Human Health & GMOs

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OUTLINE of TOPICS

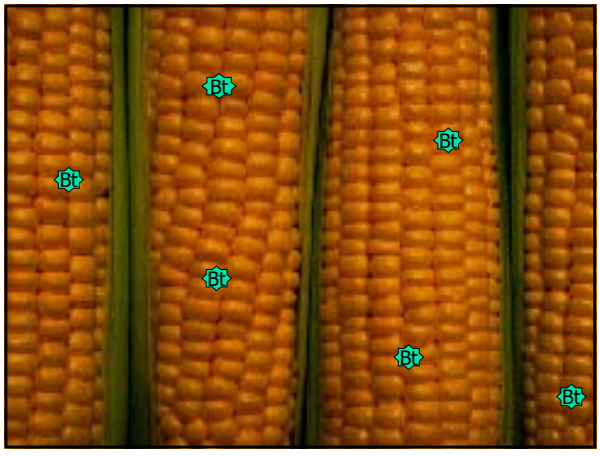
- Definition of **GMOs** and **SAFE FOOD**
- Food Safety Tests: **Risk Assessment** process for GM food

➔ **Nutritional composition**
➔ **Allergenicity concerns**
➔ **Toxicity concerns**
➔ **Antibiotic resistance markers in GM plants**

- **Risk management** & **Risk communication**

What are Genetically Modified Food or GM crops?

These are plants with particular genes inserted into these plants to improve their characteristics in a very specific way, as compared to their conventional counterparts.



Transgenic Bt corn

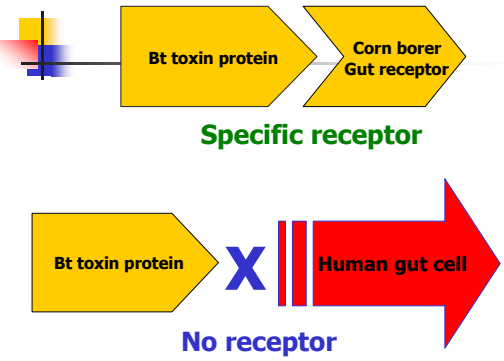
*** corn that has been genetically-engineered to express the *Bacillus thuringensis* toxin which makes the corn RESISTANT to corn borers

SOURCE of Bt toxin

- Protein in corn that protects against insects has a long history of safe consumption – derived from *Bacillus thuringensis* found naturally in soil
- Present in microbial products used globally for >35 years by organic growers as pesticide

Bt toxin

- **There are NO receptors for the protein delta endotoxins of Bt on mammalian intestinal cells**
- **Therefore, humans are NOT susceptible to these proteins**
- **BT proteins have poor solubility and stability in acidic stomach**
- **Acid in stomach and bile acids destroy the Bt protein**



Plants produce "toxins" or insecticides naturally

- **BT toxin is an insecticide**
- **Coffee and cigarettes have toxins**
- **Siling labuyo and paminta are toxins used as insecticides also**
- **Kalabasa flower repels insects**
- ***Most of the food we eat have anti-nutrients or natural "toxins"***

Definition of safe food:

- ***NO widely accepted definition***
- ***Food safety evaluated relative to acceptable levels of risk***
- ***Despite best efforts of everyone, food will inevitably carry with it some risks associated with food-borne disease***

Major issues raised against GM crops

- ***Possible health risks:***
  - **Altered nutrient levels/ different composition**
  - **Allergenic proteins**
  - **Toxicants**
  - **New antibiotic markers**

Major issues raised against GM crops

- ***Possible health risks:***

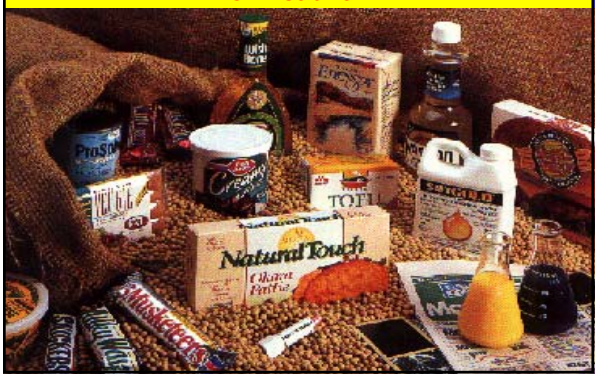
➔**Altered nutrient levels/ different composition ?**

Soybeans - For FOOD, FEED and Non-Food Products

SOYFOODS Directory

- Green vegetable soybeans
- Hydrolyzed vegetable protein (HVP) – flavor enhancer in soups, broths, sauces, gravies
- Infant formulas, soy-based
- Lecithin – emulsifier in products high in fats and oils; promotes stabilization, anti-oxidation, crystallization and spattering control
- MISO, soy sauce, soya oil, Tofu, soy nuts

Soy bean: Eat it, Wear it or Read it!!!



R Soybeans are compositionally equivalent to conventional Soybeans

- Based on the following components:
  1. Proximate analysis
  2. Amino acid composition
  3. Fatty acid composition
  4. Trypsin inhibitors; Urease
  5. Lectins; Phytoestrogens; Stachyose; Raffinose

* Based on assessment of >400 components in 2000 independent analyses-J Nutrition 1996; 126:702-716; J Allergy Clin Immunol 1996,96: 1008-1010

Roundup Soybeans and other glyphosate –based herbicides

- Health effects: EPA classifies herbicides for acute oral toxicity in 4 categories: I = most toxic; IV = least toxic

  Glyphosate is EPA Category IV

* Other extensive chronic toxicology tests➔ Glyphosate classified as Category E herbicide, or evidence of non carcinogenicity for humans

EPA Categories for human carcinogens

Group A = Human carcinogen
Group B = Probable human carcinogen
Group C = Possible human carcinogen
Group D = Not classified as to human carcinogenicity
Group E * = Evidence of non-carcinogenicity for humans

*Glyphosate classified in Group E

Major issues raised against GM crops

- ***Possible health risks:***

➔ **Allergenic proteins ?**

Protein that protects corn against insects – Results of safety assessment

- Strict specificity to target insects
- **Rapidly digested**
- No deleterious effects on mammals at > 20 million fold safety factor
- **No significant allergenic concerns**

QUESTION ?

- ***Does GM food have more potential to cause allergenic reactions?***
- **ANSWER: NO**

➔ In fact, there are efforts to remove allergens from rice, peanuts, etc. by genetic manipulation

Major issues raised against GM crops

- ***Possible health risks:***

➔ **Toxicants ?**

TOXICOLOGY

- **Acute Mouse study – purified protein (plant purified or microbial equivalent) ➔ single dose in large excess of dietary exposure**
- **Chronic study – 90 day rodent or chick feeding study on whole grain**

DNA and Protein Digestion

- The normal digestion conditions rapidly break down DNA and protein into smaller pieces that serve as important nutrients & building blocks
- Simulated gastric digestibility of introduced proteins is a part of the product safety assessment

Major issues raised against GM crops

- ***Possible health risks:***

➔**Antibiotic resistance markers ?**

ANTIBIOTIC RESISTANCE

- Use and misuse of antibiotics in clinical or veterinary applications are the major causes of antibiotic resistance
- Potential gene transfer from plant to microbe is virtually zero: $<10^{-14}$ to 10^{-27}
- Markers are now selected with limited clinical or veterinary oral use
- FDA, WHO, FAO concluded that these ARMs pose NO significant risk

Risk Assessment Biotech Foods

- Consensus that biotech foods are as safe as their conventional counterparts
  - *World Health organization*
  - *UN Food and Agriculture Organization*
  - *Org. for Economic Cooperation and Development*
  - *National academies of science * Australia, Canada, India, Mexico, UK, USA, Philippines*
  - *3000+ scientists throughout the world*

Conclusions on safety/safety assessment of GMFs

- All crop production technologies are capable of producing unsafe foods
- Food safety assessment for biotechnology products is more rigorous than for other crop production technologies
- Regulatory systems are in place to assure safety of these products

We advocate for the safe and responsible use of biotechnology