Big Cheese Yield Gains, But Sodium Gluconate is

by John Bunting

For more than a year, it's been a puzzle: why, in light of strong cheese demand and relatively flat milk volumes flowing into cheese manufacture, has so much cheese been accumulating to clog warehouses and depress prices from the CME Cheddar cash market all the way back to the farm.

What is the source of all this "extra" cheese that's piling up in U.S. cold storage facilities, if not from additional farm milk proteins and milk fat?

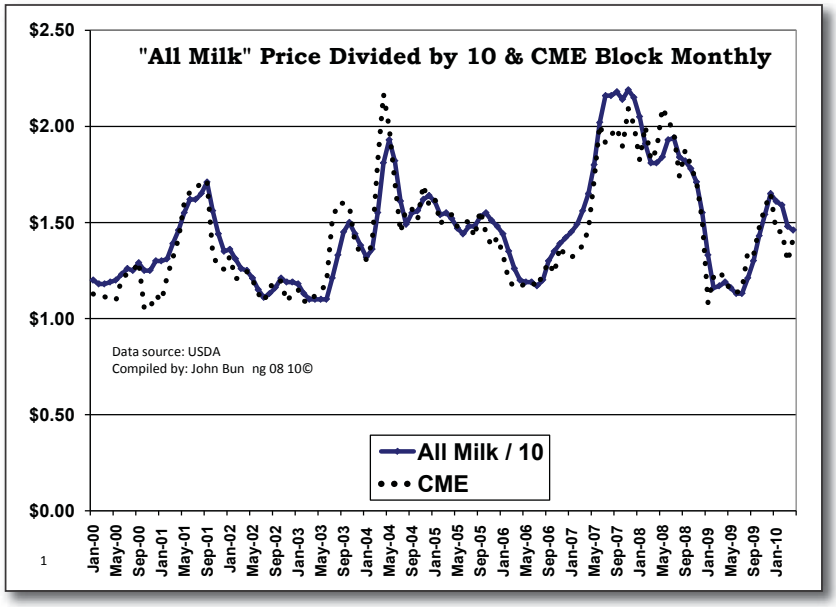
With a lot of research (and helpful sources), the deeply disturbing conclusion is that widespread use by cheese plants of "protein-enhanced," high- acid yogurt starter cultures is boosting cheese yields. The "enhanced" proteins are sourced from casein and milk protein concentrates (often import- ed). To the best of our research, these actions may be technically legal. But at least one cheese quality problem arises from such practices: formation of lactate crystals on the outside of the cheese. Those crystals are an undesirable characteristic.

In order to offset formation of the large amount of lactate crystals due to use of "protein-enhanced," high-acid yogurt starters in the cheese vats, a second step is necessary. And that second step begs serious questions of legal compliance, in the manufacture of cheeses defined by federal standards of identity by the Food and Drug Administration.

This "second step" entails adding a chemical, sodium gluconate, to the curds in the vat. Sodium gluconate is NOT, REPEAT NOT an ingredient approved for use in cheeses that have a federal standard of identity. Contrary to the assertion of one manufacturer – Nutricepts, Inc. — adding sodium gluconate to cheese curds in the vat is not a "procedure," but is in fact incorporation of an unapproved ingredient. Sodium gluconate residues remain in the curd, comprising as much as 2.8% sodium gluconate in the final product.

That's our best explanation of why the U.S. dairy industry is so besieged with "surplus" cheese and unduly low farm milk prices. Cheese yields are being increased by three (or more) pounds of product per hundredweight of farm milk through use of "protein-enhanced," high-acid yogurt starters. And that practice "works" only because a material unapproved for standardized cheeses (like Cheddar) – sodium gluconate – is then added to the curds in the vat to prevent excess formation of lactate crystals.

Take away the seeming illegal use of sodium gluconate on curds in the cheese vat … and the U.S. dairy industry will revert to far more "normal"



Cheese Yield Basics

Generally speaking, one pound of true protein in milk will produce 1.383 pounds of Cheddar cheese. However, there is an important relationship between milkfat and protein in the manufacturing of Cheddar cheese.

The universally-accepted Van Slyke formula is as follows:

$$Yield = \frac{(0.93F + C - 0.1)1.09}{1 - M} = 9.945\%$$

F = Fat content of milk 3.6% (3.6 kg/100 kg)

C = Casein content of milk 2.5% (2.5 kg/100 kg)

0.1 = Casein lost in whey due to hydrolysis of casein and fines losses

1.09 = a factor which accounts for other solids included in the cheese; this represents calcium phosphate/citrate salts associated with the casein and whey solids

M = moisture fraction (0.37)

In the formula "F" represents milk fat and "C" represents raw milk's casein content. The result was that normal farm milk produces virtually 10 pounds of cheese from one hundredweight of milk. That's why, in the above graph, the "All Milk Price" is divided by 10.

yields of cheeses, higher farm milk prices, and better-tasting, legal standardized cheeses.

Technology drives modern cheese-making

Modern, industrial-scale cheese-making is neither art nor science. The modern system is pure technology, providing the technology results in a profit. Profit and efficiency are two words which seem to be interchangeable to some.

A big modern plant, which might take in as many as 100-200 truckloads of milk per day, can be thought of as a continuous operation. Almost like a pipe, milk goes in one end and cheese out of the other. The system moves at a preordained speed.

To increase the "efficiency" of the modern cheese making system, additional protein is added at the beginning of the process. In some cases, the protein comes from ultrafiltration and in other cases from milk protein concentrate (MPC). MPC is not an approved food ingredient, according to food safety rules outlined by the federal Food and Drug Administration.

California Department of Food and Agriculture (CDFA), regularly tracks manufacturing costs for cheese. All of the plants surveyed by CDFA are modern high-speed plants. The following graph tells the story of ever increasing yields in Califor- nia. The same amount of cheese, in 2008, could be made with about a third less milk, when compared with normal farm milk.

These modern, astronomical Cheddar yields render Van Slyke's "old-fashioned" Cheddar-yield calculations obsolete.

UW-Madison researcher detailed big yields in *Journal of Dairy Science*

In the February 2006 *Journal of Dairy Science* Vol. 89 No. 2, an article titled, "Two Mathematical Programming Models of Cheese Manufacture" by Joseph Burke of the University of Wisconsin-Madison detailed the basis for yields of 13.8 pounds of Cheddar per hundredweight of milk. This research was funded in part by a Hatch Act grant from the USDA.

The Hatch Act (SEC. 2. [7 U.S.C. 361b]) states, "It is further the policy of the Congress to promote the efficient production, marketing, distribution, and utilization of products of the farm as essential to the health and welfare of our peoples and to promote a sound and prosperous agriculture and rural life as indispensable to the maintenance of maximum employment and national prosperity and security." But who as USDA is watching?

Although Burke's paper was published in 2006,

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Historic Art & Science of Cheese-making

by John Bunting

Before the 1930s, farm milk was priced as fluid (beverage) milk. Farm milk going to cheese was priced from fluid price, minus the cost of manufacturing the cheese, and minus the cost of storing cheese.

Now, even milk going to the fluid, Class I, market under the federal milk marketing system is generally priced from cheese. That's logical. Cheese production requires half of all farm milk produced in the United States … and then some.

Cheese making has a long history of preserving milk, with most of the moisture removed, for consumption weeks, months … and even years later.

Cheddar cheese production began in the Cheddar Gorge area of southwest England. Traditionally, cheese making is referred to as both an art and science. There should be the addition of one more concept: long before most people were literate, cheese makers in the Cheddar Gorge area were able to take milk of questionable origin, which varied from milking to milking, and make a consistent product, safe for consumption.

Key to this process, were traditional lactic bacteria. These bacteria prefer room temperatures (between 70 and 100° F) and are technically known as mesophilic. Until recently, the lactic bacteria generally accompanied the milk. The bacteria resided on the teats of the cow. All that was needed was to leave the night milking at room temperature. The milk would naturally sour. When combined with the morning milk, the milk in the cheese vat was slightly acidic.

Rennet was traditionally produced from the abomasums (stomachs) of calves. Rennet is a natural complex of enzymes which, when introduced to slightly acidic milk, coagulates the milk to form a curd. Curd is he marriage of milk fat and protein.

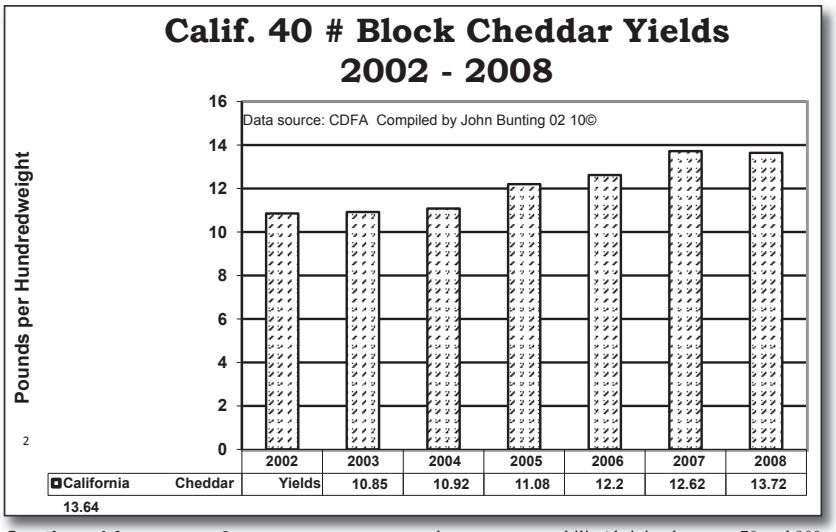
The curd is then cut, which allows the whey to separate. The curds and whey developed further acid, by way of lactic bacterial growth.

Then the whey is drained and the curd is piled. The piles of curd are stacked and restacked on the bottom of the cheese vat, while a constant temperature is maintained. This stacking process is technically known as Cheddaring. The purpose of this process is to generate a large population of friendly, helpful lactic bacteria which overwhelm all of the harmful bacteria.

Next the curd, which has now formed into slabs, is cut into small pieces in a curd mill. The pieces of curd are then salted. At this point, the curd is placed in molds and pressed form.

As the Cheddar ages, the bacteria continued to work, and if the work goes well, contribute to the aroma and taste of the finished product.

Weak Link in High-Tech Cheese Vat Shenanigans



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submission of the paper occurred in September 2005. Also in 2005 Joseph Burke submitted his PhD thesis, "Induced Product Innovation, Imports of Milk Protein Concentrate and the U.S. Dairy Industry." The title is interesting in that "induced," according to Merriam-Webster dictionary means, "Succeed in persuading or influencing (someone) to do something."

Admittedly, profit margins are tight in cheese processing (so much "cheese" gluts the market). As a result, cheese processors very readily fall into a "herd mentality." Everyone wants to remain "competitive." Therefore, the adoption of ultrafiltration and use of milk protein concentrates (MPC) has been accepted widely.

Burke stated in the article, "with respect to this model, milk protein concentrate does not hold any significant functional advantage relative to ultrafiltered milk in increasing yield. Rather, the cost reductions from the use of milk protein concentrate are largely due to the fact that imported milk proteins are generally less expensive than those in domestically sourced ultrafiltered milk."

NZ researchers chime in also

Another article on the same issue of *Journal of Dairy Science*, "Effect of Milk Protein Standardization Using Different Methods on the Composition and Yields of Cheddar Cheese" by T. P. Guinee, B. T. O'Kennedy, and P. M. Kelly of New Zealand concluded:

"An integrated approach to cheese manufacture, involving milk protein standardization/fortification, make procedure standardization (e.g., ratios of rennet activity and starter quantity to casein), and effective process intervention, where necessary, enables manufacturers to optimize standard operating procedures and, thereby, to obtain more consistent target values for key process indicators of efficiency and cheese composition. Such an approach is becoming increasingly necessary to remain competitive in the production of commodity-type cheeses such as Cheddar, Gouda, and Mozzarella, in which scale of operation, maximization of cheese-making efficiency, and the delivery of product with consistent composition (e.g., sodium) and quality are key factors in lowering product costs and securing market share."

Anything for the cheese processor's bottom line. Lately, one item in this process has become pricey. In the Joseph Burke article, even though the protein has been bumped up, cream must be added to the vat. Relative to the amount of whole milk used, the cream level must be bumped up another 4.4%. With cream running at multiples of 170 (1.7 times the price at CME of butter) the price runs up fast.

High-speed starters boost through-put

Another factor which increases the "efficiency" of a modern cheese plant is any factor which reduces the time to "make" the cheese.

Traditionally, the starter culture, as noted above, was mesophilic (thriving between 70 and 90° F). In a 2001 *Journal of Dairy Research*, a British publication, the use of thermophilic (thermophilic defined as loving heat in the range of 113 – 176° F) cultures in cheddar manufacturing is described:

"The behaviour of Streptococcus thermophilus in combination with Lactococcus lactis subsp. cremoris or subsp. lactis mesophilic starters in experimental Cheddar cheese is reported. In a standard manufacturing procedure employing a 38° C cook temperature, even very low levels (0.007%) of Str. Thermophilus combined with normal levels of the mesophilic starter (1.7%) resulted in increased rates of acid production … "

According to this paper by New Zealand researchers, the addition of high-acid Streptococcus thermophilus, normally used in production of yogurt, to the Cheddar cheese vat reduces the manufacturing time by two hours, an incredible cheese plant efficiency gain.

This efficiency means *three* batches of cheese can be made in a day rather than the usual two.

Using Streptococcus thermophilus also has the added benefit of increasing the cheese yield slightly. Increased yields are achieved because some of the lactose in the milk is not converted and remains in the cheese. Additionally, slightly higher moisture content is achieved. (Note: higher mois- ture content means reduced quality and aging char- acteristics.)

Supplementary chemical needed

Is this to say, some cheese quality problems accompany the "efficiencies" of high-acid starters. One of the problems is the formation of lactate crystals, which look like grains of salt, on the outside of cheese. Not to worry, another land grant college, the University of Minnesota, along with Nutricepts, Inc. (Burnsville, MN), came to the rescue with US patent number 7,625,589, issued December 1, 2009.

This patent solves some of the modern cheese making problems by adding sodium gluconate to the cheese vat. The patent abstract states, "Sodium gluconate is added to the typical cheese-making recipe to inhibit the growth of calcium lactate crystals as the cheese ages. The sodium gluconate is preferably added with sodium chloride or shortly after sodium chloride as part of the salting step. The amount of sodium gluconate is within the range of greater than zero to 10% of the weight of the curd, to result in a cheese having 0.26 to 2.8% gluconate in the cheese."

The patent further states, "For reasons that are not entirely clear, the use of concentrated milk and a semi-continuous cheese making process in mak- ing an aged cheese seems to worsen the calcium lac- tate crystal problem. Consequently cheese manufacturers have an unenviable choice: they can either use a less efficient cheese-making process, or they can use a more efficient manufacturing process that more likely results in calcium lactate crystals defects."

There is one huge problem with this "solution." The Code of Federal Regulations 21 C.F.R. § 133.113 for Cheddar cheese does not allow, as either an ingredient or an optional ingredient, sodium gluconate. No problem? FDA has looked the otherway in the milk protein concentrates controversy for years. MPCs are not a legal food ingredient.

At this point, persons mystified by the burgeoning U.S. cheese inventories may conclude that clearly illegal practices in cheese making creates up to three pounds more cheese per hundred pounds of farm milk.

Underlying all of this is a much greater problem. Why is it that the world's largest economy, the only remaining superpower, the "greatest country in the world" cannot "afford" to make quality dairy products and pay the dairy farmers whose milk goes into those products a decent price?

Definitely misbranded!

The FDA has a prescription for such matters, found in Section 402 of the Federal Food, Drug and Cosmetic Act, 21 CFT, Section 343. That act states, in part:

"A food shall be deemed to be misbranded –

"(a) If (1) in its label is false or misleading in any particular …

"(g) If it purports to be or is represented as a food for which a definition and standard of identity has been prescribed by regulations as provided by section 401, unless (1) it conforms to such definition and standard, and (2) its label bears the name of the food specified in the definition and standard and, insofar as may be required by such regulations, the com names of the optional ingredients (other than spices, flavoring, and coloring) present in the food."

Sodium gluconate is not approved for use in the manufacture of natural cheeses that bear varieties (like "Cheddar") defined by FDA's standard of identity. One marketer of sodium gluconate to cheese plants claims that adding sodium gluconate to cheese curds is a "procedure." Baloney: that firm is not selling a procedure, it's selling a product used as an ingredient. And that ingredient remains in the curd at up to 2.8% of total weight of the fin- ished cheese product.

Adding sodium gluconate to the curds in the vat of Cheddar, Mozzarella, etc. falls outside FDA's rules for standards of identity. Thus, we face the inescapable conclusion: any cheeses of standard identity (such as Cheddar) that are produced using sodium gluconate do not conform to FDA's standards of identity, and are therefore "misbranded."

Unfortunately, we must further conclude that creation of unduly large volumes of cheeses (like Cheddar), through use of such cutting-edge technology, has resulted in the current glut of cheese inventories and contributed to the unduly low farm milk prices paid to U.S. dairy producers over much of the past 18 months. Further, there can be no substantial improvement in U.S. dairy farmers' returns for milk as long as production of such misbranded cheeses of standard identities continues.

Sodium Gluconate: Learn More

Crystalban™ is a product sold by Nutricepts, Inc of Burnsville, Minnesota. The product is simply sodium gluconate in granular form, which can be added to cheese. Nutricepts makes a number of claims for the product including "enhanced quality, yield, and body."

According to the Code of Federal Regulations 21CFR133.113 which covers Cheddar cheese, the product is not in the list of allowed ingredients.

Nutricepts rationalizes this problem with ease. Nutricepts says "CrystalBan may be characterized as a process aid under 21CFR. Contact Nutricepts, Inc. for relevant documents."

However, CrystalBan™ is added to the cheese. Nutricepts is not selling an idea. Nutricepts is selling a product – sodium glucanate – plain and simple.

To learn more about the wonders of CrystalBanTM for yourself, go to Nutricepts Web site at:

http://www.crystalban.com