Codex Alimentarius Framework for Food and Feed Safety of Genetically Modified Plants: Best Practices in light of the latest science

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Regulatory Frameworks for Food Safety Assessment of Food derived from GM Plants

- Process (event) based regulation : focus on the process of genetic modification

  European Union, Australia, Japan, Thailand

- Product based regulation : focus on characteristics and use of the product resulted from genetic modification

  USA, Canada

Canada : All plants with novel trait (PNT) developed by GM or conventional method are regulated.

Japan : Only those were introduced with foreign DNA from other than the host must be assessed. Self cloning is exempt.

Safety of Food Derived from GM Plants

Although there are different in regulatory frameworks, approaches to the safety assessment of food derived from GM plants in most countries are similar that all tested and approved food derived from GM plant are as safe as food derived from conventionally bred plant currently consumed.

Different Regulatory Frameworks

Similar Approach

Principle of Risk Analysis
and
Safety Assessment Guideline
Developed by Codex Alimentarius Commission

OECD 1993, FAO/WHO 2000, CODEX Alimentarious commission 2003

Concept of Safety Assessment of Food Derived from GM Plants

OECD 1993, FAO/WHO 2000, CODEX Alimentarious commission 2003

There are no risks inherent in the use of recombinant technologies as all DNA is chemically and structurally the same and the transfer of genetic material across species barriers generally occurs and has been a major driving force in evolution.

Therefore the concept of safety assessment of food derived from GM plants is based on any functional and chemical changes resulted from the genetic modification.

Substantial Equivalence

Konig et al. 2004

Substantial Equivalence

Substantial equivalence is a concept that measures whether a food derived from GM plants shares similar health and nutritional characteristics with its conventional counterpart.

Food derived from GM plants that are substantially equivalent have been determined to be as safe as their conventional counterparts.

For those that are not substantially equivalent may still be safe, but must undergo a broader range of assessment prior to commercialization.

Safety Assessment of Food Derived from GM Plants

According to principle of risk analysis and safety assessment guideline developed by Codex Alimentarius Commission, risk is a function of hazard and exposure

Risk = Hazard x Exposure

and the safety assessment of each case-based GM plants includes steps of

- Identification of potential hazard (using substantial equivalence concept)
- Characterisation of the identified potential hazard
- Characterisation of risk
- Conclusion on safety

Hazard Identification

1. Information on recipient organism
2. Information on donor organism
3. Information on Transgene and transformation process
4. Characterisation of gene product(s)
5. Characterisation of the assessing GM plants

Hazard Identification

1. Information on recipient organism

- Identity
- Phenotype
- Agronomic performance
- Compositional analysis
- History of safe use

Consensus documents of major crop plants (OECD)

Hazard Identification

2. Information on donor organism

- Description of genetic material donor
- Safe history (Pathogen?)

Hazard Identification

3. Information on Transgene and transformation process

- Description of Vector
- Transformation process
  (Agrobacterium mediated, biolistic bombardment, microinjection)
- Characterisation of introduced DNA
  (unintended or unexpected new ORF, fusion protein)
- Insertion site and flanking sequences ???
  (not a routine practice as any harms to health can be identified by phenotype

Hazard Identification

4. Characterisation of gene product(s)

- Structure and identity (compare with known toxin and allergen in database)

- Characterisation
- Function
- Assessment of possible toxicity (bridging previous data & info to the assessing one, stability in food processing and digestion system, animal test (acute, sub-chronic and chronic???))
- Assessment of possible allergenicity (linear seq homology with known allergen of contiguous 8 (or 6) amino acids, stability in food processing and digestion system, serum screening, allergenicity in minor population)

GUIDELINE FOR THE CONDUCT OF FOOD SAFETY ASSESSMENT OF FOODS DERIVED FROM RECOMBINANT-DNA PLANTS

CAC/GL 45-2003

ANNE1: ASSESSMENT OF POSSIBLE ALLERGENICITY

SECTION 3.2 – AMINO ACID SEQUENCE HOMOLOGY

9. IgE cross-reactivity between the newly expressed protein and a known allergen should be considered a possibility when there is more than **35% identity in a segment of 80 or more amino acids** (FAO/WHO 2001) or other scientifically justified criteria. All the information resulting from the sequence homology comparison between the newly expressed protein and known allergens should be reported to allow a case-by-case scientifically based evaluation.

10. Sequence homology searches have certain limitations. In particular, comparisons are limited to the sequences of known allergens in publicly available databases and the scientific literature. There are also limitations in the ability of such comparisons to detect non-contiguous epitopes capable of binding themselves specifically with IgE antibodies.

Hazard Identification

5. Characterisation of the assessing GM plants

- Identity
- Phenotype and agronomy performance
- Compositional analysis
- Nutritional anaysis
- Animal test

(test with whole food is challenging, sub-chronic animal test has been suggested if the plant nutrition value and composition are significantly changed)

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Safety Assessment of Food Derived from GM Plants

- Identification of potential hazard (using substantial equivalence concept)

- Characterisation of the identified potential hazard
  (toxicity, allergenicity, nutritional and compositional analysis, estimated daily intake, maximum daily intake, exposure in vast and subgroup of a population)

- Characterisation of risk
  (weigh on the evidence)

- Conclusion on safety

Advancement in safety assessment of GM plants

- Advances in molecular biology

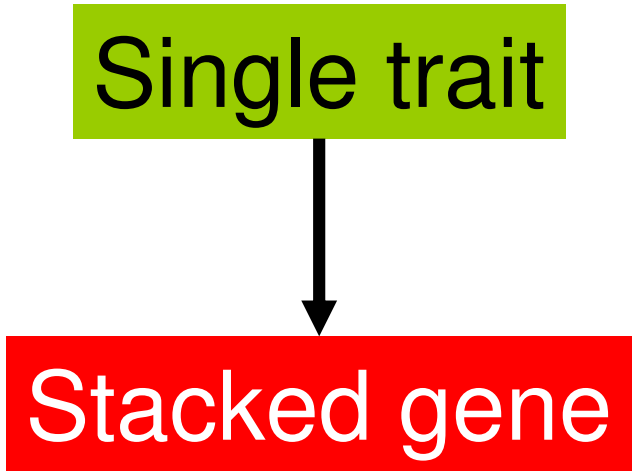
  Precise insertion site, reduced number of insertion site, no use or removal of antibiotic resistance selectable marker gene

- Advances in study of protein stablity and allergenicity

  molecular marker to distinguish allergen, microarray technique

- Advances in animal models for toxicity and allergenicity testing

  testing with whole food is still challenging



- Codex guideline for assessment
- Suitable comparator?
- more complicated compositional analysis