Commentary on agricultural biotechnology

Ripen-on-command: In a society with ample food, why bother?

Margaret Mellon

Ripen-on-command cantaloupes may be the latest among a series of genetically engineered fruit and vegetables being readied for market. Their development involves clever manipulations, and raises few questions about safety, particularly on the ecological front. But the real question is why bother with such premium R&D efforts when good quality produce is already available to consumers in such abundance? This question is especially troubling in light of the need for basic research on food crops for populations in Africa and elsewhere, who could soon face genuine food scarcities.

For many people, the term genetically engineered food conjures up an image of the Flavr Savr tomato. The first genetically engineered whole food to be commercialized, the Flavr Savr received considerable attention with its claim to be a winter tomato that did not taste like a tennis ball.

But the Flavr Savr turns out (in addition to being a commercial disappointment) to be something of a fluke in the world of engineered food. Not only was this tomato subject to a public safety review, and voluntarily labeled—so far, not the case for any subsequently engineered food—the engineers also tried to improve a trait that consumers care about, taste. For the most part, genetic engineering in agriculture—like traditional breeding—is done to meet the needs of growers, transporters, and wholesalers, not consumers. The traits that growers and the rest of the food supply system value—herbicide-resistance, disease-resistance, and long shelf-life—are generally invisible to consumers.

This issue of *Nature Biotechnology* presents a report describing a long shelf-life cantaloupe—in many ways a more typical representative of an engineered food than the Flavr Savr. The cantaloupe is engineered with an antisense gene to depress the level of ethylene—the chemical responsible for turning on the cascade of events that leads to ripening. Presumably, the cantaloupe will be picked green and hard, stored in an arrested state, and then gassed with exogenous ethylene to induce ripening. This option will give an increased degree of control and flexibility to those who transport, store, and market cantaloupes.

But for consumers, what are the advantages? In my grocery store, there is no evidence of a cantaloupe shortage, and prices are not outrageous. Quality is good and the cantaloupes usually tasty. It's hard to imagine improving the taste of ripe cantaloupe. (Indeed, the consumer issue concerning taste would be whether to assess a taste penalty if it fails to measure up.)

The engineered cantaloupe will pose few, if any, discernible food-safety risks. The cluster of issues surrounding the selectable marker, kanamycin resistance, and antisense genes have been reviewed in the context of the Flavr Savr, which was deemed safe. Presumably, analysis of the cantaloupe would lead to a similar conclusion, with the standard caveat that even the most careful review cannot eliminate the uncertainties associated with any novel technology.

Assessing the potential environmental impacts of this product, when it is grown on a huge commercial scale, is a more challenging undertaking. For instance, the wild relatives of cantaloupe are found in many parts of the world, including India and Africa, where this and other melons originated. Admittedly, it is difficult to postulate a scenario in which antisense genes could damage a wild population of cantaloupe relatives. On the other hand, the artificial antisense constructs are completely new to nature, and their effects are not easy to predict. Nevertheless, although the environmental risks of such a cantaloupe appear minimal, it and all engineered crops should be evaluated under field conditions for ecological risks.

Assuming that both the risks and the benefits of the cantaloupe are minor, if not trivial, how would they compare? Some people would conclude that, in a society with ample food, a small benefit to the food system does not outweigh any risks to health and the environment. For others, such a benefit is more than enough.

In important ways, the case-by-case assessments of risks and benefits are too confining. In truth, industrialized countries have few genuine needs for innovative food stuffs, regardless of the method by which they are produced. We have food-related problems to be sure—from the malnourished homeless to the one-third of our population that is clinically overweight. But the solutions for these problems do not lie in production-oriented genetic engineering. They lie in resolving income disparities, and educating ourselves to make better choices from among the abundant foods that are available.

That cannot be said of the rest of the world. In many ways, it is not fair to ask the private sector to solve the problem of impending food scarcity in the developing world. Companies go where the money is, and there is more money to be made in cantaloupe for Americans than in cassava for Africans. It may not even be fair to seek solutions from national agricultural research programs because they accept taxpayers' money to promote their own agriculture, not some other country's agenda.

But these questions have to be asked of someone. The problem deserves serious and immediate attention, especially from the international agricultural community. The National Research Council (NRC; Washington, DC) recently published a report that outlines promising opportunities for agricultural scientists interested in these issues. The NRC report (*Lost Crops of Africa*: Volume 1, *Grains*) is the first in a series. This report focuses on fonio, pearl millet, African rice, and other grains that have been cast aside in favor of maize, Asian rice, and wheat imported from elsewhere. The neglected foods have been rejected and labeled as inferior in the same way that peanuts once were by Americans, and potatoes by Europeans. But, according to the NRC, these native grains are not inferior. They are nutritious, tasty foods, and many of them are adapted to harsh climates and marginal soils. If this magnificent native biodiversity were fully developed, it would go a long way toward feeding Africa's burgeoning populations.

But as the NRC report stresses, only a few of these indigenous African grains have received concerted scientific attention. The report is replete with needed "next steps" for research, including plant breeding, germplasm collection, increased productivity, nutritional analysis and improvement, agronomic studies, and cultural practices. Where are the resources going to come from to follow the exciting trail blazed by this report? The resources devoted to genetically engineering long shelf-life cantaloupes, herbicide-tolerant crops, and hardier tomatoes could recover many of the lost crops of Africa. I, for one, would be willing to make the tradeoff. ///

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