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ENVIRONMENTAL CONDITIONS FOR AGING SURFACE-RIPENED CHEESES

One of the most important steps in producing a washed-rind or smear-ripened cheese, like Gruyère or Taleggio, is the curing or ripening process. Cheeses in these categories develop their characteristic flavors and textures from microbial growth on the surface of the cheese so it is crucial to dial in the correct environmental conditions that allow the bacteria, yeasts and molds to develop as desired. This article will give an overview of bacterial surface-ripened cheese, the ripening process and cover specifics such as aging room/cave setup, temperature and humidity parameters.

Before we begin, we should note that for the purpose of this article, the terms washed-rind and smear-ripened cheeses can be used interchangeably to describe cheeses in which microbial growth on the surface contributes to the characteristic flavors and textures. The term microbiol surface-ripened cheese is also used to describe theses cheeses, which we will use in this article.

What is a Microbiol Surface-Ripened Cheese?

In addition to developing unique flavors, aging cheese has historically provided practical benefits. Aging allows milk/cheese to be preserved and consumed weeks or even months later. Today, we create surface-ripened cheeses more to develop unique and complex aromatic flavors and other desirable characteristics like the appearance and textures of the cheese that consumers can enjoy.

David Niemiec, CDR

During aging, a number of enzymatic reactions occur that result in complex flavors. Microbial organisms (bacteria, yeasts, molds) breakdown proteins, fats and sugars in the cheese, which create aromatic compounds. These flavors gain intensity and complexity as the cheese ages. For some cheeses like Comté, as many as 400 aromatic compounds have been identified in the cheese. As cheese ripens, the body and texture of the cheese changes. The caseins in the cheese undergo proteolysis (breakdown) and the cheese body softens from the enzymes in the paste of the cheese from starter cultures /coagulants. The cheese also breaks down from the outside in from the surface microflora.

Finally, aging can impact the appearance of the cheese. For instance, the bacteria, yeast and molds used on the surface of the cheese can give the surface a certain color. Brevibacteria and other bacteria in associative growth with yeast results in an orange/red/brown color that we see on cheeses like Limburger or aged Brick.

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What's Inside:

Soft, Semi-Hard and Hard

There are many varieties of surface-ripened cheeses. One way to divided up these cheeses is by moisture content: soft, semi-soft and hard.

Soft surface-ripened cheeses have high moisture contents (~46-60%) and the fat in dry matter (FDM) content is ~50% or more. Soft bacterial surface-ripened cheese varieties include: Limburger, Liederkranz, Esrom, Rush Creek Reserve, and Winnimere.

Semi-soft microbiol surface-ripened cheeses have a moisture level of ~38-45% and an FDM content of ~50% or more. Semi-soft bacterial surface-ripened cheeses include: Brick, Fontina, Taleggio, and Raclette.

Hard surface-ripened cheeses have a moisture content of less than 38% and a minimum FDM content of 45%. Hard bacterial surface-ripened varieties include: Comté, Beaufort, Pleasant Ridge, Appenzeller, Cantal, and Gruyère.

Complex Cheese Microbiota

The cheese microbiota – the blend of bacteria, yeasts and molds on the surface of the cheese – gives these cheeses their distinctive characteristics. The cheese microbiota comes from the inoculated microorganisms added by the cheesemaker or affineur and the house microbiota from environmental sources such as air, wood boards, personnel, milk, and water. The cheese microbiota is started by the inoculated organisms we add but is often overtaken by the house microbiota. This leads to a unique and complex makeup of many different bacteria, yeasts and molds. For instance, a study of Limburger, Reblochon, Livarot, Tilsit and Gubbeen found 55 species of bacteria and 30 species of yeast present on the cheeses.

The smear or wash applied to these rinds by the affineur is water with diluted salt (~3-6%) and a blend of bacteria and typically yeast. The smear is rubbed, brushed or sprayed on the cheese surface at least once a day early in the initial affinage process. The smear can develop different pigmentations like red, orange or brown, depending on the colonies present on the cheese. Cheese surface microbial communities can contain yeast, mold, lactic acid bacteria (LAB), halophilic and alkaliphilic lactic acid bacteria (HALAB), Arthrobacter, Corynebacteria, Brevibcterium, Staphylococci, and Micrococci.

Ripening these Cheeses

As mentioned previously, creating and maintaining the correct environmental conditions during aging or ripening is important to promote the growth of the desired cheese microbiota to give the cheese the characteristic flavors and textures. As surface-ripened cheeses age, flavor compounds produced by the surface microbiota move from the outside of the cheese to the inside. Therefore, it's crucial to dial in and maintain the correct environmental parameters for the aging of these cheeses. Let's look at some of the environmental conditions/parameters that can help with a successful ripening process.

First of all, remember that the cheese is "made in the vat" meaning we need to have the cheese with the correct composition and microbiological makeup going into the aging room to achieve consistent, desired results. Also, keep in mind that as an affineur we control for temperature, humidity, air flow and air exchange all together as a system, not individually, as these all act on each other.

Different systems for air handling exist and each have their advantages and disadvantages including cost (initial and maintenance), ease of use, effectiveness of controlling parameters, and cleanability. A few options are static systems like a wall mounted glycol piping system, or ventilated systems like conventional walk in coolers with compressors and evaporative loops, or specialized forced air systems with textile ducts, and even modified conventional window air conditioners. As cheesemakers, most of us would probably like the state-of-the-art ventilated air conditioning systems, with conditioned fresh air and push button controls, but that is not always feasible. Therefore, as the affineur, it will take more work and attention to detail to successfully age cheese with the less than ideal air handling setup, but c'est la vie.

Ripening Room/Cave Construction

Weather your aging space is below ground, semi below ground like a natural type cellar or a room above ground, the construction or setup of the aging/curing room is crucial. For above ground spaces, proper insulation is key to moderating air conditions effectively and efficiently and to reduce condensation. Depending on the situation, walls, ceiling and floors would have around R25-35 value insulation. Additionally, the aging space itself would be a "box within a box" meaning the room would be within a larger climate-controlled space. The walls of the room should be seamless to allow for proper cleaning. Seams in the walls can make cleaning difficult and harbor unwanted bacteria/yeasts/molds that can negatively impact cheese during aging.

With natural or manmade caves, the traditional use of vaulted ceilings is not only visually appealing but also practical as it allows any condensation to flow down

the walls and not drip on the cheese and also helps air movement. Depending on the style of cheese, you will need more than one aging room because one room is needed for smearing and then the cheese is moved to a lower temperature, lower humidity, fewer air renewal room for further aging. Also, it is nice to be able to rotate rooms out of operation for cleaning. The size of the aging room based on production should also be a consideration. Too large of a room with too little cheese, makes maintaining parameters a challenge and too small of a room with too much cheese will be difficult to maintain air homogeneity.


Limburger cheese

Temperature

Maintaining the correct and consistent temperature throughout the entire aging room is essential for developing surface-ripened cheeses. For example, higher temperatures will speed up development of cheeses and amplify environmental parameters by increasing exchanges with the air like moisture loss of the cheese. Similarly, even slight changes of temperature between batches will affect cheese behavior by favoring certain microbes over others, altering the development and microbial makeup of the rind. Where to locate or measure temperature and humidity within the aging space is also important as often the room is not homogeneous. In general, soft-type cheeses need to age or cure at ~55-60°F and hard-type cheeses cure at ~40-55°F.

Hygrometry

In conjunction with temperature, the relative humidity must also be monitored and controlled. Temperature and relative humidity, along with air flow, will dictate the surface moisture loss and overall moisture loss of your cheese. This is crucial for proper rind formation, final moisture content, but also in promoting the desired microflora conditions on the cheese surface.

Most affineurs measure dry bulb and wet bulb temperatures and compute the humidity from these two measures. It is worth mentioning that some cheesemakers also take into consideration the dew point as this is a better measure of how much water is contained in the air at a given temperature and not just a relative percent that relative humidity provides. Dew point can be thought of as the water activity of the air surrounding your cheese, which will give you a better idea of the interaction taking place between the air and your cheese. Dew point can be measured with specifically designed instruments, but these are probably out of the budgets of most small producers, and also adds another piece of equipment to maintain and calibrate, which can be a challenge especially in these spaces given the harsh conditions of bacterial ripened aging rooms.

In the end, most affineurs measure temperature and relative humidity and try to maintain those targets the best they can given the air conditioning system they have and the seasonal changes that often have an effect on aging room conditions. Certainly, for example, having inadequate insulation and/or not being able to properly condition (temper) the outside air entering the room will make maintaining room parameters to a tight margin difficult. Also, no analytical tool will replace the innate sense affineurs gain with experience of being able to walk into a ripening room and assess the correct room conditions.

In general, cheese with a yeasty rind needs to cure in a room with a humidity of 85%+. A molded rind cheese should cure in a humidity of 90-95%. And an aggressive smeared-rind cheese should cure in a room with a humidity of 98%+.

Air Flow

Along with temperature and humidity, an affineur also will manage the air flow or movement of air within the aging space to use as a tool to manipulate the conditions on the cheese. Certain cheeses at certain stages of development will require different amounts of air movement or velocity across its surface (for example, if you want to surface dry a cheese before rind development or before packaging). Determining the ft/sec or m/s velocity (typical ranges can be from 0 ft/s to 1.3 ft/s) for your cheese is important, even if you are using a very low velocity static type system.

The goal is to have the same velocity air movement across each piece of cheese in the room; this will not happen if the air movement within the room is not homogeneous. Achieving this will involve diffusing the air within the room, most commonly with textile ducts, correct rack positioning in relation to air diffusion and the amount of cheese in the room. In practice, for example, the cheeses may need to be rotated from the bottom of the rack to the top as the cheese ages to mollify the small stratifications and heterogeneity of temperature, humidity and air flow that ultimately occur in these rooms.

Air Exchange/Renewal

The amount of fresh air or oxygen being introduced into the aging room and therefore the amount of ammonia and CO_2 being exhausted is an important consideration. This is especially true for surface-ripened cheeses because during ripening these cheeses release high levels of ammonia and carbon dioxide compared to other cheese types. In addition, the cheese microbiota requires an optimum oxygen level for growth. That is not to say you do not want any ammonia in the room either, for certain hard bacterial surface-ripened cheese some ammonia is essential as it helps ripen the cheese. Although not commonly measured, ammonia levels in these rooms is another factor that the affineur will be able to determine based on experience.


Brick cheese

Determining the number of air exchanges per day will be important, with that the "fresh air" being introduced to your room will also need to be filtered (reduce microbiological risks) and ideally tempered close to the ripening room temperature so you will not be fighting your own system by inputting too hot or cold air. Another consideration is the air that you are displacing needs to go somewhere (usually out the ripening room door) as not to cross contaminate other areas of the facility.

High ammonia levels (50 ppm) can be an irritant and may become an OSHA issue if levels get too high (although robots typically do not complain). Because ammonia is alkaline (basic pH), elevated ammonia levels can also deteriorate wall joints and equipment.
One practice still used today to reduce ammonia levels and also increase humidity in rooms is to pour water on the floors. Ammonia is heavier than air and will concentrate in the lower part of the room – ammonia dissolves in water and can be rinsed away. This is far from ideal as the floor should be dry at all times, but that is what some cheesemakers do given their restraints.

In Closing

This article addressed some of the environmental parameters that are key to successfully aging surface-ripened cheeses. Remember that setting up and running cheese ripening rooms is not easy – temperature, hygrometry, air flow and air exchange are the parameters affineurs can manipulate to create desired room conditions, but they work together not independently, which creates complexity. Ultimately, setting up ripening rooms can be very costly, and compromises must be made, which is where the real decision points come.

Not discussed in this article are food safety considerations when setting up and choosing which system is best for you. Cleanability of the air handling unit and room is essential as we all want to produce a safe product and try not be up at night worrying about food safety.

Ripening room considerations are one aspect of development. The other is that the cheese must have the correct composition (moisture and rate and extent of acid development) and microbiological makeup to ripen as desired. All too often, defects are created in the vat and incorrectly attributed to conditions in the ripening room.

Another important topic related to bacterial surface-ripened cheese is the use of wooden boards during aging. For more information on this topic, please see "Future Uses of Wooden Boards for Aging Cheese" in the Dairy Pipeline (Volume 25, #1). Past issues of the Dairy Pipeline can be viewed at www.cdr.wisc.edu/pipeline.

Technical contributor: Andy Johnson, CDR

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As part of CDR's new building project, it now has 10 cheese caves or ripening rooms that allow CDR staff to develop and research a variety of aged cheeses including washed rind and smear-ripened cheeses.
To learn more and view a video on the CDR specialty cheese caves, visit www.cdr.wisc.edu/building-project

CDR HELPS BRING AN ALPINE-STYLE CHEESE TO WISCONSIN

In 2015, Orphee Paillotin, owner of Alpinage Cheese, moved to Wisconsin from France and was surprised that he couldn't find some of the cheeses that he loved in his home country.

"I had a hard time finding Raclette cheese," he said. "So, we decided no one is doing this cheese here, let's focus on this."

Raclette is an Alpine-style, smear-ripened cheese, popular in Europe where it is used as a melting cheese, typically served over potatoes, cornichons, and cured meat.

By coincidence, Paillotin also met Paula Heimerl, whose family started and owned Saxon Creamery, which produces European-style, aged cheeses (Heimerl's family retired and sold Saxon Creamery in 2014). She missed working in the dairy industry and was eager to start a new venture into dairy.

"When I met Orphee, we were basically grooming him to be a cheesemaker," Heimerl says with a laugh. "I was working on him to do something with cheese because I wanted to do something with cheese."

Alpinage Cheese uses Wisconsin milk to produce cave-aged Raclette cheese.

Paillotin and Heimerl, co-founded Alpinage Cheese with the goal of making raw-milk, cave-aged Raclette cheese in Wisconsin.

"We're trying to make cheese that you buy from Europe," Paillotin said. "Why do you buy cheese from Europe when you have unlimited milk here in Wisconsin?"

However, starting a cheese company is very difficult. It was a challenge to get the various permits and licensing, find a space to make and age the cheese, and get the necessary funding and equipment to start the company. In addition, Paillotin was not a cheesemaker. So, he turned to the Center for Dairy Research (CDR) and attended the necessary classes and trainings to become a licensed Wisconsin cheesemaker. At CDR, he also worked with Andy Johnson, who helped him develop a cheesemake to produce the high quality Raclette cheese to the specifications and flavor profile that he had in mind.

"Orphee is really passionate about cheesemaking and he came at it from a new angle," Johnson said. "He didn't have any preconceived notions and he has an attitude that anything is possible."

Next was finding a place to make the cheese. Adding to the challenge was that Paillotin wanted to make a raw milk Raclette, "I wanted to use raw milk not just to differentiate myself but also to make cheese with unique flavor. Finding a place to make cheese is difficult and finding a place to make cheese with raw milk is even more difficult. We found a place that is up for the challenge."

CDR was able to help connect Paillotin and Heimerl with Pagel's Ponderosa Dairy, a family farm with a farmstead cheesemaking facility in Northeast Wisconsin. They work closely with Ben Shibler, who is the head cheesemaker and manager at Pagel's Ponderosa Dairy. Paillotin said that making the cheese there works very well. When they make their cheese, the milk is so fresh that it is still warm.

"We pour it in vat and start working on it right there," Paillotin said. "For freshness you cannot get better."

Alpinage Cheese ages its cheese in Oak Creek, Wisconsin, just south of Milwaukee. With some guidance from CDR and Paula's father, Gerald Heimerl, they built a licensed cheese cave within a business space. They fitted their cave with plastic paneling on the walls and ceiling so they can easily wash the room. For temperature control,

they installed a modified air conditioning unit fitted with a temperature microcontroller that keeps the cave at precisely 53-54°F. The fan on the air conditioning unit is turned off to avoid blowing air but the room has air flow to remove the ammonia that smear-ripened age cheese produces. They also add water to the room to keep the humidity at about 95%.

In addition, aging the cheese in Oak Creek makes sense as Paillotin and Heimerl live in Milwaukee and primarily sell and market the cheese in the Milwaukee area through retailers and some farmer's markets.

Finally, in September 2021, three years after the initial planning and creation of the company, Alpinage Cheese released and sold its first wedges of cheese. Feedback has been positive, "People were very surprised to find Raclette Cheese here made in the U.S."

Alpinage Cheese produces and sells their cheese as Mount Raclette®

They make and age the cheese using traditional methods. In addition to using raw milk, they age the cheese on wooden boards, which supports flavor development in the cheese and helps maintain humidity levels in the cave.

Aging the cheese is a very hands-on process. When the cheese first arrives in the cave, it sits briefly which allows it to dry a little since it has just come out of the brine bath. But then Heimerl, who, among other tasks, works as the company's affineur, begins the process of washing and flipping the cheeses. They are washed and flipped for about 2-3 weeks, then, once they have developed a natural rind, the cheese ages in the cave for about 3 months to develop flavor. With each batch of cheese, they continue to fine tune and tweak their recipe to dial in the proper flavor profile, composition and body.

Not only do Paillotin and Heimerl take great care in the cheesemaking and aging process, they have also built a brand and trademark to sell and market their cheese. Alpinage Cheese produces and sells their cheese as Mount Raclette®. Currently, they offer classic and mild options. The mild or summer Raclette has a sweet and fruity flavor profile and the classic has a deeper earthier flavor. Unlike the Raclette cheeses typically found in Europe the Mount Raclette® cheese is also a good table cheese.

In addition to helping Alpinage Cheese develop its cheeses, CDR has also helped Alpinage Cheese secure grants. Alpinage Cheese has received an equipment grant from TURBO, CDR's business development program, as well as two grants from the Dairy Business Innovation Alliance (DBIA), which is operated in partnership by CDR and the Wisconsin Cheese Makers Association.

Paillotin said the support they have received from TURBO and DBIA has been crucial to the company's development and growth. For instance, the grants have funded the purchase of specialized, microperforated cheese molds, which will allow Alpinage Cheese to triple their cheesemaking capacity.

Looking ahead, Paillotin and Heimerl are developing smaller format cheeses. One challenge is that they spend a lot of time cutting and packaging their Mount Raclette® cheeses. A smaller format would allow the cheese to be sold as is with minimal processing and handling. One cheese they want to develop is a mini Raclette. They are also looking at producing another smaller format cheese that will be a smeared cheese made with whole milk.

Overall, they are excited for what's ahead. "So far so good," Paillotin said. "We have good feedback with our cheese. I think it's going to work out. We really feel that there is something special here."

For more information about Alpinage Cheese, visit www.alpinagecheese.com

DAIRY INGREDIENTS TROUBLESHOOTING: SPORES IN MILK POWDERS

Technical Contributor: Nathan Price, CDR

This article is the second part of the dairy ingredients troubleshooting series and will address an issue related to the quality of milk powders.

Spore forming bacteria have become a concern within the dairy industry, especially during milk powder manufacture. In recent years, there has been an increased demand for low spore dairy powders (<50, <100, and <500 cfu/g).

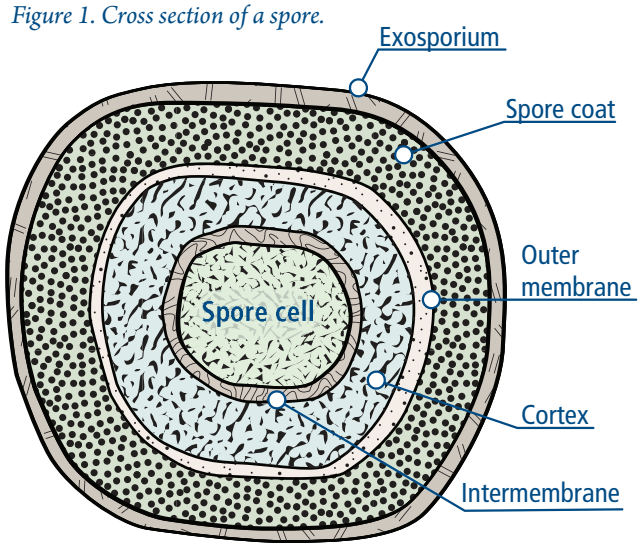
The United States Dairy Export Council has implemented limits for thermophilic and mesophilic spores in skimmed and whole milk powder destined for infant formula, and similar trends have been seen by the Food Safety Authority of Ireland and China (1). The presence of high numbers (>10,000 cfu/g) of spores in finished dairy products, like milk powders, is an indicator of poor hygiene during processing (2).

What is a Spore?

Certain bacteria can form spores as an ingenious survival tactic employed in times of stress. The spore ensures that the bacteria's genetic material will survive (3).

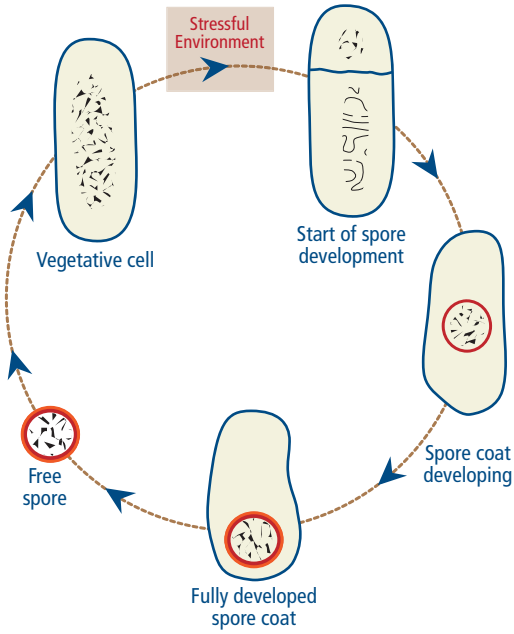
Spores can withstand arduous environmental conditions, including reduced nutrient availability, pH extremes, adverse temperatures, and reduced moisture content (4). The structure of the spore (Figure 1), which is essentially layers of protective material that encapsulate the vegetative cell, provides protection against these adverse conditions.

Figure 1. Cross section of a spore.



When the environment returns to favorable conditions, the endospores activate, germinate, and return to the vegetative state through outgrowth, which is then followed by reproduction (4); (Figure 2).

Figure 2. Life cycle of bacteria and spores.



Since spores are difficult to destroy and will grow once the conditions are favorable, they are a major problem for powdered dairy products, which are reconstituted in water before being used in food applications. This reconstitution will provide favorable conditions for the spore, which will then germinate into a vegetative cell and start to reproduce. Once this occurs there is a major concern for food spoilage.

Types of Spore Formers and Associated Risks

There are four main types of spore formers that are of concern in dairy products, which include mesophilic aerobic, mesophilic anaerobic, thermophilic aerobic, and thermophilic anaerobic (Table 1).

Anaerobic and aerobic refer to the organism's ability to grow in the presence or absence of oxygen. Aerobic bacteria require oxygen while oxygen is toxic for anaerobic spore formers. Thermophilic (113°F) and mesophilic (95°F) refer to the optimum growth temperature of the organisms and simultaneously indicates their ability to withstand temperature abuse.

Some bacterial spores can cause serious health hazards and their levels, and even presence, in dairy products are tightly regulated. Thermophilic spore formers are not reported to cause any harm in humans, in contrast to their mesophilic counterparts.

Table 1. Basic categories of sporeformers.

Type of Sporeformer	Example Organisims	Possibe Issues of Sporeformer
Mesophilic aerobic or Facultative anaerobic	Most important members belong to Bacillus family • *B. cereus* • *B. subtilus*	Present in food, water and soil. Spoilage in thermally processed, low acid foods.
Mesophilic anaerobic	All are members of the Clostridia family • *Clostridium tyrobutyricum* • *Clostridium botulinum* * • *Clostridium perfringens* *	Widely distributed in nature (soil, fish, vegetables, water, etc). Late gas in cheese. * Food spoilage * Food poisoning/death
Thermophilic aerobic	Members of the Bacillus family • *B. coagulans* • *B. stearothermophilus*	Cause spoilage of canned foods, especially those stored above 95°F (tropics).
Thermophilic anaerobic	*Clostridium thermosaccharolyticum*	Cause spoilage of canned foods for hot vending machines. Spoilage of canned foods in tropics.

Bacillus cereus is one of the mesophilic spore formers that can cause a foodborne illness (5); (Table 1). This bacterium is a major concern in infant formula applications as it can grow in the gut and produce a toxin that can result in infant death. Other strains can produce heat resistant toxins that can cause severe vomiting post ingestion.

Thermophiles, such as *A. flavithermus* and *Geobacillus* spp. are known to be a significant cause of quality and shelf-life issues in products manufactured using dairy powders as ingredients (6). These are potential spoilage organisms, as they are capable of producing enzymes and acids that may lead to off-flavors and spoilage in the final product (2).

How do Spore Formers get into Milk?

The quality of the raw milk used for the processing of dairy powder is an important starting point for controlling spore forming bacteria. The initial source of spores in dairy products is from raw milk through environmental contamination, such as bedding, feed, and dust which can be transferred to milk during the milking process on cow teats.

High quality raw milk will contain fewer spore forming bacteria and spores, which will provide less opportunities for them to colonize processing equipment.

Spore counts increase as the milk moves from raw product through finished powder. This increase in spore count may be attributed to at least 2 mechanisms: physical concentration of the product (liquid to powder) and the introduction of additional microorganisms not present in the raw material and acquired from the processing environment (7).

Spore forming bacteria can survive pasteurization and subsequently grow in the regeneration sections of heat exchangers. These sections provide adequate temperatures for mesophilic and thermophilic bacteria to grow and form biofilms (70-145°F).

A biofilm is a thin layer of microorganisms that form and coat a surface. Thermophilic bacilli have been found growing as biofilms on the surfaces of processing equipment or within milk foulant layers (2). Extensive growth may occur for a variety of reasons such as, production cycles are too long, the manufacturing equipment is not cleaned properly between production cycles, recycle loops are used or the use of ingredients that contain thermophiles (2).

As biofilm matures, it thickens, creating an anaerobic environment on the interior resulting in an increase in acid and insoluble gas accumulation that weakens the biofilm structure, causing sloughing of polymer layers from the supporting surface (8); (9). When the biofilm sloughs there is potential that the organisms present in the sloughing material can colonize downstream equipment in the processing lines.

Bacteria Removal Technologies

Spores and spore forming bacteria can be removed prior to milk powder processing with bactofugation or microfiltration.

Bactofugation is a centrifugal process and is the most common method to remove vegetative bacteria and spores. Spores and vegetative bacteria have a higher density than the components found in milk so they can be removed with centrifugal force. This process is highly recommended for powder manufacturers who intend to produce low spore powders.

Bactofugation can remove up to 99% of spores and approximately 60-75% of vegetative cells. This is a great starting point to limiting bacterial concentration in the starting milk and reducing the risk of growth in processing equipment.

Microfiltration is another means to remove spores and is a membrane fractionation technology. Higher removal of bacteria can be achieved but higher capital and operation costs are associated with microfiltration.

Protein Powders

There are a few important things to consider if protein concentrates are being produced. Spore and spore forming bacteria will not pass-through ultrafiltration (UF) membranes, both will be retained and concentrated in the protein concentrate.

If a milk or whey protein concentrates are being produced, raw milk quality and bacteria removal are an important aspect in the production of low spore powders. While the permeate stream from the UF process will not contain spores, as the pore sizes are too small to allow them to pass.

Conclusion

There are ample opportunities during the processing of milk into dairy powders for spore forming bacteria to colonize processing equipment and produce spores. The quality of the raw milk, sanitation of processing equipment, methods to remove spore forming bacteria, and shorter run times are critical aspect of troubleshooting low spore dairy powders production.

Even with this information a comprehensive spore monitoring program should be utilized to understand your processing flow and identify processing points where biofilms and spores may be growing. With this understanding effective and efficient troubleshooting can be conducted to aid in the production of low spore milk powders.

Having effect troubleshooting and monitoring spores throughout the process will provide a means to control the growth of these organisms in processing facilities. This information can help provide a strategy to reduce the spore counts in the finished dairy powder and prevent food spoilage and food safety concerns in the final powder application.

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NEW CDR EQUIPMENT AND CAPABILITIES

The Center for Dairy Research continues to get settled into its new three-story addition to Babcock Hall on the University of Wisconsin-Madison campus. The Center's staff are excited to continue to share some of the equipment and capabilities available in this new facility. CDR is rolling out a series of short videos highlighting some of the new equipment and capabilities.

To view these videos and more, visit www.cdr.wisc.edu/building-project.

APT Cheese Vats

CDR's new enclosed, horizontal APT cheese vats, located in the dairy plant on the first floor, are automated

cheese vats holding 2,500 lbs. of milk each and will be used for research, industry trials and short course trainings. These vats are common in the industry and with two vats side by side, CDR will be able to run multiple variables for research work and company trials.

APV Batch Evaporator

The APV Batch Evaporator, located on the second floor, is utilized to remove water and concentrate milk solids. The system operates under a vacuum, which lowers the boiling point of water. This is important because some of the proteins in milk, such as whey proteins, are heat sensitive. This piece of equipment is a batch evaporator, which means concentrated product recirculates back to balance tank before going through the evaporator again. The evaporator is pilot scale, which makes it perfect for testing multiple variables in a short amount of time to identify key parameters that can be utilized on industrial sized equipment.

DBIA AWARDS $1.7 MILLION IN DAIRY BUSINESS BUILDER GRANTS

The Dairy Business Innovation Alliance (DBIA), a partnership between the Wisconsin Cheese Makers Association (WCMA) and the Center for Dairy Research (CDR), announced the 38 companies and cooperatives that have been selected to receive Dairy Business Builder grants totaling $1.7 million.

The Dairy Business Builder grant program aims to encourage small- to medium-sized dairy farmers, entrepreneurs, and processors in the Upper Midwest to pursue innovative projects such as dairy farm diversification, on-farm processing, value-added product creation, and efforts to market dairy products for export. Reimbursement grants of up to $50,000 each are awarded following a competitive review process.

"A strong and successful dairy industry depends in part on a robust, diverse community of individual dairy businesses. These grants will support the continued growth of these enterprises and the overall health of our dairy industry," said WCMA Executive Director John Umhoefer.

"In these challenging times, these DBIA grants are even more important to creating a vibrant dairy industry as they support the growth of farmstead businesses and allow our small cheese and dairy plants to expand and diversify," said CDR Director John Lucey.

Companies and Cooperatives Receiving Dairy Business Builder Grants are:

Alpinage Cheese LLC, Oak Creek, Wisconsin | Grant helps fund the purchase of cheese molds and racks to triple production and expand distribution. The funding will also help develop production of an additional cheese variety.

Berrybrook Organics LLC, Marion, South Dakota | Purchase equipment to produce and expand an artisanal homemade ice cream brand.

CannonBelles Cheese, Cannon Falls, Minnesota | Purchase environmental testing equipment, a pneumatic cheese cutter, and double chamber vacuum sealer.

Cinnamon Ridge Inc., Donahue, Iowa | Support a cheese cave storage and aging project, which will allow for the production of more value-added cheese varieties and increase sales.

Concept Processing, Melrose, Minnesota | Support the launch of a major product line expansion; bottling Stony Creek Dairy milk into pint and quart containers.

Country View Dairy, Hawkeye, Iowa | Improve packaging equipment; for example, moving from a bag packaging system to traditional plastic jug containers to expand sales of fluid milk and frozen yogurt.

Crimson Kitchen and Gardens, Watertown, Wisconsin | Help revise packaging and labeling and expand sales from farmer's markets into retail, consignment and wholesale.

DARI LLC, Clinton, Wisconsin | Help fund a feasibility study for the building of an aseptic fluid milk processing plant in the upper Midwest.

Decatur Dairy, Brodhead, Wisconsin | Support expansion of the Decatur (Brodhead) cheese plant, which will result in increased production.

Deerland Dairy, Freeport, Illinois | Fund the purchase of a homogenizer, which will be used in the production of ice cream.

Driftless Gold, Highland, Wisconsin | Support the purchase of bottling equipment.

Farm Life Creamery LLC, Ethan, South Dakota | Help purchase equipment like a commercial vacuum chamber sealer and electric curd mill to improve efficiency to increase sales and production.

Fromage Spa, LLC, Green Bay, Wisconsin | Support the addition of a second production room/line for dairy product cleaning, relabeling, and repackaging services.

Frozen Innovations, LLC, Lake Forest, Illinois | Help purchase a cup filler for producing ice cream pods for an on-demand, at-home ice cream maker.

Hansen's Sugar Shack, LLC, Marshfield, Wisconsin | Help bring new, clean label dairy and maple syrup products to the marketplace.

Hightail, Plainfield, Iowa | Help acquire equipment to begin processing milk on-farm for production of farmstead specialty cheeses, custard and frozen yogurt.

Hill Valley Dairy LLC, East Troy, Wisconsin | Support Hill Valley Dairy LLC in making and marketing new products such as small-sized, soft-ripened cheeses.

Knowlton House Distillery, Junction City, Wisconsin | Support product research and development for the production of premium distilled spirits made from whey.

Landmark Creamery LLC, Belleville, Wisconsin | Support the purchase of a pasteurizer, which will allow for the production of new, fresh dairy products like butter and bottled milk.

Maple-Oak Farm, Florence, Wisconsin | Support plans to diversify Maple-Oak Farm's product line by producing and selling fluid goat milk and other dairy products.

Marieke Marketing, LLC/Holland's Family Cheese, LLC, Thorp, Wisconsin | Support sales and marketing consultants to help build a new sales base.

Metz's Hart-Land Creamery, Rushford, Minnesota | Support the purchase of equipment to create various lines of flavored shredded cheese, cubes, or flavored slices.

Milk Specialties Global, Eden Prairie, Minnesota | Support a research study investigating the possible benefits of whey protein phospholipid concentrate (WPPC) on stress, anxiety, and wellbeing for consumers.

Ms. J and Company, Monroe, Wisconsin | Support the purchase of two insulated, moveable freezers, which will allow for reduced transportation costs, larger orders, increased production, and an expanded market.

North Sky Farm, Harvard, Illinois | Support the purchase of creamery equipment designed for efficient production of artisanal cheese and the creation of labeling, packaging, and graphics.

Oxheart Farm, LLC, Hager City, Wisconsin | Help Oxheart Farm diversify as they launch a frozen dairy dessert enterprise.

Pine River Pre-Pack, Inc., Newton, Wisconsin | Grant money will be used to market Pine River products into markets that have been underdeveloped.

Prairie Homestead Creamery, Cottonwood, Minnesota | Support the expansion of goat milk gelato production and potentially help promote milking goats to other farmers and dairy processors.

Caves of Faribault/Prairie Farms Dairy, Inc., Faribault, Minnesota | Support the purchase of an additional cheese vat, allowing the Caves of Faribault to produce significantly more cheese.

Prairie Sky Ranch, Soldiers Grove, Wisconsin | Help improve efficiencies; allowing for the production of yak cheese domestically.

Radiance Dairy, Fairfield, Iowa | Support the purchase of equipment to stretch and form Mozzarella balls from curd, allowing Radiance Dairy to streamline the cheesemaking process and insure a consistent and quality product.

Renard's Cheese Store, LLC, Sturgeon Bay, Wisconsin | Grant money will be used for a labeling machine, which will help improve workflow.

Rolling Lawns Farm, Greenville, Illinois | Support the purchase of equipment to expand ice cream production into packaged containers to be sold in grocery stores and specialty retailers.

Silo View Creamery, LLC, Union Grove, Wisconsin | Support start-up equipment costs for Silo View Creamery to bottle A2 cream line milk from their Holstein and Jersey herd.

Specialty Cheese Co. Inc., Reeseville, Wisconsin | Grant funding will help production of artisanal cheese varieties by moving towards a semi-automated process.

Stensland Creamery, LLC, Larchwood, Iowa | Support the purchase of equipment to establish an ice cream sales outlet aimed at summer tourists.

Two Guernsey Girls Creamery LLC, Freedom, Wisconsin | Support additional cheesemaking training as well as equipment for the expansion of their milk bottling and cheesemaking business.

Widmer's Cheese Cellars, Inc., Theresa, Wisconsin | Grant funding will go towards new vats, which will increase production.

Dairy Business Builder Grant Program Reopens in Fall

The next round of the Dairy Business Builder grant program will begin in September 2022.

- Webinar hosted in September 2022
- Application materials available September 19, 2022
- Applications due November 10, 2022
- Applicants notified by December 15, 2022

Dairy Industry Impact Grant Competition Opens in July

The Dairy Industry Impact grant program is targeted to help dairy businesses develop an idea or tackle a challenge with the potential to advance the dairy industry as a whole. Reimbursable grants of up to $250,000 each will be awarded through a competitive review process. Grant recipients will be required to share results of their project.

Beginning July 11, applications will be available on the DBIA website – https://www.cdr.wisc.edu/dbia. Applicants must be located in Illinois, Iowa, Minnesota, South Dakota, or Wisconsin. Initial abstracts will be due August 31, 2022. Successful applicants will be invited to submit full proposals by November 3, 2022. Companies interested in applying in July should contact Vic Grassman at vgrassman@cdr.wisc.edu or Tom Guerin at tguerin@cdr.wisc.edu.

The DBIA is supported by the U.S. Department of Agriculture. Including the awards listed above, since its inception as part of the 2018 Farm Bill, the DBIA has administered approximately $3.6 million in grants to 79 dairy businesses in Illinois, Iowa, Minnesota, South Dakota, and Wisconsin. The program also offers technical assistance and education to dairy farmers and processors in the region.

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ADDRESS SERVICE REQUESTED

Congratulations Ben Oldenburg

CDR Research Cheesemaker Ben Oldenburg retired earlier this year. Ben worked for more than 25 years in dairy plants as a cheesemaker, supervisor and safety and loss control manager. Before CDR, Ben was a lead worker in the Babcock Hall Dairy Plant. At CDR, Ben helped pasteurize milk, assisted with industry trials and helped ensure that CDR's research cheesemaking runs smoothly. Congratulations Ben!

Upcoming CDR Trainings

The Center for Dairy Research is here to help with dairy processing training. Below is a listing of upcoming CDR short courses and other training opportunities.

- Cyber Security Webinar (online, live) – August 16
- HACCP Certification (in-person) – August 17-18
- Cheesemaking Fundamentals (in-person) – September 6-7
- Certificate in Dairy Processing (online, live) – September 8
- Dairy Ingredients Fundamentals (in-person) – September 13
- Advanced Preventive Controls (in-person) – September 15
- Master Cheesemakers Short Course (in-person) – September 20-22
- Food Fraud Workshop (in-person) – September 23
- Cheesemaking Fundamentals (self-study, online) – September 28
- Advanced Cheese Technology (in-person) – October 3-7
- Cheese Grading (in-person) – October 18-20
- Dairy Protein Beverage Applications (in-person) – October 25-26
- Cheesemaking Fundamentals (self-study, online) – November 9
- Dairy Ingredients Fundamentals (self-study, online) – November 16

For the latest information or to register visit www.cdr.wisc.edu/short-courses

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