Letter to the Editor: Pasteurization Temperature of Milk: A Comment on Gandy et al. (2008)

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Commercial pasteurization has proven over a century to be a highly effective and reliable means to provide consumers with microbiologically safe fluid milk, without detriment to milk's distinctive, yet subtle and delicate flavor. Judicious care is required before attempting to modify pasteurization conditions [defined by Codex Alimentarius (2004)] as this is a critical control point for food safety. We are concerned by recent statements (Gandy et al., 2008) that could mislead people to mistakenly think that milk pasteurization is unsafe.

Two reasons were given by Gandy et al. (2008) for studying volatiles from milk pasteurized at greater than standard temperatures. Their first reason was because of concerns that current pasteurization processes might not completely inactivate *Mycobacterium avium* ssp. *paratuberculosis* (MAP). However, they may not have been aware that there are now several definitive studies, published by research groups worldwide, that have examined MAP pasteurization by commercial-type heat exchangers and have found no evidence of MAP survival. The initial New Zealand study on the kinetics of MAP inactivation by pasteurization (Pearce et al., 2001) has been confirmed and extended by studies from the United States (Stabel and Lambertz, 2004), Australia (McDonald et al., 2005), Ireland (Lynch et al., 2007), and the Netherlands (Rademaker et al., 2007). The international literature is now clear that properly maintained and operated pasteurization equipment ensures the absence of viable MAP in retail milk and other pasteurized dairy products. It is important to appreciate that, when low levels of surviving bacteria are reported, the onus is on the authors to demonstrate that these are not due to cross-contamination.

The second reason given for raising pasteurization temperatures was to *increase* the shelf-life of milk. Again, Gandy et al. (2008) may not have been aware that treatment of milk at greater than standard temperatures will encourage bacterial spore germination,

and so may *decrease* the shelf-life of milk (Barbano and Boor, 2007).

Gandy et al. (2008) described a range of volatile compounds that correlated to heat treatment. A minimum standard to establish a volatile compound's identity requires its GC retention time to match that of an authentic chemical reference, as is done for other *Journal of Dairy Science* papers (e.g., Croissant et al., 2007). Such references were not used to identify most of their reported compounds, including ethylamine, guanidine, hydroxylamine, "hydroperoxide" (hydrogen peroxide), tetrahydrofuran, and pentane, although such standards can be purchased inexpensively. It is easy to misinterpret mass spectra from the GC-MS instrument. Without authentic chemical references, compounds may be reported that are not credible as milk volatiles, which was likely the case for the first 4 compounds listed above. Examples of an amine with a $pK_b < 7.4$ as a milk volatile are rare (e.g., Lundén et al., 2002) because, at milk's pH of 6.6, such amines exist predominantly as nonvolatile conjugate acids. Ethylamine has a pK_b of 3.3, making it an unlikely milk volatile. Guanidine is an implausible milk volatile because even its free form has low volatility. Hydroxylamine decomposes in hot water. Hydrogen peroxide has a combination of insufficient volatility and too great a polarity for headspace solid-phase microextraction analysis. Moreover, tetrahydrofuran and pentane are volatile solvents common in laboratories. Before reporting potential laboratory contaminants as authentic volatiles of a food, the onus is on the authors to demonstrate their absence from GC runs of blank extractions.

For the case of toxic chemicals, such as hydroxylamine, extensive experimental evidence is necessary before authors report them to be components of food, particularly when food safety is the purpose of the study.

Volatile compounds may vary between milk samples, even from the same cows (Mounchili et al., 2005), because of different collection times, lactation stage, feed type, or storage time and temperature. Any study examining processing effects on sensory properties or volatile compounds must, therefore, use the same base milk for each treatment. From their text, it is not clear

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whether Gandy et al. (2008) actually did this. For pasteurization at both the laboratory scale (Valero et al., 2000) and the commercial scale (Bendall and Olney, 2001), there is little difference in volatile compounds between pasteurized milk and the raw milk from which it was processed.

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