GM Foods: Possible Risks and Opportunities

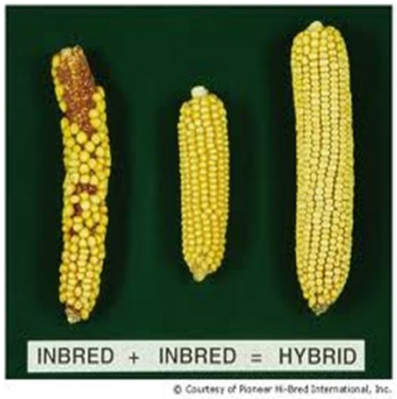
Dr. Frank Shotkoski, Cornell University, USA

l crops have been genetically modified during omestication

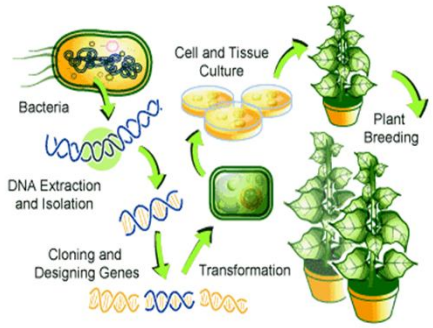
Domestication

Selection

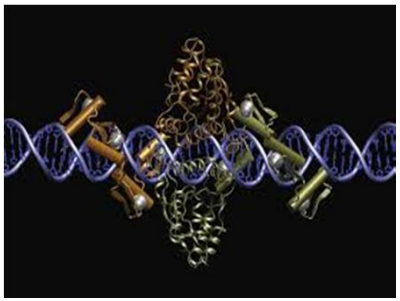
Mutagenesis



Hybridization



Transgenic/Cisgenic



Genome editing

Risks: What is Risk Management?

Risk management refers to the practice of identifying potential risks in advance, analyzing them and taking steps to minimize or curb the risk.

Real Risk versus Perceived Risk

- risk and its perception is a social phenomenon rather than a scientifically determinable factor

Regulatory paradigms

Based on Substantial Equivalence

- Risk, not Hazard; Product-based, not process-based
- Science and scientific development trusted and encouraged

Based Precautionary Principle

- Presumption favoring rigid regulation and risk aversion
- Social and political considerations more important than science and scientific development

Concerns About GM Crops/Foods

- Food safety concerns
  - Toxins
  - Allergens
  - Changes in nutritional content
  - Antibiotic resistance
- Environmental issues
  - Harmful effects on beneficial organisms
  - Impact on non-target organisms
  - Herbicide resistant weeds or “superweeds”
  - Genetic pollution/co-existence
- Ethical/social issues
  - Intellectual property/patent issues
  - Control of agriculture by big corporations
  - Business development concerns

How is a safety assessment of GM food conducted?

The safety assessment of GM foods generally focuses on:

- Direct health effects (toxicity),
- Potential to provoke allergic reaction (allergenicity);
- Specific components thought to have nutritional or toxic properties
- Stability of the inserted gene;
- Nutritional effects associated with genetic modification; and
- Any unintended effects which could result from the gene insertion.

Food Safety Realities

- All GM crops to be used as foods or food ingredients are required to undergo thorough and rigorous safety assessment
- More than one billion cumulative hectares of GM crops have been grown over the past decade with no documented adverse effects on humans or animals
- Livestock study with over a billion data points suggests that GM feed is safe and nutritionally equivalent to non-GMO feed.
- Food safety has been extensively investigated for released GM crops and consensus is that GM foods pose no greater health risks than conventionally developed foods

Major GM Crops: Highly processed food sources

Minor food crops that have been deregulated and are currently being cultivated

- Alfalfa
- Sweet corn
- Squash
- Eggplant
- Apples
- Potatoes
- Plum
- Rose
- Flax

Benefits to US farmer and consumer

- Economic
  - Increased yields (especially with IR traits)
  - Decreased insecticide costs
  - Enhanced income at an estimated $53.1B from 1996-2012
- Environment
  - Reduced insecticide exposure
  - Use of less toxic and non-persistent herbicides (glyphosate)
- Carbon Footprint
  - Reduced fuel consumption
  - Reduce other petroleum-based agricultural inputs

Near Term Opportunities for Consumers

Health
- Flavor and healthy oils

Improved nutrition
- Bio-fortification
- Micro-nutrient and mineral content

Food security for a quickly growing population
- Climate change adaptation
- Enhanced traits for staple crops such as rice, wheat and banana

Environmental preservation
- Improved yields on fewer acres using less water

Gene editing with undo buttons

Arguments in Favor of Using GM Crops

- GM crops improve productivity from a combination of lower production costs and increased yields
- Herbicide tolerant and insect resistant crops may lower chemical use in agricultural production
- Reductions in the use of agricultural chemicals will have favorable impacts on human health and the environment
- GM crops are expected to have positive effects on food safety, with lower use of chemicals on GM crops resulting in lower incidents of chemical contamination of food production and water resources
- Herbicide tolerant GM crops reduce the need for conventional tillage thus helping prevent soil erosion and reducing the carbon footprint associated with climate change
- Herbicide tolerant GM crops reduce labor requirements and use of fuel for weed control
- New GM crops are intended to improve productivity by increasing tolerance to abiotic stresses such as drought, heat and salt

Arguments Against Using GM Crops

- GM crops have additional costs for seed and traits
- GM crops may present future, unseen risks to the environment and economics of food production
- GM crops may present risks to human health that are not apparent yet
- GM crops may cross breed with wild relatives of crops which may have some negative impact
- Pesticide resistant crops may have an adverse affect on non-target insect species
- Use of GM crops may restrict access to European markets

Objective Assessment of Benefits and Risks of GM crops

- Both proponents and opponents of GM crops must have the common goal of responsible use of biotechnology
- Acknowledgement of both benefits and risks of biotechnology improves the transparent discussion and allows for interested individuals and groups to make informed choices
- Evaluation of biotechnology and its applications should be based on existing scientific principles
- Both proponents and opponents of biotechnology should refrain from exaggeration and sensationalism in discussing the benefits and risks of the technology
- When considering human health and food safety concerns, it is necessary to conduct rigorous scientific assessments to ensure safety of new products

Summary

- Humans have used genetic engineering through conventional breeding methods to improve the food supply for centuries
- The use of molecular technology to transfer genes into GM crops does not, in itself, create additional risks
- The function, efficacy and side effects of the genes being transferred could create potential risks and need to be evaluated carefully
- Safety and environmental evaluations should be on a case by case basis focusing on new component(s) in the GM product