

Can we Predict or Avoid the Allergenic Potential of Genetically Modified Organisms?

Gerhard Obermeyer Fatima Ferreira

Division of Allergy and Immunology, Department of Molecular Biology, University of Salzburg, Salzburg, Austria

The exponential rise in the prevalence of allergic disorders in the last few decades has clearly contributed to increased costs of health care and has negatively affected the quality of life of millions of children and adults. A dose-dependent relationship between allergen exposure and sensitization and the subsequent development of allergic disease is well established. Therefore, it is desirable to decrease the allergen exposure in the environment, particularly in plants used for human consumption, as these may cause life-threatening allergic reactions in sensitized humans.

With the introduction of genetically modified organisms (GMOs) and genetically modified plants (GMPs), the questions on safety and gene dispersal were and still are hotly debated among scientists and the general public. Of particular interest is the widespread concern about increased allergenicity of food derived from GMPs. In the past, new varieties of crop plants were only generated by conventional breeding methods including classical genetics, spontaneous as well as induced mutations. Consequently, the introduction of a new variety took years, even decades. At the end of the whole conventional breeding process, the consumer was faced with a new food product that may contain higher amounts of allergens or a new allergen or no allergens at all. However, techniques of molecular biology and cell cultures have changed conventional plant breeding to plant biotechnology that al-

lows generation and production of new varieties in a shorter time period by purposeful introduction of foreign genes. In parallel, molecular biology has also sped up allergy research, and an increasing number of allergens have been identified in almost all plants used for human consumption. But it has to be kept in mind that in contrast to conventional breeding of crops, biotechnological techniques allow a consumer-specific tailoring of the new crops with controllable parameters. For the first time, there is a chance to avoid an increased allergen exposure of the consumers during the whole process, starting from the design and laboratory phase until the production and finally the introduction of the new crop plant.

With this up-to-date knowledge in allergy research, plant biotechnology and the appropriate techniques, it is reasonable to demand allergen-tested food, especially when the food-producing organisms can be generated under controlled conditions. But the question remains just how and when during the GMP generation and the genetically modified food production shall we perform assays for allergens? The two articles in this issue of *International Archives of Allergy and Immunology* by Goodman et al. [1] and Spök et al. [2] independently propose procedures to test GMPs (or even all GMOs) for their allergenicity. Based on the recommendations of the US FDA, the FAO/WHO and the EU, both author groups suggest different approaches to improve the current eval-

uation scheme to control allergens in GMPs. Shortly, Goodman et al. [1] are suggesting a refinement of the existing recommendations using state-of-the-art procedures to avoid the introduction of an allergen into genetically modified food products, whereas Spök et al. [2] demand a number of new tests and assays, including testing the final product with 'standardized patient sera' to avoid an unintentional increase in allergens by possible pleiotropic gene effects. Such pleiotropic effects may occur when the expressed gene increases for example the expression of plant defense proteins (pathogen response-related proteins), which are known to behave as allergens.

For both strategies, the desirable and the reasonable have to be balanced. An expensive and laborious testing procedure for GMPs will finally affect all crops as well. There is no scientific reason why allergens would not be introduced or increased when using the normal genetic variability of the plants during the conventional breeding process. Therefore, for equal treatment, every newly introduced fruit, vegetable or any other food product or even plant product that comes into contact with humans should be tested for allergen content. Spök et al. [2] have drawn the same conclusions. Is this still reasonable? We should remember that the New Zealand kiwi fruits were introduced into the European market without any tests,

and allergies were reported afterwards. Such cases of exposure to 'new' allergens might occur repeatedly due to globalization of the food market. Still, it is desirable to do as many reliable and scientific tests as possible to exclude the occurrence of an allergen in genetically modified food and food in general; however, not every test will be practicable and reasonable. In practice, biotechnologists following the refined, improved and updated rules of the current recommendation can avoid an accidental overproduction of known allergens in food products, but it is not possible to prevent that some individuals in the population will develop allergic immune responses to proteins that were not yet described or presumed to behave as allergens.

References

- 1 Goodman RE, Hefle SL, Taylor SL, van Ree R: Assessing genetically modified crops to minimize the risk of increased food allergy: A review. *Int Arch Allergy Immunol* 2005;137:153–166.
- 2 Spök A, Gaugitsch H, Laffer S, Pauli G, Saito H, Sampson H, Sibanda E, Thomas W, van Hage-Hamsten M, Valenta R: Suggestions for the assessment of the allergenic potential of genetically modified organisms. *Int Arch Allergy Immunol* 2005;137:167–180.