What's for Dinner Tonight?
An examination of Genetically Modified Organisms in our food supply

Genetic engineering. Biotechnology. Genetically modified organisms. GMOs. Even scientists can't agree what to call them. This (uncharacteristic) nomenclatural disparity certainly adds to their mystery. Ask a stranger on the street and the chance is great that they won't recognize any of those terms. If they do, they might reply with any one of wide ranging definitions … and opinions.

In tonight’s paper, I am going to present two sides of the Great GM Debate and allow you to form your own opinions. I hope to prevent my own passionate opinion from shining forth too brightly and risk shadowing another. I strongly believe people should take interest in their food and decide for themselves “what’s for dinner”.

Today’s society has many concerns regarding the health, economics, ecology, and ethics of their diet. Tonight we will “chew over” GMOs. An estimated 80% of processed food within the United States contains at least one genetically modified ingredient. So, we may literally ruminate on this issue later this evening.

But before we begin choosing sides, I should provide you with the definition of genetically modified. As I said, there are many different definitions to choose from. Some people give GMO a wide definition that encompasses any “artificial” processing including the use of hormones, antibiotics, genetics, or pesticides. Others argue that humans have been genetically modifying crops and livestock since the agricultural
revolution of 6000 BCE through the use of selective breeding. For our purposes tonight, we will use the definition from the scientists who develop GMOs. A genetically modified organism is an organism that contains selected genes from naturally incompatible species incorporated via DNA recombination technologies. It means that a gene from one plant or animal can be directly inserted into the genome of another developing plant or animal using a variety of insertion methods. The second organism will then grow up able to express the new trait derived from the new gene. Typically, the two species involved cannot breed with one another, like taking an antifreeze gene from a fish and adding it to a strawberry. However, some breeders now use DNA recombination technologies to speed up the process of conventional breeding and swap genes between different varieties of the same species. This is especially common among apple breeders due to the inconsistent nature of cross-breeding apple trees.

Now that we know what we’re talking about, let’s discuss how GMOs can be good. First, it must be said, that GMOs are safe to eat. The only difference between a GM tomato and a classic tomato is a single piece of DNA. That piece of DNA is not man-made, but has naturally evolved within another organism. All DNA is made of the same four chemicals (Adenine, Thymine, Guanine, and Cytosine) and all living things, even humans, contain DNA. We safely consume DNA every day. In fact, if your food doesn’t contain DNA, you may want to think twice about what it really is you’re eating.

In fact, GMOs can actually be healthier than their classical counterparts. Scientists can develop fruits and vegetable that produce more energy and more nutrients. A similar philosophy is used to make biofuels more efficient as the fuel of
the future. Some GMOs are used to restore health and produce medicines or other drug precursors. This process is usually referred to as “pharming”. The idea is used hypothetically in the case of an apple that can be eaten as a daily prescription to “keep the doctor away”. In reality, strains of *E. coli* have been developed to produce insulin for diabetic patients. Previously insulin had to be harvested from pigs and presented many more issues, which we will discuss shortly.

Healthier GMOs that produce more nutritious food or serve as an easy source of medicine have the greatest impact in developing countries. Imagine, the same small handful of rice with the ability to feed more people. Far from reality, such rice is already being developed and transported from places like Cornell University to remote areas of Africa. In the future, scientists will be able to ship seeds to places in need that will be able to grow their own medicinal supply without relying on irregular shipments from abroad.

Along with the nutritional shortages, developing countries usually lack sufficient resources to maintain sufficient agriculture. Numerous crop species have been modified to be more ecologically friendly than their classical counterparts. Some require less water and are more drought tolerant. Others, like corn and soybeans, have been developed to grow more compactly and require less land to generate a yield equal to classical species. Transposing bacterial genes into plants allows the plant to produce its own natural pesticide. In bacteria, these genes serve as a competitive defense mechanism, but in crops they reduce the need for farmers to spread more chemical pesticides, which pollute land and water.
Ecological benefits are not limited to plants. GM animals are also more environmentally friendly, like cows that produce less greenhouse gas like methane. Other organisms benefit the environment by changing the way they work. Bacteria are currently underdevelopment that can clean oil spill, process nuclear waste, and break down plastic. *E.coli* now produces rennet used in cheese making, rendering rennet production ecologically cleaner. Formerly it was produced by cows. Cows that require lots of land, food, and water to raise (not to mention all of those greenhouse gases). The same is true for the insulin producing pigs!

Lessened resource consumption equates to less expense and more economical practices. Imagine the rennet producers’ overhead. The cost to maintain a Petri dish of *E. coli* that virtually consumes no space or food compared to the cost of maintaining a heifer. The same is true of farmers who yield more corn per acre with GM corn. He can plant fewer acres while earning the same amount of profit. If his corn is modified to produce its own pesticides, his bottom line is further reduced without the extra cost of purchasing additional chemical pesticides.

GMOs can also enhance the bottom line after cultivation. The Flavr Savr tomato, for example has a modified ethanol production gene. It was essentially a faulty gene that delayed ethanol production, which causes the fruit to rot. This allowed them to last longer on grocery store shelves and saved owners money because they had less cost to absorb with spoilage. Another cost-effective GMO, is a barely modified to produce clearer beer and eliminates the need for a clarifying step during processing. Ben Franklin would be proud.
Ethically, these economic improvements also improve livelihoods by reducing the time, cost, and labor farmers and producers spend working. With higher yields and fewer expenses, farmers can harvest fewer acres to earn the same living, saving both time and money. Without the need for pesticides farmers not only save money, but also handle fewer hazardous chemicals. As ethical eaters, modern consumers must account for the way their food is produced. The United States already has a system to certify imports as “Fair Trade” and with GMOs, we may become more conscious of domestic agriculture. The next step is an ethical obligation to feed the world. GMOs make it easier to share high producing, nutritious crop seeds that require fewer resources.

Human ethics are closely tied to GM plants, but GMOs can also aid the ethical treatment of animals. Remember the cows that were needed to produce rennet to make cheese? I didn’t mention that it’s only found in baby cows. It’s a protein in their stomachs that helps coagulate milk to make it easier to digest. And the only way to harvest the rennet is to kill the baby cow. With the advent of a bacterium to the same job, baby cows no longer need to be sacrificed for rennet. Likewise, a GM goat helps to protect spider habitats. Spider webs are made of protein that is stronger than steel and can potentially be used to manufacture equipment like car airbags, bulletproof vests, or parachutes. Spider silk also has medical applications as bandages that reduce scarring or as scaffolding for tissue regeneration. The gene for this protein has been transposed into goats that produce it in their milk. Now, instead of rendering thousands of spiders homeless, a herd of happy goats is papered and can be harmlessly milked. The list goes on.
Of course not everyone agrees that GMOs are saviors of the earth. They would be much happier if all GMOs, like the Flavr Savr tomato, disappeared forever. First, it must be said, that not all GMOs are safe to eat. Individuals in favor of GMOs conveniently exclude people with food allergies from their statements on the safety of consuming GM foods. Remember the strawberry that contains anti-freeze genes? Those fish genes terrify people with severe fish allergies. Proteins synthesized from those genes within the strawberry have the potential to induce an allergic reaction with the consumer. Worse, consumers have little to no protection from such produce due to the dearth of labeling allowed by the government in fear of hampering the free-market.

Apart from changing the health of the food supply, GMOs may actually begin reducing it in the near future with the advent of biofuels. Biofuels rely on the renewable resource called biomass, which can be anything from forest-harvested lumbar to GM corn or soybeans specifically designed to produce more efficient energy. In the later case, growing crops takes time, labor, land, and resources that could be used to grow more food to feed the global population. Occasionally this idea is combated with the idea that developers are using “field corn” or the type of corn used to feed livestock, instead of the type of food corn that is consumed by humans. However, a diminished field corn supply makes it more difficult to raise livestock that also contribute to the global food supply. It does not matter which type of corn or biomass is used in biofuel production, they will all contribute to forth-coming shortages.
The health risks of GM crops and biofuels, however, pale in comparison to the severe ecological impacts. A common modification is the ability to grow crops more compactly to produce more per acre. More organisms living in smaller areas means soil is eroded faster and resources are depleted faster than among their classical counterparts. Such destruction will waste land, making cultivation impossible for decades. If too much arable land is damaged, it will be impossible to feed everyone with the current methods we have available.

By far the biggest ecological risk of GMOs is the danger of outcrossing. Outcrossing is the result of two populations of an organism interbreeding. It happens all the time in nature and is known to occur between cultivated crops and their wild counterparts (corn and teosinte for example). Usually, this does not cause problems in the natural ecology. When GMOs are guilty of outcrossing, it becomes something known as gene escape. Wild organisms with improvement genes have the potential to outcompete local competitors, creating an imbalanced, unhealthy ecosystem. Just last summer the world experienced one of its first instances of “gene pollution” when a population of GM canola was found growing wild along the highways of North Dakota. Researchers are still investigating how they spread: through natural means, like pollen dispersal, or through human means, like seed transport. Either way, eradication of unique organisms is nearly impossible and will be at a high expense.

Indeed, economics plays a major part of genetic modification technology and is its most detrimental factor. The farmers (and their neighbors) who cultivate super-producers are suffering from a flooded market. Grain elevators, spilling over with
surplus, purchase produce at marginal prices. Small farms cannot recoup their losses over the seasons and are slowly being forced off their land by larger collectives.

Corporations, which have a virtual monopoly on GM crops, do not aid their plight. Some GMOs are designed to correspond with certain pesticides or herbicides like Liberty Link corn. Liberty Link corn is resistant to a powerful herbicide that non-selectively eliminates other organisms like weeds. When buying seed from the Liberty Link company, farmers must also purchase the corresponding pesticide only available through Liberty Link. So few companies develop commercially available GMOs that they have cornered the market and tend to divide varieties between themselves.

GM seeds are more expensive in order to cover research and development costs not associated with their classical counterparts. Most GM products are granted intellectual property rights and are patented. This becomes a problem in cases in which modified genes escape into other farms that cultivate classical varieties. Affected crops then become genetically modified and, technically, property of the company that originally designed the modification. In many cases, the company can sue the second farmer for intellectual theft. Such lawsuits are devastating and further inhibit small farmer from being able to afford working.

The ethical practices of Monsanto in particular, further collapse in India where the suicide rate has skyrocketed due to the business practices of this one company. Monsanto has developed a special line of products for India to prevent the ecological dangers of outcrossing. Unlike classical seeds, these seeds “self-destruct” and become unviable after a set number of generations. Once they expire, farmers must purchase
more seeds to continue the cycle. In India, farmers suspect that this practice is more about economics than ecology. Whichever it is, it is unethical and ruins the livelihood of thousands of individuals taking the gamble that such crops will produce more, increase profits, and make GM seeds affordable every few years.

Back in the United States the ethical issues continue with the government for consumers. Unlabeled GMOs cause intellectual dilemmas for individuals with special diets in addition to the physical problems for people with food allergies. Genes from animals call into question the laws governing kosher preparations and the philosophies of vegans and vegetarians. Is a strawberry with a fish gene a fish? By not mandating GMO labeling the United States inhibits the right of consumers to make informed decisions about their food.

Overall, the anti-GMO portion of our discussion may have fewer points, but each point carries more weight. Does it matter if a tomato can last longer on store shelves when a single company can destroy a country’s agricultural system? GMOs can be strange, like the Chinese cows being developed to produce milk that resembles human breast milk, or downright impractical, like pet zebra fish with jellyfish genes that make them glow-in-the-dark. But overall they are designed to benefit the world’s health, ecology, economics, and ethics.

It is a tough decision on a complicated issue, but I hope I have sparked the debate within your own food philosophies. So, what will it be? The endangered wild salmon or the genetically modified AquAdvantage?

The choice is yours.