Wisconsin Center for Dairy Research

Dairy Pipeline

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Could cheese be the culprit when meat turns green?

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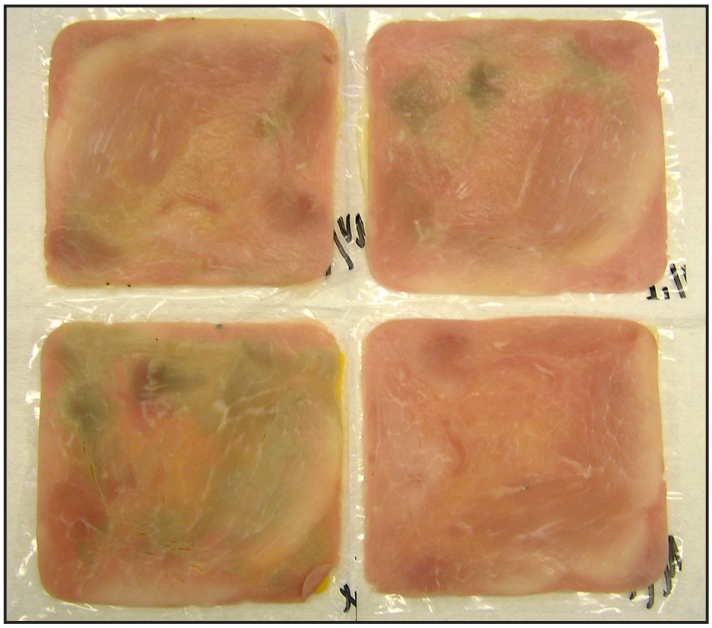
Over the past 4 or 5 years we have fielded a number of questions concerning cheese products causing green discoloration in meat or sausage. First, one of the major meat companies found green discoloration in smoked sausages with cheese added but not in the same sausage without cheese. Although they used the same cheese product in a ham and cheese loaf they did not see the same greening.



The discoloration showed up within 2 days in the problem sausages. After changing cheese suppliers and adding an antimicrobial agent in the formulation, they were able to resolve the problem.

After that, a similar report arrived from a specialty meat market in western Wisconsin: another observation of discoloration after adding natural cheese pieces to sausage products. They noted serious problems in fermented sausages as well as more minor issues in hot dogs and Polish sausages—products cooked at higher temperatures for longer times. When they first noticed problems with greening, they tried adding more nitrite to the emulsion because they hypothesized the cheese was absorbing the nitrite. Later, they thought the growth of Lactobacilli in the cheese might have been the problem. Eventually, switching to high-temperature, high-melt processed cheese eliminated the problem.

The third case came from a food service company supplying cheese to a deli making prepackaged sub sandwiches. A few hours after assembling subs, they noticed that wherever mozzarella cheese touched the meat (salami and ham) the meat turned green. However, this didn't happen with American cheese. With this background, we decided to investigate the possibility that some varieties of cheese may cause greening in cured meats.

Green discoloration in meat

Several bacterial species that are contaminants in meat, or in the processing environment, can cause green discoloration of meats. Previous research demonstrated that lactic acid bacteria, especially heterofermentative Lactobacilli, *Streptococcus spp., Weissella*

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viridescens, and Leuconostoc are the major cause of bacterial greening in cured meats (Grant, et al., 1988). These bacteria are Gram positive, catalase negative, microaerophilic or anaerobic in nature. Most of these bacteria are salt and nitrite tolerant, heat and smoke resistant and capable of growing at low temperatures in cured meats. Bacteria responsible for greening produce hydrogen peroxide (H_2O_2), which reacts with the cured pink pigment, nitrosohemochrome, to produce green cholemyoglobin or greenish oxidized porphyrins (Lawrie & Ledward, 2006). Since these bacteria are catalase negative, and catalase normally present in meat is destroyed by heat treatment and by nitrite, hydrogen peroxide formed in the cured meat can react to cause green discoloration. In some cases, lactic acid bacteria will grow prior to processing and produce peroxides, which are relatively stable compounds. During processing, these bacteria may be killed but the peroxides remain in the finished product that is vacuum packaged. Once the package is opened and the product is exposed to oxygen, discoloration will develop. (A thorough review of bacterial greening in cured meats has been published by Grant, et al., 1988.)

Greening of cured meats

Lactobacillus spp. are the major type of organisms responsible for greening in cured meats (Grant et al., 1988). Their predominance is due to their tolerance of anaerobic conditions, low pH, salt, nitrite and cooking temperatures. In addition, scientists have identified *Leuconostoc spp* (Anifantaki et al., 2002) and *Enterococcus spp.* (Borch, et al., 1996) as microbes that can produce hydrogen peroxide and cause bacterial greening of cured sausages. Yap and Gilliland (2000) reported isolating strains of *Lactobacillus delbrueckii subsp. lactis* that produced more H_2O_2 than other Lactobacilli. All of them are typical bacteria present in cheeses as primary cultures or secondary microflora. Cogin and Hill (1993) reported that many starter lactic acid bacteria, when exposed to oxygen, produce H_2O_2, which can inhibit their subsequent growth. Certainly there is no question about the possibility of H_2O_2 being produced by cheese cultures or secondary microflora in cheese. In some cases, processors have been able to reduce or eliminate greening by using high-melt process cheese because this cheese has fewer bacteria that may be causing the problem.

The purpose of this study was to answer the question: Can natural cheeses cause greening in cured meats? If so, are the causative organisms the lactic cultures used to produce the cheese or a secondary microflora that grew during the aging of the cheese?

Current study

In the first phase of the study, we paired sliced cheeses with cured meat products to see if any combination could consistently produce greening in the meat product. We tested american, cheddar, mozzarella, provolone, swiss, process swiss, and muenster. Meats used in the trials included ham, salami, bologna, and corned beef. The cheese/meat pairings were placed in sealable plastic sandwich bags and then in a 12˚C (54˚F) incubator. Samples were evaluated daily for 1 week for evidence of potential greening of the meat. Muenster and mozzarella produced greening with all 4 meats while provolone and sharp cheddar produced greening only in ham and bologna. Swiss cheese and the two process cheeses showed no evidence of greening on any of the process meats. Isolates taken from the greened areas of cured meats were grown up in MRS broth which is selective for lactic acid bacteria (LAB). A majority of the isolates showed growth on Rogosa SL agar, selective for lactobacillus. After some preliminary attempts to determine which isolates may be H_2O_2 producers, we decided to use the method of Marshall (1979) in the next studies.

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Can natural cheeses cause greening in cured meats?

Permeate can help you reduce sodium while improving flavor

By Sarah Minasian, applications lab coordinator, Wisconsin Center for Dairy Research

Chef's love salt. Simply put, it's what makes food taste good. We know that a little goes a long way, and that it helps to bring the essential flavors out in a dish.

Professional chefs, bakers and home gourmets have moved from cooking with basic iodized and kosher salt to the a new world where Hawaiian Black Lava Salt, Applewood Smoked Sea Salt, White Truffle Salt, Fleur de Sel and Bali Lime & Coconut Smoked Sea Salt preside. No matter what the variety, in and of itself salt is not bad for you, and our bodies do need it in moderation. However, moderation is not the norm. According the American Heart Association, the current average sodium consumption runs between 3600 and 4800 mg per day.

Here at the University of Wisconsin Center for Dairy Research in Madison, WI, we have been trying to get the word out on about an ingredient that allows chefs, bakers and manufacturers alike to deliver the salt flavor we crave, while reducing sodium levels. Our bodies need sodium to maintain the proper balance of fluids, to transmit nerve impulses, and to influence the contraction and relaxation of muscles. Our kidneys balance the amount of sodium stored in our bodies, but when they don't eliminate enough sodium it starts to accumulate in our blood. Because sodium attracts and holds water, blood volume increases, which makes the heart work harder to move blood through our vessels, possibly increasing pressure in our arteries.

The National Academy of Science recommends a sodium intake level of at least 500 mg a day, but less than 2,300 mg a day based on its expert group consensus. Following suit, the 2010 USDA's Dietary Guidelines for Americans, (http://www.cnpp.usda.gov/dietaryguidelines.htm) advises us to limit daily sodium intake to approximately 2,300 mg, or one teaspoon a day. However, if you are older than 51, or of African American descent, or you suffer from hypertension, diabetes or kidney disease you should reduce your sodium intake even more, to 1,500 mg a day. This group includes approximately one half of the U.S. population.

Table 1. Sodium content of common foods

Description	Weight (g)	Common measure	Sodium (Na) per measure (mg)
Canned mac & cheese entrée	252 g	1 cup	761 mg
Marinara spaghetti sauce	250 g	1 cup	1025 mg
Chicken Noodle dry soup mix	252.3 g	1 cup	578 mg
Chex Mix snack	28.35 g	2/3 cup	341 mg

According to the National Salt Reduction Initiative, only 11% of the sodium in our diets comes from our saltshakers, nearly 80% is added to foods during processing, particularly pizza, cold cuts, bacon, soup, bread, prepared dinners like pasta, meat and egg dishes, and fast foods. Food manufacturers use salt or other sodium-containing compounds in processed food to enhance flavor and help prevent spoilage by inhibiting the growth of bacteria, yeast and mold. Salt can also help to disguise metallic or chemical aftertastes.

The USDA National Nutrient Database for Standard Reference, Release 23, (http://www.ars.usda.gov/SP2UserFiles/Place/12354500/Data/SR23/nutrlist/sr23a307.pdf), listed several entries showing the sodium content of some common household foods. (See Table 1.)

National Salt Reduction Initiative

The National Salt Reduction Initiative is a public-private partnership of local and state health authorities and health organizations working to assist food manufacturers and restaurants who want to reduce the amount of salt in their products. Coordinated by the New York City Health Department, this national effort aims to reduce American's salt intake by 20% over five years by targeting 62 categories of packaged food and 25 categories of restaurant food.

How can dairy help?

We produce permeate, a byproduct from whey protein concentrate, whey protein isolate, ultra-filtered milk, milk protein concentrate or milk protein isolate. Permeate has several other names including de-proteinized whey, dairy product solids and modified whey. Recently, the American Dairy Products Institute and the USDA have recomended that permeate ingredients be listed as "dairy product solids" on product labels to reduce confusion. Although there is no standard of

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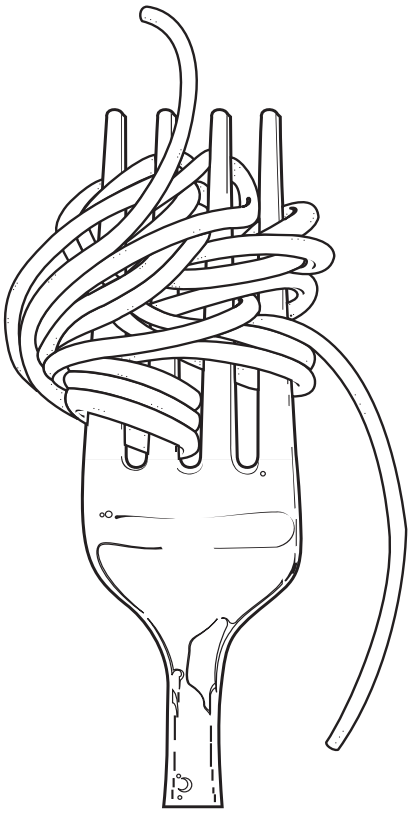
identity and the composition of the spray-dried white powder permeate does vary, a minimum of 59% lactose, maximum of 10% protein and 27% ash is typical.

Researchers at the University of Wisconsin Center for Dairy Research have learned that permeate has salt-enhancement properties. It is possible that the mineral salts in the ash—calcium phosphate, magnesium, sodium and potassium— may function as salt enhancers, while the non-protein nitrogen compounds found in the protein –urea, creatine, creatinine, uric acid, orotic acid and ammonia—may serve as flavor potentiators. Additionally, the calcium in permeate enhances salty, sweet and umami tastes. (Summarized in the Dairy Pipeline, Vol. 22, No. 1) Fat content is low, so there is no added functionality from the fat.

How to use permeate

In general, 10 grams of permeate will replace 1 gram of salt in a food formulation. To balance the addition of permeate in a formula, you should reduce other macro-ingredients such as flour, fat, eggs, sugar and other carbohydrates—which ideally could result in a total ingredient cost savings.

The possibilities are endless, but because of the high percentage of lactose, permeate is particularly beneficial in baked applications. Due to the Maillard reaction of lactose and other sugars with available protein, permeate in baked applications contributes a golden brown appearance, enhanced crumb texture and caramelized dairy flavor. An additional bonus is the moisture retention benefit of lactose. The high lactose content of permeate in dough can produce bread that retains its softness longer, thus extending shelf life.



Here at the Center for Dairy Research (CDR), we've had remarkable success using permeate in cookies, muffins, scones, cake, crackers, brownies, rolls, breadsticks and pizza dough. Working in partnership with the Dairy Research Institute, a non-profit organization affiliated with the Innovation Center for U.S. Dairy, CDR has been able to significantly reduce sodium levels in several of these applications. Building on the success of baked applications, CDR has also begun to explore permeate in snack seasonings, soup applications and sauces. Moreover, descriptive taste panels, from soup to scones indicate that the majority of panelists preferred the product prepared with permeate.

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Table 2. Differences in sodium content: Salt versus permeate

Product (Serving Size)	Control-With Salt	Permeate-Without Salt*	% of Sodium
	Content (mg)	Sodium Content (mg)	Reduction
Scones (55g)	230	110	52%
Chocolate Chip Cookies (30g)	100	40	60%
Snack Cake (55g)	45	40	11%
Pound Cake (88g)	150	80	47%
Muffins (55g)	230	70	70%
BBQ Popcorn Seasoning on 1 Cup Popcorn (16g)	290	210	28%
Broccoli Cream Soup (1 cup)	550	135	75%

Source: Center for Dairy Research, Madison, WI
*In some bakery formulations, sodium-based leavening agents are responsible for the remaining system.

Formula Ideas

Since permeate is a dry powder it blends easily into dry mixes. Think seasoning mixes for salty snacks like popcorn, potato chips, corn chips, vegetable chips, nuts and legumes, or even a dry spice rub for barbecue.

Consider permeate in any dry soup mix or canned soups and sauces, particularly creamy soups and chowders. In addition, tomato and pizza sauce could easily incorporate permeate.

There are numerous salad and dip dry mixes ranging from Ranch to French onion, as well as plenty of dry savory—Alfredo to gravy, or an herb bread crumb mix to shake your chicken in, as well as sweet —pudding to cake, mixes that could easily incorporate permeate to reduce sodium content. Manufacturers of pasta and cheese meals, beef stew, and rice, potato and legume ready to serve side dishes will find that permeate can work for you, too.

And speaking of pizza, how about permeate in the crust, sauce, cheese and pepperoni for a low-sodium pizza? In addition to reducing the sodium in pepperoni, permeate can protect color, mask bitter flavors and improve structure formulation. The abundance of lactose in permeate provides an effective starter culture carbohydrate for fermented sausages and/or cooked hams. Researchers at CDR and several other large cheese manufacturers have been focusing on developing reduced-sodium cheese. In addition to flavor, salt in natural cheese plays several food safety roles, and has been more difficult to tackle. However, there is opportunity for permeate in process cheese.

For a pizza dough with permeate formula that provides a 70% sodium reduction, go to www.innovatewithdairy.com. In addition to help with pizza, you will find an in-depth white paper and many formulas calling for permeate to aid your low-sodium product development.

For product sampling, here is a list of permeate manufacturers that will be happy to provide you with product and additional information.

Permeate Suppliers

Agropur
Kevin Thomson
Director of Dairy Ingredient Sales
2901 Freedom Road
Little Chute, WI 54140
920-574-5618
kevin.thomson@tregafoods.com

Agrimark
Peter Gutierrez
Vice President, Global Ingredient Sales
Tel: +1 608 783 9755
Mob: +1 608 797 9920
Fax: +1 608 783 9778
Pgutierrez@agrimark.net

Proliant
Lori Stevenson
Vice President of Sales & Marketing
Proliant Dairy Ingredients
2425 SE Oak Tree Court
Ankeny, IA 50021
515-289-7621 (phone)
515-289-5821 (fax)
lori.stevenson@proliantinc.com

Idaho Milk Products (milk permeate)
Tara Russell
Director of Sales and Marketing
2249 S. Tiger Dr.
Jerome, ID 83338
phone: 208-644-2882
fax: 208-644-2899
trussell@idahomilk.us

Saputo Cheese USA
Virginie Saulnier, Sales Manager
25 Tri-State International Office Center,
Suite 250
Lincolnshire, IL 60069
(847) 219-1895
vsaulnier@saputo.com

Sorrento Lactalis
Todd Wittlinger
Regional Sales Manager
2376 South Park Avenue
Buffalo, NY 14220
608-201-5545
todd.wittlinger@lactalis.us

For more information about sodium replacement with permeate see Dairy Pipeline, Volume 17 No. 4, Volume 20 No. 4, and Volume 22 No.1

To determine which lactic acid bacteria were causing greening in cured meats, we repeated the cheese/meat pairings. Cheddar and muenster were linked with the most intense greening. Samples from the greened areas were streaked onto the Marshall plates to isolate H_2O_2 producing organisms. The isolates were transferred to a general growth broth (TSB) to produce active growing cultures. Samples of ham and salami were then inoculated with each of the active growing isolates to confirm they were an H_2O_2 producing organism that could cause greening. The isolates from muenster and cheddar both greened the cured meat within 1 week of storage at 12˚C. Isolates from mozzarella showed very slight greening of cured meat at 2 weeks of storage and the isolate from provolone did not green the meat at all. The isolates from cheddar/ham and cheddar/corned beef pairings were grown on Marshall media and sent to Midi Labs, Newark, DE for species identification. The isolates were identified as *Weissella paramesenteroides*.

Weissella paramesenteroides (formerly identified as *Leuconostoc paramesenteroides*) is a heterofermentative lactic acid bacteria that has been isolated from grasses and silage (Cai et al., 1998; Pasebani et al., 2010). It is also a malolactic bacteria that has been isolated from wine (Dicks and Endo, 2009). It has been reported to produce a bacteriocin that exhibits inhibitory activity against foodborne/spoilage organisms, including gram-negative bacteria (Pal and Ramana, 2010). *W. paramesenteroides* has been reported to be a non-starter lactic acid bacteria (NSLAB) that contributes to cheese ripening in aged cheeses e.g., Manura (Gerasi et al., 2003); Serra cheese (Macedo et al., 1995); Ibores (Mas et al., 2002); and Cabrales cheese (Nunez and Medina, 1979). Grant et al. (1988) reported that *W. paramesenteroides* is a lactic acid bacteria capable of growing at refrigeration temperatures to 4˚C (15.5ºF) and in foods with salt in the moisture phase up to 8% and a cause of greening in cured meats. Most likely the *W. paramesenteroides* isolated in our current study was the result of the NSLAB being a secondary microflora from raw milk or an environmental contaminant in the cheese plant.

Cheese cultures: potential greening organisms

Previous researchers (Anifantaki et al., 2002; Grant et al., 1988; Yap and Gilliland 2000) reported some lactic organisms currently used as cultures for cheese production are H_2O_2 producers. In fact, Leuconostoc spp and Lactobacillus spp. have been identified as lactic acid bacteria causing greening of cured meats (Anifantaki et al., 2002; Lee and Simard, 1984). Could current cheese cultures used by our cheesemakers be potential greeners of cured meat? To find out we streaked pure cultures onto Marshall plates and incubated them at 32ºC for 48 hr. The relative intensities of H_2O_2 production are shown in Table 1.

Table 1. Relative intensities of H_2O_2 production by commercial cheese cultures

Organism	Relative intensities of H_2O_2*
Leuconostoc mesenteroides	+++++
Lactobacillus delbrueckii subsp bulgaricus	+++
Streptococcus thermophilus	++
Lactobacillus helveticus	++
Lactococcus lactis/L. cremoris blend	---

* Intensity: +++++ = very intense, + = very slight, --- none

Leuconostoc mesenteroides was the most active producer of H_2O_2 while the Lactococcus spp. blend did not show any H_2O_2 production. Colonies from each of the positive H_2O_2 producing organisms were transferred to TSB broth and incubated at 32˚C for 48 hr to produce active growing cultures. Then the cultures were inoculated on slices of salami and placed in sealable sandwich bags and stored at 12˚C for 1 week. *L. mesenteroides* and *L. bulgaricus* caused significant greening on the salami while *L. helveticus* exhibited some slight greening. *S. thermophilus* did not show any greening at 1 week of storage but did start producing some greening after 2 weeks of storage.

Cheeses produced with greening cultures

To determine if commercial cultures producing H_2O_2 induce cheese to cause cured meat greening, two cheeses were selected and paired with ham and salami. The first cheese was 6 month old romano cheese produced with *Lactobacillus delbrueckii subsp bulgaricus* and *Streptococcus thermophilus*. The second cheese was 60 day old graviera cheese produced with *Leuconostoc mesenteroides, Streptococcus thermophilus and Lactobacillus helveticus*. Duplicate sets of cheese/meat pairings were set up with the romano cheese and graviera cheese, paired with ham or salami.

After 1 week of storage at 12˚C. The most intense greening appeared in the graviera/ham pairing. However, when isolates from each of the greened meats were plated out on the Marshall media, the *L. delbrueckii subsp bulgaricus* appeared to be the most active H_2O_2 producer of the two cheeses.

The two isolates were sent to Midi Labs, Newark, DE for species identification

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and confirmation. The isolates from romano cheese were confirmed as *L. delbrueckii subsp bulgaricus*; however, the isolate from graviera cheese was identified as *Lactobacillus brevis*, a NSLAB present in many aged raw milk cheeses produced without adding culture. (Abdullah and Osman, 2010; Berta et al., 2009; Butikofer and Bachmann, 2008; Radovanovic and Katic, 2009; Ransiou et al., 2008) *Lactobacillus brevis* is a native hetero-fermentative lactobacilli that contributes significantly to the proteolysis and organic acid evolution in aged cheeses (Pereira et al., 2010).

The 60 day old graviera cheese appeared to produce a more intense green discoloration on ham than romano cheese. *L. mesenteroides* may have actively produced H2O2 in the initial curd and fresh graviera cheese and then died off when the pH of the cheese dropped during aging. Several researchers (Centeno et al., 1996; Nieto-Arrihas et al., 2010) have reported that Leuconostoc cultures are susceptible to acid stress and tend to die off after 30 days of age when the pH of the cheese is below 5.2. As *L. mesenteroides* decreases, NSLABs, including *L. brevis*, tend to increase and develop additional lactic acid and enzymes contributing to the aging process in the cheese. *L. mesenteroides* has been reported to be responsible for green discoloration in frankfurters by Anifantaki et al. (2002). Additional research is needed to confirm that *L. mesenteroides* contributed to some of the H_2O_2 in the early phases of aging graviera cheese.

Conclusion

Our work confirms that cheese can indeed cause greening in cured meat products. The mechanism is lactic acid bacteria that can produce hydrogen peroxide, which then reacts with the cured meat pigment to form green cholemyoglobin or greenish oxidized porphyrins. Some lactic cultures used as cheese starters are active H_2O_2 producers and they can be the culprits behind greening in cured meats. In addition, NSLABs involved in flavor development of aged cheeses can also produce some H_2O_2 once again causing green discoloration. Lactococcus cultures do not produce H_2O_2; but NSLABs can be H_2O_2 producers, thus you can't assume that aged cheeses, which typically use the mesophilic cultures, are safe from potential greening. How can a cheesemaker guarantee that a cheese could be safely paired with cured meat in sandwiches or other food applications where the cheese and meat contact each other under refrigerated storage for up to 3-4 days? The only solution is to analyze the cheese using the Marshall procedure to determine the presence or absence of H_2O_2 producing bacteria.

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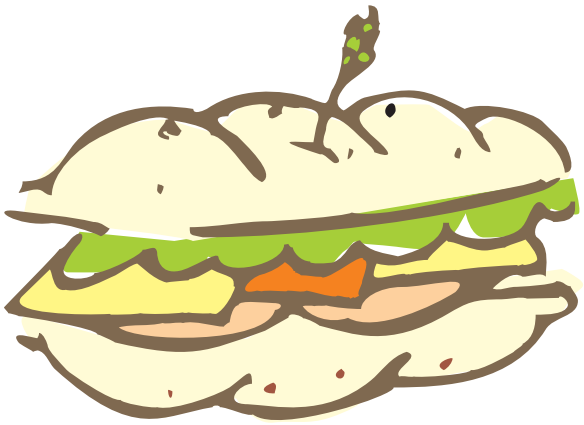
Our work confirms that cheese can indeed cause greening in cured meat products.



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News from CDR

WDPA Announces Scholarship Winner

Susan Hodgson, Plymouth, WI, has been selected as this year's recipient of the 2011 Robert L. Bradley Scholarship, awarded by the Wisconsin Dairy Products Association (WDPA).

Susan, who grew up on a dairy farm in Plymouth, WI, just completed her freshman year at the University of Wisconsin-Madison. She is currently enrolled in the Food Science and Dairy Science programs at the university.

The scholarship is named after Dr. Bob Bradley, a long-time professor at the University of Wisconsin- Madison and a major supporter of WDPA. Dr. Bradley has been very active for over 25 years in WDPA's annual Dairy Product Grading and Evaluation Clinic and has been the assistant judge for WDPA's World Dairy Expo Championship Dairy Product Contest for the past 7 years.

Olson named a National Dairy Shrine Pioneer

Norm Olson, researcher, professor, and the major force behind the beginning of the Wisconsin Center for Dairy Research was recently honored at an awards dinner during the 2011 World Dairy Expo. Olson was named a National Dairy Shrine Pioneer in recognition of his research and scholarship that continues to move the Wisconsin dairy industry forward.

National Dairy Shrine brings together dairy producers, scientists, students, educators, marketers and others who share a desire to preserve our dairy heritage and keep the dairy industry strong. Founded in 1949 by a small group of visionary dairy leaders, National Dairy Shrine now has over 18,000 members encompassing virtually every facet of the industry.

The Dairy Shrine also maintains a wonderful museum as part of the Hoard Historical Museum in Fort Atkinson, Wisconsin. Dr. Olson's portrait will now be on exhibit at the National Dairy Shrine Visitors' Center in Fort Atkinson, Wisconsin. Congratulations Norm!

CDR welcomes two new employees

Bénédicté Coudé and Luis A. Jiménez-Moroto, both graduates of the Food Science Dept., University of Wisconsin-Madison, have joined the staff of CDR. Luis is sharing a CDR and Food Science position as he coordinates sensory analysis. Bené is putting her expertise into CDR's Cheese Industry and Applications program.

Surprising Norm at the awards are friends and fans, as well as some of the earliest employees at CDR. From left, John Jaeggi, Carmen Huston, Mark Johnson, Norm Olson, Tom Szalkucki, George Shook, John Umhoefer, Carol Chen.

Curd Clinic

Curd Clinic doctors for this issue are Mike Molitor, pilot plant manager at CDR and Bob Bradley, emeritus professor, Dept. of Food Science

Q. We are interested in developing several new products but we need some help retooling our plant. Specifically, we are looking for an alternative to pasteurizing water that is added to pasteurized streams. Can you help?

A. Let me clarify this for readers who might not be familiar with the issue. According to the FDA, "there shall be no physical connection between unpasteurized products, dairy, nondairy, or water, and pasteurized milk or milk products." (See sidebar on page 11 for complete text.)

Why would this be a problem?

Plants that add milk solids to Grade A products, use burst rinsing of culture vats to reclaim product, wash cottage cheese curd and retool a plant to make greek style yogurt all have to pasteurize any water they add during processing. This isn't an ideal option because it takes time to pasteurize, you would need two tanks for storing pasteurized water and, in addition, water doesn't really store that well. In addition, most operators would rather reserve pasteurizers for product, rather than water.

The best solution is one that would generate the clean water you need precisely when you need it. Think of an on-demand hot water heater, equipment that is easy to start and stop while delivering the volume you need. Two different systems could do this for you: one uses ultraviolet light (UV) and the other involves filtration. CDR has helped several Wisconsin companies successfully install the filtration option.

To meet regulatory requirements, any plant using an alternative to pasteurizing added water will need to follow the steps outlined in the 2009 Grade A Pasteurized Milk Ordinance (see sidebar) to demonstrate that the system works as well as pasteurization.

Plant operators need to set up the equipment to have consistent and verifiable conditions with safeguards in place that ensure the equipment won't be misused or neglected after approval is granted. Since pasteurizers have several pieces of hardware and software monitoring efficacy you need to create a similar monitoring system for a filtration setup. Thus, you should create a quality control schedule that will verify that the filters are operating correctly. In addition, if the filter tests are done with specific flow rates and /or pressures then you should specifically state how you will monitor your system.

The best solution is one that would generate the clean water you need precisely when you need it.

After your filtration system is installed and operating with consistent microbiological results, i.e. equivalent to pasteurized water, then you need to conduct some tests to show the filter system is effective. Use a small strain of bacteria, like *Streptococcus thermophilus*, (size 0.5 to 2.0 µm), which is available from culture supply houses. Add a known concentration to a volume of water and then filter the water. Collect a sample of water when operating conditions are steady state and perform a Standard Plate Count on both the filtered water sample and a sample of pasteurized water. The results should be comparable and then you can use them to gain regulatory approval.

References

http://www.fda.gov/Food/FoodSafety/Product-SpecificInformation/MilkSafety/CodedMemoranda/MemorandaofInformation/ucm081208.htm

http://www.fda.gov/downloads/Food/FoodSafety/Product-SpecificInformation/MilkSafety/

For more information contact Mike Molitor at (608) 265-5919 or molitor@cdr.wisc.edu

From Grade "A" Pasteurized Milk Ordinance, 2009 Revision

U.S. Department of Health and Human Services Public Health Service Food and Drug Administration

Section 7 15p B.2
2. Except as permitted in Item 16p, there shall be no physical connection between unpasteurized products, dairy, non-dairy, or water, and pasteurized milk or milk products. Pasteurized non- dairy products not completely separated from pasteurized milk and milk products, shall be pasteurized in properly designed and operated equipment at times and temperatures which meet at least the minimum times and temperatures provided for in Definition FF. In the case of water shall:

a. Meet at least the minimum times and temperatures provided for in Definition FF in equipment that may not meet Item 16p; or

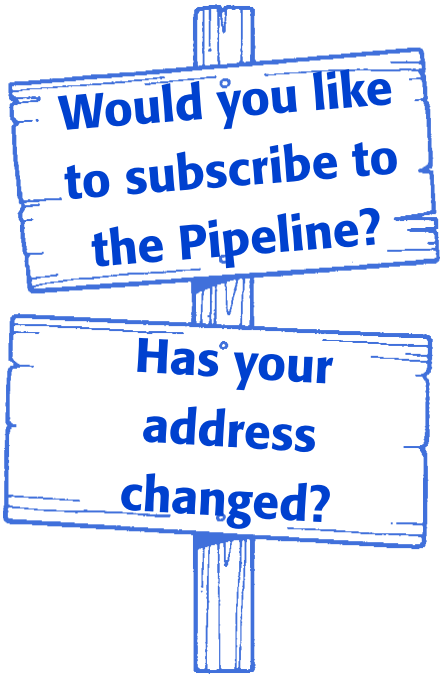
b. Meet the requirements found in Appendix H, Section IX; or

c. Have undergone an equivalent process found acceptable by FDA and the Regulatory Agency; or

d. Have undergone a hazard evaluation and safety assessment of the specific water supply and application involved and has undergone an additional treatment to destroy or remove 80 bacteria acceptable to the Regulatory Agency, in consultation with FDA, to ensure the water will not compromise the safety of the milk or milk product.

Supporting information shall be submitted to and approved by the Regulatory Agency. The supporting information may include, but is not limited to the following:

(1) Statement of proposal;
(2) Intended use;
(3) Review of equipment to be used in the process;
(4) Diagram of the process of interest;
(5) Documentation that the source water shall meet or exceed the EPA Safe Drinking Water Bacteriological Standards. Safety Assessment comparison of samples from the facility's water source, pasteurized water, and proposed equivalent water. Water samples shall be collected daily for two (2) weeks following approval of the initial installation and every six (6) months thereafter; and
(6) Protocol for the continued monitoring of criteria and procedures. Provided, that daily tests shall be conducted for one week following any repairs or alteration to the system.



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Calendar

2011

Nov. 15-16 Dairy & Food Plant Waste Water Short Course

Nov. 17 Carbon Accounting for Dairy & Food Manufacturing Short Course

Nov. 30 - Dec. 2 Ice Cream Makers Short Course

2012

Jan. 10-11 Milk Pasteurization

Jan. 13-16 Successful Ice Cream

Jan. 17-19 Batch Freezer Course

Feb. 7-8 Dairy Field Reps

Feb. 21-22 Process Cheese Course

Feb. 28–Mar. 1 Buttermakers Short Course

Register on-line at www.peopleware.net
For more info: www.cdr.wisc.edu/shortcourses
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