information about the course or the open position, please contact Marianne Smukowski, msmuk@cdr.wisc.edu

January 5-6
- Milk Pasteurization

January 12-14
- Batch Freezer Workshop

February 9-10
- WI Dairy Field Reps

February 23-24
- WI Process Cheese

March 14 - 18
- Cheese Technology

March 22-24
- Buttermakers

April 25-29
- World of Cheese

May 3
- Cleaning and Sanitation

May 4
- HACCP

May 10-11
- Applied Dairy Chemistry

June 7-9
- Cheese Grading

August 2-3
- Milk Pasteurization

September 20-22
- Master Artisan Course

October 3-7
- Cheese Technology

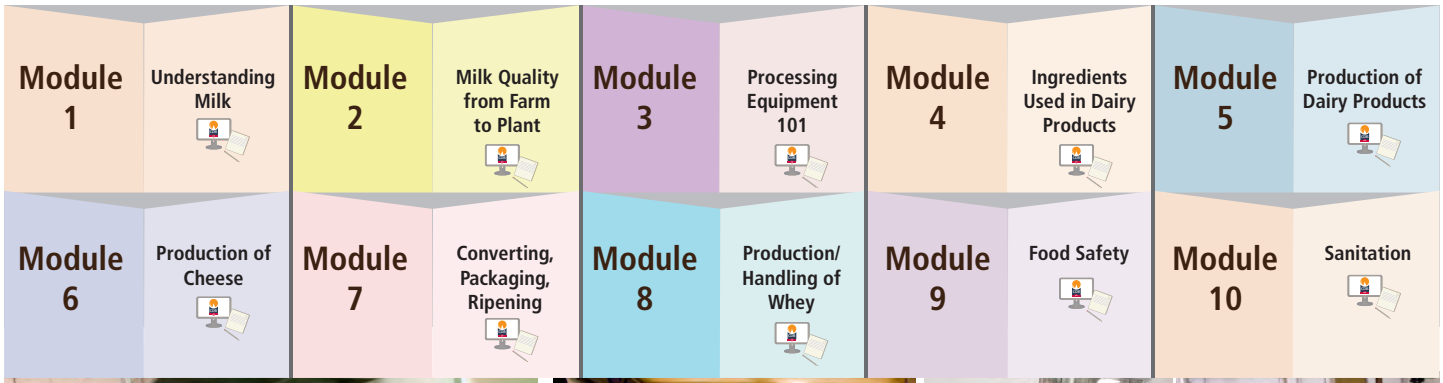
October 11-12
- Dairy Ingredient Manufacturing

November 2-4
- Cheese Grading

November 30-December 2
- Ice Cream Makers

For more information on each short course see www.cdr.wisc.edu/shortcourses

The Dairy Plant Certification online course will be composed of 10 modules each covering an important aspect of dairy product manufacturing.






MEXICAN QUESO TIPO MANCHEGO

Contributed by: Rubén Zárraga-Alcántar Instituto Tecnológico y de Estudios Superiores de Monterrey, Campus Querétaro and Luis A. Jiménez-Maroto University of Wisconsin – Madison / Wisconsin Center for Dairy Research

With the current popularity of specialty cheese, Mexican style cheeses have become an area of interest for both manufacturers and consumers in the United States. Similar to the U.S., dairy products, cheese in particular, are important ingredients in a wide variety of Mexican dishes, so it's not surprising that several Mexican cheeses, such as queso fresco, queso Cotija and queso Chihuahua/quesadilla, are already common sights in specialty cheese aisles in the U.S. While many are available, there are still other cheese varieties to understand and explore. One such variety, which will be the focus of this particular article, is known as queso tipo manchego (manchego-type cheese).

Queso tipo manchego is a very popular product in the Mexican market and is manufactured by almost every medium and large Mexican cheesemaking operation. This cheese is well liked for its versatile melting functionality and mild but distinctive flavor which allows it to pair well with other ingredients. This cheese is also a source of confusion to the international dairy community, for it bears the same name as the more worldly-known queso manchego from Spain.

In this article, we explain the origin of Mexican queso tipo manchego, the differences between it and Spanish queso manchego, the organoleptic characteristics, and its common uses.

History of Mexican Queso Manchego

In the 1970s, the Mexican cheese market was saturated with several popular cheeses being produced in large quantities: queso ranchero (farmer's cheese, made with unpasteurized milk and highly variable), queso panela, queso Oaxaca, and a few stronger-flavored ripened cheeses similar to queso Cotija. Trying to compete in this saturated market and knowing that there were more cheese varieties to offer than those in the marketplace, Juan Martínez y Martínez, owner of a Mexican cheesemaking operation named Productos de Leche Noche Buena, S.A. de C.V., in the city of Tulancingo, Hidalgo, some 75 miles northeast of Mexico City, instructed his cheesemakers to develop a new type of cheese with the following characteristics:

- Versatile, to be consumed on its own or as an ingredient
- Functional, it should melt without being runny
- Mild flavored, without the sometimes harsh flavors generated by native bacteria in the milk

To achieve this cheese, the company's cheesemakers contacted their suppliers, looking for starter cultures and techniques to make a cheese with the prescribed characteristics. A culture house in Europe sent the Mexican cheesemakers their cultures with instructions on how to use them, but within a month, they received a complaint stating that the cultures received were not working as expected. A replacement shipment of cultures was promptly sent, only to receive a second letter of complaint a few weeks later. The culture house suspected that the Mexican cheesemakers were not using the starter cultures properly, so the culture house decided to send a technician to review the situation and give training, if necessary. The technician sent to Mexico was the Chilean dairy engineer Guillermo Silva Silva.

After arriving in Mexico and reviewing the procedures that were being followed by the Noche Buena cheesemakers, Mr. Silva realized that the source of the problem was that they were using the new cultures, but following their usual processing techniques. This resulted in cheeses with characteristics similar to their existing product lineup, but not in a new style of cheese with the desired specifications.

Mr. Silva proceeded to train them in a different cheesemaking method, similar to the manufacturing technique used at the end of the 19th century to make Monterey Jack in California (Scott et al., 1998). The resulting cheese impressed the Noche Buena cheesemakers, who praised that not only did the cheese have the characteristics specified by the company owner, but the cheese was consistently 'creamy', referring to its soft texture, milky flavor, and malleable texture when melted. The cheese was named queso manchego by the company owner, Juan Martínez y Martínez, because it reminded him of a young (<1 month) Spanish queso manchego. This new style of cheese proceeded to become a great commercial success, propelling the company from a regional into a national supplier in a few years. Ultimately, Guillermo Silva Silva was made an offer to stay and work for the Noche Buena Company and he became one of the most influential people in the modernization of the dairy industry in Mexico.

Differences between Spanish queso manchego and Mexican queso tipo manchego

Spanish queso manchego is a cheese protected under Spain's Denominación de Origen (Designation of Origin) regulatory classification system, and the cheese was granted Protected Designation of Origin (PDO) status by the European Union in 1996 (European Commission, 1996). It is a pressed curd cheese made exclusively with whole milk from Manchega sheep herded on the plains of the La Mancha region in Spain. It is ripened for a minimum of 30 days for cheeses smaller than 1.5 kg (~3 lb), and a minimum of 60 days for all larger sizes, and a maximum of 2 years. Its shape must

be cylindrical, with a maximum height of 4.7 inches and a maximum diameter of 8.6 inches. It has a hard, pale yellow to black rind, with a semi-hard to hard texture and a strong flavor. It also generally has the "basket weave" exterior on the rind of the cheese.

Mexican queso tipo manchego is not protected by any Designation of Origin (D.O.) classification. It is a ripened pressed-curd cheese made with cow's milk, often aged for no more than two weeks, and has no specifications regarding its shape or size. It forms no rind, its texture is semi-hard, has a mild flavor, great melting properties and is significantly less expensive to produce. It was never meant to compete directly with the Spanish variety, and the naming came before the international markets placed a great deal of importance in designations of origin.

The Spanish government has tried to negotiate with the Mexican government to modify the name of queso tipo manchego, trying to protect the D.O. status of the Spanish manchego. Due to the more than 30 years of popularity of the cheese in Mexico, however, these attempts have proven unsuccessful (Oficina Económica y Comercial de la Embajada de España en México, 2012).

Characteristics of queso tipo manchego

Composition ▶ There is no standard of identity for queso tipo manchego, but manufacturers must comply with the specifications of the Mexican standard for the cheese (Dirección General de Normas, 1984), which states that the final cheese composition must have a minimum of 25 percent fat, 22 percent protein, a maximum of 48 percent moisture, a pH between 5.0 -6.0, and a salt content of no more than 3.0 percent.

Organoleptic characteristics ▶ Queso tipo manchego is pale to light yellow in color, with some slight mechanical openings and uncommonly showing a few small eyes from heterofermentative bacterial action.

It has a semi-hard, compact texture, but is firm enough to be sliced and shredded and is often described as creamy due to its suppleness once it has been sliced.
The taste is slightly acid and mildly salty with a well-balanced, very slight bitter finish caused by the small amount of proteolysis that the low pH might be able to achieve. Being only ripened for one to two weeks, the flavor is milky, with a buttery aroma originated from the diacetyl produced by the starter culture.
The cheesees main functional property is its melting characteristics. When heated, the cheese will soften and melt without being overly runny, or leaking fat or moisture. Not being a pasta filata cheese, it will not string and is not very stretchable, which makes it useful in certain applications.

Size ▶ It is manufactured in several sizes, depending on its intended market. For retail, it can be found as blocks or rounds of 400 g (~0.9 lb) and 700 g (~1.5 lb). For food service, it is typically made in blocks of 3 kg (~6.5 lb) to 5 kg (~11 lb).

Common uses ▶ Due to its semi-hard and creamy texture, its mild buttery flavor with no rancidity, and its melting properties, Mexican cuisine has adopted queso tipo manchego as an ingredient in many recipes. Cubed, it is eaten as a snack or alongside regional desserts. It can also be used in cheese sticks instead of mozzarella, or as an ingredient cheese in dishes such as quesadillas, queso fundido, a Mexican dish akin to fondue, or stuffed into chile relleno (poblano pepper stuffed with minced meat and/or cheese), enchiladas (rolled maize tortilla stuffed with minced meat or cheese, and covered with salsa), croquettes, and omelets.

This cheese can also be grated over soups, such as tortilla soup and squash blossom soup, as it will melt but not form strings. It is seen as a healthy protein addition for salads. Shredded or grated it is used as a topping on tinga, rajas con crema, nopalitos, or mixed with shredded beef, pork, chicken, goat, and other meats to make tacos.

Sliced, it is used in subs, sandwiches and tortas (a kind of sandwich made with bolillo, a variation of a baguette), to the point where international sub chains offer sliced queso tipo manchego as an option alongside mozzarella and cheddar cheeses. It is even used in Mexican-Japanese cuisine to make unconventional makis and kushiage (squewered breaded cheese sticks).

So regardless of your company's end product, there is probably a use for queso tipo manchego. For more information on the product or if you have questions on any portion of this article, please contact one of the authors: Rubén Zárraga-Alcántar, Instituto Tecnológico y de Estudios Superiores de Monterrey, Campus Querétaro, rzarraga@itesm.mx; Luis A. Jiménez-Maroto, UW–Madison/ Center for Dairy Research, jimenezmarot@wisc.edu

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IMPROVED SEPARATOR EFFICIENCY II. QUALITY CONCERNS

Contributed by: Robert L. Bradley, Professor Emeritus, Dept. of Food Science University of Wisconsin

The proper operation of separators, which was discussed in part one (Dairy Pipeline Vol. 27 #1) of this two part series, goes a long way towards creating an efficient, quality product. Of equal importance, however, is the finished quality and composition of the cream itself. Cream quality will dictate the value of the product and whether it is used for further processing in the current plant or sold. This second part of the series will provide a look at the variables that should be considered when assessing cream quality and, also, what can be done to maintain the product's quality throughout processing.

If you are selling cream, the first thing to be aware of in regard to your cream is, what sort of needs or specifications your cream buyer has regarding the product. For example, does your buyer have a list of product quality and compositional requirements or specifications that you must fulfill? If you have not been provided with such a list, it is highly recommended that you contact your buyer for a listing. This will usually include some requirements for bacteriology and chemistry concerning the quality minimum for the cream and then some legal statements about payment and compliance. This is incredibly important as "out-of-spec" product sent to your supplier could be returned, the price could be reduced due to downgrading or you could possibly lose the buyer.

While each cream buyer may have slightly different specifications, the following topics are likely to be considered by nearly all buyers.

Composition Testing ▸ A total solids analysis using a vacuum oven (three hours) will be necessary for accurate measurement. Microwave oven values are unacceptable because higher accuracy is necessary for payment purposes. Once the vacuum oven solids analysis is complete, subtract the results of a Babcock fat test (9" bottle for best accuracy) to get the solids-not–fat (SNF) total.

Figure 1. *Ideal vacuum oven with metal door. Glass doors are heat sinks and contribute to variable results in moisture tests.*

Bacteriology ▸ The Standard Plate Count (SPC) and Coliform Count (Coli) indicate the populations of troublesome bacteria that may lurk in both raw and pasteurized cream. Raw sweet cream should never exceed 100,000 Colony Forming Units (CFU)/ gram on SPC agar. There is no legal maximum Coli count for raw cream but pasteurized cream should be no greater than 10 CFU/ gram. A reasonable maximum for coliforms in raw sweet or whey cream would be 50 CFU/gram. Low counts well below the limits are exemplary. In addition to SPC and Coli counts there should also be no pathogenic bacteria in a 25 gram sample and no yeasts or molds.

Titratable Acidity ▸ This is a quick assay to measure if lactose fermentation has started. Follow the instructions in the latest edition of Standard Methods for the Examination of Dairy Products. Remember that acid production occurs only in the skim milk portion of cream and there is always some acidity present (0.15-0.18 percent) from proteins, minerals and carbon dioxide. This is termed apparent acidity as opposed to developed acidity from fermentation of lactose. In 40 percent sweet cream the skim milk represents 60 percent of the volume. Using the greatest apparent acidity value of 0.18 percent, the upper limit for apparent acidity would be 0.18x 0.60=0.108 percent. A value greater than 0.11 percent for 40 percent sweet cream would indicate developed acidity which you do not want. In whey cream, since almost all of the casein is in the cheese, substitute a factor of 0.12 percent as the maximum apparent acidity in the calculation where 0.18 percent is used for sweet cream.

Free Fatty Acids ▸ This issue is the result of lipase activity on milkfat that was exposed, usually by mishandling of the cream. Standard Methods labels the procedure as Acid Degree Value. This method is somewhat complex and requires a skilled lab person to truly perform the test with accuracy, including performing the test at least five times on the same cream sample. These five plus results must be nearly identical. In testing for free fatty acids be sure to weigh the volume of fat removed from the Babcock bottle. You will attain greater accuracy by weighing the sample to four decimal places rather than relying on a volume measurement. A test result greater than 1.0 with this test procedure indicates a rancidity level that can be detected by trained tasting.

Temperature ▸ A critical issue with the best quality milk, cream and whey is storage, shipping and receiving temperatures. While Wisconsin and federal dairy regulations have a maximum allowable temperature of 45°F (7°C) [(Food Code, if followed by your state for dairy practices, requires 41°F (5°C)], the rapid cooling and temperature maintenance is essential for quality preservation, particularly concerning bacterial growth, off flavors and lipase activity. For example, one should never add warm cream, milk or whey to chilled (<45°F) product in a storage vessel. Storage vessels are designed with sufficient cooling capacity to maintain temperature and because of this, the addition of warm product will cause the products to cool too slowly. Also, the addition of raw or insufficiently heat-treated milk and cream is likely to exacerbate bacterial problems with the longer cooling times. Chill any product to <45°F before adding to the stored product. Do not transport any dairy product that will arrive at the receiving plant in excess of

45°F, or 41°F in states using the Food Code. Chill again through a plate cooler before loading if necessary.

Latent Heat ▶ Problems with this become evident when cream is high-temperature/short-time (HTST) or vat pasteurized then cooled and pumped to a storage vessel. Within about five hours the temperature of the cream will rise about 5°F. The latent heat released when milkfat crystallizes is the source of the issue. Consider this factor when adding heat-treated cream to a storage vessel. Note that additional cooling will be necessary to maintain storage temperature at 38-40°F. You cannot rely on the refrigeration in the holding vessel to remove this heat. Also, reconsider the cooling mechanism and its efficiency that is needed here. A shell and tube may not efficiently cool freshly separated heat-treated cream coming from the hot side of the regenerator. Instead, a plate system may be necessary.

Live Cultures ▶ The issue of live cultures becomes a problem when cheese whey is separated without a pasteurization step to inactivate the starter culture. For example, in some cheese plants, the whey cream is added to sweet cream in a storage vessel. The difficulty occurs when the active culture develops acidity which then coagulates some of the casein in the sweet cream serum. Active rennet will also contribute to precipitation of casein and whey protein. These curds, firmed by subsequent pasteurization before churning, then become lodged in the strainers within the continuous butter churn preventing proper serum removal. The end result is the lack of final moisture control in the butter and subsequently a cleaning problem. To correct this, pasteurize the whey before separation to inactivate the culture and rennet. When other products are manufactured from the blend and homogenization is practiced, the protein particulates become a non-issue.

Fat Content ▶ Unlike butter manufacturers, dairy product manufacturers can use any percentage of fat in cream since their finished products are manufactured using a variety of ingredients and procedures. Weight of each ingredient used is determined by calculation and measurement. However, butter manufacturers want and need a cream supply between 35 and 45 percent milkfat for the continuous churn operation. Even batch churns have difficulty with less than 35 percent cream because of time to churn and the loss of milkfat in the buttermilk. If cream fat content is above 45 percent milkfat, viscosity makes pumping difficult, requiring extensive steaming or hot water to completely empty the tanker truck.

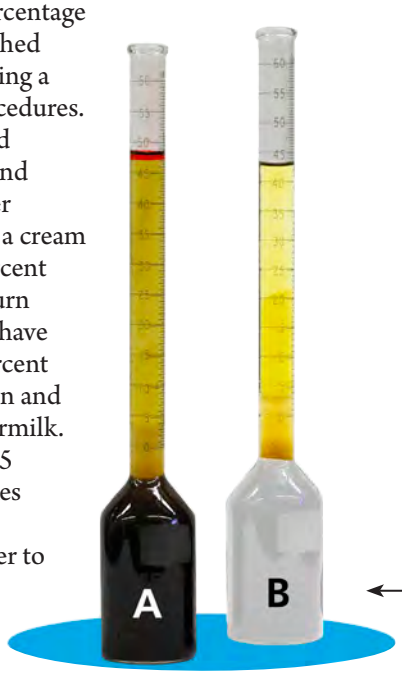

Figure 2. Nine inch Babcock bottles.
A. Cream test with glymol added to depress top meniscus to improve accuracy.
B. Milkfat ready for removal, weighing and titration for free fatty acids.

Lipase Activity ▶ Lipase is present in all raw milk and is a difficult enzyme to inactivate in milk and cream. Even pasteurizing cream at 190°F for 15 seconds will not inactivate 100 percent of the lipase.

There are several process controls that when used will control the liberation of free fatty acids (e.g. hydrolytic rancidity.) To avoid potential problems, only pump cream using a positive displacement pump. Also, avoid rough handling and splashing of cream and foam formation. Allowing raw or heat-treated cream to splash into a holding vessel allows fat globule collisions which remove portions of the protective fat globule membrane permitting lipase to free fatty acids. Also, this action generates foam and partially removes the fat globule membrane which again allows lipase activity in the slow-to-cool foam. Foam insulates and will not cool at the same rate as liquid. Check the entire processing system for air leaks that create foam. Loose fittings, hard or cracked gaskets, leaking back seals on pumps, particularly centrifugal and emptying vats until dry, are some spots to check for problems.

Conclusion

By applying the operator specifications outlined in part one of this series, and following the product quality suggestions outlined above, you should expect improved quality of both your raw and finished products. Quality cream is the result of hard work and paying attention to the small details, which all add up to create your end product. Remember that proper operations require proper training and experience to ensure a safe working environment as well as a safe product.

Reference: Standard Methods for the Examination of Dairy Products. 17th edition, American Public Health Association., Washington, D.C.

THE CHEESE ANTIMICROBIAL TOOLBOX

Contributed by Matt Dean, CDR Student Intern

The conversion of highly perishable milk to the more stable cheese is accomplished through a series of steps including the removal of water, adjusting the pH and in some cases, the use of antimicrobial assistance. Remember that cheese quality and safety begins with quality milk, but maintaining that quality throughout the manufacturing, storage and distribution process creates a particular challenge. Microbial contamination and growth is at the forefront of the minds of cheesemakers as it affects cheese quality in a number of ways including surface discoloration, high acidity, off-flavors, odors and excessive gas (D'Amico, 2014).

While heat treatment and pasteurization are designed to eliminate pathogens in raw milk, bacterial contamination can still occur at later stages in the cheesemaking process costing manufacturers time and money. While thorough and well-maintained cleaning practices are the best defense against bacterial contamination, there are several preservative tools that can be used to extend a product's shelf-life. Please note that many of the standards for use of preserving agents differ in the U.S. versus the rest of the globe so consider your market when reviewing the preservatives described in this article.

Lysozyme

Lysozyme is a common enzyme often employed in Europe in the cheesemaking process to prevent the bacterial contamination problem known as "late blowing." The contamination caused by heat resistant spores of the bacterium Clostridium tyrobutyricum is most common among dairy farm operations that feed their livestock silage, the origin of the heat-resistant spores. Late blowing caused by a spore's ability to survive the normal heat treatments used on milk prior to cheese production often occurs in the ripening process and is the classic case that lysozyme is used to prevent (Speijers and Apeldoorn, 1991).

Lysozyme is essentially used to break down the cell walls of microbes, bringing about "lysis" or cell rupture. While not included in the U.S. Standard of Identity list for cheese, and thus not an approved ingredient for use in cheese produced in the United States, lysozyme is widely used in Europe with currently 99 percent of Italian Grana Padano and 8 percent of France's hard cheese industry using lysozyme in their products according to one of the major producers of the preserving agent.

A small dose of lysozyme added to the raw milk benefits the cheesemaker by preventing the growth of C. Tyrobutyricum spores. The spores readily survive the heat treatment applied to raw cheese milk but when they germinate during cheese ripening lysozyme lyses the cell preventing growth and spoilage (late blowing).

Lysozyme, which would be labeled "egg white lysozyme" is Generally Recognized As Safe (GRAS) in the United States, but it should be noted that it is produced from hen egg-whites, posing an allergen concern. Although a 2007 study indicated the preservative has no negative effects among those allergic to eggs, products including lysozyme do fall under the Food Allergen Labeling and Consumer Protection Act of 2004 (FALCPA) requirements.

Sorbic Acid

Sorbic acid, and its potassium salt form known as potassium sorbate, are both commonly used food preservatives which inhibit yeast and mold growth on the surface of cheese and other dairy products. Sorbic acid was first isolated as a naturally occurring antimicrobial compound found in mountain ash berries.

Sorbates have a neutral taste and are used in a number of food products including yogurt, dried fruit, fish, meat, soup, jelly, wine, beer, soft drinks and some baked goods. While sorbates are unnoticeable when used in the correct proportions, excessive application can cause a chemical taint. If the concentration used is too low, certain resistant molds can metabolize and produce an off-flavor often described as "kerosene-like" that can completely ruin a product.

Sorbic acid is permitted in a number of cheese varieties under the Standards of Identity literature. No more than 0.2% by weight of sorbic acid, potassium sorbate, sodium sorbate, or any combination of these is permitted in pasteurized process cheese. The federal regulations should be checked for other cheese classes.

While sorbates provide a highly effective and allowable preserving agent, some companies have moved away from it seeking a more "all natural" image to appease consumers.

MicroGARD®, HoldBac®, and other fermentates/ microbial inhibitors

MicroGARD® ▶ is a dairy-based product derived from cultures in skim milk using lactic acid fermentation as an antimicrobial agent. It is used to prevent spoilage in a number of cheeses including cottage, cream, mozzarella, and ricotta along with sour cream and refrigerated yogurts. The white powdery buttermilk flavored additive is also used in an array of non-dairy products that include pizza sauce, dried sausages and refrigerated tortillas. MicroGARD® is used to prevent the growth of gram negative psychrotrophs, a type of bacterium capable of surviving cold storage temperatures below 7°C as it can have adverse effects on the yield, texture and flavor of dairy products. Produced by DuPont's Danisco division, the preserving agent has been used as a natural microbial growth inhibitor for decades and was first approved for commercialized food use in July 1983 in the United States. It was approved and defined as GRAS in May 2003.

HoldBac®, ▶ another product of DuPont's Danisco division, is a microbial inhibitor used in the prevention of fungal contaminants including when spoilage yeast arises in fermented dairy products like yogurt, white cheese and sour cream.

Natamycin

Natamycin is used to suppress the growth of yeasts and mold on the surface of various types of cheeses. Natamycin can be applied to the surface of various types of cheeses in either a liquid or powder form, extending the shelf life. The allowable use permitted by the FDA is currently 20 mg/kg in finished product. This can be used in conjunction with MAP (Modified Atmosphere Packaging) to provide mold inhibition after opening the package.

Sources:
Fox, P.F. 1999. Cheese: Chemistry, Physics, and Microbiology (General Aspects). Springer Science & Business Media, Berlin.
D'Amico, Dennis J. 2014. Adventitious Microbes Can Affect the Safety and Quality of Cheese. Microbe Magazine, American Society for Microbiology.
Speijers, G.J.A. and Apeldoorn, M.E. Lysozyme. 1991. Lysozyme. National Institute of Public Health and Environmental Protection, Laboratory for Toxicology, Bilthoven, The Netherlands.
Tamime, A.Y. 2011. Processed Cheese and Analogues. Wiley-Blackwell Publishing, Chichester, UK.

MASTER ARTISAN SHORT COURSE SERIES

A Comprehensive Review of Cheese Yield
September 22-23, 2015

This year's Master Artisian course will review potential impacts on cheese manufacturing resulting from many current cheese milk standardization options. These options currently include membrane processing, addition of dairy powders, and use of other ingredients designed to increase cheese yield. Additionally, this class will review specifics of cheese yield calculations, current regulations relating to standardization methods, and review the economics of concentrated milks and their by-products. Please join us to get a glimpse of the present and future as it relates to milk standardization and cheese yield in the US dairy industry.

To register visit:
www.cdr.wisc.edu/shortcourses/master_course_15

USDEC & CDR PARTNER TO BRING INNOVATION TO IFT

The CDR Dairy Ingredients and Functionality program is honored to once again join the U.S. Dairy Export Council (USDEC) in developing dairy-based prototypes for the Institute of Food Technologists (IFT) Annual Meeting to be held July 11-14, 2015 in Chicago at McCormick Place. The products developed for this conference are meant to be creative, dairy-based products that highlight the versatility of dairy and promote U.S. dairy ingredients.

Each year, CDR, the Midwest Dairy Foods Research Center and California Dairy Foods Research Center submit dairy-product ideas to a committee at USDEC who then selects which products will be showcased at IFT. This year, two of CDR's product prototypes were selected: a yogurt barley soup, which will be showcased through a handout, and a savory kimchee-se pancake, which will be exhibited as the mass sample in USDEC's booth during the Food Expo.

Developed under the direction of CDR Ingredients and Functionality Coordinator KJ Burrington, Applications Lab Coordinator Sarah Minasian created the two products which were inspired by her various cultural experiences. The yogurt barley soup is a modern take on the traditional Armenian Tanabour soup that Minasian ate during her childhood. Creamy with a slight tang, the yogurt barley soup has a strong buttery-mint note along with spinach and onion providing eight grams of protein in a 160 calorie cup serving, making this atypical warm yogurt application a "powerhouse" soup.

Kimchee-se pancake

Yogurt barley soup

With its 12grams of protein per serving, the savory kimchee-se pancake incorporates Pepper Jack cheese, milk protein concentrate (MPC) 70 and whey permeate. Minasian was inspired to create this dish while preparing for a Korean USDEC reverse trade mission tour. The kimchee-se pancake, as the name suggests, contains a mild kimchee which is a fermented vegetable blend popular in Korea. While not overly spicy, the kimchee-se pancake contains a unique Asian inspired flavor while providing an excellent source of protein, all packaged in a satisfying snack.

Sarah Minasian preparing kimchee-se pancakes

In addition to the development of these products, CDR staff will be attending IFT, helping to man the USDEC booth (#1043), answering questions about the various prototypes and about U.S. dairy ingredients in general. Minasian will also be on-hand for the first two hours of each day for a special live cooking demonstration of the savory kimchee-se pancake.

BUILDING UPDATE

The Center for Dairy Research and Babcock Hall building project continues to move forward. The design team will shortly complete the key 35 percent design report, which is a major milestone for this project as it describes the details of the building design that meets the budget/scope. This report must be approved by the University of Wisconsin Board of Regents, scheduled to meet August 2015, and is on track for design approval by the State Building Commission in September 2015. Once the 35 percent design report is approved, all of the final design details should be completed by the end of 2015. Following this, the construction and bid documents are created and publically advertised for six weeks. The review process for received bids will likely take about one month before a company is awarded a contract. The project is still set to meet the goal of a summer 2016 groundbreaking with a 26 month construction period.

Center for Dairy Research and Babcock Hall building project rendering of exterior. © Zimmerman Architectural Studio, Inc.

INCREASING THE GLOBAL DEMAND FOR U.S. DAIRY PRODUCTS

Global demand for Wisconsin and U.S. dairy products and ingredients continues to grow. Thanks to the dedication of our dairy farmers and processors, global markets can rely on the U.S. for consistent, quality dairy products. To enhance this demand for U.S. dairy products and ingredients, CDR has had the opportunity to work with USDEC to provide training and technical expertise to many parts of the world; from Dean Sommer and Mark Johnson providing Cheese 101 training for Southeast Asian pizza chain operators and restauranteurs to KJ Burrington joining USDEC trade missions, explaining the attributes and technology of permeate along with the benefits of using permeate and other US dairy ingredients in applications. CDR's role is to contribute technical expertise to help U.S. companies grow their export sales.

With Southeast Asia being an important market for the U.S., representing our second largest market for dairy exports, KJ was asked by USDEC to present during the USDEC sponsored U.S. Dairy Business Conference held in Singapore in April. Over 170 participants from 10 countries representing Southeast Asian food and beverage companies attended the conference, all with an interest in a wide range of dairy products for a variety of applications.

KJ Burrington, CDR.

KJ's presentation focused on maximizing value through innovation with U.S. permeate, and the benefits of using permeate as an ingredient. The U.S. leads the world in permeate production, seeing an increase of 80% from 2009 to 2014, so with the trends of clean labels, changing consumer habits, and the need for value-driven functional ingredients, permeate is taking off on a global scale. "The more we can promote the benefits of permeate, such as flavor enhancement/sodium reduction, added nutrition (from dairy minerals) and cost reduction, to the Southeast Asian market, the greater the opportunity for Wisconsin and U.S. manufacturers to build markets in that area," explains KJ.

In addition to technical and market trend presentations, 25 U.S. dairy suppliers had exhibits there allowing direct interaction between the suppliers and the Southeast Asian attendees; 11 of those suppliers are CDR Industry Team members.

"One of the greatest benefits of being part of a great program like USDEC's Business Conference is the chance to share the expertise of CDR's staff while also promoting the benefits of using Wisconsin and US dairy ingredients, particularly permeate," shares KJ. "Add in the opportunity to work with CIT members and it's a win-win situation for the Wisconsin and U.S. dairy industry."

CONGRATULATIONS

Please join us in congratulating CDR Safety and Quality Coordinator Marianne Smukowski and CDR Cheese Applications Coordinator John Jaeggi on their University of Wisconsin-Madison, College of Agricultural and Life Sciences (CALS) academic staff awards.

Thanks to letters of support from members of the industry as well as academic peers, Marianne received the CALS Award for Academic Staff Excellence in Leadership while John received the CALS Award for Excellence in Research. These prestigious awards are only given to one staff member within CALS each year. The recipient of each award is expected to show excellence in performance, meaningful and/or influential personal interactions, initiative and creativity all while exemplifying what it means to be a leader or researcher in their field.

CDR is honored to have so many staff that fit this criteria and we are proud to use our expertise and knowledge to serve the dairy industry.

John Jaeggi & Kate VandenBosch, CALS Dean, UW-Madison

Marianne Smukowski & Kate VandenBosch, CALS Dean, UW-Madison

SWISS AMBASSADOR VISITS CDR

On June 22, CDR helped to host Swiss Ambassador to the U.S. Martin Dahinden as he visited the Madison region and the University. The Ambassador participated in a variety of events and presentations with business and education providers in the area after participating in New Glarus' Sangerfest. CDR had the chance to share its work in dairy research and innovation, as well as have the Ambassador taste examples of the dairy products staff help to develop with industry partners.

John Jaeggi, CDR, visits with the Swiss Ambassador in the CDRApplication Lab.

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Short Course Calendar:

- Milk Pasteurization, August 4-5
- Cheese Grading Short Course, August 25-27
- Cultured Dairy Products Short Course, September 8-9
- Master Artisan Short Course - A Comprehensive Review of Cheese Yield, September 22-23

For detailed information on each CDR short course:
www.cdr.wisc.edu/shortcourses

Events:

ACS Cheese Camp 2015: Craft, Creativity, Community
Wednesday, July 29 – Saturday, August 1, 2015
Rhode Island Convention Center, Providence, RI

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