A New Way to Pasteurize: Microfluidizer® Processing

> *"This may open up an entirely new avenue for pasteurizing fluid foods — one that is more effective at eliminating pathogens than existing methods and less harmful to the food."*
>
> *— Dr. James Martin, Mississippi State University*

Pasteurization alone cannot get rid of all the bacteria in milk. Some, like *Bacillus cereus,* form spores that can only be eliminated entirely by cooking the milk at autoclave temperatures. Spores that survive mere pasteurization can germinate at room (or even refrigeration) temperature and multiply. The problem with autoclaving milk is that it ruins the taste and also reduces the vitamin content and other nutrients. Studies have shown that bacteria present as spores even in supposedly "safe" milk can reach populations that can cause food borne illness within a few hours to a day or two, depending on the temperature at which the product is kept.

One researcher who has studied the impact of bacterial spores on food since the mid 1960s thinks he may have found a way to eliminate more than half the spores present in a sample of milk — without cooking it. This is significant for two reasons. First, because toxicity is related to spore count — reducing the number of spores reduces the chances of getting sick significantly. Second, the method's potential as a spore remover has not yet been reached. There is reason to believe that by "turning up the pressure" on the spores even more, the numbers will drop even further.

"*Bacillus cereus* has become quite prominent in the past 15 years as a pathogen causing food poisoning," says the researcher, James H. Martin, Professor Emeritus of Food Science at Mississippi State University. "They're heat resistant, they're pressure resistant — you can boil them and boil them and boil them — and they'll still survive and grow. That means that if you can destroy spores in a product, you can destroy almost any other pathogen too."

Martin's idea was to combine high (but not excessive) temperature with the ultra high pressure homogenization found in a Microfluidizer Processor. "I used temperatures that would be likely in a processing operation using HTST (high temperature short time) pasteurizers. We wanted to see if the Microfluidizer processor were introduced within a normal commercial operation if spore count could be dramatically reduced."

The Microfluidizer Processor is an ultra high-pressure mixer, homogenizer and particle/droplet size reducer used in many applications in food, pharmaceuticals, coatings, and cosmetics. Its principle of operation is as follows: product is pumped at constant high pressure (up to 40,000 psi), split into two smaller channels, and forced to collide against itself within an interaction chamber. Forces applied to the product are incredibly intense:

- Shear forces as the product travels along the walls of microchannels at high velocity
- Impact against the walls of the interaction chamber
- Impact of the two streams colliding
- Cavitation caused by bubbles forming and collapsing as the stream passes through various zones of pressure differentiation within the interaction chamber.

Martin set up a Microfluidizer Processor in a milk processing pilot plant. But instead of milk, he tried his idea out on ice cream. "I used ice cream mix mainly because it's thicker — it contains a high percentage of solids which might protect bacterial spores from destruction by the high pressures generated in the Microfluidizer system. If the process works on ice cream, you can downsize to milk very readily. If it works on ice cream, it will surely work on milk, because milk has less solids in it."

Instead of *Bacillus cereus*, Martin used a close (but not harmful) relative, *Bacillus licheniformis*. "We didn't want to introduce a pathogen into a processing plant environment," Martin states.

Heat + Pressure

Martin was specifically interested in the *combined* effect of heat and pressure on the spores. The temperature of the product coming out of the pasteurizer was between 30 and 50˚ C . The forces at work in the Microfluidizer Processor transferred more heat to the mix — raising its temperature another 50˚ C (at 30,000 psi). "We wanted to see if the temperatures typically found in a milk processing plant would work in conjunction with the Microfluidizer Processor to reduce spore count."

It would. At an inlet temperature of 33˚ C, and pressures ranging from 7500 to 30000 psi, outlet temperature ranged from 46 to 75˚ C. Destruction of spores ranged from 6% to 48%. At an inlet temperature of 50 degrees, and pressures ranging from 7500 to 30000 psi, outlet temperature ranged from 59 to 88˚ C. Destruction of spores ranged from 19% to 68%. More complete details of Martin's results are reported in the September, 1997 edition of the *Journal of Dairy Science*.

"What this research does," says Martin, "is prove in principle that you can — within a normal commercial plant environment — drastically reduce the population of bacterial spores in dairy products without destroying taste or nutritional value." Martin also notes that since more powerful models of Microfluidizers are available than the one used in the experiment, even greater reductions are probably possible. "This may open up an entirely new avenue for pasteurizing fluid foods — one that is more effective at eliminating spores than existing methods and less harmful to the food."

"...[one can] drastically reduce the population of bacterial spores in dairy products without destroying taste or nutritional value."

Microfluidics™

30 Ossipee Road
Newton, MA 02464-9101 USA
617-969-5452
800-370-5452
Fax 617-965-1213
info@mfics.com
www.microfluidicscorp.com

A DIVISION OF MFIC CORPORATION

European Office
c/o Freudenberg, Bau 42
Höhnerweg 2-4
D-6945 Weinheim, Germany
+49 (0) 6201-80-6670
Fax +49 (0) 6201-88-6679
microfluidics@t-online.de
www.microfluidicscorp.com