

DAIRY PIPELINE

A primer on milk proteins

by Karen E. Smith, Ph.D., Wisconsin Center for Dairy Research

A deceptively simple description of milk often lists four components suspended in water. It includes minerals, like calcium, lactose, a milk sugar, and roughly three and half percent each of milkfat and protein. Of course, each component can be further divided into a longer list.

There are a variety of reasons to focus on the components of milk. Allergists might be interested in the protein beta lactoglobulin, the culprit behind many milk allergies. Another protein, casein macropeptide, found in many sport supplements, might catch the eye of a body builder. But for cheesemakers, casein is the major milk protein. In fact, milk proteins are defined by what happens to them during coagulation in cheesemaking, where casein forms the curds and the rest are designated as whey proteins. Casein becomes the star, the actual framework for cheese, trapping fat, minerals and water. The remaining milk proteins, the whey proteins, are relegated to play a minor role in the cheese scenario since they are flushed out of the cheese vat with the whey. However, you can use membrane technology to reclaim whey proteins. Since milk proteins, both casein and whey proteins, are receiving much more attention we invite you to review the basics about this bedrock of the dairy industry.

Milk constituents

Milk consists of fat, proteins, lactose and minerals. The fat component, or milkfat, is not a great concern since the fat portion is usually removed before milk is processed into milk protein products.

Although milk contains many types of proteins, as mentioned above they can be grouped into two general categories, casein and whey proteins. When milk is made into cheese, casein remains in the cheese while the whey proteins exit into the whey stream. Approximately 80% of the proteins in milk are caseins. Casein will coagulate when treated with rennet or acid.

The rest of the milk proteins

The rest of the proteins in milk are whey proteins. These proteins are soluble unless they are denatured by exposure to high temperatures. A denatured protein has an irreversible change in its structure that causes the protein to precipitate. A precipitated protein is not soluble in water; which means it will not dissolve.

Lactose, or milk sugar, is a carbohydrate found only in milk. Lactose is a disaccharide; that is, it is made up of two sugar molecules, glucose and galactose and most bacteria will convert the two sugars to lactic acid. It is lactic acid that is responsible for acid flavor in cheese. When milk products are heated to high temperatures the lactose can interact with proteins and produce a brown color in the milk.

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Minerals are also known as milk salts or ash. The major salts are calcium, sodium, potassium, and magnesium, which combine with phosphates, chlorides and citrates in milk.

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Probiotics—Can they tip the microbial balance toward better health?

A summary of health benefits associated with yogurt containing probiotic microorganisms (Some of these benefits are well documented, others have been reported recently.)

- ◆ enhanced lactose digestion
- ◆ prevention and treatment of acute rotavirus and antibiotic induced diarrhea
- ◆ stimulation of intestinal immunity
- ◆ stabilization of Crohns disease
- ◆ stimulation of intestinal peristalsis
- ◆ improvement in microbial balance
- ◆ decreased fecal enzyme activity
- ◆ activity against *Helicobacter pylori*
- ◆ reduced carrier time for *Salmonella sp.*
- ◆ improved immunity to disease
- ◆ inhibition of some cancers
- ◆ reduction of serum cholesterol
- ◆ reduction of hypertension

From: Fermented Foods and Healthy Digestive Function, Danone Vitapole Research

With the aid of antibacterial soaps, lotions, detergents and cleaners we humans seem determined to sterilize the world around us. But we will never sterilize the world within us. Our digestive system is a world unto its own, a thriving ecosystem of millions of bacteria—and we wouldn't be alive and healthy without them. In fact, the populations of bacteria that we host in our lungs, gut, and on our skin easily outnumber the entire tally of cells in a human body.

We couldn't live without these silent, largely unseen bacterial pals of ours because they help to digest vitamins and nutrients and play an important role protecting us from pathogenic, or harmful, bacteria. The idea that we could improve health by tinkering with the balance of the bacteria we host is not a new one, it has been around for at least a century. However, in the last decade scientists have been actively researching the health effects of ingesting beneficial bacteria, dubbed probiotics. One of the ways probiotics are thought to exert their influence is by improving the balance of microbes to prevent colonization by pathogens.

Beneficial bacteria come from lactic acid species

The dairy industry is particularly well placed to take advantage of consumer interest in probiotics—and there is a lot out there. Not only do beneficial bacteria generally come from lactic acid species, but cultured dairy products like yogurt and fermented milks are ideal foods to transport and nurture beneficial microorganisms in the gut. According to Danone Vitapole Research in "Fermented Foods and Healthy Digestive Functions," researchers have not isolated a probiotic microorganism that can be used alone to produce an acceptable product. Instead, scientists are looking at novel combinations of organisms to use as starter cultures when making yogurt, as well as combinations that will thrive in fermented dairy products. In addition, microencapsulated probiotics bacteria can be taken as a supplement or added to food.

Although you will find many references to the potential health benefits of probiotics (see sidebar), it's important to remember that particular strains of bacteria, or combinations of specific bacteria, are likely responsible for the benefit. This vein of research is continuing as scientists seek to match particular bacteria to specific benefits. For example, if you were trying to maintain your happy go lucky vacationing attitude while fighting a bout of travelers diarrhea you would most likely want *Lactobacillus* GG (LGG), a variant of *Lactobacillus casei*. This probiotic has been studied extensively, and research has shown it can reduce both the severity and duration of travelers diarrhea and antibiotic-associated diarrhea.



The overall consensus among the experts is that probiotic microorganisms need to reach a critical mass to produce a health effect; right now the standard they recommend is an excess of a million per gram available at the end of the product expiration date. In addition, probiotics are more effective if they grow and thrive once they are safely past the destructively low acid environment produced by stomach acids and bile salts. In adults, local populations of bacteria can mount an effective defense against probiotics, which means you have to continue taking them to continue the benefits. However, it's possible that newborns may reap many probiotic benefits. Scientists are investigating the possibility of that inoculation soon after birth, before resident bacteria develop, may provide lifelong benefits.

Probiotics is an active area of research, increasing in volume and interest. In fact, the International Scientific Association for Probiotics and Prebiotics (ISAPP) was formed May 2002 in London, Ontario. Scientists met to identify future research requirements and to define the structure and role of ISAPP in the scientific community. Recommendations are being compiled, and the group already has plans to meet in May of 2003.

Prebiotics — a new concept

As mentioned above, prebiotics are another new concept often discussed with probiotics. What do prebiotics do? They keep probiotics happy by nourishing and encouraging growth. Examples include inulin, a nondigestible carbohydrate, varied combinations of fiber and oligosaccharides, and honey. Researchers predict that prebiotics may be added to infant formula in the future. The goal is to supply an advantage that breast fed babies receive from their mothers, a natural prebiotic that seems to help protect infants from intestinal disease.

Synbiotics, a combination of prebiotic and probiotic, is another new direction. A few European firms are using this approach, packaging the probiotic in a straw that will mix with the prebiotic in juice or yogurt drinks. This type of packaging protects the viability of the probiotic in a package that doesn't need to be chilled.

Both European and Japanese consumers are far ahead of the U.S. when it comes to interest in probiotics and prebiotics added to food. However, Americans are spending more money every year on dietary supplements and it's likely these consumers will also be interested in probiotics. Let's hope they like yogurt!

Resources

Innovations in Dairy, Dairy Industry Technology Review. Opportunities for Probiotics in Dairy Foods. Dairy Management Inc. at www.extraordinarydairy.com

Food Product Design, July 2002
Probiotics and Prebiotics for Healthful Benefits by Judy Rice. www.foodproductdesign.com

Fermented Foods and Healthy Digestive Functions
Danone Vitapole Research, John Libbey Eurotext
www.john-libbey-eurotext.fr

American Journal of Clinical Nutrition, 2001;73
Supplement, 1121-1151



The dairy industry is particularly well placed to take advantage of consumer interest in probiotics.

Skim milk powder manufacturing process

Skim milk powder, or nonfat dry milk (NFDM) is essentially skim milk with the water removed. Skim milk is pasteurized to eliminate pathogens and then dried on either a roller or spray dryer. The milk can be given a heat treatment before drying. This heat treatment denatures the whey proteins, giving NFDM different functional properties. The Whey Protein Nitrogen Index (WPNI) describes the amount of denaturation and NFDM is then categorized according to its WPNI as low, medium or high heat powder.

Milk protein concentrate manufacturing process

Milk protein concentrate (MPC) is produced from skim milk by a series of processes that include ultrafiltration (UF), evaporation, and drying. Ultrafiltration determines the composition of the MPC while evaporation and drying are only used to remove water. The product is pasteurized to eliminate potential pathogens in raw milk.

The first step in the manufacture of MPC typically begins by filtering the skim milk. This filtering process is done by UF, a sieving process that separates two different groups of milk components according to their size. Minerals and lactose are smaller while proteins, including casein and whey proteins, are much larger. This large difference between the sizes of the two groups of components allows milk to be separated efficiently by UF.

During UF, milk passes across a membrane that resembles a piece of thin plastic. Some of the lactose, minerals and water will cross through the membrane and become the permeate stream. Because of their large size, casein and whey proteins cannot pass through the membrane. The proteins, along with the lactose and minerals that did not go into the permeate stream, will become the retentate stream. The concentration of protein in the retentate stream will increase as more lactose and minerals are removed in the permeate stream. A diafiltration (DF), or washing step, is required to get protein concentrations greater than 65% in the final dried product. Diafiltration involves adding water to the retentate, as it is being ultrafiltered to reduce product viscosity and further remove lactose and minerals.

UF can be done over a range of temperatures; however, for microbiological reasons milk UF is typically done either cold (41°F) or hot (115°F). The temperature of the process affects the cost of producing MPC but does not affect the final product composition.

Following UF, you can evaporate the retentate to increase the total solids in the processing stream. This also improves dryer performance. Falling film tubular evaporators are used most often since heating can damage milk proteins.

Next, the retentate is spray dried. Dryer designs such as tall form, spray bed and stage dryers are all considered appropriate for drying MPC. These types of dryers are designed to minimize the temperature exposure of the MPC during drying so that important functional properties, such as solubility, are retained.

Whey protein concentrate manufacturing process

Whey is a byproduct of cheese manufacture. After milk is separated by coagulation into curds and whey, the whey is drained from the curds (casein) and becomes the starting material for WPCs.

Producing whey protein concentrate (WPC) is very similar to the method used to make MPC. Ultrafiltration, evaporation, and drying are used to manufacture WPCs containing 34 to 80% protein in the dry product. Additional processing steps are needed to make whey protein isolates, which have greater than 90% protein. Like MPC, the UF step determines the composition of the WPC while evaporation and drying are used to remove water only.

Casein manufacturing process

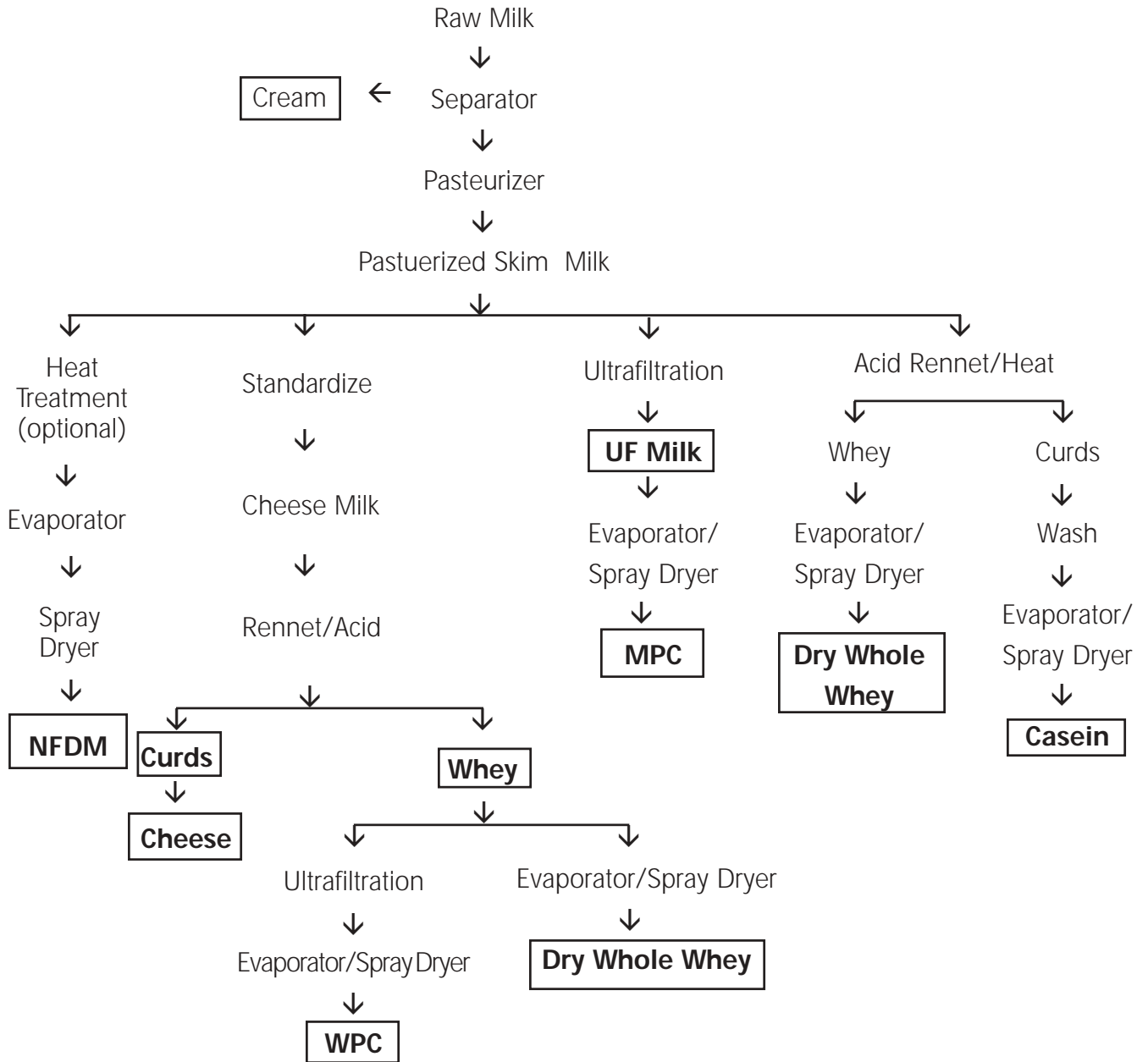
Commercial casein is made from skim milk by one of two methods, precipitation by acid or coagulation by rennet. To improve the quality of the final casein product you need to remove fat, whey proteins, lactose and minerals by washing with water. The product is then dried to improve keeping quality.

Precipitation by acid produces acid casein while rennet coagulation produces rennet casein. Either method of coagulation causes casein particles to join together and separate from the other milk components, exactly what happens during cheese manufacture. The casein is then separated from the whey before being washed and dried.

To produce a co-precipitate, calcium chloride or dilute acid is added to skim milk and the mixture is heated to precipitate both casein and whey proteins. The precipitated proteins are washed and dried to produce an insoluble protein mixture. The proteins can be treated with neutralizers to make a co-precipitate that is more soluble in water.

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Producing Milk Protein Products



Composition of milk protein concentrates (MPC)

Component	Skim milk (%)	MPC 42 (%)	MPC 56 (%)	MPC 70 (%)	MPC 80 (%)
Moisture	3.2	3.5	3.8	4.2	3.9
Fat	0.8	1.0	1.2	1.4	1.8
Protein	36.0	42.0	56.0	70.0	82.8
Lactose	52.0	46.0	31.0	16.2	4.1
Ash	8.0	7.5	8.0	8.2	7.4

Composition of commercial casein and caseinate products.

Component	Rennet Casein	Acid Casein	Sodium Caseinate	Calcium Caseinate	Co- Precipitate
Protein	89	95	94	93.5	89-94
Ash (max)	7.5	2.2	4.0	4.5	4.5
Sodium	0.02	0.1	1.3	0.05	-
Calcium	3.0	0.08	0.1	1.5	-
Phosphorous	1.5	0.9	0.8	0.8	-
Lactose (max)	-	0.2	0.2	0.2	1.5
Fat (max)	1.5	1.5	1.5	1.5	1.5
Moisture (max)	12	10	4.0	4.0	5.0
pH	7	-	6.6	6.8	6.8

Composition of whey protein concentrates (WPC)

Component	Sweet whey (%)	Acid whey (%)	WPC 34 (%)	WPC 50 (%)	WPC 80 (%)
Moisture	4.5	4.5	4.0	4.0	4.0
Fat	1.0	0.5	3.0	4.0	5.0
Protein	12.0	12.0	35.0	50.0	80.0
Lactose	73.0	68.0	51.0	35.0	4.0
Ash	8.0	11.0	6.0	7.0	4.0

continued from page 4

Caseinate, another product made from casein, is produced by neutralizing acid/rennet casein with alkali and then drying the resulting product. This alkali treatment makes caseinate more soluble in water than casein.

Composition and functionality of milk protein products

Skim milk powder, or NFDM, has approximately 3.2% moisture, 0.8% fat, 36% protein, 52% lactose and 8% ash. Both casein and whey proteins are present. The amount of heat used to produce NFDM affects the solubility of the proteins. High heat powder is slightly less soluble than low heat powder.

Whey protein concentrates average 4% moisture. They have protein contents ranging from 34 to 80%. Casein is not present. As the protein levels increase, the percentage of lactose decreases. Minerals range from 4 to 7%. WPCs are soluble in water because of the processes used to make them.

MPCs can be produced with protein contents ranging from 42 to greater than 80%. As the protein content increases, the lactose content decreases. Because some of the calcium is bound to casein, the concentration of calcium remains fairly constant in MPCs. Both casein and whey proteins are present. Since all of the proteins in skim milk remain in a MPC the biological protein value does not change for MPCs versus skim milk.

The processes used to make MPC do not damage the proteins; thus the proteins in MPC behave like milk proteins when MPC is used as an ingredient. The ability of a milk protein product to dissolve in water is one of its most important functional properties. Since MPC production processes do not alter the proteins, it is soluble in water.

Casein

Acid casein is the major casein product of world markets. It is used as an additive for glazing high quality paper and in the production of paints and cosmetics. Lactic acid casein is favored for food uses by New Zealand and Australia.

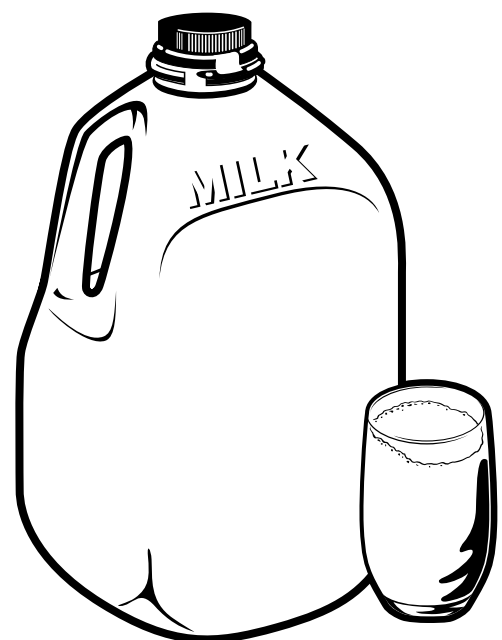
Acid casein has 10 to 12% moisture. Fat and minerals are less than 4% and lactose is absent. It is approximately 90 to 95% protein, which is all in the form of casein (whey proteins are not present).

Rennet casein has a wide range of uses. For example, it can serve as a nutritious ingredient in process cheese products. In addition, rennet casein can be modified to produce products that function like plastic. Moisture varies from 12 to 13% and fat and minerals make up approximately 8.5% of rennet casein. There is approximately 89% protein in rennet casein, all in the form of casein. Whey proteins are not present and lactose is absent.

The processes used to make acid and rennet casein make the products insoluble in water. Neither acid or rennet casein will react further with rennet. Acid/rennet casein in general does not react with other components and therefore acid/rennet casein does not have many functional properties.

Caseinates have approximately 3.8% moisture and 91% protein—all in the form of casein. There is 0.1% lactose and approximately 3.7% ash in caseinates. These products are usually salts of sodium or calcium. Although the neutralization process makes caseinates soluble, they generally will not react further with acid or rennet. Caseinates are used in the food industry, you'll find them in cured meats, and they are also used as milk and cream substitutes.

Unlike acid rennet casein and caseinates, co-precipitates contain whey proteins. Calcium may be present in greater amounts because of the use of calcium chloride in the production process. Small amounts of lactose (0.5%) also are present. Co-precipitates have approximately 5 to 10% moisture and 89 to 94% protein. Co-precipitates are insoluble unless they are treated with neutralizers in a process similar to that used for caseinates. Because whey proteins are denatured during production of co-precipitates, this product may remain incompletely soluble despite treatment with neutralizers. ☹



Introducing Juustoleipä Cheese

Juustoleipä—it’s a word new to the American vocabulary and a cheese new to the palate. Pronounced you-stow-leap-a, this specialty cheese of Finland, Sweden, and Lapland is poised for its Wisconsin premiere at the latest CDR Artisan Seminar on September 24-25th. According to Jim Path, cheese outreach specialist, “We believe that it has an extremely good chance at being a successful specialty cheese in Wisconsin and the USA.”

Juustoleipä originated in East Bothnia, a province that follows the Bay of Bothnia from the Swedish border in the north to Finland. The name juustoleipä is derived from the Finnish language, juusto meaning cheese, and leipä which translates into English as bread. These two words are clues to the distinctive character of the cheese, a sweet caramel crust that not only coats the cheese but helped to name it. A baking or grilling step during the cheesemaking process produces juustoleipä’s trademark flavor and appearance. Path notes, “To our knowledge, it is the only cheese in the world manufactured using this process, although Scandinavian immigrants to the United States currently produce a similar homestead cheese called ‘squeaky cheese’.”

You can serve juustoleipä cold or warm, for breakfast, snacks, or desserts, and in Finland it is often accompanied by cloudberry or lingonberry

jam. (You might want to try cranberry jam in Wisconsin!) Juustoleipä isn’t a finicky cheese, you can store it in the refrigerator for several weeks, or frozen, for months. You can warm it in the oven or, briefly, in the microwave.

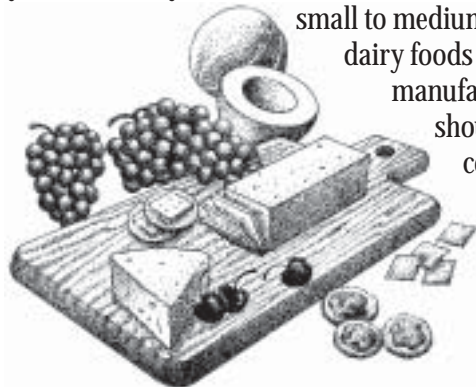
We suspect that juustoleipä will find a niche in Mexican cooking. It resembles several Mexican style cheeses, although they are usually manufactured, refrigerated and the buyer follows with the cooking step.

In Finland, juustoleipä is a commercial cheese with extremely attractive packaging. You can find it easily since it fills a reasonable amount of shelf space in every food store. Finn producers of the cheese note that it represents 1 to 2 percent of the total cheese production. However, in Finland they only bake the product to an internal temperature of about 140° F, which means the shelf life is only 7-9 days—a major draw back.

Here at CDR, we have modified the manufacturing procedure of juustoleipä and are able to bake it at a much higher temperature, over 200° F. This effectively creates a more microbiologically stable cheese. Currently, we are expecting a 60-day shelf life, refrigerated and possibly 1 year frozen. Both the UW Babcock Hall Dairy Plant and Bass Lake cheese factory, near the Twin Cities, have begun limited production of juustoleipä. If you plan on making a special trip to Madison to pick some up, it’s best to call first and check on availability, (608) 262-3045. If you don’t want to make the trip, use the same phone number to ask about mail order. ☺

Artisan Dairy Foods Conference

Are you thinking about making dairy products on your farm? Anyone interested in the details of



small to medium scale dairy foods manufacturing should consider

attending the Artisan Dairy Foods Conference, which will be held on October 22 in Mosinee, Wisconsin.

This one day conference will present experienced speakers ready to tell you about regulatory compliance, marketing savvy, business planning, and making dairy products. In addition, a concurrent advanced topics session, from 9:30 to 11:30, will be held for experienced artisanal dairy processors. You must contact Scott Rankin if you are interested in attending the advanced session and you can also call Scott if you have any questions about the conference. His phone number is: (608) 263-2008. ☺

Skimming the Shelf—



What's New in Print?

What if It's All Been a Big Fat Lie?

by Gary Taubes

New York Times Magazine, July 7, 2002

or

The Soft Science of Dietary Fat

Science 2001 March 30; 291: 2536-2545

Pressed to name one commonly held conviction about good nutrition, many of us might offer the opinion that fat is bad. It's a notion we've heard over and over from nutritionists, from nurses, from public health policy makers and from everyone in between.

When offering samples of cheese at trade shows, I often hear, "Oh, I shouldn't be eating this", as another happy grazer pops a cube of Cheddar into their smiling mouth. However, Walter Willett, chairman of the department of nutrition at the Harvard School of Public Health was recently quoted in the New York Times magazine explaining that "you will gain little to no health benefit by giving up milk, butter, and cheese and eating bagels instead."

Willett was one of the 150 people science writer Gary Taubes interviewed while researching his award winning article, "The Soft Science of Dietary Fat." Science magazine was the first to publish Taubes story, and condensed version was recently printed in the Times magazine. Either version will grab the attention of anyone in the dairy industry, and all purveyors of cheese and butter.

Taubes tells us that the "science of dietary fat is not nearly as simple as it once appeared." Since the 70's we have known that saturated fat can raise cholesterol levels, and high cholesterol can then increase the risk of coronary artery disease. However, he notes that although each step of the fat to cholesterol to heart disease chain may be true, "the veracity of the chain as a whole has never been proven." Thus the notion that a low fat diet will benefit healthy Americans remains unproven. Taubes goes on to suggest that adopting a high carbohydrate diet could

"...you will gain little to no health benefit by giving up milk, butter, and cheese and eating bagels instead."

be a shift in the wrong direction, possibly influencing the surge in obesity among the American public. He educates readers about insulin's role in hunger control, obesity, and the glycemic index, which measures the rate carbohydrates break down into simple sugars.

Gary Taubes has opened the low fat diet debate to the public, read all about it and join in the fray. But when you've finished you'll probably agree with what Taubes told the National Association of Science Writers. When asked for scientifically sound dietary advice, he repeats what his mother told him, "Eat your fresh fruits and vegetables, and watch your weight."

Where to find these articles:

Try the NYT website, www.nytimes.com

Science

www.sciencemag.org

or read it on the National Science Writers website at:

<http://nasw.org/mem-maint/awards/>

[The%20soft%20science.pdf](http://nasw.org/mem-maint/awards/The%20soft%20science.pdf)

Taubes will also be presenting at the IDF World Dairy Congress in Paris, September 24 to 27, 2002

Curd Clinic

Curd Clinic doctor for this issue is Scott Rankin, Associate Professor of Food Science

Q. We have customers who claim that there is a difference in the flavor of white and yellow Cheddar. Do the annatto colorants that make cheese yellow contribute to flavor?

A. Numerous processes affect the flavor and functionality of cheeses in the marketplace. The foremost influences on cheese flavor include factors such as milk quality, attention to manufacturing detail and aging/ripening conditions. However, in addition to those factors, numerous researchers, consumers, and cheesemakers have wondered if the colorant annatto does indeed influence cheese flavor.

For decades cheesemakers have turned to the plant world and enlisted an extract of the annatto bush to color cheese. As a coloring agent, annatto has been a proven performer because it adds a consistent, visually appealing hue to cheeses. Lately, more and more natural colored cheeses are coming into the U.S. market and we've also seen more "sophisticated" domestic Cheddars manufactured

without colorant. Thus, the question as to whether annatto influences the overall flavor character of cheese has drawn more attention.

Although it is generally accepted that annatto's sole influence in cheese is to add color, there are no studies that directly address this issue. In many cases, colored cheeses were intended for slightly different markets or different applications than their non-colored counterparts. However, an increasing number of products has blurred those lines substantially and we are still left with that fundamental question: Does annatto influence cheese flavor?

While the answer is far from conclusive, some findings suggest that annatto can indeed influence, both directly and indirectly, the overall flavor character of cheese.

Color of food affects other senses

Almost invariably, the color of a food affects other senses, such as taste and smell. The human brain processes visual signals in a way that makes purple foods taste like grape and red foods taste like strawberry, regardless of their actual flavor. When presented with a bright orange Cheddar next to a pale white product, our visual sense instantly signals our minds to expect some difference. In many cases, humans may perceive differences (or similarities) that simply do not exist. However, in the case of colored versus non-colored cheeses, there may be some actual differences.

Commercial annatto extracts have a very distinctive aroma. Prepared from the seeds of the annatto plant, the extract contains a caste of aroma-active compounds, some similar to those found in hops used in making beer. Unlike hops, however, such a small amount of annatto is added to cheese that most people agree any aroma compounds would be diluted in the cheese milk, yielding no direct influence on the flavor. Additionally, after decades of research, flavor chemists have yet to discover the chemical definition of Cheddar flavor, and they have not isolated any uniquely annatto-derived flavor compounds.

Another possible influence on the flavor pathway stems from the ability of annatto extracts to influence microbial growth. Like many plants, the annatto bush manufactures chemicals that protect it from organisms. Our earlier studies on annatto



Annatto plant with seed pods

flavor have identified several compounds that are known to influence microbial growth. It's possible that these compounds may influence the ripening microflora involved in flavor or texture development. While the jury is still out on this latter hypothesis, we do have data demonstrating that annatto extracts show activity against some Gram (+) microorganisms, namely *Staph. aureus*. In general, the annatto concentrations needed to act as an antimicrobial are somewhat higher than those typically encountered in colored cheese. However, annatto's inhibitory effect may well be operating in some of the more highly colored cheeses, as well as in cheeses like Muenster, that have a surface coating of annatto. A brief abstract is referenced below; the entire study is currently under review.

Annatto still under scrutiny

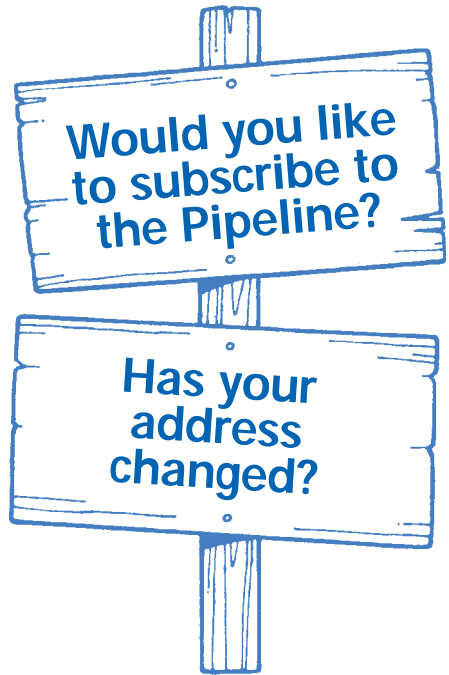
The influence of annatto in colored cheeses is still under scrutiny. Based on our preliminary work, it is possible that annatto influences cheese flavor directly through the contribution of aroma compounds or indirectly through the alteration of ripening microflora. Regardless of those influences, the psychology of flavor perception predicts that a visual cue is sufficient to bias flavor perception i.e. a bright orange cheese will be perceived as different than its white counterpart. At this stage, it may be more useful to determine which color variant your consumers prefer. ☺

For further details see:

Galindo-Cuspinera, V., Lubran, M. B. and Rankin, S.A. 2002. A comparison of volatile compounds in water and oil soluble annatto (*Bixa orellana* L.) extracts. J. Agric. Food Chem. 50: 2010-2015.

Galindo-Cuspinera, V., D. C. Westhoff, S. L. Owens, S. A. Rankin. 2001. Antimicrobial properties of annatto extracts against selected fermentation, spoilage and pathogenic bacteria. Presented at Institute of Food Technologists annual meeting, New Orleans, Louisiana. Abstract 84-3.

Irobi, O. N., M. Moo-Young and W. A. Anderson. 1996. Antimicrobial activity of Annatto (*Bixa orellana*) extract. Intl. J. Pharmacognosy. 34(2): 87-90.



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Karen Paulus, Editor
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You can also find the Dairy Pipeline on our website: www.cdr.wisc.edu

Calendar

Oct. 29-30 Membrane Processing of Dairy Products Short Course. Madison, WI. Program Coordinators: Bill Wendorff (608) 263-2015 and Karen Smith (608) 265-9605.

Nov. 5-6 Wisconsin Cheese Grading Short Course. Madison, WI. Call Scott Rankin at (608) 263-2008.

Nov. 7-9 Great Lakes Dairy Sheep Symposium, Ithaca, NY. For information, call Dr. Michael Thonney at (607) 255-2851.

Dec. 5-7 Premium Ice Cream Short Course, Madison, WI. Call Scott Rankin at (608) 263-2008.

Jan. 7-8 Milk Pasteurization and Process Control School. Madison, WI. Call Scott Rankin at (608) 263-2008 for information.

Jan. 15-18 Ice Cream Makers Short Course. Madison, WI. Call Scott Rankin at (608) 263-2008 for information.

Feb. 11-12 Quality Milk Conference (WI Dairy Field Reps). Madison, WI. Call Scott Rankin at (608) 263-2008 or Bill Wendorff at (608) 263-2015.

Feb. 25-26 Wisconsin Process Cheese Short Course. Madison, WI. Call Jim Path at (608) 262-2253 or Bill Wendorff at (608) 263-2015 for more details.

Mar. 24-28 Wisconsin Cheese Technology Short Course, Madison, WI. Call Bill Wendorff at (608) 263-2015.



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