“Communicating Agricultural Science in the 21st Century”

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## Opinion differences between the public and scientists

*Percentage agreeing with statement*

<table>
<thead>
<tr>
<th>Statement</th>
<th>U.S. adults</th>
<th>Agreement gap</th>
<th>Scientists</th>
</tr>
</thead>
<tbody>
<tr>
<td>Safe to eat genetically modified foods</td>
<td>37%</td>
<td>51%</td>
<td>88%</td>
</tr>
<tr>
<td>Climate change is mostly due to human activity</td>
<td>50</td>
<td>37</td>
<td>87</td>
</tr>
<tr>
<td>Humans have evolved over time</td>
<td>65</td>
<td>33</td>
<td>98</td>
</tr>
<tr>
<td>Favor more offshore drilling</td>
<td>32</td>
<td>20</td>
<td>52</td>
</tr>
<tr>
<td>Childhood vaccines such as MMR should be required</td>
<td>68</td>
<td>18</td>
<td>86</td>
</tr>
</tbody>
</table>

Most Americans Can’t Name a Living Scientist

Can you name a living scientist? (first volunteered responses)

- Yes: 66%
- No: 34%

- Stephen Hawking: 15%
- James Watson: 1%
- Jane Goodall: 1%
- Bill Nye: 1%
- Michio Kaku: 1%
- Neil Degrasse Tyson: 1%
- Other: 14%

Source: Your Congress - Your Health Survey, March 2011
Charlton Research Company for Research!America

Partial list of publicly-funded applications

Genetic engineering technology often gets identified with Monsanto/Big Ag policy. It is a breeding method – not a company, specific application or production system.

- University of Hawaii/Cornell **Rainbow Papaya** – highly resistant to ringspot virus
- SUNY-ESF **American Chestnut tree** – resistant to blight (wheat gene)
- Texas A&M/Florida/California **Orange** - resistant to citrus greening (spinach gene)
- USDA-ARS Appalachian Fruit Research Station Honeysweet **Plum** - highly resistant to plum pox potyvirus (PPV)
- University of Florida **Fungus-resistant strawberries**
- INRA’s virus-resistant **Grape rootstock** – resistant to the grapevine fanleaf virus
- CSIRO’s low G.I. **Wheat** - altering wheat carbohydrate content to reduce glycaemic response and improve metabolic health
- Bangladeshi B.t. **Eggplant** - pest-resistant Bt brinjal (eggplant)
- **Biocassava** (Bill & Melinda Gates Foundation, the National Root Crop Research Institute of Nigeria and the Donald Danforth Plant Science Center) - cassava with increased nutrient (zinc, iron, protein, and vitamin A) levels, increased shelf life, reductions in toxic cyanogenic glycosides, and resistance to viral disease for Africa
- **Golden Rice** (USAID, the Syngenta Foundation, HarvestPlus, and the Bill & Melinda Gates Foundation) rice enriched with beta-carotene - the delayed application of Golden Rice in India alone has cost 1,424,000 life years since 2002
Google image search for “Ideal Farm”

Of the total annual pest losses in crops, weeds account for 37%, insects 29%, diseases 22% and other pests 12%.
Weeds use water, nutrients and decrease yield per acre
The narrative that is told is never associated with the tradeoffs.
What happens to animal welfare when switch to a raised “antibiotic-free” production system?

Pinkeye – bacterial infection
Which is the Sustainable System?

1. Improved product quality and safety.

2. Improved animal welfare and natural behavior.

3. Decreased impact on the environment and efficient use of natural resources.

“Some of the most polarizing topics in American politics are scientific ones. Even the existence of phenomena, such as global climate change and evolution, that are widely accepted in the scientific community is questioned by significant proportions of the US public.”

Scheufele DA. Science communication as political communication. Proceedings of the National Academy of Sciences 2014;111:13585-13592.
“One of the biggest problems with the world today is that we have large groups of people who will accept whatever they hear on the grapevine, just because it suits their worldview—not because it is actually true or because they have evidence to support it. The really striking thing is that it would not take much effort to establish validity in most of these cases…. but people prefer reassurance to research.”

Neil deGrasse Tyson
**Spiral-of-silence model** (Elizabeth Noelle-Neumann, 1974)

Most people are to some degree fearful of isolating themselves in social settings and this “fear of isolation” makes them less likely to express unpopular opinions in public.

This is exacerbated by ‘parallel science’. Unlike regular science, ‘parallel science’ serves political goals and describes itself with positive-sounding terms such as ‘concerned’, ‘responsible’, ‘citizen’ and ‘independent’ science, which carries the implication that ‘normal’ science is not any of these.


Van Eenennaam NCSL 8/3/15
Summary statements of leading science organizations regarding safety of genetic engineering

- “No effects on human health have been shown as a result of the consumption of such foods by the general population in the countries where they have been approved.” (World Health Organization)
- “No adverse health effects attributed to genetic engineering have been documented in the human population.” (National Academy of Sciences)
- “The science is quite clear: crop improvement by the modern molecular techniques of biotechnology is safe.” (American Association for the Advancement of Science)
- “There is no scientific justification for special labeling of bioengineered foods. Bioengineered foods have been consumed for close to 20 years, and during that time, no overt consequences on human health have been reported and/or substantiated in the peer-reviewed literature.” (American Medical Association)
- “No scientific evidence associating GMOs with higher risks for the environment or for food and feed safety than conventional plants and organisms.” (European Commission)
Professional Scientific and/or Medical bodies with an opinion on safety of GE

**Generally Positive**

- The U.S. National Research Council (NRC)
- U.S. National Academy of Sciences (NAS)
- The American Medical Association (AMA)
- U.S. Department of Agriculture (USDA)
- U.S. Environmental Protection Agency (EPA)
- U.S. Food and Drug Administration (FDA)
- European Food Safety authority (EFSA)
- American Society for Plant Biology (ASPB)
- Federation of Animal Science Societies (FASS)
- World Health Organization (WHO)
- Food and Agriculture Organization (FAO)
- Royal Society (London)
- Brazil National Academy of Science,
- Chinese National Academy of Science
- Indian National Academy of Science
- Mexican Academy of Science
- Third World Academy of Sciences

**Generally Negative**

- The American Academy of Environmental Medicine (AAEM)*

*Not recognized by the American Board of Medical Specialties*
Dr. Oz: “You know in Jeffrey Smith’s documentary he attributes an increase in inflammatory bowel disease, to ulcerative colitis, other gastrointestinal illnesses in this country to genetically modified foods. Dr. Bernhoft, that’s a pretty bold claim, as a doctor how do you make sense of that?”

“Well I agree with Jeff completely. There is an increase in incidence not just in reflux but also in allergies, autoimmunity, asthma, high cholesterol, there’s a wide range of chronic illnesses…”

…..Cause and effect is hard to prove. However, if you take people off genetically modified foods then things like reflux, type-2 diabetes, allergies and so on improve and sometimes they go away completely.”
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DISCUSSION

No scientific consensus on GMO safety

Angelika Hilbeck1,2*, Rosa Binimelis1,3, Nicolas Defarge1,4,5, Ricarda Steinbrecher1,6, András Székács1,7, Fern Wickson1,3, Michael Antoniou8, Philip L Bereano9, Ethel Ann Clark10, Michael Hansen11, Eva Novotny12, Jack Heinemann13, Hartmut Meyer1, Vandana Shiva14 and Brian Wynne15

Abstract

A broad community of independent scientific researchers and scholars challenges recent claims of a consensus over the safety of genetically modified organisms (GMOs). In the following joint statement, the claimed consensus is shown to be an artificial construct that has been falsely perpetuated through diverse fora. Irrespective of contradictory evidence in the refereed literature, as documented below, the claim that there is now a consensus on the safety of GMOs continues to be widely and often uncritically aired. For decades, the safety of GMOs has been a hotly controversial topic that has been much debated around the world. Published results are contradictory, in part due to the range of different research methods employed, an inadequacy of available procedures, and differences in the analysis and interpretation of data. Such a lack of consensus on safety is also evidenced by the agreement of policymakers from over 160 countries - in the UN’s Cartagena Biosafety Protocol and the Guidelines of the Codex Alimentarius - to authorize careful case-by-case assessment of each GMO by national authorities to determine whether the particular construct satisfies the national criteria for ‘safe’. Rigorous assessment of GMO safety has been hampered by the lack of funding independent of proprietary interests. Research for the public good has been further constrained by property rights issues, and by denial of access to research material for researchers unwilling to sign contractual agreements with the developers, which confer unacceptable control over publication to the proprietary interests.
No Scientific Consensus on GMO Safety Statement Published in Peer-Reviewed Journal

A statement signed by over 300 scientists and legal experts to the effect that there is “No consensus” on the safety of genetically modified (GM) crops and foods has been published in a peer-reviewed open access journal, Environmental Sciences Europe.[1] It now belongs to the body of open peer-reviewed scientific literature and stands as a citable publication.

“The European Network of Scientists for Social and Environmental Responsibility”

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Number of predatory journals “pay-to-play” and publishers is growing rapidly

http://scholarlyoa.com/2015/01/02/bealls-list-of-predatory-publishers-2015

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*Not recognized by the American Board of Medical Specialties*
The internet and particularly social media have opened up dialogue – and can be used to help counteract the spiral of silence and “parallel science” narratives

“Scientists and universities need to develop proactive communication strategies that accurately portray scientific consensus in public discourse. Such efforts will go a long way toward countering the development of spirals of silence based on misperceptions of public support or opposition.”

Scheufele DA. 2014. Science communication as political communication. PNAS. 111:13585-13592
It is possible to have a discussion about this topic with people who have not made up their mind.

December 2014, New York City
Globally there are substantial benefits from first generation (input trait) GE crops

“On average, GE technology adoption has reduced chemical pesticide use by 37%, increased crop yields by 22%, and increased farmer profits by 68%. Yield gains and pesticide reductions are larger for insect-resistant crops than for herbicide-tolerant crops. Yield and profit gains are higher in developing countries than in developed countries.”

RESULTS  GENETICALLY MODIFY FOOD

FOR The Motion 32% 60%
AGAINST The Motion 30% 31%
UNDECIDED 38% 9%
And you never know who you will reach
Not all scientists are comfortable speaking out in public – for a variety of reasons

http://www.zmescience.com/medicine/bill-nye-view-gmos-5345435/

http://www.naturalnews.com/049257_Bill_Nye_Monsanto_propaganda_GMOs.html
Scientists are cautious about public outreach

Researchers online react to a survey showing mixed feelings about news and social media.

Chris Woolston

Caleph Wilson @HeyDrWilson

@PCRcmu @sldewit Been saying for years scientists need to come down from "ivory tower" and engage public. #AAASmtg

7:40 PM - 14 Feb 2015

Richard Sever @cshperspectives

Twitter, etc. may be the future of sci comm but remember most scientists aren't there (yet).. pewrsr.ch/1vw6wMD

David Grinspoon @DrFunkySpoon

@drkeegansawyer @chelle_ecoed ah thanks. Should b OK to not engage. Some not inclined, ill equipped, shy, etc. The 87% sounds pretty good...

GM food opponents, like these in Los Angeles, are adopting new strategies that put academics on the spot.

Updated: Agricultural researchers rattled by demands for documents from group opposed to GM foods

http://news.sciencemag.org/scientific-community/2015/02/agricultural-researchers-rattled-demands-documents-group-opposed-gm
Like this? lol

Now all we need is to see where they have attached the strings ...... ;)

Dr. Kevin Folta
Professor and Chairman
Horticultural Sciences Department
University of Florida
BLOG “Illumination”  http://kfolta.blogspot.com

Van Eenennaam NCSL 8/3/15
The Potential Impacts of Mandatory Labeling for Genetically Engineered Food in the United States

Alison L. Van Eenennaam, Ph.D.
Department of Animal Science, University of California, Davis
There are three main themes that are often associated with mandatory GE labeling, with the following arguments for and against it:

**Public Opinion**

**PRO:** Polls show an overwhelming majority of people support mandatory labeling of GE foods when specifically asked whether “the federal government should require labels on food saying whether it's been genetically modified, or "bio-engineered"”

**CON:** In unprompted polls in which participants are asked what additional labeling they would like to see on food, more than 99% of respondents do not volunteer a desire to see mandatory labeling of GE foods.
**Consumer Choice**

**PRO:** People should have a choice regarding what types of products they purchase and consume. Many believe that this should include the choice to “vote with their wallets” about how the food was produced even if it does not result in any change or consequence for the food product itself.

**CON:** U.S. consumers who want to avoid GE products already have that choice available through voluntary non-GMO and organic labeling. In countries that have implemented mandatory GE labeling, GE products have generally been removed from the market, so choice has been reduced.
Right to Know

**PRO:** People have the right to know what is in their food. Mandated calorie and nutritional content panels on packaged foods are examples of labels to inform consumers about food composition.

**CON:** The right to know what is in food is different to the right to know what processes were used in its production. Furthermore, this uniquely singles out GE technology—not other production methods and processes—for right to know.
Food Labeling

• In the United States, the Food, Drug, and Cosmetic Act (FDCA) grants authority for food labeling to the FDA.

• Production methods or processes that create no material difference in products require no special labeling.

• Although some may consider the insertion or manipulation of genes in a laboratory a “material difference” per se, the science of food safety has not identified differences in the composition or safety of food derived from commercialized GE crops that would necessitate mandating a process-based label on GE food.

• The FDA allows voluntary process-based labeling as long as it is not false or misleading.
Although some labels do exist that are both false and misleading!!
*Meets the Humane Farm Animal Care Program standards, which include nutritious diet without antibiotics or hormones, animals raised with shelter, resting areas, sufficient space and the ability to engage in natural behaviors.
Common crop breeding methods

1. Cross Breeding: Combining two sexually compatible species to create a variety with the desired traits of the parents. Example: Honeycrisp Apple.

2. Mutagenesis: Use of mutagens such as radioactivity to induce random mutations, creating the desired trait. Example: Radiation was used to produce a deeper color in the red grapefruit.

3. Protoplast Fusion: Fusion of cells or cell components to transfer traits between species. Example: Male sterility is transferred from radishes to red cabbage by fusing their cells. Male sterility helps plant breeders make hybrid crops.

4. Polyploidy: Multiplication of the number of chromosomes in a crop to impact its fertility. Example: Seedless watermelons are created by crossing a plant with 2 sets of chromosomes with another that has 4 sets. The seedless fruit has 3 sets.

5. Genome Editing: Use of an enzyme system to modify DNA directly within the cell. Example: Genome editing was used to develop herbicide-resistant canola to help farmers control weeds.

6. Transgenesis: Addition of genes from any species to create a new variety with desired traits. Example: The Rainbow Papaya is modified with a gene that gives it resistance to the Papaya Ringspot Virus.

www.biofortified.org

Follow us on Twitter (@frankfoode) or join our Facebook Page.
Recent state-based GMO food labeling activity

Vermont bill passed
Pop’n size in 2012 = 626,011

http://www.leg.state.vt.us/docs/2014/Acts/ACT120.pdf
Actual Votes on GMO Labeling

- Prior failed ballot initiatives – all failed
  - Oregon in 2003 (30% vs. 70%)
  - California in 2012 (48.6% vs. 51.4%)
  - Washington in 2013 (48.9% vs. 51.1%)
  - Colorado (34% vs. 66%) in 2014
  - Oregon (49.8% to 50.2%) in 2014
Why did people vote no on Proposition 37?

What is the primary reason you plan to vote NO on Proposition 37?

- To avoid higher food costs: 35%
- To avoid needless lawsuits by trial lawyers: 11%
- Because genetically modified foods are not harmful: 17%
- Because it will impose unneeded costs on farmers: 22%
- Other: 15%

Slide credit: Jason Lusk, Oklahoma State University
State GE Labelling Bills

Require labeling of GE foods & prohibit use of the “natural” label

- June 3, 2013 Connecticut, bill has trigger (need 4 other states to pass GE labeling bill + have population > 20 million)
- June 12, 2013 Maine, bill has trigger (4 other states)
- April 23, 2014 Vermont, no trigger clause – 7/1/2016
  - Signed into law May 8, 2014
  - VT sued by GMA et al. on June 12, 2014
  - District Court of Vermont ruled to allow on April 27, 2015
  - GMA brief filed in Second Circuit Court of Appeals June 24, 2015
Legal Issues

There are three major legal issues associated with state laws requiring mandatory process-based GE labeling:

1. **Commerce Clause of the U.S. Constitution**
   - forbids individual states from unduly burdening interstate commerce

2. **Supremacy Clause of the U.S. Constitution and FDCA Preemption**
   - federal law prevails in any conflict with state law

3. **The First Amendment Protection of Commercial Speech**
   - prohibits government compulsion of commercial speech unless the speech is factual, uncontroversial, and reasonably related to a legitimate government interest.
Chocolate Chip Cookies - Lunchbox Size

Nutrition Facts

Serving Size 1 lunchbox size cookie (17g)
Servings Per Container

Amount Per Serving

Calories 70
Calories from Fat 30

Total Fat 3.5g
  Saturated Fat 1.5g
  Trans Fat 0g

Cholesterol 0mg

Sodium 70mg

Total Carbohydrate 11g
  Dietary Fiber 0g
  Sugars 6g

Protein 1g

Vitamin A 0%
  Vitamin C 0%

Calcium 0%
  Iron 2%

*Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs.

INGREDIENTS: FLOUR (WHEAT FLOUR, MALTED BARLEY FLOUR, NIACIN, ITON, POTASSIUM BROMATE, THIAMIN MONONITRATE, RIBOFLAVIN, FERMENTED ACID), BROWN SUGAR, GHIRARDELLI SEMI-SWEET CHOCOLATE CHIPS (SUGAR, UNSWEETENED CHOCOLATE, COCOA BUTTER, SOY LECITHIN, NATURAL FLAVORS VANILLA), MARGARINE (PARTIALLY HYDROGENATED SOYBEAN OIL, WATER, PARTIALLY HYDROGENATED COTTONSEED OIL, SALT, MONO AND DIGLYCERIDES, COLORED WITH ANNATTO/TURMERIC, CALCIUM DISODIUM EDTA ADDED AS A PRESERVATIVE, ARTIFICIAL BUTTER FLAVOR, VITAMIN A PALMITATE ADDED), LIQUID EGGS (CONCENTRATED WHOLE EGGS, SUGAR, WITH LESS THAN 1% OF THE FOLLOWING: SODIUM ALGINATE, GLYCEROL AND MALTODEXTRIN), PALM OIL, GRANULATED SUGAR, BAKING SODA, SALT, ALSO CONTAINS NON-FLAVOR INGREDIENTS: DEXTROSE, CORN STARCH, LESS THAN 0.1% TURMERIC, LESS THAN 0.1% APO CAROTENAL, ALCOHOL, NATURAL MIXED TOCOPHEROLS AND A NATURAL SOURCE OF VITAMIN E USED TO PROTECT FRESHNESS, BUTTERMILK SOLIDS.

CONTAINS: WHEAT, SOY, EGG, MILK.
MANUFACTURED ON THE SAME EQUIPMENT AS PEANUT AND TREE NUTS.

- Riboflavin
- Sugar
- Soybean oil
- Cottonseed oil
- Soy lecithin
- Corn starch
- Tocopherols
- Vitamin E
Reformulation of “yellow box” cheerios after removal of “GMOs”


“The new version is certainly less nutritious.”

General Mills told FoodNavigator-USA: “We don’t normally discuss product formulation. But we will note we made no assertion non-GM ingredients were ‘more wholesome.’ That is simply mistaken.”

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Original Cheerios</th>
<th>New Cheerios</th>
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</thead>
<tbody>
<tr>
<td>Protein</td>
<td>9%</td>
<td>9%</td>
</tr>
<tr>
<td>Vitamin A</td>
<td>10%</td>
<td>10%</td>
</tr>
<tr>
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<td>10%</td>
<td>10%</td>
</tr>
<tr>
<td>Calcium</td>
<td>8%</td>
<td>8%</td>
</tr>
<tr>
<td>Iron</td>
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<td>60%</td>
</tr>
<tr>
<td>Vitamin D</td>
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<td>6%</td>
</tr>
<tr>
<td>Thiamin</td>
<td>35%</td>
<td>35%</td>
</tr>
<tr>
<td>Riboflavin</td>
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<td>35%</td>
</tr>
<tr>
<td>Niacin</td>
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<tr>
<td>Vitamin B₆</td>
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<tr>
<td>Folic Acid</td>
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<tr>
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<tr>
<td>Phosphorus</td>
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<tr>
<td>Magnesium</td>
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</tr>
<tr>
<td>Zinc</td>
<td>30%</td>
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</table>

*Amount in cereal. A serving of cereal plus skim milk provides 2g total fat, less than 5mg cholesterol, 200mg sodium, 380mg potassium, 26g total carbohydrate (7g sugars, 17g other carbohydrate), and 8g protein.

**Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs:

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<tr>
<td>Zinc</td>
<td>30%</td>
<td>30%</td>
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</tbody>
</table>

Before and after: The new reformulated Original Cheerios (on the right) contain hardly any Riboflavin. The old version has 25% of the daily value in a 28g serving while the new version only just 2% of the DV.
### Nutrition Facts

<table>
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<th>Amount/Serving</th>
<th>%DV*</th>
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<tbody>
<tr>
<td><strong>Total Fat</strong></td>
<td>8g</td>
<td>12%</td>
<td>Sodium</td>
<td>230mg</td>
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<tr>
<td><strong>Sat. Fat</strong></td>
<td>5g</td>
<td>25%</td>
<td>Potassium</td>
<td>220mg</td>
<td>6%</td>
</tr>
<tr>
<td><strong>Trans Fat</strong></td>
<td>0g</td>
<td>0%</td>
<td>Total Carb.</td>
<td>30g</td>
<td>10%</td>
</tr>
<tr>
<td><strong>Cholesterol</strong></td>
<td>0mg</td>
<td>0%</td>
<td>Dietary Fiber</td>
<td>4g</td>
<td>16%</td>
</tr>
<tr>
<td><strong>Sugars</strong></td>
<td></td>
<td></td>
<td>Protein</td>
<td>20g</td>
<td>40%</td>
</tr>
<tr>
<td><strong>Fiber</strong></td>
<td></td>
<td></td>
<td>Low Glycemic</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


**Allergen Statement:** Contains soy and almonds. May contain traces of dairy, peanuts, wheat and other tree nuts. We source ingredients that are not genetically engineered. May contain nutshell pieces. 33% organic ingredients.

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**Allergen Statement:** Contains soy and peanuts. May contain traces of dairy, wheat and tree nuts. We source ingredients that are not genetically engineered. 35% organic ingredients.

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To assure best quality, store in a cool, dry place.
I would personally like to see the outcome of the ongoing litigation in Vermont to determine whether current federal law regarding the Food and Drug Administration’s authority over food labeling preempts state action before passing the federal labeling bill as it may be unnecessary if it is ruled that the FDA already has federal authority over food labeling.

Moreover there are some other provisions of the H.R. 1599 “Safe and Accurate Food Labeling Act of 2015” or the “DARK Act” depending upon your perspective, that are concerning to me as a scientist working in this field.
Makes it illegal to sell a “non-regulated genetically engineered plant” upon the signing of the Act unless the Secretary of Health and Human Services issues a certificate that the Secretary agrees that the “non-regulated genetically engineered plant” is safe for use because all questions have been answered.

Implications of this Section 461(a)(1):
It singles out and introduces mandatory food safety assessment for “GMOs” into United State law. This would preclude well known GMOs from receiving exceptions or being declared GRAS, and permanently sets crops made using this one breeding method aside as special products based on the way they are made, not on their intrinsic properties.
Thanks for inviting me!

Questions?

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