

It has taken me quite some time to decide how I morally feel about Genetically Modified Organisms, and it is only after a great deal of thought that I have finally come to a conclusion. I have struggled with separating the scientific processes of genetic engineering from the way in which they are used after they are produced in the lab. Only after separating science from the usage practices, was I able to finally decide that, while I may have issues with the policies and regulation of GMO's, that the science behind genetically engineering food is not morally wrong.

All living things share the same basic code of life. Whether you are looking at a bacterium, a tree, a dog or a human, a series of nucleotides (A, T, C and G that make up DNA) determines how our cells function, what we look like, how we grow, etc. What differs between organisms is simply how those four letters are arranged. It is the varying patterns of these nucleotides that ultimately make us unique. That said it is actually only about 2% of these 3.8 billion nucleotides (at least this is the number for humans) that code for information. The rest is often times referred to as nonsense DNA and it is not believed to be of any use to the organism.

The process of genetic engineering involves "cutting" out a sequence of nucleotides (a gene) from an organism and inserting them into the DNA of another organism. This gene gets incorporated into its DNA and becomes just another sequence amongst billions of base pairs. Ninety-eight percent of the time it ends up embedded in the nonsense DNA and thus has no effect on the other functioning genes of that organism. The organism is able to carry out all of the life functions that it was capable of before the insertion of the new gene; it now simply has one extra gene that it is able to express. If the large majority of the time it is not impacting the genes of the organism into which it is

being injected and therefore not adversely affecting that organism, then the process of injecting genes should not be considered morally wrong.

There are a number of cases where the same processes being used to produce GE food, is used to help cure human diseases. If we were to decide that this process was immoral, we would also have to deem the cases where we use the same science for curing diseases as immoral. An example would be that genetically engineered bacteria are now able to produce Human Growth Hormone; a hormone that used to be difficult and expensive to get (it used to come from cadavers). This protein hormone is now readily available for people with Growth Hormone deficiencies and one could argue that the bacteria that produce the protein actually benefit from the process as they receive all the nutrients and space they need to thrive (because of course the labs want them to grow so that they will produce the hormone). If we are to take a Utilitarian view, the greater good is obviously being maximized and therefore the insertion of this gene should be considered a moral act.

One of the objections brought up by Stephen Palumbi is that unlike artificial selection, genetic engineering does not select for all of the regulatory genes that usually accompany a gene. Instead scientists only include a few regulatory genes to activate the new gene. “The complex and species-specific set of genes that control the timing of gene expression – or the tissues in which expression occurs – are in general unknown” (VanDeVeer & Pierce, 2003). This seems to be a very valid argument, because most genes are only expressed at certain times in an organisms life span and therefore need to be turned on and off at specific times, or only expressed in certain tissues.

However, biotech has chosen their regulatory genes wisely. According to the GMO Handbook, "*A promoter is a segment of DNA that regulates the expression of the gene under its control. Constitutive promoters are continuously active; inducible promoters become activated only when certain conditions, such as the presence of an inducer, are met. It is important to select an appropriate promoter to optimize the expression of the target genes for desired timing and level of expression.*" (Parekh, 2004)

A number of the characteristics that genetic engineering selects for are ones that should be expressed for the duration of the plants life (ex. viral infection tolerance or herbicide resistance) and therefore a constitutive promoter is all that is necessary because there is no need to turn it off. Other characteristics such as the delay of ethylene production (a chemical that causes fruit to ripen) only need to be expressed once ethylene (inducer) production starts and it doesn't need to be turned off before the fruit is consumed, so once again an inducible promoter is all that is necessary. In other words, inserted genes do not seem to require the same host of regulatory genes as the ones that control other life cycle processes. Because the failure to include the normal regulatory genes does not seem to harm the plants, this argument does not seem to have the grounds to consider them morally wrong. Also, as was pointed out by a student in our philosophy class, "just because something is not normal does not make it immoral".

While I still feel strongly that there are a number of issues with the regulation of genetically engineered organisms, I believe that when considering the science of GE, the actual process of injecting the genes into host organisms, that it is difficult to find it immoral.

References:

VanDeVeer, D., & Pierce C., (2003) *The Environmental Ethics and Policy Book*, Wadsworth/Thomson Learning, Belmont, CA.

Parekh, S., (2004) *The GMO handbook: Genetically modified Animals, Microbes and Plants in Biotechnology*, Humana Press, Totowa, NJ.