Hormone-Boosted Milk Passes FDA Review

In its first published evaluation of one of the most controversial animal drugs of the decade, the Food and Drug Administration has declared that dairy milk produced with the help of recombinant bovine growth hormone (BGH) is as safe to drink as the old-fashioned variety.

After reviewing dozens of studies addressing BGH and human health, FDA scientists report in the Aug. 24 SCIENCE that the drug – a genetically engineered version of natural BGH – "presents no increased health risk to consumers." Another research review echoing that conclusion, authored by scientists from Washington University in St. Louis and Cornell University, appears in the Aug. 22/29 JOURNAL OF THE AMERICAN MEDICAL ASSOCIATION. The two papers represent the strongest affirmation yet that the experimental milk is safe for human consumption.

Although BGH-stimulated milk from FDA-approved experiments has been legally sold in several states, the commercial product still awaits federal licensing.

The hormone has both tantalized and alarmed milk producers and consumers since the early 1980s, when scientists learned to mass-produce it in bacteria and experiments showed it could increase dairy milk production by 10 to 40 percent. Besides stirring health concerns about hormones in milk, the newly synthesized drug worried small dairy farmers, who foresaw gigantic farms quickly exploiting the hormonal advantage while smaller farms struggled to revamp their operations to incorporate the new technology. Earlier this year, Wisconsin and Minnesota – where small farms are rapidly disappearing – banned the sale or commercial use of the drug for at least a year.

FDA now concludes that BGH is biologically inactive in humans. The hormone refuses to bind to human tissues; nor does it show toxicity when fed to rats, even at doses equivalent to 100 times those normally given to dairy cattle. A substance called insulin-like growth hormone, produced by cows in response to BGH, also shows no biological activity at various doses in rats. Although increased levels of this hormone showed up in the milk of treated cows, the total amount "was lower than what you would find in human breast milk," says report coauthor Judith C. Juskevich, now a toxicology consultant in Halifax, Nova Scotia.

Though these findings may calm the anxieties of many milk drinkers, some analysts say they do not bode well for the nation's small dairy farmers. "Some people are going to get hurt," says Robert J. Kalter, an agricultural economist at Cornell. He anticipates that within five years of BGH reaching the market, the number of U.S. dairy cattle will decrease by as much as 25 percent as fewer cows suffice to supply the market demand. These decreases, he predicts, will hit small or poorly managed dairy farms the hardest. "Frankly, the small farms are disadvantaged with or without [BGH]," says Kalter. "They may survive five, 10, 15 years, but 40-cow operators in this day and age are not a viable enterprise anymore."

Nonetheless, he says, "I think the benefits [of BGH] outweigh the costs. If you don't keep prices competitive, other food sources will take over the market – much as margarine replaced butter. I think the industry would be shooting itself in the foot if it banned BGH."

Larry O'Neill, a spokesman for Monsanto Co. in St. Louis – one of four companies developing and testing BGH under FDA guidelines – says he expects FDA approval for a commercial license next year. But legal hurdles remain, according to FDA spokesman John K. Augsburg. Some critics of BGH claim that the stress of increased milk production lowers bovine disease resistance and conception rate. Augsburg says FDA is now reviewing data on dairy cow and calf health from each of the BGH-producing companies.

"All the data that we have asked for, the firms have been able to generate," he adds. "I would not say it would be approved within a year, but there are no big stumbling blocks." – *W. Stolzenburg*

Solutions to crystal-growth mysteries

Crystallizing chemical compounds serves as a simple rite of passage for chemistry students. But even professional chemists admit that controlling how molecules pack together and dictating the shape of the crystals that emerge still falls largely under the category of black magic.

If scientists could demystify the physics behind that magic, they might discover ways of making drug-laced crystals that disintegrate at specific rates in the body, for instance, or crystals that process photons the way silicon-based chips process electrons, creating a new generation of communication and computing technologies, notes chemist Bruce M. Foxman of Brandeis University in Waltham, Mass.

Electrostatic, geometric and other physical interactions between a liquid solvent and the surface of a growing crystal play crucial, though poorly understood, roles in determining whether that crystal will assemble into a flat flake, a thin needle or a bulkier, more complex form. In 1985, Leslie Leiserowitz, Meir Lahav and Lia Addadi and others at the Weizmann Institute of Science in Rehovot, Israel, found that "tailor-made" chemical additives could bind to specific faces of a growing crystal, thereby influencing its shape.

Now, they and their co-workers report that the same principles hold for additive-free solvents. In the Aug. 15 JOURNAL OF THE AMERICAN CHEMICAL SOCIETY, the team describes how specifically formulated solvents control crystal growth and disintegration.

When grown in water, crystals of asparagine (an amino acid) monohydrate can have as many as 18 faces. When the researchers replace some of the water with methanol or ethanol, the surface areas of some faces increase at the expense of others, resulting in a flatter, less complicated shape. Crystals of rhamnose (a sugar) monohydrate undergo comparable changes. The researchers attribute this behavior to the relative ease with which alcohol molecules bind to specific sites normally occupied by water molecules. This binding, they say, inhibits growth of these faces but not of others.

But when solvent molecules bind to specific surface sites on some crystals, they can enhance growth by a dynamic "relay" mechanism, the Israeli team suggests. To test this solvent effect, they examined crystals of the amino acids alanine or glycine, which form with positively charged amino groups and negatively charged carboxylate groups exposed at different ends.

Changing the solvent's alcohol/water ratio alters the relative rates of growth or dissolution at these ends, they found. Enhanced growth of the carboxylate ends of alanine crystals, for example, arises from a cyclic process in which new alanine molecules dock into surface pockets that are not blocked by overlying water molecules. Once in place, the newcomer alanine molecules temporarily get capped by water molecules, while repulsive forces drive away adjacent water molecules, opening new sites to the next wave of alanine molecules. "The repetitive succession of these steps results in a 'relay'-type mechanism of crystal growth," the researchers conclude. – *I. Amato*