/THE FIRST WORD

Bread and Biotechnology

As noted previously, the transformation of wheat and other food crops has proved more difficult than originally imagined. It has seemed as if crop transformation was stuck in the trough of the "first wave" of agricultural biotechnology advances—the control of insects, weeds, and plant diseases—that Robert Fraley of Monsanto wrote about in an article published in these pages in January 1992. It now appears that the second wave he wrote about then may be forming—the one that will impact the food processing and pharmaceutical industries.

In this issue, Peter Shewry and his colleagues review what is currently known about the biochemistry of wheat gluten proteins. Wheat gluten was first isolated in 1745 by Jacopo Beccari at the University of Bologna, who showed that wheat flour could be divided into two fractions—starch and gluten.

Gluten has elastic properties that give breads and other foods their "doughy" quality: When wheat grain is milled to make flour, proteins are released. When water is added to the flour and kneaded, these proteins form gluten. Add a little yeast (which will soon become, in the form of *Saccharomyces cerevisiae*, the first higher organism for which the DNA sequence of the entire genome will be available; see this month's Last Word) to leaven the mixture, and the gluten in the dough stretches around the resulting carbon dioxide bubbles, causing the dough to rise.

Breadmaking machines may have replaced handmills and brick ovens, but even a novice baker gets to be an experimentalist: Use old yeast, or too little water, or water that is too hot or too cold, and your bread turns to stone. Use too much of the same, and it flops out of the mold. Use too much sugar, and the gluten gets thin and scraggly and your bread falls apart.

Gluten has been the subject of scrutiny by the food processing industry because its elasticity determines the strength of the dough that results. Strong doughs with very elastic glutens are required for making bread, bagels, pizza, pasta, and noodles, while doughs made of less elastic glutens are needed to make cakes and cookies, for example.

Knowing the ins and outs of the gluten complex will make altering the texture, color, flavor, cooking, and storage properties of gluten-based foods possible. One also wonders if gluten can't be put to the same use as other elastic biomaterials (for example, elastin and collagen) to make such products as tissue wound healing matrices. And perhaps understanding gluten brings a bit closer the possibility of manipulating food products for drug delivery—nutriceuticals, as was suggested earlier this year, when the banana genome became accessible.

It may also bring insight into the basis of gluten intolerance, which is a significant problem for those who suffer from it because gluten is not only used in easily identifiable foods, but also in many other, less obvious, foods as binder or filler. Beyond the chronic inflammatory intestinal and skin disorders (celiac sprue and dermatitis herpetiformis) gluten intolerance is known to cause, it has also been implicated in problems ranging from arthritis to autism.

Technical problems remain to be solved before the transformation of wheat and wheat gluten can be begun in earnest: When it comes to the cereal crops, robust transformation procedures are still elusive, as are tissue-specific, or developmentally regulated, promoters. But the next revolutionary wave in agriculture is on its way.

—SUSAN HASSLER
E-mail: s.hassler@natureny.com