

Questions related to Freezing/Super Chilling

1. Have you seen lactate crystals when freezing?

Yes, but only in gas flushed packages of aged Cheddar. We believe there was some temperature fluctuations in the freezing cycle that allowed for moisture (ice) accumulations at the cheese surface and drying in certain areas of the cheese. We have not seen calcium lactate crystals in vacuum sealed cheeses unless they are already there.

2. Are the effects of freezing minimized if the cheese is frozen in converted forms like shreds, slices, cubes?

The faster you freeze cheese the better and smaller pieces freeze faster. Previous studies indicated that shredded cheese melts less but stretches more after freezing. The concern with slices is they are likely to become brittle, due to more surface area and thus more moisture migration.

3. Was the Mozzarella super chilled immediately after it was made?

No, 2 weeks later. Same for the HPP treatment.

4. Is there any reason why you didn't hold it (Mozzarella) at like 25° or 28° vs 32°F?

We did not go too low for fear of freezing and ice crystal formation. Cycling of the coolers and temperature variability adds to this risk. The freezing temperature of the cheese will depend on the salt content, proteolysis, and dissolved solutes in the cheese.

5. Has CDR had any experience freezing shredded Mozzarella without IQF and the best time to freeze/utilize that product for best performance?

Yes, all of our experience is without IQF. In IQF Mozzarella additives such as sodium phosphates or citrates are often added to rapidly chelate the calcium and this allows for faster hydration of the casein. We normally have to age the Mozzarella for maybe a week to allow sufficient calcium loss from casein and hydration of the casein in non-IQF process. Loss of calcium and hydration allows for better stretch characteristics. This is vital for frozen pizza or entrée use where little time is given during baking to allow for the necessary reactions to occur. Without the hydration of the casein the moisture would be free to form large ice crystals and could damage the cheese and the cheese would not stretch and would burn when baked. Could the calcium and moisture equilibration occur after thawing and holding the cheese under refrigeration for a week? Yes.

6. We have found that natural cheese that has been frozen then eventually used for process cheese does not emulsify. It creates a pudding-like mass. Can you discuss any tips to make frozen cheese play nice in process cheese?

We never froze any of the recent Cheddar for processing projects. In general, frozen cheese should be allowed to thaw completely before processing. It's possible that extreme temperature differences between frozen cheese and other ingredients at refrigeration or room temperature would not be conducive to even heating and mixing in the process cheese. The superchilled cheese stored was always given at least a day in the 4°C cooler after shredding before making process cheese. All the refrigerated ingredients were given an hour or two to come up to room temp before processing.

7. Have we done any work with freezing Cream Fraiche? Sour Cream?

We do not think that freezing of Sour Cream is a good idea, it will likely destabilize the texture and result in a very poor texture after thawing, much like we saw with Mascarpone. Lots of different fat levels possible in Cream Fraiche but likely issues with this product too, we suggest caution.

8. Has work been done with super chilling flavored Cheddars? And mixed milk cheeses?

No, but superchilling would be much better than freezing and I would never freeze a cheese with added condiments. And mixed milk cheeses? Superchilling would be just as beneficial for any cheese made from any milk. Frozen goat curd works good for Chevre cheese. Sheep milk has been frozen regularly and used to make cheese.

9. Dean Sommer said there have been good results with superchilling shredded cheeses, but has the CDR had any experience freezing shredded Mozzarella without IQF and the best time to freeze/utilize that product for best performance?

See answer to question 5.

10. Are temperature recorders in different areas of the super cooler helpful to catch variability of temperature and cycling? Was humidity an issue?

The cheese was in a package so no issue about humidity in the product, not a factor in the cooler.

11. For Blue cheese, would you superchill after the mold development or is it ok to start at day 1 of storage?

I would superchill after mold development. Superchilling does not prevent the open texture from slightly collapsing over prolonged storage. While molds are acid tolerant, I am not sure what prolonged exposure could do to their activity. I presume it would be less after superchilling.

12. Have you looked at pallet quantities of cheese as it relates to freezing and thawing? Was your work done on block quantities or pallet quantities for freezing and thawing?

The CDR worked with 40lb blocks. Pallets can be done but depends on airflow. Need to have air circulation. It is hard to control at exact temperature in a cooler, don't want to risk freezing. That is why I would not recommend supercooling to less than 27°F as you could get freezing for some cheese types.

Questions related to High Pressure Processing (HPP)

1. Can you do HPP and superchill?

Yes, you can.

2. What happens to the water during HPP and how is that handled?

You are not squeezing water out of the cheese. The water in the cheese doesn't get released. If it did, it will get re-absorbed during cooling. No free water gets squeezed out of the cheese. The cheese is packaged so it is protected from the water medium. After HPP, more water binding takes place especially in young cheeses due to calcium shift. After HPP we don't see free, expressible water.

The water in the HPP chamber itself is re-used again. It is only a media where the HPP treatment is taking place. The water itself is HPP treated too.

3. What will be the impact on freezing after 30-40 days of shred? Food safety concerns? Functionality concerns? Physical characteristics concerns during thaw like balling up?

For 30-40 day shreds, the surface area is too large; maybe drying will take place. Will need anti-caking agents, use the minimum. Anytime you use anticaking, there will be functionality issue because of anticaking agent.

No food safety concerns. May need to use IQF – fast freezing.

Cheddar shreds – Freezing could cause calcium lactate crystals if old cheese. concerned with moisture migrations during freezing and thawing in the package. Functionality issues. Risk of balling up.

4. What was the age of the cheese when pressure treated?

Age of cheese – 4 days for Cheddar. Age of cheese needs to be selected for the purpose of the cheese. If you need intact casein, then do Cheddar cheese early. If you want some ripening or flavor development to occur, then you wait. Also have used HPP at lower pressures, that accelerated ripening. If trying to accelerate ripening do it early. We have done Mozzarella at 2 weeks.

LMPS Mozzarella (Reduced salt) – HPP 2 weeks

Block Gouda, both stirred-curd and milled-curd (Reduced salt) – HPP 1 month

Cream cheese – HPP 1 week

Mascarpone – HPP 1 week

Cheddar for processing – HPP at 4 days

Low-Fat Cheddar – HPP at 1 week (50-400 MPa)

Low-Na Cheddar cheese, UF Retentate – HPP at 1 day (500 MPa)

Regular, reduced and low-Na Cheddar – HPP at 1 week (405 MPa)

5. Is there any difference in oiling off of super chilled, HPP, or a combination of the two when it was used on pizza?

There were no differences in oiling off between superchilled, HPP, combo when the cheeses were baked on pizzas.

6. So would applying HPP to our cheese decrease the need of anti-caking when it's shredded?

No. 12 month cheese was soft. We need anti-caking agents.

7. What mechanisms are at work improving shelf life of Mozzarella during HPP? Is it just enzyme and micro reduction?

Yes, you need to use at least 600 MPa to inactivate rennet (much but not all of its activity). HPP doesn't kill all bacteria at that pressure (600 MPa) and depends on the cheese itself (moisture, salt, pH, etc). Different bacteria are killed at different pressure levels. Solubilization of calcium occurs immediately during HPP treatment.

Question related to High Temperature Processing**1. For the high heat milk treatment extension method for CCFM, what is the impact on yield?**

We didn't do any yield measurements. In general, there could be an increase in yield due to incorporation of some extra denatured whey proteins as well as a possible increase in moisture content.

Increasing the HTST temperature is a great point. High fat and high protein. You do not want to denature too much protein, but from a past involvement in fluid milk 7 days extra could be achieved on shelf life with increasing the HTST temperature from 165 to 175°F.

CDR has seen an extension in shelf life with an increase in the HTST temperature.

2. With waterless cooker, what was the impact on fat loss at 190°F? Hoping it is much less if we are using waterless cooker.

We found there was 3-4% more fat losses compared to 140°F. Fat may possibly be re-incorporated back with the proper strategy or processing approach.

Other Questions**1. What is the best way to add the salt on cheese? Add it all at once or divide it into 2 or 3 stages?**

3 applications – 5-10 mins apart. For Parmesan, you need slower rate.

2. For Cheddar and MJ type of cheese what would be the shelf life increase if we go from 40 to 32°F?

Additional 6 months could be possible.

3. Are there ingredients to prevent large ice crystal formation in frozen cheese?

No, not likely possible to add gums/stabilizers due to cheese standards (they are common in ice cream for this purpose). Suggest rapid freezing to a low temperature and limit freeze/thaw cycling.