Perceptions of Genetically Modified Foods

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When you walk into a grocery store, how do you decide what foods you are going to buy? Do you decide based on nutrition? Flavor? Price? For most people, the answer is a combination of all three. But what about how the food was grown or made? This is a question people do not tend to think of often. In America, where a huge number of the foods we eat are processed and pre-packaged, most of us do not know where our food comes from or how it is made (Schlosser, 2002, p. 121). Despite the fact that many of us may be ignorant about our food sources, people still have opinions of different methods of growing food, including conventional farming, organic farming, and bioengineering.

While many praise organic farming methods, those foods that are brought about by genetic modification are looked at as tainted "frankenfoods," a term coined by Boston College English professor Paul Lewis to denigrate genetically modified (GM) foods (O'Neill, 1992). As reflected in the UCSB student population, I argue that many post-secondarily educated Americans are opposed to eating genetically GM foods because they believe them to be unnatural and unhealthy. However, many people base their preconceived notions of GM foods on incomplete knowledge about what they are eating, not facts.

GM foods are often associated with terms like "unhealthy" and "unsustainable," and many of these opinions stem from the media and "word of mouth" (Hornsby, 2012). However, these views of GM foods are not necessarily true. Studies show that food produced through genetic modification, also known as bioengineering, can be just as healthy, sustainable, and nutritious as conventional foods. In some cases, they are even better for the environment and our health, as demonstrated by EnviroPig and Golden Rice. In order to address the safety concerns many have with GM foods, extensive testing and safety measures are taken before any GM food is grown and available for purchase. I believe that the negative views people have of

bioengineered foods stem from the media and could be changed to see the benefits of genetic modification with more education in the natural sciences. As shown by Saher and Hersti (2006) and Hornsby (2012), education in fields like biology and genetics is likely to affect people's opinion of GM foods in a positive manner. Moreover, as the public grows to accept bioengineered foods, more money and research dollars can go toward creating GM foods that benefit malnourished populations, reduce pollution to our planet, and save us money.

The Roots of "Frankenfood"

As defined by Ian Shaw, GM foods "are simply foods that have been produced using alien genes inserted into crops or animals to introduce a useful production or flavour characteristic" (2005, p. 213). Foods are genetically modified for many reasons. In the EnviroPig, the genome of a pig was altered using *E. coli* and mouse DNA to produce less phosphorous – a potentially toxic substance – and in Golden Rice, the DNA of rice was modified to combat childhood blindness and mortality by the addition of beta-carotene (Silver, 2006, p. 14; Mayer, 2005). Scientists have engineered other crops to be herbicide-resistant and drought-resistant and to have a longer shelf life. Despite the many possible benefits of GM products, bioengineered foods tend to conjure grotesque images of mutated food made by mad scientists in a laboratory. Years of anti-GM food campaigns and negative media attention are largely responsible for this.

In May of 1999, Cornell scientist John Losey and colleagues published a paper, claiming that Bt corn, a corn plant bioengineered with bacterial genes to be pest-resistant, was causing the death of the already endangered monarch butterfly: "Losey's paper was the front page story in the *New York Times;* the monarch photo accompanying the story was captioned 'Bambi of the insect world' " (Brown & Fedoroff, 2004, p. 204). Environmental groups like Greenpeace and

Friends of the Earth latched onto the story based on Losey's poorly supported paper, which was criticized by scientists for its unrealistic experimental conditions, and used it as a platform to gain support for their anti-GM food movements. Friends of the Earth sent out letters to potential members, asking, "If deadly toxins that kill butterflies are being introduced into our food supply, what effects are these toxins having on you and your family?" (p. 204). This captivating story had lasting effects on those who read it or heard about it. Although further research verified the safety of Bt corn, this is not something readers would remember as well as the poor, dead monarch (Brown & Fedoroff, 2004). And this is not the only example of environmental groups affecting public perceptions of GM foods.

Greenpeace once again began protesting a genetically modified crop in 2005. The profound creation of Golden Rice ignited strong opposition from Greenpeace: "rather than celebrate the potential of this breakthrough to alleviate the suffering and reduce the number of deaths caused by malnutrition – in the millions, many of them children in developing countries – Greenpeace greeted the development with claims that Golden Rice is 'not effective' and 'superfluous' " (Mayer, 2005). The attention bioengineered foods receive in America has repercussions all across the globe. When influential groups claim that Golden Rice and other GM crops are unnecessary and dangerous, people tend to listen, whether or not there is data to support their claims. Policy makers in countries that would greatly benefit from GM crops sometimes begin to echo the opinions of Greenpeace. This became apparent when "Zambia, for example, rejected US donations of genetically modified maize, despite the severe grain shortage caused by devastating drought in central and southern Africa; other nearby countries hit by the grain shortage also rejected the US-approved transgenic product." (Mayer, 2005). Even though bio-fortified crops could alleviate much of the suffering caused by severe drought, many

countries are not willing to import these crops because of their fear and disapproval of GM foods. Regrettably, groups like Greenpeace perpetuate and exploit these unwarranted suspicions.

While there are an overwhelming number of anti-GM food campaigns and protests, there are relatively few advocating for the benefits of GM foods. According to my survey, 83.8% of respondents heard negative opinions of bioengineered foods, while only 48.2% of people heard positive opinions. Media, friends, and the Internet bombard people with the negative aspects of bioengineering but rarely explore the positive features, which are unlikely to be heard, unless the source is a scientific article or a professor in college (Hornsby, 2012). This is clearly having an impact on people's thoughts of these beneficial foods.

UCSB and Genetic Modification

To establish public perceptions of GM foods among Americans with post-secondary education, I distributed a 10-question survey to college students and graduates. The sample size of this survey is 58 people, with 56 completed surveys because two respondents skipped five of the ten questions. The majority of the participants are third-year UCSB students, although some are recent graduates (two graduated seven or more years ago). This survey establishes trends in public perceptions of GM foods among college students, especially between majors. Students were asked questions regarding their major, class year, genetics education, willingness to eat GM foods (and reasoning), familiarity with Golden Rice, and what type of opinions they have heard of GM foods.

According to my survey, only 25% of respondents do not have a problem eating GM foods; the other 75% did. The most common reasons for electing to not eat GM foods included: "I prefer to support organic and/or local foods" (51.8%; 29 people) and "they are not natural" (50%; 28 people). Of the 58 people who responded, 58.6% took a biology class during college

that had genetics as part of the curriculum. About 39.7% took such a class in high school, and only one person had no formal education in genetics. When asked how well the phrase "I prefer not to eat genetically modified (GM) foods" described them, I had assumed that most of those who had taken a course in college that included genetics in the curriculum would answer with "inaccurately" or "somewhat accurately"; however, 29.4% (10 of 34 people) felt that the phrase described them "very accurately." This means that even with some knowledge of genetics gained at the college level, they were still not willing to eat GM foods. On the contrary, none of the biology or chemistry majors felt that the statement described them "very accurately" (Hornsby, 2012). This suggests that those majoring in the hard sciences like biochemistry are more likely to accept GM products as harmless food sources. While both groups—hard science and non-science majors—had college-level courses that discussed genetics, it is probable that those who study chemistry or biology have learned about genetics more extensively. It is possible that with further distribution of my survey (providing a much larger sample size than 58), this trend would be even more apparent, as it was in Saher and Hursti's survey.

Saher and Hursti conducted a similar survey in 2006, using mainly Finnish university students as their population sample. Their data showed that "the leading GM predictor was field of study: students of the natural sciences tended to be more clearly positive about GM than others." They had a much larger sample size, 3282, where 85% were full-time students, and the mean age of their population was 24 years (Saher & Hursti, 2006). This resembles my survey, where the majority of the respondents were full-time students (some are college graduates) and the average age was 20 years old, excluding those who graduated seven years ago or longer (Hornsby, 2012). These resemblances, in both findings and sample population, allowed me to reach similar conclusions.

The major limitation to my survey was the small sample size of 58 participants. Additionally, the hosting website for the survey only permitted 10 questions, limiting the amount of information that could be obtained. Furthermore, all of the questions were closed ended, although some did have a comment box to further expand upon answers. But, despite the limitations of this survey, a general pattern of disapproval of GM foods was apparent. University students and graduates, especially those who did not major in biology or chemistry, do not want to eat GM foods. But why?

The Benefits of Bioengineering

Clearly, many people hold negative opinions of bioengineered foods. People do not want to eat them because they believe they are "unhealthy," "unnatural," disease causing, and unsustainable (Hornsby, 2012). I argue that many of these opinions are merely that: opinions. They are often not based on facts but rather gut reactions to the idea of GM foods perpetuated by negative media attention. I believe this is simply because people do not know about all the benefits that some transgenic foods could provide. Two excellent examples are Golden Rice, as mentioned in the survey, and EnviroPig.

Golden Rice was created through bioengineering in 2000. According to goldenrice.org, Golden Rice has been biofortified "as a contribution to the alleviation of life-threatening micronutrient deficiencies in developing countries" ("Golden Rice," 2011). Biofortification is the process of genetically modifying organisms so that they provide beneficial nutrients or characteristics. In many third world countries, vitamin A deficiency is a leading cause of childhood blindness and death. To help combat this serious issue, scientists created Golden Rice.

Some opponents of GM crops believe that there are better ways to provide beta-carotene than substituting regular rice with Golden Rice. One of these opponents described the reasoning

behind this belief: “It claims to provide an essential vitamin that many impoverished populations are deprived of, and seen as an efficient way to deliver these vitamins. However, opponents have proven that a small amount of squash/vegetables (one serving, I believe) could deliver the same amount of vitamins” (Hornsby, 2012). While their argument against it is true, there are issues preventing this from being a feasible option. As stated by Mayer in 2006:

> Initiatives promoting a more varied diet have met with limited success. This is because fruits and other food sources of previtamin A [beta-carotene] are not available throughout the year. Moreover, many of these food sources do not grow in the areas where they are most badly needed. Most of all, people affected by vitamin A deficiency usually cannot afford to buy a varied diet.

Clearly, using squash and other vegetables as a source of this micronutrient is not always a viable choice. In countries where a family can only afford to plant a single crop that must store for many months, the most common choice is rice. If they could get the necessary amount of vitamin A from a crop they already cultivate, they would greatly benefit.

Another challenge Golden Rice faces is not the argument against genetic modification, but general knowledge of the crop’s existence. According to my survey, 69.9% of the 56 respondents had never even heard of the GM crop (Hornsby, 2012). Despite being from a minority of highly educated college students and graduates in America, those who answered the survey are overwhelmingly unaware of the existence of this extraordinary crop. But, there were some exceptions.

Surprisingly, a quarter of the individuals who strongly opposed GM foods had heard of Golden Rice. All five of these people acknowledged the benefits of Golden Rice; one such person said, “it is the rice that is being genetically modified to contain higher levels of vitamin A

so countries with vitamin deficiencies can get the nutrients that are essential for them to live" (Hornsby, 2012). Based on this statement, it seems he or she favors Golden Rice because of the enormous benefits in can provide under-developed, malnourished populations. This was a pattern seen among those who opposed GM foods, but had heard of Golden Rice: while they may see the benefits of Golden Rice or support growing it in third world countries, they themselves are not willing to eat bioengineered foods. Contrarily, more than half of the people (8 of 14) who approved of GM foods *had* heard of Golden Rice and the benefits it provides (Hornsby, 2012). This data supports the idea that the more knowledge people have of the benefits of GM crops, especially for malnourished, underfed populations, the more likely they will be to support this kind of food. This alludes to education as a possible solution to dissipate adverse, preconceived notions about the genetic modification of food.

Another perfect example of the benefits of bioengineering is EnviroPig. The typical pig farm produces an extraordinary amount of phosphorus. For monetary reasons, the pigs on these farms are fed diets extremely high in grain, which contains phosphorus. Unfortunately, pigs are unable to process and digest the phosphorus, and it is excreted. Through surface runoff, much of the phosphorus is washed into streams and rivers where it has detrimental effects on natural ecosystems: algae blooms and consequently, massive numbers of fish die. Luckily, with research that started in 1995, scientists were able to modify the genome of a pig with bacterial and mouse genes so that it could break down and use the phosphorus in its diet, reducing the pollution by as much as 75%: they called these pigs EnviroPigs (Silver, 2005).

This pig had an amazing potential to help local ecosystems. Unfortunately, farmers were not willing to raise EnviroPigs because they feared the public would not want to purchase GM food. They were correct. Much protest followed the announcement of the EnviroPigs and the

research project was shut down earlier this year due to a loss of funding ("Genetically modified pig," 2012). Although 28.6% of those who disapproved of GM foods believed "they are bad for the environment," this genetically modified pig is just the opposite (Hornsby, 2012). EnviroPig works to combat pollution in a way that pigs that had not been genetically modified never could.

As seen with Golden Rice and EnviroPig, bioengineered foods can be better than their traditional or organic alternatives. With advanced techniques in genetics, like biofortification, scientists are able to provide sustainable, nutritious food for the ever-growing population. Unfortunately, anti-GM food campaigns obscure these advantages for some people.

Still Have Doubts about GM Foods?

As demonstrated by my survey, there are a variety of reasons people do not want to eat GM foods, including the idea that "they are bad for the environment." The most common reason for not eating GM foods, chosen by 51.8% of survey participants, was "I prefer to support organic and/or local foods" (Hornsby, 2012). However, there is no reason GM should be mutually exclusive from organic and local.

The organic food movement has gained much popularity in the past 10 years. The U.S. Department of Agriculture (USDA) defines organic foods as those "produced and handled without synthetic substances" (as cited in Silver, 2005, p. 16). The USDA's definition of organic excludes foods created through bioengineering. However, "natural" mutations to animal food sources, such as those resulting from irradiation from the sun, are completely acceptable. Interestingly, these "new varieties of animals with extreme but natural mutations undergo no safety testing at all," while GM foods undergo an extensive array of testing by both the labs creating them and the FDA (Silver, 2005, p. 16; Pandey et al., 2010, p. 450). These types of facts and scientific data should help dissipate the belief that GM foods, and only GM foods, are

unhealthy and cause disease, as believed by 23.3% of my survey participants (Hornsby, 2012). The USDA definition of organic foods also prohibits the use of synthetic pesticides in the growing process; conversely, rotenone, a naturally occurring pesticide, is acceptable, despite its possible links to Parkinson's disease (Silver, 2005, p. 16). If organic farmers grew genetically modified crops, the use of any type of pesticide or herbicide would be obsolete due to introduced pest-resistance, as seen with Bt corn (Pandey et al., 2010, p. 449; Brown & Fedoroff, 2004).

Another complaint about GM foods is that they are "unnatural" (Hornsby, 2012). While foods may not develop beneficial characteristics like drought-resistance and increased beta-carotene levels if grown in the wild, this is no reason to exclude them as food options. If it is possible to reduce pollution and childhood morbidity by enhancing crops and farm animals with genes from other bacteria, plants, or animals, this option needs to be explored.

Changing the Public's Opinion

People have many opinions about genetic modification. Some people, even those with in-depth knowledge about bioengineering, still may not want to promote, produce, or eat GM foods. However, this is not my main concern. I am targeting those that are forming their opinions about bioengineering based on incomplete facts and sensationalized media stories. They should be educated about the truth of GM foods.

One particular survey respondent had never taken any genetics classes and felt very strongly about the negative aspects of GM foods. Unfortunately, his or her only source of information on bioengineered foods was "word of mouth" (Hornsby, 2012). This response clearly exemplified the fact that many of those who obtain post-secondary degrees base their opposition to GM foods on incomplete data and instinctive reactions, not facts. Fortunately, it appears that education in genetics, biology, and chemistry can change these opinions. People

need to be educated on bioengineering and hear both sides of the argument from a variety of sources. If people are more educated about genetics, they are more likely to be open to the idea of GM food (Hornsby 2012). People tend to fear the unknown and unfamiliar. If we could make bioengineering known and familiar, it is possible people will accept bioengineered foods.

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