Barnyard biotech: Dissent on the farm

Agricultural biotechnology is being forced to face a new challenge to its application. This time the question raised is not "Is it safe?" but rather "Is it economically and socially desirable?"

The technique in question is the use of bovine growth hormone, or somatotropin, to boost milk production in dairy cows. Injections of this hormone, which is normally produced in low levels by a cow's pituitary gland, have been shown to increase milk production 10 to 40 percent with only a modest increase in feed (SN: 5/5/84, p. 284).

More recently genetic engineering has created bacteria that can produce the hormone in quantities large enough to allow wide distribution. The U.S. Food and Drug Administration (FDA) has issued permits to several companies, including the Monsanto Company of St. Louis, to test bovine growth hormone, and will consider requests for commercial licensing of the hormone.

The power of this prospective innovation in the dairy industry poses an economic dilemma. Scientists predict that use of the hormone will increase milk production by at least 20 percent. But it is a *surplus* of milk, not a shortage, that already faces the United States. This week a national program begins in which dairy farmers will be paid more than $1.8 billion to slaughter nearly 1 million cows – leading to an expected 7 percent decrease in milk production. Participating farmers agree to leave the business for at least five years.

On April 1, a coalition including Wisconsin's Secretary of State Douglas LaFollette petitioned the FDA to prepare an environmental impact statement on bovine growth hormone. Widespread use of the hormone will wreak havoc on the dairy industry as well as damaging the environment and causing cows to suffer, charge LaFollette, the Wisconsin Family Farm Defense Fund, the Humane Society of the United States and Jeremy Rifkin of the Washington, D.C.-based Foundation on Economic Trends. If the FDA does not agree within 30 days to begin preparing an environmental impact statement, Rifkin says the coalition will sue in federal court.

Introduction of the hormone into dairy farms will produce "the single most devastating economic dislocation in U.S. agricultural history," Rifkin says. The coalition cites a 1984 economic study by Robert J. Kalter at Cornell University predicting that 25 to 30 percent of U.S. dairy farmers would be forced out of business within three years of the introduction of bovine growth hormone.

But long-range economic considerations do not necessarily determine whether a new technology is adopted. "If it's a good tool, we'll use it," says David Zartman, a dairy scientist at Ohio State University in Columbus.

"You can't stand in the way of progress," agrees Truman Graf, an agricultural economist at the University of Wisconsin at Madison.

"Is this technique progress? Is it good for the public welfare? I quickly come to the answer that it is not," says Mike Cannell, a dairy farmer in Cazenovia, Wis., and chief spokesperson for the Wisconsin Family Farm Defense Fund. "Rural communities will be disrupted and the chemical companies [expected to produce the hormone] will take their money and run."

There is concern that the family farms, such as those in Wisconsin – the state that currently produces the most milk – are far more likely to be forced out of business by a milk surplus than are the much larger corporate farms in the Southwest and California.

But Zartman predicts that bovine growth hormone will actually increase the survival of the family dairy farm, which typically has about 50 cows as opposed to up to 2,000 on some corporate farms.

"As we move into more technology, large corporate farms will have to hire skilled and educated people, and that will cost them dearly," Zartman says. "Family farmers will learn to use the technique themselves." He also argues that the smaller farms currently obtain less milk per cow, so they may expect to benefit more from a boost in milk production.

A study released last month by the congressional Office of Technology Assessment (OTA) predicts that bovine growth hormone use would benefit dairy farms of all sizes. But, it says, "Emerging technologies need to be transferred to moderate-size dairy farms at a much earlier time in the technology adoption process for these farms to survive."

The OTA report predicts that new technologies in general will provide greater financial opportunities for large rather than small farms; that there will be a trend to fewer and larger dairies in all regions; and that there will be a need for farms in the Great Lakes states and the Northeast to substantially restructure to compete.

The Humane Society, in a rare alliance with farmers, is focusing on the potential effects of increased milk production on the individual cow. "The dairy cow is now under intense pressure to produce," says Michael Fox of the society. "Growth hormone will turn the cow even more into a milk machine." Fox contends that increased milk production increases cows' susceptibility to a variety of diseases.

In addition, Fox predicts that growth hormone will bolster the largest "superfarms," where he says there are "real problems of inhumanity to animals." He says the cows there get no individual attention and infections tend to be overlooked.

The environmental effects of bovine growth hormone use will come from an increase in total feed requirements that will change agricultural land use, accelerating soil erosion and nutrient depletion, Rifkin says.

"Industry is not prepared for consumers saying no to biotechnology," Rifkin adds. "Bovine growth hormone will be a key metaphor for what is wrong with genetic engineering." *– J.A. Miller*

Conditioning stirs 'synaptic memory'

The hippocampus, a small bundle of cells deep in the brain, plays an important role in making the learned associations that characterize classical conditioning. When rabbits, for example, are simultaneously presented with a tone and an air puff aimed at the eye, the activity of pyramidal cells in this brain region increases before the animals learn to blink their eyes in response to the tone alone; pyramidal cell activity does not increase when the air puff and tone are presented separately (SN: 12/10/83, p. 380).

A similar type of conditioning has now been observed in rats, in the synapses that transmit nerve impulses to the same hippocampal cells. Since there is a form of "synaptic memory" in the hippocampus, say Stephen R. Kelso and Thomas H. Brown of the Beckman Research Institute of the City of Hope in Duarte, Calif., it may mediate simple types of learned associations. Learned associations involving more than one conditioning stimulus can be used with the synapses to see if cellular changes run parallel to similarly produced behavioral responses, they report in the April 4 SCIENCE.

Kelso and Brown obtained 14 hippocampal slices from 10 rats. In each slice, one of two nerve fibers feeding into the same synapse was weakly stimulated with an electrode and electrical activity in the synapse was measured. This stimulation was then paired with stronger electrical pulses delivered at the same time by another electrode placed in the same region. Electrical activity in the synapses in response to weak stimulation alone increased markedly 12 to 16 minutes after the pairing. If strong stimulation occurred just before or after weak stimulation, synaptic activity was not enhanced later.

It remains to be seen, say the researchers, whether hippocampal synapses in complex neuronal networks respond to conditioning sequences.

– B. Bower