

DAIRY PIPELINE

Avoiding defects in process cheese

By Franco Milani, Ph.D., and John Lucey, Ph.D., Dept. of Food Science, UW-Madison

When consumers pay top dollar for a fine natural cheese they expect some variation and they know aging will change the cheese, enhancing its unique character. Process cheese is different. If natural cheese is a sheet of artisan glass chosen for uncommon patterns and interesting texture, then process cheese is a sheet of plate glass, predictable, uniform and defect free. Process cheese is purchased for performance.



Process cheese: purchased for performance

When you make process cheese, like most other dairy foods, you need to follow certain parameters to prevent defects. The focus of this discussion is on crystals and inclusions, rather than the subtle nature of the emulsion related defects in process cheese. We have noticed a distinct decrease in the incidence of this type of crystals and inclusions over the last decade, and we attribute it to the improved traceability of ingredients. It began as a customer requirement but now traceability is part of government bioterrorism regulation and the information is available to processors. The net result is crystal and inclusion defects are much less common. When they do occur, the root cause is known or the incidence is so low

that the cost of an investigation might not be justified. Still, understanding the causes of process cheese crystals and inclusions can be valuable when planning and assessing changes in formulation, production, and utilization.

We developed a table (See page 6-7) to help people sort out the causative threads of process cheese crystals and inclusions. Our table assumes a US style process cheese, a cheese processed with conventional cookers using minimal processing. New factors may be needed to trouble shoot crystals and inclusions in a heavily processed type product, for example a UHT European style process cheese.

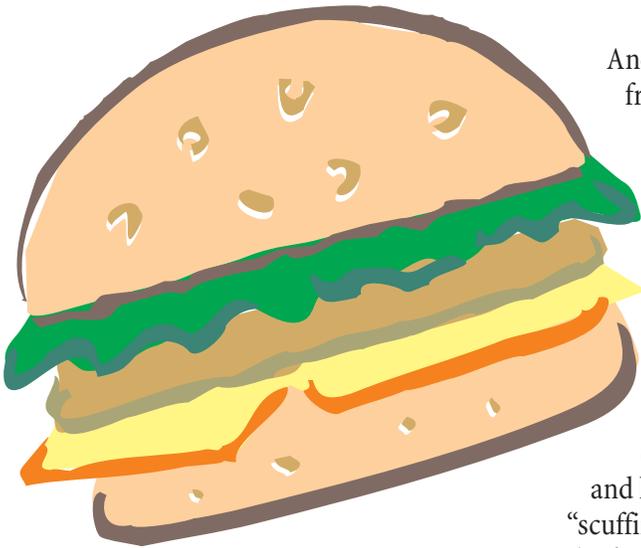
The most common inclusion seen in process cheese is evidence of undissolved emulsifier salts. This is always a risk when you are working with no-water-added formulas, and the obvious fix is to switch to a formula that calls for a solution of emulsifier salt rather than a powdered form. If you are still having problems, try using emulsifier salts that dissolve faster and make sure you mix well enough to disperse them. However, if using an emulsifier salt solution is not an option, then revise the formulation and add a small amount of water at the same time you add the emulsifier salt.

In contrast to the example above, tetrasodium pyrophosphate (TSPP) crystals form when TSPP is in contact with free water. This is an exothermic, or heat producing, reaction that can fuse TSPP and water. These small inclusions are

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Another avenue to inclusion defects in process cheese follows from added cheese, typically aged cheese. If you are using an aged cheese that already has some tyrosine crystals then the tyrosine will not dissolve upon cooking. Manage the inclusions by filtering or limiting or both.

When using emulsifier salts that bind calcium, the calcium salt is always formed. These low solubility crystals are so small that you can't see or taste them. If the conditions are right, there are times when they can grow large and may be present as a surface haze. We are unsure of the mechanism of calcium citrate haze, but pay attention to the way you package and handle your process cheese product. Surface deformation, or "scuffing", can encourage calcium citrate formation and are usually the first sign that something is wrong.

Continued from page 1

not visible during cooking but provide a seed for TSPP to grow into large crystals in or on the surface of the cheese within one to two months. To avoid this problem we recommend dry blending TSPP with sodium chloride, making sure it is finely dispersed, and not adding free water at the same time as the TSPP.

Some inclusion defects in process cheese are caused by incompatible concentration ratios of emulsifier salts, for example citrate versus a phosphate salt. The process cheese industry and supporting vendors commonly rely on an 85:15 rule of thumb ratio (Europeans talk about an 80:20 rule) when using blends of citrates and orthophosphates. If you exceed the rule, you may see inclusions of the lesser emulsifying salts in or on cheese within one to two months.

Improper handling of your product can cause condensation on the inside of a loose fitting package. Most at risk is process cheese that has a predominantly phosphate based emulsifier salt. Through the process of osmosis the moisture will draw the phosphate salts to the surface and cause phosphate haze or worse, plaques, if the condensation was excessive. You will see this happen with unwrapped cheese in a humid plant environment; the cheese literally appears to be sweating. It is very similar to times when you can see warm breath while sitting in a cold car. Cheese will "expire" moisture when the temperature is as little as 3° (F) different than the loose packaging, which will be the same temperature as the cooler.

The remaining crystal and inclusion defects listed in our table are rarely encountered. For example, calcium tartrate crystals are rarely seen because tartrates are not used very often. Heat induced precipitation of calcium phosphate is a rare cause of crystals or inclusions, mostly because you'll notice something else going wrong first-like your doughy, over emulsified cheese slowing the equipment.



We have attempted to list the most common causes of blatant crystals and inclusions in process cheese to help you prevent, and if necessary, solve problems in your plant. Consider attending our process cheese short course, held every February, for in depth discussion of these issues.



Skimming the Shelf—



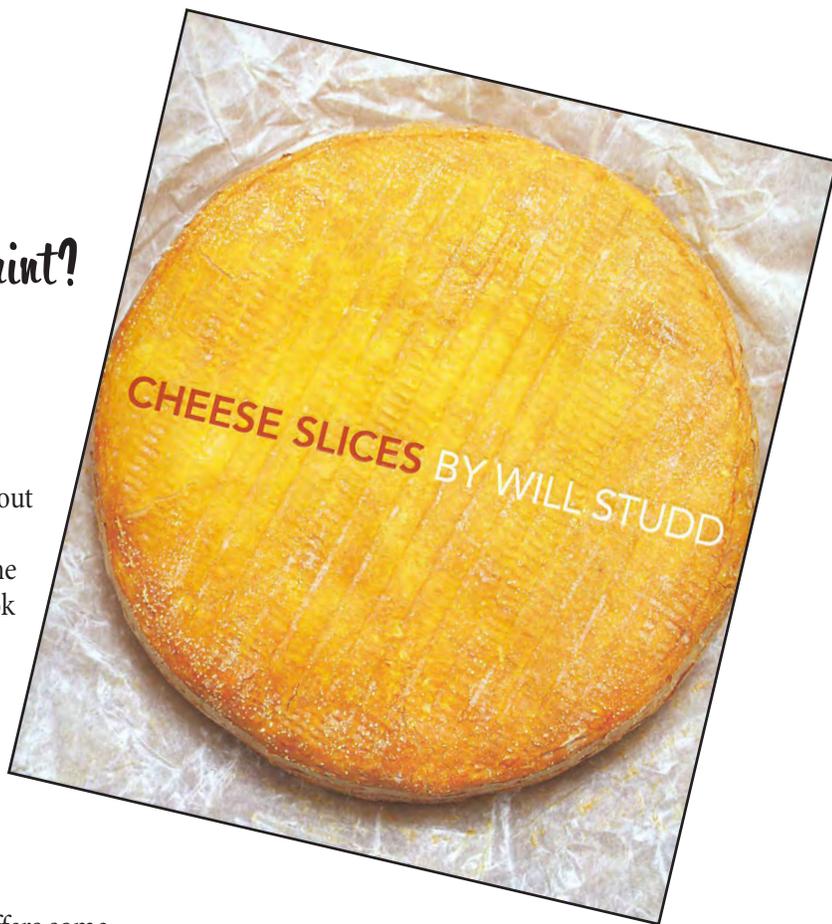
What's New in Print?

Cheese Slices by Will Studd **Hardie Grant Books 2007**

I believe I first heard about Will Studd's book about cheese several years ago at an American Cheese Society meeting when someone sitting next to me declared that Chalk and Cheese was the best book on cheese out there. Apparently others agreed, Chalk and Cheese was awarded Best Cheese Book in the World at the World Cookbook Fair Awards in 2000. The book is out of print and hard to find but you might get lucky while perusing the used book sales on the Internet.

Will Studd has produced a second book about cheese, Cheese Slices. While Chalk and Cheese offers some information about making cheese, types of cheese, buying cheese, and tasting cheese, the featured cheeses are all made in Australia, Studd's home since 1981. Cheese Slices, published in 2007, reflects the knowledge, research, and fun he had putting together an Australia television series of the same name. The series is described on his website as a "10-part global odyssey traveling to France, Italy, Portugal, England, Cyprus, Sardinia, Corsica, Japan, Quebec and the USA to explore a variety of authentic artisan cheeses."

I haven't seen the DVD's of the series but his book, Cheese Slices, does feel like a travelogue, it is full of beautiful photos and plentiful stories about Studd's search for the authentic classic cheeses in the countries mentioned above. He tells his readers about goats and sheep, maturing cheese, buying cheese and cooking with cheese. In Cheese Slices you will learn the difference between Parmagiano Reggiano and Grana Padano, as you read the chapter about hard cooked cheeses. Did you know that there are more than fifteen recognized breeds of buffalo? Two main breeds are used for producing milk, and Studd tells us "water buffalo are big, lumbering hairy beasts, slightly prehistoric in appearance, with inquisitive natures and long memories."



Will Studd is a great spokesperson for Australian cheeses and he clearly is passionate about European artisan cheeses. Perhaps that is enough for him. Although only one American cheese is mentioned, cheddar made by Jasper Hill Farms in Vermont, Studd does mention the increasing interest in artisan cheeses in the US and the growing network of farmers markets.

This book might make you happy if you have ever wanted to pack your bags and travel the world to try every cheese you can find. You won't taste all the cheeses that Will Studd managed to, but after sharing his stories, enthusiasm, and knowledge of cheese I think you might taste cheese in a different way. 

Resources

<http://cheeseslices.com/>

Editors note

I apologize for getting your hopes up if you can't find Cheese Slices. It was available through amazon.com but they seem to have run out. You can get it from Will Studd's website and I know that our local cheese store, Fromagination, has two copies. You could also put in a request for it at a book-selling site like alibris.com - that is how I found Chalk and Cheese..

Research Update

Recently, CDR has been the lucky, and grateful, beneficiary of an assortment of valuable equipment for the 1st floor dairy pilot plant and the basement dairy ingredients pilot plant. Thanks to Foremost Farms, Snyder Filtration, TC Jacoby, Krebs, and DR Tech. Pictured below are some of our latest acquisitions.

Vee-Mag

Essentially, this is the cheese version of a sausage extruder. Ever wanted to try adding fruit or nuts into your cheese? This is what you would use to do it. The equipment also produces shapes, forms, and even novelties like stars and moons.



Hydrocyclone

(pictured below)

Krebs (a F/L/Smith Co.) donated two types of hydrocyclones, which can be used for both cheese and whey ingredients projects. According to Krebs, two liquid-solid style hydrocyclones in sequence allow for the efficient removal of cheese fines from whey with no moving parts, no screens to replace and a hands off (CIP) cleaning system. The liquid/liquid cyclone has successfully removed fat from mozzarella brine, allowing the brine filtration to run more efficiently.





Vacuum/press

DR Tech donated this cheese vacuum/press, which allows us to produce different styles of cheese, like longhorns. Want to see how this press compares to what you are using? Call us to come in and try it.



Microfiltration

You may be surprised to know that CDR has a microfiltration skid containing 8” diameter (an industry favorite) and 10” vessels. This is a portable, self-contained unit that is compact and mobile but also holds lots of membrane area because microfiltration requires low operating pressure. Mike Molitor designed and supervised its construction from some obsolete equipment and generous donations from three companies. TC Jacoby paid for a large pump and a variable frequency drive (VFD) and Foremost Farms (a Wisconsin based cooperative) donated the 10” vessel and Snyder Filtration provided a free microfiltration element. This unit is a crucial part of CDR’s research on native whey proteins and the skid has been used to produce serum protein isolate for DMI projects and industry trials.

Process Cheese Crystal and Inclusion Defects (Milani & Lucey, 2009)

Cause	Action
High pH in process cheese promotes crystal development	<ul style="list-style-type: none"> • Reduce concentrations of DSP or TSP (at high pH phosphate crystals are more likely to form, lower the concentration of orthophosphate added) • Reduce citrate concentration • Reduce long chain polyphosphate concentration • Use natural cheese with lower pH value
Undissolved emulsifier during cooking	<ul style="list-style-type: none"> • Use solutions of emulsifier instead of dry salt • Provide sufficient mixing to disperse emulsifier • Use emulsifiers with more rapid hydration • Provide formulas with added water to dissolve the emulsifiers • Check emulsifier grind size for variation
Very high cooking temperatures (heat induced precipitation of calcium phosphate)	<ul style="list-style-type: none"> • Reduce cook temperature and time • Change type of emulsifier used
High orthophosphate levels causing crystals	<ul style="list-style-type: none"> • Do not exceed a ratio of 4.0 orthophosphate to water • Check ingredients for unaccounted sources of orthophosphate • Avoid long holding times during refrigerated (months) storage, which causes hydrolysis of polyphosphates • Avoid long holding times during heating (hours), which causes hydrolysis of polyphosphates, particularly at low pH • Avoid cheese with poor emulsifying properties (e.g., such as a combination of extreme parameters like cheese with low moisture, low fat, high pH, and high salt) • Avoid surface sweating on cheese from humid rooms when handling cooled finished blocks, if unavoidable, then lower orthophosphate level as much as possible • Switch from loose fitting packaging to tightly adherent packaging • Do not allow cheese with loose outer wrap to warm more than 3°F if it is will be placed into a cooler (allows condensation to form on the inside of the package) • Avoid low temperature storage, which causes low orthophosphate solubility
TSPP crystals	<ul style="list-style-type: none"> • When adding TSPP, make sure it is finely dispersed and do not allow the TSPP to contact free water (TSPP will “shell” when contact with water from exothermic heating causing fusion with TSPP and water). • Use low levels of TSPP

Calcium citrate crystals	<ul style="list-style-type: none"> • Avoid a situation where process cheese is produced with a low degree of protein hydration • Avoid cheese with poor emulsifying properties (e.g., such as a combination of extreme parameters like cheese with low moisture, low fat, high pH, and high salt) • Avoid using high levels of aged cheese which will require lower emulsifier levels to prevent over modification • Reduce citrate levels when the level of natural cheese-based casein is low and if formulated with a dried dairy ingredient that has high casein content and high casein-associated calcium content (such as milk protein concentrate or rennet casein) • Avoid excessive acidification when preparing the cheese blend or prior to cooking (it solubilizes calcium) • Decrease or remove sources of surface deformation or “scuffing” during processing and packaging
Exceeding the 85:15 ratio for blends of orthophosphates and citrates	<ul style="list-style-type: none"> • The process cheese industry in the US often uses an 85:15 rule of thumb when using blends of citrates and orthophosphate. This rule suggests that no more of 15% of the other type of emulsifying salt should be mixed in a blend. • During conventional processing using orthophosphate and citrate emulsifiers together, (moderate shear, not exceeding 95°C, and using total emulsifier concentrations between 2 to 3% solids) the citrate or the orthophosphate solids should not drop below 85% of the total emulsifier solids
Calcium tartrate crystals	<ul style="list-style-type: none"> • Avoid using tartrates such as sodium potassium tartrate (Rochelle Salt) as they are exhibit sandiness
Lactose crystallization	<ul style="list-style-type: none"> • Reduce lactose to water concentrations to below 16% • Prevent frozen water in the cheese, if unavoidable, then re-formulate the lactose to water percentages to below 10%
Tyrosine Crystals	<ul style="list-style-type: none"> • Avoid use of sandy cheese, (i.e., tyrosine crystals), since that could provide “seeding” for emulsifier crystals • Limit or remove cheese with excessive tyrosine crystals. • Filter hot cheese if unavoidable
Sorbic Acid	<ul style="list-style-type: none"> • Maximum permitted level in process cheese is 0.2%. If needed, use potassium sorbates as they have very high water solubility

© Wisconsin Center for Dairy Research
 DSP disodium phosphate
 TSP trisodium phosphate
 TSPSP tetrasodium pyrophosphate

2009 Master Cheesemaker

Family, farming and feta

Ken Heiman of Marshfield fits a lot into his day. He lives on a dairy farm, he makes cheese and somehow he managed to find the time to earn master certification in feta cheese.

Although Ken went to college and earned a degree in Architectural Engineering, he ended up following his father, Arnold, into the cheesemaking business at Nasonville Dairy, which was founded in 1886 and is the oldest cheese plant in Wood County. After starting out with simple cheddar, this plant now puts out over thirty different specialty cheeses, from chipotle cheddar, to queso fresco to feta. It is this opportunity to create new things and make new cheeses that keeps Ken satisfied in the cheese business.

Like other Wisconsin Master Cheesemakers, Ken's introduction to cheesemaking came early. Ken notes that his mother, Rena, was always very involved in the cheese plant, so all his brothers and sisters spent some time as babies safely gathered in the dry vats, "We were literally brought up in a cheese vat." One of his first jobs in the cheese plant was also the most fun—washing vats from the inside when he was around 5 years old. He remembers sliding around in the soapy water, being careful to avoid bumping his head on the agitator.

The family participation at Nasonville continues; employing three brothers, six sons, his mother and father, 4 nephews, 1 brother in law, and his daughter, who works weekends. And it turns out that the degree in Architectural Engineering is pretty handy after all, as the plant continues to expand and grow.

Ken Heiman enjoys farming and he enjoys making cheese, he is proud to produce a healthy product, one he can trace from the soil to high quality food that people enjoy. "We touch all the bases and we make sure we do a good job of it," he says. "The public has confidence in cheesemakers, and all segments of the dairy industry, and that is a responsibility that I take very seriously."

One of his first jobs in the cheese plant was also the most fun—washing vats from the inside when he was around 5 years old.



Ken Heiman at the vat

Ken Heiman will graduate April 23, 2009 at the Awards Banquet in LaCrosse, WI during the Wisconsin Cheese Industry Conference. Ken's father, Arnold Heiman, is his mentor.

Returning Masters

Several Masters have returned for certification in additional cheeses, including Gary Gossen of Babcock Hall, Sid Cook, Carr Valley, and Steve Tollers, Burnett Dairy.



News from CDR

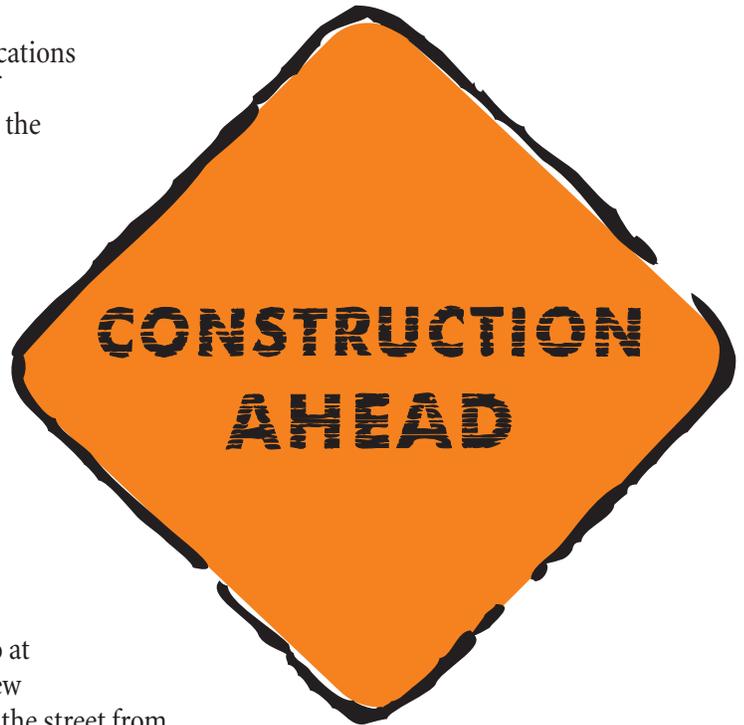
Don't forget about the Wisconsin Cheese Industry Conference set for April 22nd and April 23rd. If you are interested in sustainability, succession planning, cheese technology, or the latest on the benefits of whey proteins then you will find something of interest at this conference. For more information: www.wischeesemakersassn.org/

DMI online resource

The DMI National Dairy Research Centers and Applications Labs online resource is now live on the home page of www.innovatewithdairy.com (IWD). When you go to the IWD.com home page look for Product Research and Technologies in the gold box. Just click on the link "National Dairy Foods Research Center and Applications Labs." This online resource is designed to help guide industry partners to the facility and resources best suited to their needs in dairy research and innovation and CDR's resources are there in full.

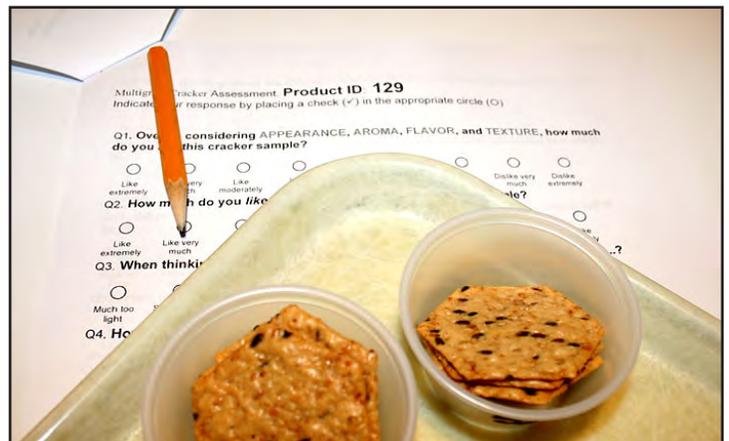
Construction

The long awaited Phase II renovation of Babcock Hall is set to start in May. Yes, this May! Our next short course, Cheese Utilization, which runs from May 3rd to the 7th will be in the usual room (205) but after that everything changes. From mid May 2009 to at least June of 2010 short courses will be held in the new Microbial Sciences building that is diagonally across the street from Babcock Hall. And that isn't all the construction going on around here. Union South will be torn down and rebuilt, the Discovery Institute is still going up on Randall St. and the old Biochemistry building is undergoing a facelift. University Avenue, from State St. to Lake, is often one lane and traffic backs up quickly. What I am trying to tell you is, make sure you leave yourself extra time when coming to campus because you will need it.



Sensory Analysis Laboratory

Since 1975, the UW Food Science Dept. has operated a Sensory Analysis Laboratory, providing sensory evaluation services to both industry and university researchers. The lab, located in Babcock Hall on the campus of the University of Wisconsin-Madison, draws on a diverse pool of panelists readily available for participation in sensory panels. In addition, proximity to the Food Science Department allows integration of sensory analysis data with the problem-solving facilities of a gas and high-performance liquid chromatography laboratory. For more information visit <http://foodsci.wisc.edu/services/sal/index.php> or contact Scott Rankin at sarankin@wisc.edu



Curd Clinic

Curd clinic doctors for this issue are Mark Johnson, John Jaeggi, and Bill Wendorff

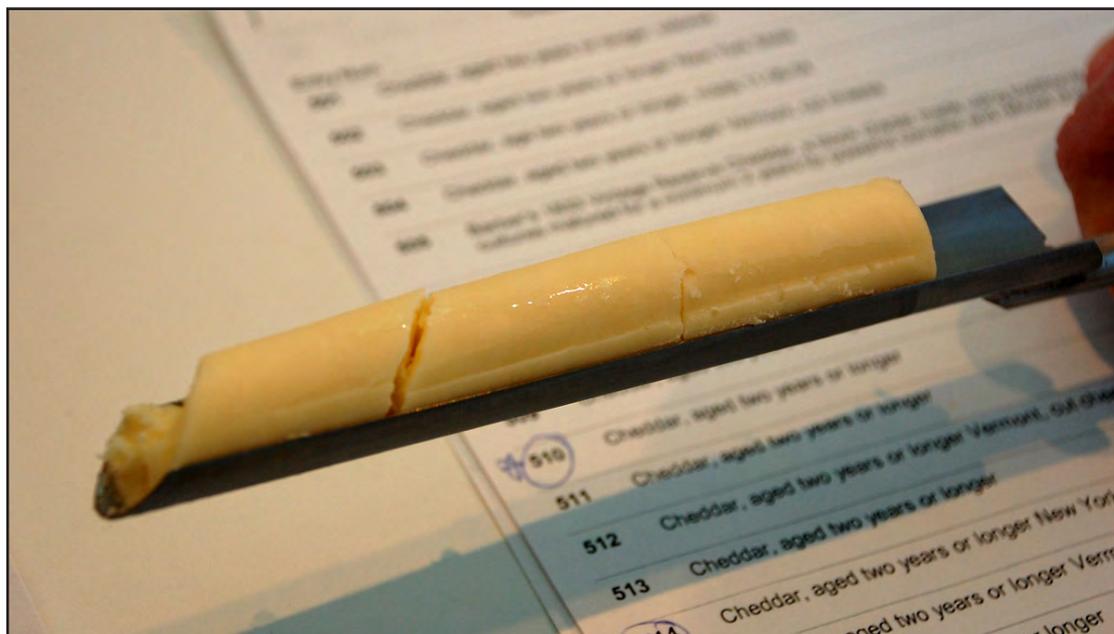


Above, Mark Johnson in action at a cheese contest. Cheese sample with scoring sheet, below.

Q. You were involved in the recent U.S. Championship Cheese Contest in Green Bay. Were there any interesting trends in cheese entries in this year's contest?

A. This year's contest had 1360 entries, which was a 17% increase in entries over the 2007 U.S. contest, the last national contest. (Every other year is a world contest.) Wisconsin Cheese Makers Association expanded the number of classes from 53 in the 2007 contest to 65 in the 2009 contest. The added classes helped balance out the increased entries in specialty cheeses over the past several years. There was a 31% increase in cheddar entries due in part to adding a bandaged cheddar class and expanding the aged cheddar classes. On the other hand, there was a 19% decrease in mozzarella entries and a 22% decrease in swiss and baby swiss entries.

The most significant increase in entries in the 2009 U.S. contest was a 33% increase in flavored cheeses. Over 25% of all the cheeses entered were cheeses with added flavorings or condiments and pepper-flavored cheese entries increased over 35% from the 2007 contest. Other flavorings added to cheeses ranged from the traditional herbs and spices to fruit, nuts and smoked meats. The variety of flavored cheeses represents the significant growth in artisanal and specialty cheeses in today's market. This represents a significant challenge for today's cheesemaker entering cheese competitions. Many of these flavored cheeses have been developed to address certain geographic or ethnic markets and often this dictates the character and intensity of the flavorings added to the cheese. The question that arises is, "Will the contest judges appreciate the flavor of the cheese and what the cheesemaker is trying to produce?"





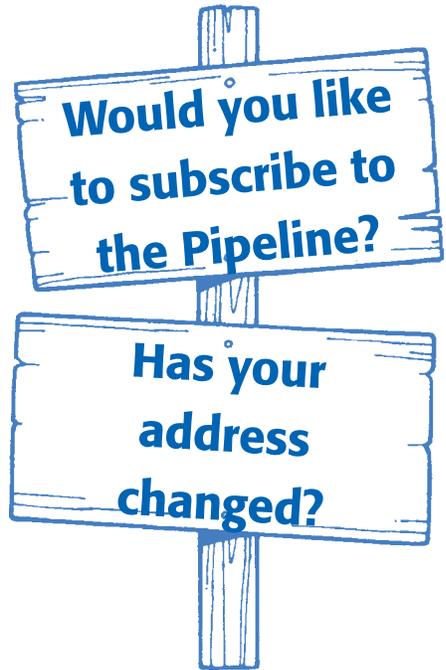
“The most significant increase in entries in the 2009 U.S. contest was a 33% increase in flavored cheeses.”

At the conclusion of this year’s U.S. Championship Cheese Contest, Chief Judge Robert Aschebrock indicated that several judges reported that flavorings in many cases were too intense in the flavored cheeses. He indicated that in a major cheese contest you expect to be able to taste the cheese, along with the flavoring and if you can’t taste the cheese, points will be deducted. A major criticism of flavored cheeses is the lack of cheese flavor (called flat) and excessive flavoring or condiment taste. The flavors aren’t necessarily bad, they are just overpowering.

The added flavoring should not mask the flavor of the cheese but rather, it should accentuate or compliment the cheese flavor. This is especially true with intense flavorings, e.g., peppers, garlic, horseradish or smoke. In some cases, cheesemakers may have to decide if they want to make a cheese with balanced flavors for the market year around or, if they make an intense flavored cheese for the market, they may want to make a batch of balanced flavored cheese for the contest.

Because of the growing interest in flavored cheeses, the Center for Dairy Research has decided to focus on flavored cheese in the next Master Cheesemaker Artisan Short Course in September. The Natural Flavorings for Natural Cheeses Short Course is scheduled for September 15-17 in Madison, WI. Information on the course is available at:

http://www.cdr.wisc.edu/courses/natural_flavorings_09.html



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Calendar

Apr. 22-23 Wisconsin Cheese Industry Conference, La Crosse, WI.
For information, call Judy Keller at (608) 828-4550.

May 3-7 Cheese Utilization Short Course, Madison, WI. Call
Dean Sommer at (608) 265-6469.

May 12 Wisconsin CIP Workshop, Madison, WI. Call Bill
Wendorff at (608) 263-2015.

May 13 Dairy HACCP Workshop, Madison, WI. Call Marianne
Smukowski at (608) 265-6346.

May 19-20 Applied Dairy Chemistry Short Course, Madison, WI.
Call Scott Rankin at (608) 263-2008.

June 2-3 Cheese Grading and Evaluation Short Course, Madison,
WI. Call Scott Rankin at (608) 263-2008.

Aug 4-5 Milk Pasteurization and Control School, Madison, WI.
Call Scott Rankin at (608) 263-2008.