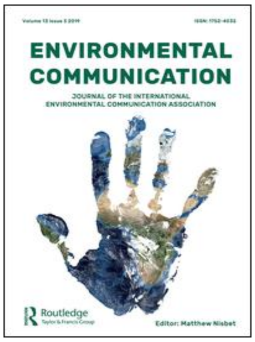

Routledge Taylor & Francis Group

Environmental Communication

ISSN: (Print) (Online) Journal homepage: https://www.tandfonline.com/loi/renc20

Is This Safe? Addressing Societal Concerns About CRISPR-Edited Foods Without Reinforcing GMO Framing

Kevin Doxzen & Hope Henderson

To cite this article: Kevin Doxzen & Hope Henderson (2020): Is This Safe? Addressing Societal Concerns About CRISPR-Edited Foods Without Reinforcing GMO Framing, Environmental Communication, DOI: 10.1080/17524032.2020.1811451

To link to this article: https://doi.org/10.1080/17524032.2020.1811451

Published online: 07 Sep 2020.

ENVIRONMENTAL COMMUNICATION
https://doi.org/10.1080/17524032.2020.1811451

COMMENTARY

OPEN ACCESS Check for updates

Is This Safe? Addressing Societal Concerns About CRISPR-Edited Foods Without Reinforcing GMO Framing

Kevin Doxzen and Hope Henderson

Innovative Genomics Institute, University of California, Berkeley, USA

Introduction

This is a call to science communicators. We have an opportunity to engage with the public and direct the future of a technological revolution. With an ever-growing CRISPR genome-editing toolbox, scientists are creating crops that can resist diseases and pests, withstand global warming, and offer better nutrition. The emergence of this technology offers a crucial opportunity for renewed public engagement around crop engineering. In order to actualize the potential of CRISPR-edited food, we must work together to create and share strategies for productive dialogue. This article identifies one area of necessary improvement in communication and public engagement.

The story behind CRISPR technology began only a few years ago, but its immediate impact on biological research is unprecedented. In 2012, researchers at University of California, Berkeley and Umeå University in Sweden were in the midst of an exploratory collaboration. Their project focused on a peculiar protein that appeared to help bacteria defend themselves against viral infection. The researchers discerned that this immune system, known as CRISPR, was able to precisely identify and cut viral DNA, but how exactly this process worked remained a question. Once the researchers, co-led by Dr. Jennifer Doudna, revealed the mechanism behind CRISPR's ability to target and cut specified genetic sequences, the enormous potential for genome editing was obvious. Using CRISPR genome editing, researchers are now able to remove, insert, and change sequences of DNA in nearly any organism.

UC Berkeley is seen as an epicenter of CRISPR discovery and continued innovation. In 2014, Jennifer Doudna set up the Innovative Genomics Institute (IGI) as a joint research partnership between UC Berkeley and UCSF, focused on advancing genome editing and the translation of resulting technologies to improve human health and sustainable agriculture. Meeting these goals requires an informed, engaged, and empowered public. This is where I, co-author Kevin Doxzen, was brought in to help engage diverse stakeholders, working with the public to navigate the rapidly advancing CRISPR field.

A key part of this engagement involves community presentations, offering an opportunity to ask questions and share perspectives. During these outreach events, I always pause on a particular slide. This slide displays a staggering list of crops–some obscure, some familiar–that together constitute the main source of calories for over half of the world's population. From wheat to cassava, each of these foods is the focus of a genome-editing project at the IGI. Standing in front of this slide during my public presentations, I represent the IGI and its research. But to these audiences, I also represent the potential and peril of genome editing.

CRISPR technology is advancing the field of genome editing so rapidly that my presentations can barely scrape the surface of what scientists, entrepreneurs, and institutions like the IGI are trying to

CONTACT Kevin Doxzen kdoxzen1@berkeley.edu Innovative Genomics Institute, University of California, 2151 Berkeley Way, Berkeley, CA 94720, USA

accomplish, but audiences quickly grasp the magnitude of this technology. Out of the breadth of applications one could cover, I prioritize the topic of genome editing in agriculture. Biotechnology plays a pivotal role in engineering sustainable food capable of feeding a growing population, adapting to fluctuating climates, and providing increased nutrition. Despite these benefits, applications of biotechnology in food have received increasingly polarized and adverse reactions, particularly in response to genetically modified organisms (GMOs). Decades of crosstalk between media, companies, scientists, advocacy groups, and other stakeholders have generated a narrative – a storyline with big corporations, small farms, and consumers caught in the middle.

GMOs are not safe. GMOs are unnatural. GMOs are an environmental risk. These ideas have grown more common among consumers, and many people in my audiences have absorbed these messages. As I work through my long list of CRISPR-edited crops, explaining applications of disease resistance and drought tolerance, an audience member often raises a hand and asks, "Is this safe?" I receive this question under different guises, sentiments, or clearly and bluntly in those three words. This question is, at least in part, an extrapolation from the GMO storyline. Having received this question many times, I follow a formulated and scripted response. My answer stresses that CRISPR-edited crops are different than GMOs in several ways. I intentionally distance myself from GMOs, knowing that if I don't, the audience will add CRISPR-edited crops to the GMO narrative. My approach is a stop-gap measure, but ultimately inadequate for both the consumers and the scientists, and a weak effort in science communication.

Describing how CRISPR-edited crops are arguably more natural than GMOs, or how these crops could potentially use fewer chemicals than their GMO predecessors reinforces pervasive societal suspicions of GMOs. If we think that engineered crops will play a key role in addressing environmental and public health issues, then promoting CRISPR-edited crops at the expense of GMOs is shortsighted. Instead, we must use CRISPR as a new avenue for renewing productive discourse with the public. CRISPR offers a way to bring everyone back to the table, reintroducing voices into vital conversations that will impact us all.

The question, "Is this safe?" captures this tension between distancing CRISPR from GMOs in order to separate a new technology from its polarized relative, while not discarding GMOs and avoiding difficult conversations. Science communicators can use the question "Is this safe?" as a case study to further identify problematic practices and offer strategies for communication alternatives. Before answering this question, we must better understand the consumer's decision-making process.

A risk worth taking?

Modern American grocery stores are examples of abundant choice. These stores carry an average of 30,000 items (Food Marketing Institute, 2019), creating an overwhelming environment that forces rapid decision-making. In an attempt for simplification, we look to reduce and categorize choices: good or bad, healthy or unhealthy, especially if that product is meant to enter the body (Broniarczyk & Griffin, 2014). Consumers implement this approach when distinguishing between organic and GMO foods, two bins with a convoluted history of branding and framing.[1] The framing of GMOs exemplifies the idea that a debate or argument can be less about the content and more about the delivery or presentation (National Research Council, 2015; Scheufele, 1999). Framing suggests that how an issue or concept is characterized influences how it is understood. In addition to its role as a messaging tool, framing is deployed by consumers to make sense of complex topics amongst a flurry of scientific explanations, media coverage, and peer influence. Framing impacts how consumers weigh safety versus risk (Pham & Mandel, 2019), a pivotal balancing act when deciding between two choices like organic and GMO.

My conversations with community members have indicated that many people find it difficult to bin CRISPR-edited food as good or bad, to label them healthy or unhealthy, or, most importantly, to categorize them as safe or risky. These anecdotal interactions align with analyses that have identified pervasive neutral sentiments related to CRISPR (Calabrese et al., 2019). Science communicators have an opportunity to frame CRISPR-edited food, and in doing so, bring GMOs back into the discussion. Part of this framing hinges upon subtle, underlying biological differences between CRISPR-edited crops and GMOs, and how these differences impact how we explain agricultural engineering.

Subtle similarities and difficult distinctions

My attempt to separate CRISPR-edited crops from GMOs inadequately simplifies a complicated reality. The processes behind engineering a CRISPR-edited crop and a GMO share many commonalities and, in some instances, lead to nearly identical outcomes. In an attempt to keep pace with advancing engineering technologies, government regulators across nations are continually updating their lexicons and policies, sometimes coming to different conclusions. Despite the inability to articulate clear and universally established distinctions, audiences want to know why they shouldn't immediately reject CRISPR-edited crops. To ease their fears, I find myself scrambling to separate the new from the old.

The landscape is messy. The legal, political, and biological differences between CRISPR-edited crops and GMOs are not clear cut. Despite subtle similarities, CRISPR-edited crops and GMOs are different in a key way worth noting: the non-compulsory use of foreign DNA. GMOs are commonly made through the introduction of foreign DNA into a given organism, a process called transgenesis. This DNA can originate from another species. For example, scientists engineered pest-resistant corn via the insertion of a bacterial gene encoding an insect-specific toxin, *Bt* (Saxena et al., 1999). This method of engineering allows researchers to transfer tolerance, resistance, or other desirable traits between distinct species. To regulators and consumers alike, it is important to note that these insertion events did not occur through normal evolution or breeding, thus these products require a range of tests to validate safety for both the consumer and the environment.

The advent of CRISPR now offers researchers a new tool for crop engineering. Cas9 is the most common CRISPR protein used in genome editing, acting like a pair of molecular scissors capable of targeting a specific sequence of DNA amongst billions of bases constituting an organism's genome. After Cas9 creates a break in the DNA, the cell's own repair machinery goes to work. During the DNA repair process, the cell can add or delete a few letters of DNA, a process that does not require the use of foreign DNA. This insertion or deletion of a few letters of DNA can lead to the deactivation of a gene, which is useful if a specific gene makes a crop susceptible to disease infection or water shortage. Mutation of a few nucleotides is a frequent occurrence in the wild and a driver of evolution. This similarity between natural evolution and CRISPR genome editing is an angle which can separate CRISPR-edited crops from GMOs.

The argument that CRISPR genome editing can produce genetic changes that mimic evolution begins to associate these crops with the concept of "naturalness." The idea of natural food has penetrated the modern consumer vernacular and decision-making, enticing shoppers to reach for items that they hope preserve or benefit human health. When confronted with the question "Is this safe?," human health is a key concern and one linked to the idea of naturalness. The historical framing of GMOs has forced consumers to question what is natural, but will science communicators create a new narrative for CRISPR-edited crops or work to challenge the preconceptions of the modern consumer?

Human health and safety

Many factors play a role in how we choose our food. From extrinsic factors like social trends and cultural settings to intrinsic factors like educational background, we reach our dietary decisions from multiple angles (Perry et al., 2017). One key component of this decision-making process, influenced by both extrinsic and intrinsic factors, is a consumer's desire for naturalness, which can include attributes like freshness and minimal processing. This desire stems from the idea that natural products are healthier for people and better for the environment (Román et al., 2017). If natural products are assumed healthy, and if GMOs do not occur through natural evolutionary processes, then they must be unnatural and therefore unhealthy (Rozin et al., 2012). Consumers looking for "naturalness" may reach for products branded simply as "natural." Natural means safe – right? In fact, outside of meat products, a "natural" label carries no regulatory meaning. A significant number of "natural" products actually contain GMO-derived ingredients (Butler & Vossler, 2018). Despite this fact, consumers value "naturalness" and are willing to pay higher prices for products that they believe are "natural" and non-GMO. Connecting with consumers requires that we understand more deeply how GMOs came to be thought of as unnatural, unhealthy, and risky.

Going beyond associations with un-naturalness, transgenesis has provoked multiple concerns among consumers and experts alike (Nawaz et al., 2019). Evidence that DNA originating from food is capable of migrating from the digestive tract into the circulatory system has led some to suggest that GMO DNA may transfer into humans (Skeptical Raptor, 2016; Lusk, 2014; Spisák et al., 2013). A more substantiated concern is the unanticipated effects of transgenesis on the genetic and molecular makeup of the engineered crop. For example, an allergen was identified following the transfer of a gene originating from a brazil nut into a soy plant (Nordlee et al., 1996). US regulatory agencies who oversee the development and deployment of engineered crops have established an extensive testing pipeline, but consumers do not fully trust the scientists who create the crops and the government in charge of testing. This distrust propagates across consumers even though traditional breeding, considered more natural, can produce unexpected allergens and large companies have quality control measures to check for allergenicity.

Adding to the complexity is decades of corporate decisions about food made behind closed-doors, some of which knowingly or unknowingly harmed consumers. For example, the sugar industry's plan to divert public concern from sweets to fat, or years of deception around BPA in plastics (Kearns et al., 2016; Vogel, 2009). GMOs in particular have suffered from their corporate image. The combination between intellectual property rights and expensive regulatory review have kept GMO technology in the domain of only a few large multi-national corporations. The concerns of the public are valid, and the mistrust is well-earned, yet not all actions of private entities are nefarious. Detangling the notions of corporate with untrustworthy, natural with good, and unnatural with bad is a difficult endeavor, but the advent of CRISPR offers communicators a new opportunity. Now we must learn how to use it.

In the wake of an incoming wave of CRISPR-edited crops, communicators have an opportunity to renew conversations surrounding what is "natural," and in doing so, address concerns about "naturalness" and safety. For science communicators, do we suggest that CRISPR-edited crops are more natural? Do we explain how brands with a "natural" label don't always align with what consumers think they are buying? Or do we do we zoom out and try to separate "natural" from "safe," so we don't tacitly buy into notions that GMOs are all unsafe? Similar types of questions arise not only in the context of human health, but in the area of environmental safety.

Environmental safety

When concerned about safety, many people aren't focused solely on human health, but also on the environment, including farmlands, waterways, and forests. Under the umbrella of environmental concerns exist a list of common topics, each requiring a unique conversation. Identifying these topics is paramount in beginning a constructive dialogue and answering the question "Is this safe?" Ironically, while CRISPR may raise some of the same environmental risk questions as GMOs, scientists are using this genome-editing approach to ameliorate other environmental concerns, such as engineering drought-resistant plants, crops that require less fertilizer, and even vegetation for carbon capture. Despite these potential environmental wins, attitudes towards GMOs may associate CRISPR-edited plants with negative environmental impacts.

The impact of GMOs on the environment, and the associated backlash and hesitation of the public, has a deep-rooted history in the pesticide- and herbicide-resistant crops created by large multinational corporations. Roundup Ready crops sold by Bayer, formerly Monsanto, use large amounts of a synthetic chemical called glyphosate as a weed-killer for herbicide-resistant crops. Capturing headlines for decades, glyphosate controversies have roused public concern about GMOs and human and environmental safety. This has created a difficult environment for honest and productive dialogue, even for science communicators from academic institutions. It is within this environment that I present my slides of CRISPR-edited crops, eager to discuss our institute's ongoing projects but wary to devolve into unpacking GMO misinformation and confusion. Despite these difficult conversations, we have an opportunity to frame a new CRISPR narrative, but where to begin and how do we avoid perpetuating the GMO debate?

Focusing on the variety of intended phenotypes of CRISPR-edited crops compared to herbicide- and pesticide-resistant GMOs is a way to separate CRISPR technology from earlier engineering applications. In my presentation slides, I highlight efforts to engineer disease-resistant crops that would diminish or eliminate the use of herbicides or pesticides. Focusing on this aspect of certain CRISPR-edited crops touches on concerns surrounding the introduction of chemicals into the environment and helps separate these crops from Roundup Ready crops that have fueled intense public rhetoric. However, highlighting efforts to reduce chemical usage via CRISPR-edited crops may bolster negatively framed ideas about currently grown GMOs. Discussing the ecological benefits of CRISPR-edited crops by grossly vilifying "chemicals" runs the risk of providing an overly simplistic answer to a complex situation. Studies have pointed towards positive economic impacts and higher yields for GMO crops, supporting the idea that GMOs play a role in sustainable agriculture (Zilberman et al., 2018). It is important to note that these benefits exist alongside agroecological burdens and other impacts (Montenegro, 2015). The environmental implications of agricultural engineering are complex, and reducing the conversation down to CRISPR and GMO, natural and synthetic, or sustainable and untenable is counterproductive.

In addition to concerns about chemicals, I have heard environmental questions concerning reductions in biodiversity, impacts of monocultures, and pollination containment. While these questions each warrant a much longer response than the few minutes I am allotted during a public presentation, all of these questions impact the sentiments of CRISPR. When addressing environmental concerns, CRISPR genome editing offers the potential to pick up where previous attempts have fallen short, but we must be wary of painting this new engineering approach as a "fix" to GMOs.

Conclusion

The development, deployment, and discussions around GMOs are learning opportunities for all parties involved and those of us just joining the conversation. From the choice of which crops to modify to weak public engagement campaigns, the rollout of GMOs led to inadequate dialogues between scientists, consumers, companies, and the media. Learning from the past, science communicators have an opportunity to decide how to frame CRISPR-edited crops. We must assume that this window of constructive communication may be narrow, before genome editing becomes politicized, regulations are solidified, and companies stake their claims.

The goal of framing should not be to bias the conversation towards trusting scientists and creators of the technology, but to open the door for two-way conversations. Establishing CRISPR as a neutral tool with a range of applications gives stakeholders a voice on which applications we should pursue, expectations of regulations, and other common causes of concern. The translation of public feedback into actionable outcomes is a hurdle unto itself, but the first step in approaching this reciprocal relationship is to prevent CRISPR-edited crops from following down the path of the GMO debate.

This article deconstructs a point of tension I have experienced during outreach events – describing the uniqueness of CRISPR while reinforcing negative opinions around GMOs. Many of the public's concerns are warranted, which is why certain CRISPR-edited crops are designed to address various shortcomings associated with GMOs. That said, the development of GMO crops and other forms of genome-engineered crops will still play a vital role in feeding a growing global population and adapting our food supply for a rapidly changing climate. Placing CRISPR on a pedestal while dismissing other approaches will not help advance either the scientific field nor constructive engagement with the public. I look to the field of communicators to offer new insights on how to relieve this tension and reignite a renewed conversation with the public about the past, present, and future of engineered food.

Note

1. We note that although genetically engineered (GE) food is the more accurate terminology used by the FDA, we will use genetically modified (GM) or genetically modified organism (GMO) to better align with the public lexicon.

Disclosure statement

No potential conflict of interest was reported by the author(s).

ORCID

Kevin Doxzen http://orcid.org/0000-0002-3616-6569
Hope Henderson http://orcid.org/0000-0002-1373-296X

References

Broniarczyk, S. M., & Griffin, J. G. (2014). Decision difficulty in the age of consumer empowerment. *Journal of Consumer Psychology*, *24*(4), 608–625. https://doi.org/10.1016/j.jcps.2014.05.003

Butler, J. M., & Vossler, C. A. (2018). What is an unregulated and potentially misleading label worth? The case of "natural"-labelled groceries. *Environmental and Resource Economics*, *70*, 545–564. https://doi.org/10.1007/s10640-017-0132-9

Calabrese, C., Anderton, B. N., & Barnett, G. A. (2019). Online representations of "genome editing" uncover opportunities for encouraging engagement: A semantic network analysis. *Science Communication*, *41*(2), 222–242. https://doi.org/10.1177/1075547018824709

Food Marketing Institute. (2019). *Supermarket facts*. https://www.fmi.org/our-research/supermarket-facts

Kearns, C. E., Schmidt, L. A., & Glantz, S. A. (2016). Sugar industry and coronary heart disease research: A historical analysis of internal industry documents. *JAMA Internal Medicine*, *176*(11), 1680–1685. https://doi.org/10.1001/jamainternmed.2016.5394

Lusk, R. W. (2014). Diverse and widespread contamination evident in the unmapped depths of high throughput sequencing data. *PLoS One*, *9*(10), e110808. https://doi.org/10.1371/journal.pone.0110808

Montenegro, M. (2015). *Opinion: The complex nature of GMOs calls for a new conversation*. https://ensia.com/voices/the-complex-nature-of-gmos-calls-for-a-new-conversation/

National Research Council. (2015). *Public engagement on genetically modified organisms: When science and citizens connect: A workshop summary*. The National Academies Press. https://doi.org/10.17226/21750.

Nawaz, M. A., Mesnage, R., Tsatsakis, A. M., Golokhvast, K. S., Yang, S. H., Antoniou, M. N., & Chung, G. (2019). Addressing concerns over the fate of DNA derived from genetically modified food in the human body: A review. *Food and Chemical Toxicology*, *124*, 423–430. https://doi.org/10.1016/j.fct.2018.12.030

Nordlee, J. A., Taylor, S. L., Townsend, J. A., Thomas, L. A., & Bush, R. K. (1996). Identification of a Brazil-nut allergen in transgenic soybeans. *New England Journal of Medicine*, *334*, 688–692. https://doi.org/10.1056/NEJM199603143341103

Perry, E. A., Thomas, H., Samra, H. R., Edmonstone, S., Davidson, L., Faulkner, A., & Kirkpatrick, S. I. (2017). Identifying attributes of food literacy: A scoping review. *Public Health Nutrition*, *20*(13), 2406–2415. https://doi.org/10.1017/S1368980017001276

Pham, N., & Mandel, N. (2019). What influences consumer evaluation of genetically modified foods? *Journal of Public Policy & Marketing*, *38*(2), 263–279. https://doi.org/10.1177/0743915618818168

Román, S., Sánchez-Siles, L. M., & Siegrist, M. (2017). The importance of food naturalness for consumers: Results of a systematic review. *Trends in Food Science and Technology*, *67*, 44–57. https://doi.org/10.1016/j.tifs.2017.06.010

Rozin, P., Fischler, C., & Shields-Argelès, C. (2012). European and American perspectives on the meaning of natural. *Appetite*, *59*(2), 448–455. https://doi.org/10.1016/j.appet.2012.06.001

Saxena, D., Flores, S., & Stotzky, G. (1999). Insecticidal toxin in root exudates from Bt corn. *Nature*, *402*(6761), 480. https://doi.org/10.1038/44997

Scheufele, D. A. (1999). Framing as a theory of media effects. *Journal of Communication*, *49*(1), 103–122. https://doi.org/10.1111/j.1460-2466.1999.tb02784.x

Skepitical Raptor. (2016). GMO genes transfer to humans – debunking a myth. https://www.skepticalraptor.com/skepticalraptorblog.php/gmo-dna-transfers-humans-debunking-pernicious-myth/

Spisák, S., Solymosi, N., Ittzés, P., Bodor, A., Kondor, D., Vattay, G., & Csabai, I. (2013). Complete genes may pass from food to human blood. *PLoS One*, *8*(7), e69805. https://doi.org/10.1371/journal.pone.0069805

Vogel, S. A. (2009). The politics of plastics: The making and unmaking of bisphenol a "safety". *American Journal of Public Health*, *99*(Suppl 3), S559–S566. https://doi.org/10.2105/AJPH.2008.159228

Zilberman, D., Holland, T. G., & Trilnick, I. (2018). Agricultural GMOs – What we know and where scientists disagree. *Sustainability*, *10*(5), 1514. https://doi.org/10.3390/su10051514