DUPONT™ INSIGHTS FOR CULTURED DAIRY

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Welcome to the nineteenth edition of our Insights for Cultured Dairy newsletter! The purpose of this newsletter is to share information within the dairy industry about stabilizers, cultures, antimicrobials, probiotics, fiber addition, processing, and specific ingredients used in cultured product and cheese applications. We will always add a recipe utilizing cottage cheese and discuss troubleshooting issues from the field! We hope you enjoy it and look forward to your feedback! If you would like to see specific subjects covered in this publication or if you want added to the electronic mailing list, please contact the editor, Doug Vargo, at doug.vargo@dupont.com.

From the Field
by Doug Vargo

Fat is Back! Face It: Most of the Flavor in Dairy Products is Found in the Fat

I admit it, I have a love affair with dairy fat. I love butter. I love higher fat premium ice creams and I love higher fat premium yogurts. I like higher fat cheeses too. So, I ask you, “What is wrong with that?” In my opinion, Fat = Flavor! The key is moderation.

People can consume higher fat products, they just don’t need to consume them in such high quantities. Would you rather have a smaller portion of a good tasting product, or a bigger portion of a so-so tasting dairy product? I choose the former, please. I love that diacetyl flavor that comes from butter or from some flavor producing dairy cultures. I used to have a saying when nonfat products first came on the market: No Fat = No Good! Please don’t take exception to my statements. These are my personal opinions. The pork industry likes to say, “Things go better with bacon”. I have a dairy saying that goes, “Things go better with butter”, or in this case…with butter fat!

In other countries, sour cream really means, “sour heavy cream”- such as in a 40% fat level heavy cream. In Australia, for example, their fat level in sour cream is 36-40% fat. Ours in the United States is 18% fat. The Australians would consider our regular sour cream “light” given that it contains only half the fat of their regular fat product. As more international products are introduced to the US, we need to be receptive to these types of products.

For example, take the Greek yogurt craze. Ten years ago, nobody knew about Greek yogurt. But it turned out it was a better product than traditional yogurt and has taken the nation by storm. Another product that comes to mind is Wallaby sour cream. According to the nutritional statement and the number of grams of fat per serving, it's a sour cream with 33% fat. Who doesn't like a sour cream with more fat in it? If you are not watching your calories, why not opt for the creamier and better tasting product?

Making it Work

Throughout my dairy career, I have learned from a few ideas that I first thought wouldn't work, but in fact worked just fine. That brings to mind an instance of a dairy farmer in Pennsylvania who had a herd of Brown Swiss cows he was milking. He asked me to show him how to make yogurt from his milk. His goal was to make value-added products out of his higher fat raw milk rather than just bottling and selling milk. The fat level from the milk expressed from his Brown Swiss cows was in the range of a 3.8 – 4.0% butterfat. He took this whole milk, vat pasteurized it and made whole milk yogurt for his small retail store on the farm. His neighbors just loved it. Why not? It was a whole milk yogurt and a higher fat one too - about 4% butterfat! It was creamy and had a great flavor.

After that experience, he wanted to try making sour cream. This is where it gets interesting. He would take 19-20% fat cream that was given to him by a local dairy, add stabilizer, vat pasteurize it, culture it, and wait for the pH to come down to <4.60 and make sour cream. He did not have a homogenizer and had no plans on homogenizing the stabilized 19% fat mixture. I told him he would probably get a cream layer on his sour cream given that un-homogenized dairy fat will rise to the top because the specific gravity of cream is less than the specific gravity of milk or skim milk. All he could do was try it and see how it came out. To my surprise, he *did not* get a cream layer, and he had fantastic tasting sour cream. It had better flavor than many of the sour creams I have tasted. The un-homogenized butterfat actually had a better diacetyl flavor - probably due to a much larger fat globule size that was easier to detect and more pleasing on the palate. The explanation of no evident cream layer on top was related to the stabilizer, which consisted of a blend of starch and gelatin. Vat pasteurizing created a much higher viscosity than is evident in a straight fluid product. The sour cream culture incubation took about 16-18 hours. The unhomogenized fat globules could not rise through the thicker sour cream mixture because it was sitting quiescently before the coagulum was set up by lactic acid coagulation. The casein proteins create a gel network as they approach the isoelectric point of the casein which is about a pH of 4.65. Thus, no cream layer was ever produced.

The dairy farmer started selling his sour cream to chefs in restaurants because they loved his sour cream's flavor. They felt it was better tasting than any other sour cream they could purchase through retail channels. This was a pleasant surprise and a learning experience. Just when you think you have seen everything in the dairy industry and you predict that something won't work, it works just fine and has becomes a successful product.

Dairy Chemistry – Part IV of IV: Water Properties

By Jon Hopkinson, PhD.

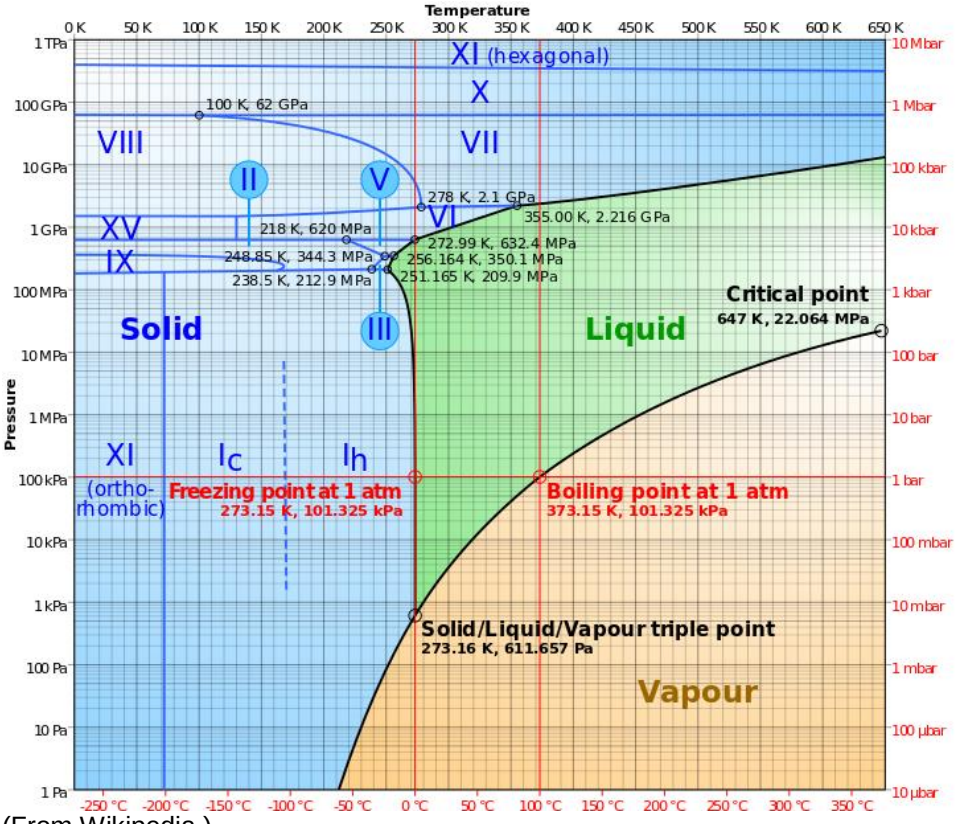
Water is the biggest constituent of almost all dairy products (the exceptions are some cheeses, butter and spray dried products such as dry whey and non-fat dry milk). Milk, in fact, is comprised of 87% water. In general, we ignore water when we think of dairy products, but some of its properties and interactions are very important to how dairy products function. Below is a table listing some of the properties of water.

Some of water's physical properties	
Weight:	62.416 pounds/cubic foot at 32°F (0°C); 1,000 kilograms/cubic meter
	61.998 pounds/cubic foot at 100°F (37°C); 993 kilograms/cubic meter
	8.33 pounds/gallon; 1 kilogram/liter
Density - water:	1 gram/cubic centimeter (cc) at 39.2°F (4°C), 0.95865 gram/cc at 212°F(100°C)
Density - ice:	0.9167 g/cm^3 at 0° C
Some water volume comparisons:	1 gallon = 4 quarts = 8 pints = 128 fluid ounces = 3.7854 liters
	1 liter = 0.2642 gallons = 1.0568 quart
	1 million gallons = 3.069 acre-feet = 133,685.64 cubic feet
Flow rates:	1 cubic foot/second (cf/s) = 449 gallons/minute = 0.646 million gallons/day = 1.98 acre-feet/day
Freezing point:	32° Fahrenheit (0°C) at sea level
Boiling point:	212° Fahrenheit (100°C) at sea level (186.4°F (86°C) at 14000 feet (4267meter)
pH	7 Neutral neither basic (>7 nor acidic <7)
Conductivity	Not conductive (1.2 × 10−4 Siemens per meter, unless something is dissolved in it)
Speed of sound	3313 miles/ hour (1481 m/s) in water at 68°F (20 °C) (in air 343 m/s dry air at 20°C (68°F)
Heat capacity water	4.184 J/g°C (Joules of heat for the temperature of one gram of water to increase 1 C)
Heat capacity ice	For ice 2.108 J/g°C
Heat capacity steam	For Steam 1.996 J/g°C
Latent heat of melting	334 J/g (1 J = 0.239 Calories) The amount of heat necessary to melt 1 gram of ice.
Latent heat of evaporation	2257 J/g the amount of heat energy needed to evaporate 1 gram of water.

Some of the more interesting properties of water are as follows:

- Water is unique in that it is the only natural substance that is found in all three physical states—liquid, solid, and gas—at the temperatures normally found on Earth. Earth truly is a water world.
- Water is unusual in that the solid form, ice, is less dense than the liquid form, which is why ice floats.

- Water is called the "universal solvent" because it dissolves more substances than any other liquid. This means that wherever water goes, either through the ground or through our bodies, it takes along valuable chemicals, minerals, and nutrients.
- The water molecule is highly cohesive—it is very sticky. Water is the most cohesive among the non-metallic liquids.
- Water has a high specific heat index—it absorbs a lot of heat before it begins to get hot. This is why water is valuable to many industries and in your car's radiator as a coolant. The high specific heat index of water also helps regulate the rate at which air changes temperature, which is why the temperature change between seasons is gradual rather than sudden, especially near the oceans.
- Water has a very high surface tension. In other words, water is sticky and elastic, and tends to clump together in drops rather than spread out in a thin film, like rubbing alcohol. Surface tension is responsible for capillary action, which allows water (and its dissolved substances) to move through the roots of plants and through the tiny blood vessels in our bodies.
- Water ice can exhibit up to sixteen different phases (packing geometries) depending on temperature and pressure. Though the clear majority is the one phase (ice 1h) we are familiar with. Below is a phase diagram:



(From Wikipedia.)

- It is possible to make a glass (non-crystalline solid) form of water, but this takes extremely fast cooling and ultra-cold environments (below -215°F or −137 °C that is the glass transition temperature for pure water). Some say that most of the water in the universe is glass state water.
- Water like many substances can be supercooled. Water normally freezes at 273.15 K (0 °C or 32 °F), but it can be "supercooled" at standard pressure down to its crystal homogeneous nucleation point (where water spontaneously crystalizes) at almost 224.8 K (−48.3 °C/−55 °F). The process of supercooling requires that water be pure and free of nucleation sites. It is this phenomenon that enables many animals and plants to withstand very cold temperatures without damage from ice crystals forming within their tissues.
- Likewise, water can superheat. This is the phenomenon where a liquid is heated to a temperature higher than its boiling point, without boiling. Superheating is achieved by heating a homogeneous substance in a clean container, free of nucleation sites, while taking care not to disturb the liquid. We often see this when we heat water in the microwave. Sometimes the very hot water suddenly explodes out of its container on disturbing the water or adding a small number of particles.

  I hope this quick review of water and its properties can be beneficial when we think about dairy products as well.

Cottage Cheese – The Forgotten High Protein Food?

by Doug Vargo

This is a delicious dish and another great recipe using cottage cheese as one of the ingredients. With Fall approaching and people having the desire to fire up the oven more, give this one a try. If you love meat pies or want something different for dinner, then this dish is for you! Enjoy!

Beef Cottage Cheese Pie

- One 9” unbaked pie crust
- 1 onion chopped
- 2 cloves garlic, minced or use jar minced garlic (2 tbsp.)
- 1 pound of lean ground beef
- 2 eggs -beaten
- 1/3 cup ketchup
- 3 tbsp. mustard
- 2 tbsp. flour
- ½ teaspoon dried marjoram leaves
- ½ tsp. salt and ¼ tsp. pepper (or to taste)
- 1 cup small curd cottage cheese
- 2 tbsp. grated Parmesan cheese (or use the shaker cheese)

Bake Time: 35 minutes

Prep Time: 20 minutes

Yield: 4-6 servings

Directions: Preheat oven to 350F. Line a pie pan with the pie crust and flute the edges.

Cook the onion, garlic, and ground beef in a skillet over med. Heat until ground beef is cooked. Stir and pour off any grease.

Add the ketchup, mustard, flour, marjoram leaves, salt and pepper to the mixture in the skillet and cook for an additional 3 minutes while stirring. Remove from heat and let cool for 10 minutes. Add mixture to pie crust and even the surface.

In a small bowl, beat the eggs, Parmesan and the cottage cheese. Mix thoroughly. Pour this mixture over the meat in the pie pan.

Bake in a 350F degree oven for 35- 40 minutes until the filling is set, and the crust edges are golden brown. Cool for 5 minutes. Cut into wedges to serve.

And a Word on Behalf of our Friends from Penn State! Be Sure to Sign Up and Attend the Penn State Cultured Products Short Course

It's that time of year again! With Summer almost over and football season approaching and thoughts of Fall on the horizon, don't forget to register for the Penn State Cultured Products Short Course! Every third week in September for the past 17 years DuPont and Penn State have been collaborating to offer our colleagues in the dairy industry practical training in the cultured products field in a short course called the "Penn State Cultured Products Short Course". This fall is the 18th consecutive offering of this highly recognized and well respected dairy industry specific short course.

This course provides participants with an overview of basic dairy technology including milk composition, microbiology, protein chemistry, and the sensory evaluation of cultured dairy products. The course also covers the manufacture of the following cultured dairy products: buttermilk, sour cream, cottage cheese, yogurt, Greek yogurt, yogurt drinks and cream cheese. Other lectures from industry speakers address probiotics, novel dairy products, metabolic and technological aspects of starter cultures, and flavoring systems for cultured dairy products. The course emphasizes interactive learning through the integration of classroom discussions, demonstrations, and hands-on laboratories.

If your company is involved in making these products from the farmstead to an industrial scale, or if you just have an interest in learning more about these products, this course covers it all. The curriculum is an excellent training tool for all involved in the cultured products industry from plant supervisors, QC mangers, plant managers, sales personnel, and your local entrepreneur. Be sure and sign up soon. The course this year is offered from September -19th through the 21st in the Erickson Food Science Building on the campus of the Pennsylvania State University located in State College, Pa. Class size is limited to the first 50 registrants. The website link for registration and more information is: http://agsci.psu.edu/cultured.You can contact the course director, Kerry Kaylegian at kek14@psu.edu with any questions. We look forward to seeing you there!

Discussion Threads – Questions from the Field

by Doug Vargo

Question: You see and judge dairy products all the time. What are your favorite kinds of yogurt?

Answer: First of all, the opinions in this article represent my personal preferences. DuPont does not endorse any brand of dairy product and neither do I. With that said and in keeping with the theme of "fat is back" in our leading article, I can tell you that I like the higher fat yogurts. The same holds true for ice cream. There is nothing wrong with a 10% fat ice cream, but for my taste I prefer a 14 – 16% fat premium ice cream. I also like one with a lower overrun (less air pumped into it). Why do I mention this and what has this got to do with yogurt? Well, you guessed it. The higher the fat in the yogurt, the better

I like it. I just plain like the taste of dairy fat. There are several brands out on the market that have a 6-7% fat level. I also like Greek yogurt because it is heavier and has a more pudding-like creamier texture or heavier mouthfeel.

Here are a few of my personal favorite brands: Noosa, Greek Gods and Liberte yogurts. All of them are higher in fat. I also like Fage yogurt and Wallaby yogurt. These products differ quite a bit from the yogurt that was first introduced to the United States! Remember those old wax containers with the sundae style fruit-on-the-bottom type of yogurt? There was always a pool of whey on top you had to mix in and the coagulum was rough looking and somewhat grainy. Yogurt sure has come a long way! I like smooth pudding style types of yogurt and all types of Greek yogurt. In fact, a large yogurt producer used to make a "custard style" yogurt that was creamier, more pudding like and heavier in the mouth. I enjoyed that type of yogurt. When yogurt was first introduced in the US, it seemed it was taken as a diet food. No yogurt on the market at that time was made from whole milk like in Europe. Ours were always low-fat or nonfat. One company made a whole milk yogurt with unique flavors and then killed the yogurt culture by heat treating it after fermentation. It had the taste and was quite good, but did not have the live and active yogurt bacteria in it that we know are good for our gut. A regional dairy back in the 1990's in the Minneapolis-St. Paul area introduced a 5% premium yogurt. That was a good yogurt that was perhaps ahead of its time based on the popularity of the higher fat yogurts we have on the market today.

I also recognize the benefits of probiotic yogurts. These cultures are quite mild, boast benefits to digestion and help you maintain a healthy microflora in your small intestine. They don't alter the taste of yogurt while providing a benefit. DuPont has a line of premium probiotics called HOWARU cultures that were part of a clinical research trial promoting the benefits of consuming these probiotic bacteria in sufficient numbers as to provide a health benefit. If you are interested in our line of probiotic culture strains please consult with your DuPont sales representative today!

We hope you have enjoyed the latest issue of "DuPont Insights for Cultured Dairy." See you next issue!