Food Safety

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Safety Concerns Associated with Genetically Modified Foods

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Introduction

Food safety issues are as old as mankind and humans have developed strategies to ensure that the food they eat does not harm them. An absolute guarantee that a food is safe is virtually impossible. This holds true for foods and ingredients made from conventional methods as well as from genetically modified (GM) organisms. All foods are composed of a complex mixture of numerous substances some of which may be toxic to the health of humans. However, the foods consumed today are generally viewed as safe, based on their long history of use with no obvious evidence of harm. This policy brief addresses potential safety issues associated with genetically modified foods that are the subject of safety assessment as carried out by regulatory authorities around the world.

Modern biotechnology or genetic engineering (GE) is considered a more precise method of altering or introducing genes into a plant compared to most conventional methods (e.g. traditional breeding and random mutagenesis) that introduce many uncharacterized genes along with the desired gene(s) or result in multiple mutations of an unknown nature. Scientific bodies from around the world have concluded that there are no food safety issues that are unique to GM technology and none have so far been detected in existing GM food products. Still, the potential occurrence of undesirable "unintended effects" or "unexpected effects" has been pointed out as a possible safety concern with respect to the production of food using GE technology. The safety to consumers of the intended GM effect e.g. the expression of a new and potentially toxic protein must also be established and is routinely the subject of the safety assessment procedures developed for foods derived from GM crops.

Unintended effects

Unintended effects here refer to unexpected alteration(s) beyond the primary expected effect(s) of introducing the targeted gene(s). Although unintended changes may be desirable or undesirable, typically they refer to the latter characteristics. Unintended effects are not restricted to modern biotechnology, traditional breeders observe off-types (undesirable variants) due to unintended effects and they methodologically eliminate these plants through selection during the evaluation process, long before commercialization. The same scrutiny is employed on GM crops but additional information on molecular genetic characteristics, compositional data, data from agronomic and phenotypic field trials and any other relevant data is also evaluated in an effort to detect unintended changes.

Allergenicity

One area of concern is that introducing a gene into an organism raises the possibility that levels of allergens in the modified organism may be increased above the natural range in the conventional food or new allergens may be introduced. Since the primary product of gene expression is protein and almost all food allergens are proteins, there exists a possibility that any novel protein introduced into a plant might be an allergen. It is important to note however that most foods do not cause allergenic reactions in most people, but for people who have any kind of food allergy, certain proteins in food can cause an unusual immune reaction. Therefore the possibility of introducing new allergens is a primary concern and subject of extensive food safety evaluations carried out during development of a GM crop.

Toxicity

Even though foods naturally contain toxic substances or antinutrients, the vast majority of these compounds usually occur at levels that are not harmful to humans when foods are consumed and processed appropriately. However, concerns have been raised about the possibility of introducing new toxic substances or elevating naturally occurring toxins to levels that are harmful to the health of humans with respect to GM foods. This possibility is precluded by the fact that as part of the safety assessment of GM foods, the levels of the naturally occurring toxins in the GM food are compared to those of the conventional food to ensure that the levels of the toxins are not

elevated above their natural levels. In addition, the source of the gene is routinely investigated to ensure that the gene product itself has no harmful toxic effects. Furthermore, the safety evaluation process requires the newly expressed product, typically a protein, be investigated to demonstrate that their properties are similar to those of thousands of proteins that are safely consume on a daily basis and dissimilar to known toxic proteins.

Gene safety

There has also been concern in the public domain of the health impact of consuming a foreign gene in a food, in this case the newly introduced gene or DNA. There is no general basis for this concern since we safely consume large amounts of foreign DNA daily in conventional foods (all plants and animals contain DNA). The DNA from the food we eat is degraded during the digestion process and is not transferred into our own cells or those of the bacteria in our digestive tract. A second concern focuses on the antibiotic resistant genes used in the transformation process as selection markers and the possibility of transferring this resistance to intestinal bacteria in humans and thus rendering them unresponsive to antibiotics. However, there is general consensus in the scientific domain that this kind of horizontal gene transfer is extremely unlikely. Furthermore, the antibiotics in question are typically not of clinical importance because resistance genes against these antibiotics already exist in the environment and these resistance genes are already very common in nature so that any very small additional transfer that might occur through transgenic foods would be negligible in both scope and medical impact. However, the use of antibiotic resistance marker genes is still controversial in some quarters and there is pressure to phase them out.

Nutritional concerns

In addition to the aforementioned safety concerns, the risk of health hazards that may be brought about by nutrient excesses, deficits or imbalances as a result of genetic modification through genetic engineering is also an issue that may be of concern and is also addressed before the marketing of foods derived from genetically modified crops. Both nutritional studies in animals and comparisons of nutrient levels between transgenic and comparable conventional crops are used to determine that nutritional factors have not been affected negatively.

Summary

For the past 14 years that GM foods have been consumed there has not been any documented evidence to indicate that these foods pose any more risk than their conventional counterparts. On this evidence it would be reasonable to suppose that the current regulatory framework for evaluating safety is effective in ensuring that the GM foods currently in the market are as safe as their conventional counterparts. This vigilance should be maintained as new GM products are developed and placed on the market to ensure safety.

This is the second of a series of policy briefs to be developed by the African Union/NEPAD - African Biosafety Network of Expertise (ABNE) addressing food safety aspects of modern biotechnology. ***This policy brief is targeted for regulators and decision makers.***

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