

Ref 49

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USING COLD ULTRAFILTERED MILK IN CHEESEMAKING

Robert Fassbender
T.C. Jacoby & Co., Inc.

Background

Necessity, as they say, is the mother of invention. In the Mid 1990's, a group of New Mexico dairymen headed by Mike McCloskey, approached Dave Hibbard of Membrane System Specialists and Ted Jacoby of T.C. Jacoby and Company to explore ways to balance their New Mexico milk supply. Concentrating milk on-farm in a traditional way was tried in the early 80's in California with some success but also with several major obstacles. The trio approached FDA with an idea to UF the milk, not in a traditional sense, but as a cold process. FDA had major concerns with the idea, including:

- could the equipment be kept clean?
- will concentrated milk support bacteria growth differently?
- will pasteurization be as effective on concentrated milk?
- what will this product be called?

After thousands of samples were analyzed and countless other tests conducted, FDA approved "Cold Process – Ultrafiltered Milk" for use in cheesemaking in the fall of 1996, assigning IMS Product Code 39 – Concentrated Raw Milk Products for Pasteurization as the "Official" nomenclature.

The first production facility was constructed on Mike McCloskey's dairy located in Lake Arthur, New Mexico. This facility began commercial operation in early 1997 and processed about 150,000 pounds of milk into one load of 3X retentate per day for shipment to Minnesota. Subsequently, UF plants have been built in Dexter, New Mexico, Comanche, Texas, and Tipton, California.

Currently, there is about 2.4 million pounds of milk per day undergoing "Cold" UF processing, making about 15 loads of 3.4X retentate for the cheese industry. The customer base has grown from one original plant in Minnesota to 15 plants throughout the United States. Several additional plants are waiting for a supply of "Cold Processed – Ultrafiltered Milk".

Why is “Cold Processed – Ultrafiltered Milk so popular?

Declining milk supplies in the “traditional” cheese manufacturing states have led to cheesemakers utilizing a variety of methods to boost cheese yields and thus, improve plant performance. “Cold Process – Ultrafiltered Milk” is the latest product to be incorporated into the cheesemaker’s arsenal to improve his plant’s performance. Improved cheese functionality and quality, ease of use and other economic considerations also enhance the popularity of “Cold Process – Ultrafiltered Milk”.

Commercially produced “Cold Processed – Ultrafiltered Milk” is derived from high quality raw milk produced on large dairies in Texas, New Mexico, and California. The UF milk meets all FDA criteria for raw, commingled milk, is produced in IMS approved facilities.

“Cold Processed – Ultrafiltered Milk” has the following physical and analytical characteristics:

Composition:	Butterfat:	11.9%
	True Protein:	10.0%
	Other Solids:	<u>6.1%</u>
	Lactose:	4.1%
	Ash:	2.0%
	Total Solids:	28.0%
Quality:	Bacteria (SPC):	Max 300,000 / ml
	Somatic Cell:	Max 750,000 / ml
	Coliform:	Max 4,000 / ml
	Antibiotics:	Negative on the raw milk
	Temperature:	45 degrees F. or less upon receipt
Sensory:	Color:	Creamy white – fresh milk
	Flavor:	Unheated, clean, rich - fresh milk
	Odor:	Sweet and clean – fresh milk

A Skim product will soon be commercially available, meeting all of the above physical and analytical properties of the whole UF product except the fat content will be only 0.3% – 0.4%

Research Objectives

Research studies have been conducted at the Wisconsin Center for Dairy Research in Madison, Wisconsin using “Cold Processed – Ultrafiltered Milk” in cheddar, swiss, parmesan, a variety of Mexican cheeses, and cottage cheese. The purpose of the studies is to optimize the make procedure, fortification rate, and to determine the actual benefits of using “Cold Processed, Ultrafiltered Milk” in a commercial setting. I will review a synopsis of those studies here.

Mexican Cheese – April 1999 (USDEC): This trial examined the use of “Cold Processed – Ultrafiltered Milk” in Mexican cheese varieties at varying levels of fortification. Cheese varieties manufactured included Chihuahua, Manchago, Oaxaca, and Panela. The level of solids in the cheese milk ranged from 20% to 30% utilizing manufacturing techniques similar to what would be found in Mexico.

Chihuahua and Manchago Cheese – October 1999 (NAMP): This trial utilized manufacturing techniques recommended as a result of the earlier (April) trial. Cheese was specifically made for a trade mission to be held in November, 1999. Utilizing cheesemilk with a solids content of 20%.

Cheddar Cheese - April & May 2000 (NAMP): This study compared the yield, quality and sensory preferences of cheddar cheese manufactured with conventional “warm” UF milk to cheese made with “cold” UF milk and to a control of “regular” whole milk.

Cottage Cheese - August 2000 (NAMP): This trial examined the yield impact of fortifying skimmilk with “Skim Cold Processed – Ultrafiltered Milk” at 7%, 15% and 20% fortification (replacement) rates.

Swiss – November 2000 (CDR): This trial examined the yield impact and the sensory perception of Swiss cheese using reduced fat milk fortified with “Cold Processed – Ultrafiltered Milk”. Cheesemilk solids was approximately 14%.

Parmesan – January 2001 (CDR): This trial examined the yield impact of Parmesan cheese, fortifying the reduced fat milk with “Cold Processed – Ultrafiltered milk”. Cheesemilk solids were targeted at 14.5%.

Results and Observations

The trials listed above as well as the experience of those cheesemakers regularly using “Cold Processed – Ultrafiltered Milk” has revealed a number of advantages in its use as well as areas of concern to be aware of.

Advantages

Handling: The “cold” UF milk, since it is a raw product, can be added directly to raw milk silos with no threat of rancidity or other problems associated with blending raw and pasteurized products. It also does not have any of the problems associated with reconstituting powder (labor, shrink, dwell time, etc). Cold UF can be added directly to the raw milk stream and achieve the same level of efficiency in the vat as if it were blended with the milk in a silo.

Protein Standardization: "Cold" UF is used by manufacturers of reduced fat cheeses (Swiss and Parmesan) to standardize protein levels in cheesemilk. This practice adds considerably to the efficiency of a plant, particularly swiss, where the consistency of block size is extremely important to plant throughput.

Yield Efficiency Enhancement: Yield per pound of casein is improved over other forms of fortification. This was dramatically exhibited in the cottage cheese study which showed a 4.3% improvement in yield as expressed in pounds of casein in the cheesemilk when the skim was fortified at a 7% "cold" UF rate.

Plant Efficiency Gain - Throughput Gain: Fortifying cheesemilk in a plant manufacturing cheddar cheese at the rate of 10% (replacing 10% of the raw milk with "cold" UF milk will result in a yield increase of about 25%. The corresponding drop in manufacturing cost about is 18.5%. In the model plant, this "savings" resulted in a reduction in per pound cost of over \$1,000,000 per year.

Lactose Reduction in the Cheese milk: Lactose is a factor in both mozzarella cheese and in longer hold cheese (swiss, parmesan, or long hold cheddar) causing excessive blistering -burning in mozzarella and flavor or visual defects in the other varieties. Reducing the lactose prior to the milk entering the manufacturing process is a big advantage. The manufacture of "No-Burn Mozzarella" is greatly enhanced when using the "Cold" UF milk as the fortifying agent.

Coagulant Usage Reduction: The use of higher solids in the cheesemilk results in a reduction in the rennet usage. The gelling of the curd will occur to rapidly without reducing the amount of rennet used, resulting in a spongy curd and excessive fat loss to the whey. One plant reduced rennet by 4 oz per vat, resulting in savings of over \$28,000 annually.

Rate of Proteolysis is Reduced: Cheeses made with "Cold" UF milk at higher levels of concentration (20% solids or higher) showed a lack of proteolysis. In one case, Manchago cheese made in April still exhibited a fresh flavor and "curdy" structure at six months of age. In a recent report from South Dakota State University, their research indicated that cheese made from UF milk had a rate of proteolysis slower than other forms of concentration and that flavor development was also slower as the cheese ages.

Concerns

Curd structure - speed of clotting: Due to the increase in solids in the cheesemilk, the clotting of the curd will occur quite rapidly. In a trial utilizing 20% cheesemilk and no reduction in rennet addition, the vat set in five minutes Vs the 30-minute target. The result was a 200% increased in fat and a loss of 27% solids loss in whey. This concern can be managed through aggressive management of the vat.

Curd Brittleness: The curd tends to exhibit more brittleness as the protein level of

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the cheesemilk increases. This can be a concern in a "OO" style vat resulting in curd shattering and again, excessive fat and solids loss to the whey. A longer, slower set will minimize the impact of higher protein, allowing the casein matrix in the curd to trap the fat and solids.

Conclusion

"Cold Processed – Ultrafiltered Milk" offers another tool for the cheesemaker seeking to improve his plants economic performance or desiring to target a specific compositional parameter in his cheese. Substantial operating enhancements can be achieved by using a 6% - 10% fortification rate (14% solids in the cheesemilk). In addition, advantages to the cheesemaker seeking particular functionality in his cheese can realize advantages. In the short term however, "Cold Process - Ultrafiltered Milk" offers milk-starved plants in the Midwest an opportunity to maximize their throughput while producing a quality cheese product.

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Notes