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A golden bowl of rice

What a year for agbiotechnology. After months of bad publicity, vandalism of field trials, scaremongering, and misinformation in Europe, the contagion looks to be spreading west. Indicative of the growing aversion for all things genetically modified, US baby food manufacturers Gerber and Heinz—-a subsidiary of Novartis no less—-announced they intend to ban gene-spliced materials from all their products (even if the alternatives are nutritionally inferior or less safe). With GM phobia threatening to engulf the globe, are there any grains of hope left for agbiotechnology? A talk at the XVI International Botanical Congress in St. Louis suggests there are. In work that fulfills many of the grand promises of agbiotechnology, Ingo Potrykus and his colleagues at the Swiss Federal Institute of Technology and University of Freiberg have genetically engineered two new rice strains with the potential to combat nutritional disorders afflicting billions of people worldwide.

Rice endosperm—the edible bit—lacks a number of vital micronutrients. In countries where rice is a staple food, this causes widespread and devastating nutritional deficiencies. The World Health Organization estimates that close to a quarter billion children worldwide suffer from vitamin A deficiency. Many of them will fall prey to disease because of their weakened immune systems, and nearly half a million will go blind. Staple food crops are widely distributed, so in theory, such food could be engineered to provide micronutrients to those in need—in effect, making food staples double as nutrient supplements. Potrykus and colleagues have taken a significant first step toward making this strategy a reality, and now report bioengineering of two rice strains to combat vitamin A and iron deficiencies.

One strain is engineered to make the grains produce beta-carotene, which is converted to vitamin A in the body. The scientists achieved this by expressing genes encoding enzymes that produce beta-carotene: Two of the genes were from daffodil, and one from the bacterium *Erwina*. The transgenic rice produced golden grains with enough beta-carotene to meet the daily requirement of vitamin A in a meal-sized portion.

The rice strains developed by Potrykus and his colleagues will be freely available to agricultural research centers worldwide. The International Rice Research Institute will cross the transgenic material with publicly available rice breeding lines that, within three to five years, are expected to reach farmers in far flung corners of the world. And all this without a terminator gene in sight. In this time of patents and manic research commercialization, it is refreshing to see a true sense of moral responsibility successfully combined with scientific progress. For this we can thank the Rockefeller Foundation and the European Union, who funded the research.

But while we applaud the ingenuity and dedication of the scientists who achieve these successes, we wonder if such gains could become casualties of the battle being waged over GM crops. If they do, it would be the loss of a golden opportunity to actually help the several billion people in the world whose food doesn't arrive in packaging requiring labeling, if it arrives at all. ///

Make biology compulsory for presidential candidates

It's difficult to take issue with Al Gore, the only US presidential candidate who ever even mentions the words "science" and "technology" and "research" while on the campaign stump. But a speech he made in Philadelphia in June outlining his five-point plan to continue the war on cancer suggests he needs to educate himself about the complexity of cancer and the danger of throwing more money at an ill defined problem.

According to Gore, we are "on the verge of identifying the genes that cause every type of cancer" and must get to work "mapping all cancer genes so there are no secrets left in cancer's arsenal." But we now know that very large numbers of genetic alterations in relatively "high-risk" genes are actually not predictive of cancer or malignancy. And whatever happened to the role of the host of extrinsic, nonmutagenic factors in cancer?

Gore's aims are not disconcerting, but his oversimplification of the problem is. He proposes to double the current cancer research budget from $3 billion to $6 billion over the next five years, and has issued a challenge to the research community to "develop simple blood tests and new diagnostic techniques for every major cancer," presumably using his A-Z catalog of cancer genes.

More money alone is not the answer, but more thinking about the problem of cancer might be. Gore and his advisors should step back a moment from the current vogue of genetic determinism and recall that, in multifactorial diseases such as cancer, no single gene is responsible for the manifestation of the disease. It has become apparent that networks of genes—perhaps hundreds of genes and their products interacting with environmental stresses—are required for disease manifestation. Genetic predisposition to cancer, therefore, depends on all the other genes a person has, as well as on extrinsic factors and on that individual's unique history.

And so it will not, at the moment, be possible to come up with simple tests for cancer based on a single gene or genes that will have any real predictive value for large populations of people. We simply don't understand how all this works yet. And that's because we are still looking for ways to get beyond the one gene/one disease model of cancer.

The "breast cancer genes" BRCA-1 and BRCA-2 are a case in point. As noted previously in these pages, what originally appeared to be a diagnostically significant few mutations in these genes indicating high risk in women has now mushroomed into hundreds of mutations. As one might expect, these mutations are also involved in other illnesses, don't behave the same way in different groups of women or men (or in mice for that matter), and are likely to be joined by mutations on other "breast cancer genes" in a variable constellation that may ultimately be of some predictive or therapeutic use.

And so perhaps before we spend additional time and money trying fruitlessly to understand cancer gene by gene by gene by gene, we should spend time and money reassessing, the battle plan—reimagining the central question of how to characterize cancer as a genetic illness—and determine on which fronts, and how, our future government-sponsored wars against cancer should be fought. ///