

TECH TIPS

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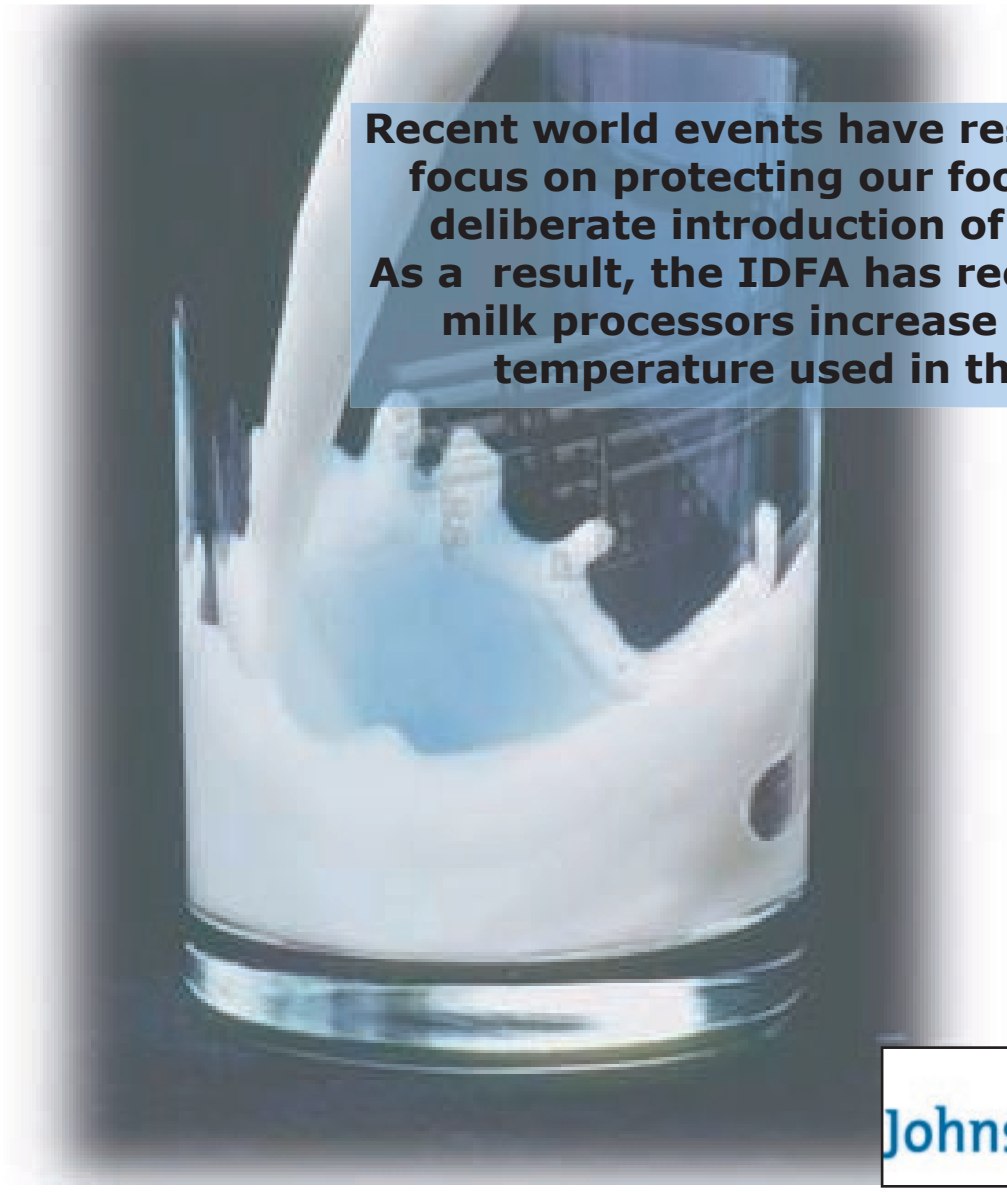
Spore Activation in HTST Dairy Operations



Recent world events have resulted in an increased focus on protecting our food supplies from the deliberate introduction of harmful materials. As a result, the IDFA has recommended that fluid milk processors increase the pasteurization temperature used in the HTST process.

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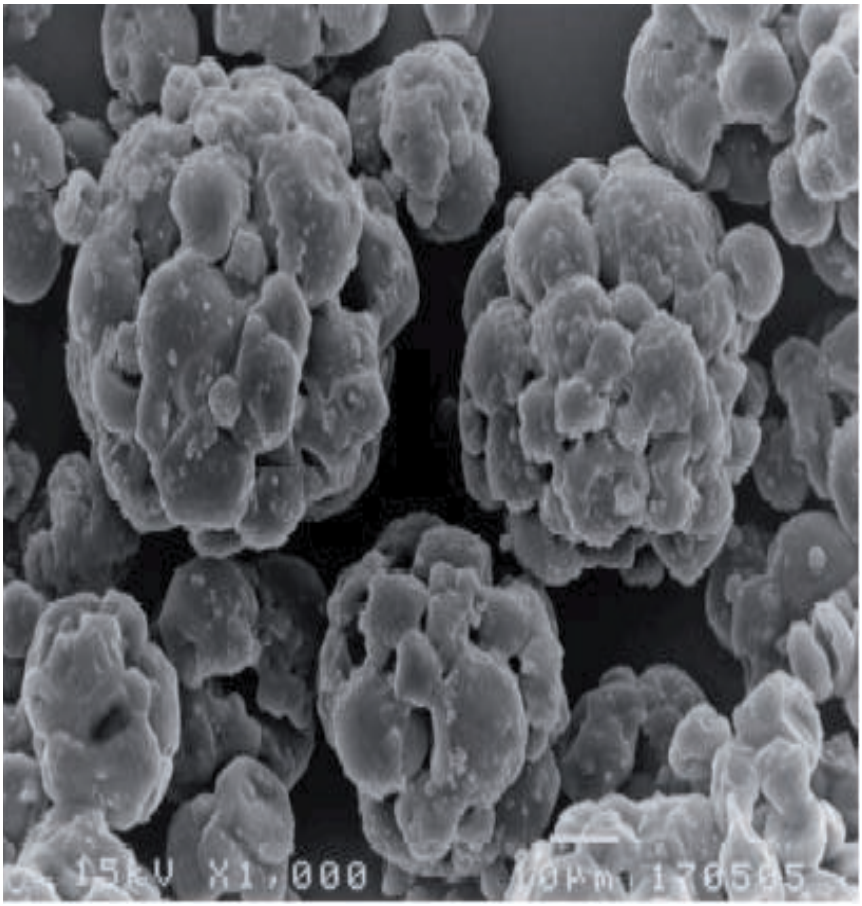
Changes in processing temperature on the HTST can affect shelf life due to increased spore activation at the higher temperature. We have tried to summarize some of the information available in the literature in the following points.

1. From the International Dairy Federation's (FIL IDF) Bulletin No. 275/1992:

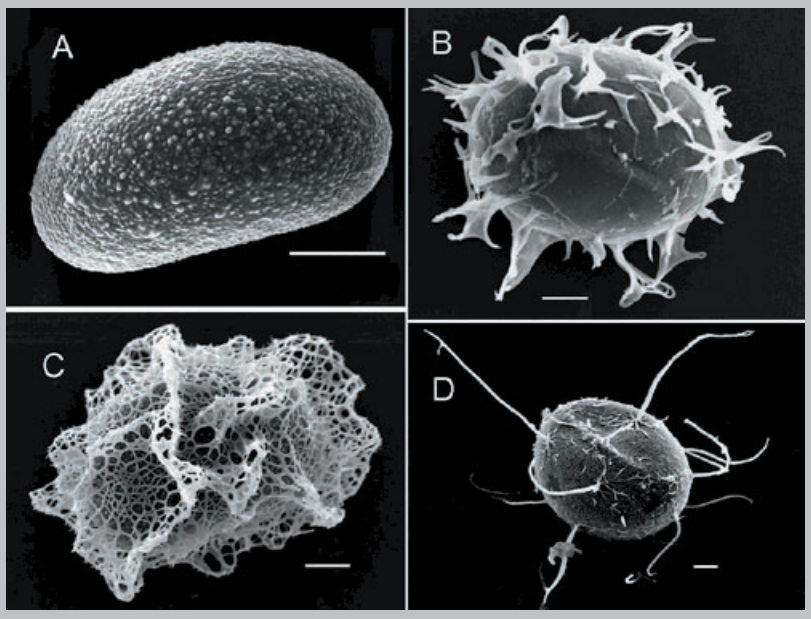


- "The effect of an increase in the pasteurization temperature on the germination rate of B. cereus spores, especially slow germinating spores, is one of the main causes of the fall in keeping quality of pasteurized milk when the pasteurization temperature is higher than normal."

- Table 1 shows the data for two pasteurization temperatures, 170ºF and 176ºF (76.5ºC and 80ºC). This data shows that after 2 days incubation 35% of the slow growing spores remain ungerminated after heat treatment at 170ºF (76.5ºC) but only 5% remain ungerminated after heat treatment at 176ºF (80ºC).

Table 1: Effect of heat treatment on the germination rate of slow (S) and fast (F) germinating B. cereus spores in milk.

Pasteurization Temperature	% Germinated spores after incubation		
	1 day (F)	1 day (S)	2 days (S)
170ºF (76.5ºC)	98	18	65
176ºF (80ºC)	99	34	95



These effects would be most evident on days when there are high spore loads in the incoming raw milk as shown by elevated LPCs, as can happen frequently in milk supplies.

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Generation times (hours) for some sporeformers in milk:

	36ºF (2ºC)	43ºF (6ºC)	50ºF (10ºC)
Bacillus cereus	no growth	18	4
Bacillus circulans	22	11	7
Bacillus licheniformis	N/A	24 - 36	8 - 14

There is a big difference in growth rates between 36ºF and 43ºF which may explain any differences between your lab shelf life flavor grading and field complaints. If the milk is held closer to 36ºF than 45ºF, the growth of these particular organisms is either absent or very slow. Generally speaking, the development of flavor defects would require bacterial populations in excess of 10^6 organisms/mL, or about 20 doublings or generation times from a single organism.

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Information from a recent IFT publication (Characterization of Pasteurized Fluid Milk Shelf-life Attributes, H.I. Fromm and K.J. Boor, Vol. 69, Nr. 8, 2004 – Journal of Food Science M207) suggests that "in general, product shelf lives were limited by multiplication of heat-resistant psychrotrophic organisms that caused undesirable flavors in milk."

This seems to be a consequence of a processor's success in eliminating sources of typical post-pasteurization contamination, i.e. fast growing psychrotrophic Gram negative rods that are readily killed by pasteurization. These organisms cause flavor defects much earlier in the shelf life of fluid milk and limited code dates to a shorter period than is current practice. The use of longer code dates allows the slower growing heat-resistant psychrotrophic organisms present in raw milk to grow to levels that cause flavor defects, generally accepted to be in excess of 10^6 organisms/mL. These defects are often described as bitter and putrid smelling, which is usually indicative of proteolytic activity by Bacillus sp., and can also be observed as a "sweet curdle" or coagulation of the milk.

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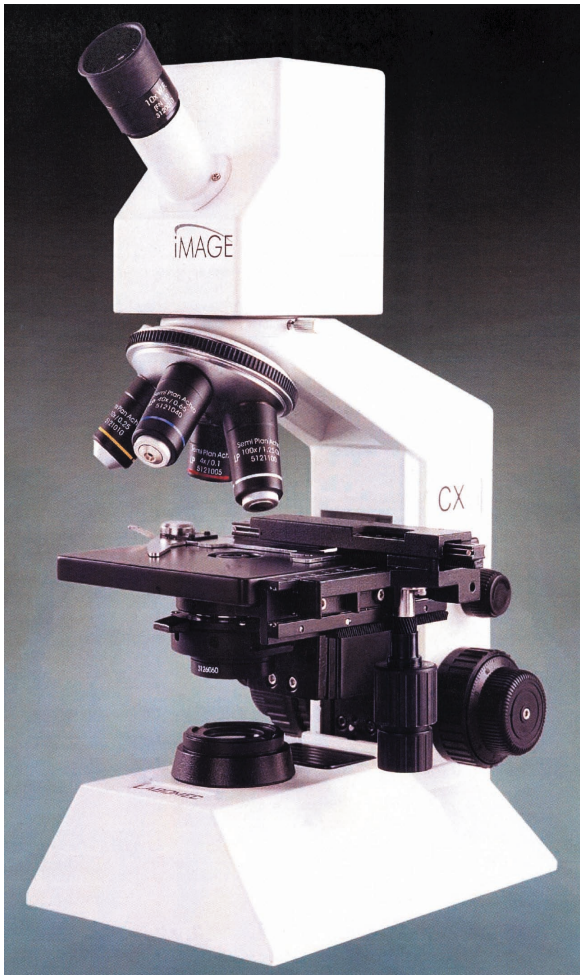
The source of these heat-resistant psychrotrophic organisms is generally accepted to be the raw milk received by a plant but there are also areas within the plant that can contribute to the overall load.



The condition of receiving hoses, receiving meters, raw silos, and distribution lines as well as the practices used for the rotation of silos can contribute to in-plant sources of heat-resistant psychrotrophic organisms. The condition of the HTST is also important, particularly the separator. Also of concern are the areas of the pasteurized regeneration zone that are at a suitable temperature during production, i.e. not at either holding temperature or cooling temperature. These relatively temperate zones can allow these organisms to grow and form biofilms during extended runs. A mid-shift flush or mini-wash is recommended to minimize these effects.

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