The Nutrition Professional’s Guide to GMOs

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Session objectives

1. Explain the history of GMOs in the food supply and describe the process involved in developing GM crops.
2. Identify benefits of GM foods supported by science, as well as scientific and consumer concerns with GM foods.
3. Identify sources of science-based information on GM foods.
Speakers

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Future of Food Resources for Members

- **Toolkits** [www.eatrightfoundation.org/toolkits-webinars](http://www.eatrightfoundation.org/toolkits-webinars)
  - Hunger in Our Community. What We Can Do.
  - Smart Choices. For a Healthy Planet. *(English/Spanish!)*
  - Tossed Treasures. How We All Can Waste Less Food. *(English/Spanish!)*

- **Supervised Practice Concentrations:**
  - Food Insecurity and Food Banking—**available now!** [www.healthyfoodbankhub.org](http://www.healthyfoodbankhub.org)
  - Food Systems—**under development!**

- **Webinars and Infographics** [www.eatrightfoundation.org](http://www.eatrightfoundation.org)

- **Affiliate Presentations:**
  - “Changing the Way We Look at Agriculture” 32 affiliates/DPGs *(2015)*
  - Food waste, food additives, and GMO presentations 10 affiliates *(2016)*
  - Foods of future, farming tools, and food preservation presentations 10 affiliates *(2017)*
Last year our donors’ generosity helped us award:

$446,900 in student scholarships to 194 students

$14,000 in student stipends to help 140 students attend FNCE.

$40,000 through Home Food Safety Challenge grants to dietetics students.

www.eatrightfoundation.org
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Disclosures

- **Immediate Past President 2014-2015**
  Institute Food Technologists

- DuPont 2005-2015

- Monsanto 1997-2005
What is ‘Biotechnology?’¹

Agricultural biotechnology is a range of tools, including traditional breeding techniques, that alter living organisms, or parts of organisms, to make or modify products; improve plants or animals; or develop microorganisms for specific agricultural uses.

Modern biotechnology today includes the tools of genetic engineering.
Genetic engineering (GE) is the technology that allows for selected individual genes to be transferred from one organism to another.

Genetically modified organisms (GMOs) are organisms in which the genetic material has been altered in a way that does not occur naturally.
Safety Assessment of GM Crops

• **Weight of evidence approach**
  - GM proteins (eg. Bt gene)
    – Gene source
    – History of safe use
    – Bioinformatics
    – Digestibility/stability
    – Mechanism of action/specificity
    – Exposure
    – Mammalian toxicity testing

• **GM Crop**
  – Composition assessment – Substantial equivalence
  – Animal feeding studies
International Biotech Guidance

- **OECD**
  - **Substantial Equivalence (1993)**
    - Not possible to demonstrate that any food is absolutely safe
    - Composition and agronomic properties of the GM crop comparable to those in an appropriate non-GM comparator

- **Codex Alimentarius**
  - **Principles for Risk Analysis**
    - Guidelines for the Conduct of Food Safety Assessment of Foods Derived from Recombinant-DNA Plants
      - Allergenicity Annex
      - Nutritional Composition Annex
    - Guidelines for the Conduct of Food Safety Assessment of Foods Derived from Recombinant-DNA Microorganisms and DNA Animals

- **Cartagena Protocol on Biosafety**
US Biotech Regulatory\textsuperscript{5,6}

Three Federal agencies review under a coordinated framework to ensure human and environmental safety

- **FDA** - safety and *labeling* of whole foods, food ingredients and additives
  - Once tested and approved no labeling required to differentiate GM vs. Non-GM
- **USDA/APHIS** - biotech plants; field test inspection
- **EPA** - registration of use of pesticides and herbicides
GMOs in Food

- 1st trait commercialized in 1993
  - 23 years in food supply
- Primarily for animal feed
- Human foods
  - Most processed - oils
- History of safe use
- Currently 9 crops commercially
  - 1 more and 1 animal coming to market soon
GMO Crops Available Commercially

- Apples
- Potatoes
- Field Corn
- Sweet Corn
- Canola
- Alfalfa
- Soybeans
- Papaya
- Cotton
- Sugar Beets
- Zucchini and Yellow Summer Squash
Global Adoption of Plant Biotech

GLOBAL AREA OF BIOTECH CROPS
Million Acres (1996-2015)

Up to ~18 million farmers, in 28 countries planted 444 million acres (179.7 million hectares) in 2015, a marginal decrease of 1% or 4.4 million acres (1.8 million hectares) from 2014.

Source: Clive James, 2015.
Who Says GM Foods are Safe?\textsuperscript{9-12}

**International authorities**

- Food and Agriculture Organization of the UN
- World Health Organization of the UN
- Codex Alimentarius- FAO/WHO

**National authorities**
Summary

- GMOs produced through genetic engineering are a part of agriculture biotechnology
- GM foods are regulated
  - Robust established safety testing paradigm
- GM crops have been consumed safely for over 20 years
- GM crop adoption continues to increase

(The Economist 2003)
Thank You!

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Disclosures

• American Society Nutrition, Member
• IFT, Professional Member
• GMO Answers Expert (volunteer)
• Center for Food Integrity content provider (volunteer)
**ROUNDUP® READY**

RoundUp® is glyphosate
- Inhibits shikimate pathway – plant specific enzymes

Resistance gene inserted using *Agrobacterium tumefaciens* process

Allows plant to survive exposure to glyphosate
- Herbicide tolerant

**BACILLUS THURINGIENSIS (Bt)**

Bt is a naturally occurring pesticide

Bt toxin approved as natural pesticide since 1960s – approved for use under organic standard

Bt gene inserted into plant

Plant produces Bt pro-toxin that kills corn borer insect
- Pest resistant
Food Sources of GMO\textsuperscript{16,17}

Currently in the food supply
- Corn
- Soybean
- Canola
- Sugar beets
- Papaya
- Squash

Approved – coming soon
- Apples
- Rice
- Eggplant
- Salmon
- Melon
- Sweet pepper
- Plum
- Tomato
- Potato
“70-80% of processed foods have GMO”

**Corn**
- Sweeteners (HFCS)
- Corn starch
- Corn oil
- *Animal feed*

**Soybean**
- Soy flour - proteins
- Soy oil
- *Animal feed*

**Canola**
- Canola oil

**Sugar beets**
- Sugar

**Alfalfa**
- *Animal feed*

Mainly contributed by food ingredients
Purified lipids and carbohydrates have no DNA or proteins therefore GMO products are not different from non-GMO products.

GMO grains fed to animals do not change the composition of meat, milk or eggs.
In the 1992 policy, FDA also addresses the labeling of foods derived from new plant varieties, including plants developed by bioengineering.

The 1992 policy does not establish special labeling requirements for bioengineered foods as a class of foods.

The policy states that FDA has no basis for concluding that bioengineered foods differ from other foods in any meaningful or uniform way, or that, as a class, foods developed by the new techniques present any different or greater safety concern than foods developed by traditional plant breeding.
Safety Testing\textsuperscript{1,23-25}

Safety assessments begin with concept of product
No variety is released without substantial safety evidence

Research on safety
\begin{itemize}
\item Nutrient and chemistry same as non-GMO
\item No inadvertent compounds – no allergens
\item Transfer and/or breakdown of trait
\item Environmental safety
\end{itemize}

Independent researchers
\begin{itemize}
\item Animal studies
\item Environmental studies
\end{itemize}

\begin{itemize}
\item Goldstein, DA. Journal Medical Toxicology 10(2):194-201, 2014.
\item USDA: https://www.usda.gov/wps/portal/usda/usdahome?navid=AGRICULTURE&contentid=BiotechnologyFAQs.xml
\end{itemize}
Evidence of Safety

1. FDA considers technology equivalent to conventional plant breeding
2. Study of 100 billion animals fed conventional compared to GMO feed for 25 years found no health risks (Van Eenennaam and Young, J. Animal Science 92(10):4255-78, 2014)
3. No human disease or illness ever linked to GMO food
4. Most scientific organizations approve safety of GMO
   - American Medical Association
   - American Academy of Pediatrics
   - American Association for the Advancement of Science
   - Center for Science in the Public Interest
   - European Commission
   - Union of German Academies of Science and Humanities
   - French Academy of Sciences
   - World Health Organization
“...the committee found no differences that implicate a higher risk to human health from GE foods than from their non-GE counterparts.”
Current GMO labeling policy

Signed by President Obama in July 2016 – *National Bioengineered Food Disclosure Standard*

Requires USDA to define how the bill (S.764) will be implemented

Three options for labels

- Label on the food package
- USDA symbol on the package (to be created)
- Electronic access – either a QR code, website or toll-free phone number

Currently in rule-making phase

Defines GMO food as: “*(Food) that has been modified through in vitro recombinant deoxyribonucleic acid techniques; and for which the modification could not otherwise be obtained through conventional breeding or found in nature.*”
Thank you!

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- Chair, LEAD Network, Monsanto
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- Advisory Board, Ajinomoto USA
- Trustee, Denver Botanic Gardens
- Dietetics Advisory Board, Univ. Northern Colorado
Genetically Engineered Crops

- Food Security
- Food Waste
- Health

Photo credit: Amy Myrdal Miller
Food Security: Resistance to Diseases and Viruses

Next Generation: More consumer benefits

Banana Wilt Disease

Virus-resistant & nutritionally enhanced cassava

Insect resistant rice

Photo Credit: Lepoint, Pascale / Bioversity International, Source: Musarama.
Closer to Home: Resistance to Diseases and Viruses\textsuperscript{35,36}

Citrus Greening

Citrus crop devastation

Modification through spinach gene introduction

Photo credit: http://www.ars.usda.gov/citrusgreening/
Food Security: Waste, Shelf Life and More

Arctic® Golden & Arctic® Granny Apples
Okanagan Specialty Fruits

Innate® Russet Burbank (left) next to conventional Russet Burbank 30 minutes after peeling

Photo credit: Okanagan Specialty Fruits

Photo credit: Simplot Plant Sciences
Healthier Food Products

Soybeans

High oleic acid

Omega-3’s

Photo credit:: Scott Bauer http://www.ars.usda.gov/is/graphics/photos/k4389-11.htm
Concern
Independent Studies $^{28,46}$

Are there studies not conducted or funded by the GMO industry?

Search the Atlas

GENERIA
Genetic Engineering
Risk Atlas

http://genera.biofortified.org/

Photo credit: Genetic Literacy Project
Can glyphosate (Round-up) cause cancer?
Concern – Allergens\textsuperscript{50-52}

Can introducing new genes into foods cause allergies?

Photo credit: Ekaterina Sotova, https://www.flickr.com/photos/

Photo credit: Satendra Mhatre
http://www.freepik.com/index.php?goto=41&idd=36008&url=aHR0c
DovL3d3dy5zeGMuaHUvcHvdG
8vMTlzMsI5NA==

Photo credit: Dömötör Gergely
FreelImages.com
http://www.freeimages.com/photo/peanut-1486433

Photo credit: Leonardo Menezes
FreelImages.com
http://www.freeimages.com/photo/the-shrimp-1322833
Opportunities & Challenges-GMO

PROS

- Enhanced nutrition quality
- Increased pest & disease resistance
- Greater insect biodiversity
- Decreased crop losses
- Conservation tillage
- Reduced pesticides
- Tolerance climate change
- Improved farmer income

CONS

- Ethical or religious issues
- Resistant weeds and bugs
  - Not unique to GMO
- Herbicide tolerant weeds
- Corporate seed consolidation
- Regulatory challenges
- Labeling issues
- Public Skepticism

1. Reference
2. Reference
Shared Values\textsuperscript{56,57}

Winning the science isn’t the same as winning the argument

- Find shared values & common ground
- Balance interests of all sides to ensure all forms of agriculture thrive
- Build on co-existence & cooperation to grow food that is abundant, affordable, and safe
- Practice courteous discourse

Photo credit: Pigalle, Cambodia. Fruit And Vegetable Stall, Psah Chas, Siem Reap Creative Commons on Flickr
https://www.flickr.com/photos/pigalleworld/5195836355
Where to go for more information


**Food & Agriculture Organization of the United Nation -** [www.fao.org/biotech](http://www.fao.org/biotech)


**Food and Drug Administration -** [www.fda.gov](http://www.fda.gov)

**Environmental Protection Agency -** [www.epa.gov](http://www.epa.gov)

**The International Crops Research Institute for the Semi-Arid Tropics -** [http://www.icrisat.org](http://www.icrisat.org)


**AgBiosafety -** [http://agbiosafety.unl.edu/](http://agbiosafety.unl.edu/)

**Council for Agricultural Science and Technology -** [www.cast-science.org](http://www.cast-science.org)

**The Genetic Literacy Project -** [http://www.geneticliteracyproject.org](http://www.geneticliteracyproject.org)

**Academy of Nutrition & Dietetics -** [www.eatright.org](http://www.eatright.org)

**Institute of Food Technologists -** [www.ift.org](http://www.ift.org)
Evidence Analysis Library (EAL)\textsuperscript{58}

Advanced Technology in Food Production (ETFP) 2013-2015

https://www.andeal.org/topic.cfm?menu=5021
Thank you!

Questions?

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Please complete this short online feedback survey: https://www.surveymonkey.com/r/gmowebinar

Photo credit: Amy Myrdal Miller
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9. FAO. Food and Agriculture Organization of the United Nations. Rome IT. 


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   Published online 2013 December 24. doi: 10.3389/fpls.2013.00526


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