

# Food Biotechnology



# Introduction

- Food biotechnology is the application of technology to modify genes of animals, plants, and microorganisms to create new species which have desired production, marketing, or nutrition related properties.
- Remember... **genes** are sections of DNA that code for protein.



# Introduction

- Called genetically engineered (GE) or **genetically modified (GM)** foods, they are a source of an unresolved controversy over the uncertainty of their long-term effects on humans and food chains.
- Nicknamed “Frankenfoods” by anti-GM food groups.



# Why genetically modify food?

- Food biotechnology is and will continue to be an important area in science as the world's human population continues to increase and the world's agricultural lands continue to decrease.
- The following are reasons why “we” genetically modify food.

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# 1) Extended Shelf Life

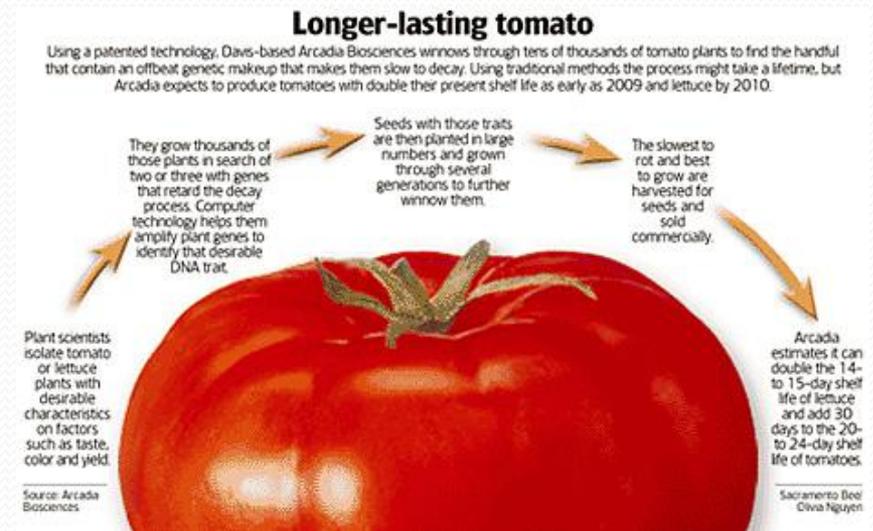
- The first steps in genetic modification were for food producers to ensure larger profits by keeping food fresher, longer.
- This allowed for further travel to and longer availability at markets, etc...



Extended Shelf Life Milk

# Example: Long Shelf Tomatoes

- These genetically modified tomatoes promise less waste and higher profits.
- Typically, tomatoes produce a protein that softens them after they have been picked.
- Scientists can now introduce a gene into a tomato plant that blocks synthesis of the softening protein.
- Without this protein, the genetically altered tomato softens more slowly than a regular tomato, enabling farmers to harvest it at its most flavorful and nutritious vine-ripe stage.



## 2) Efficient Food Processing

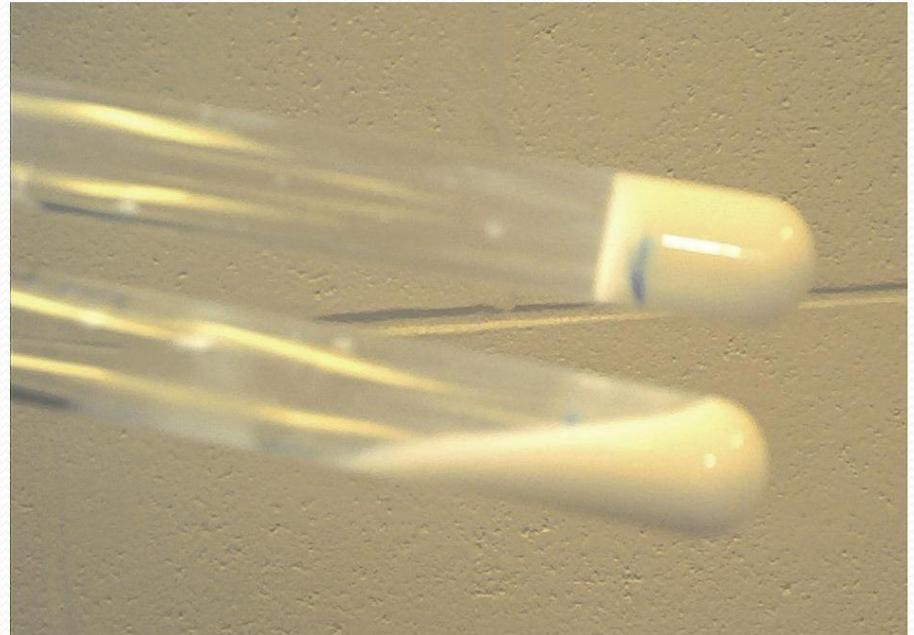
- By genetically modifying food producing organisms, the wait time and quantity of certain food processing necessities are optimized.
- Again this is a money saver.



Although efficient, this type of food processing is not an example of biotechnology.

# Example: Rennin Production

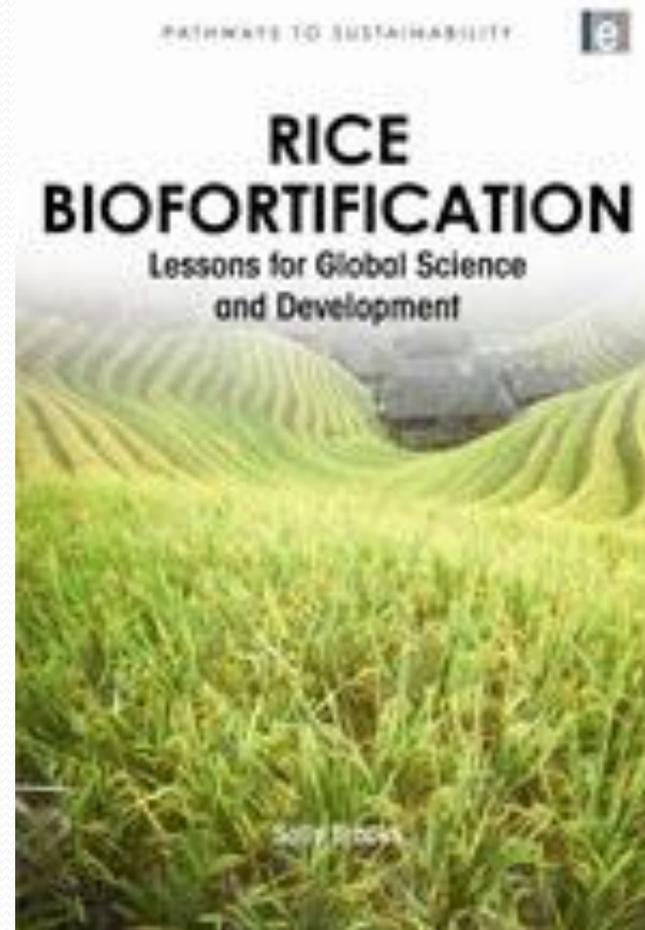
- The protein **rennin** is used to coagulate milk in the production of cheese.
- Rennin has traditionally been made in the stomachs of calves which is a costly process.
- Now scientists can insert a copy of the rennin gene into bacteria and then use bacterial cultures to mass produce rennin.
- This saves time, money, space and animals.



Rennin in the top test tube... not there in the bottom one.

# 3) Better Nutrient Composition

- Some plants, during processing, lose some of the vital nutrients they once possessed.
- Others are grown in nutrient poor areas.
- Both these problems can be solved by introducing genes into plants to increase the amount or potency of nutrients.
- “**Biofortification**”



# Example: Golden Rice

- Scientists have engineered "golden rice", which has received genes from a daffodil and a bacterium that enable it to make **beta-carotene**.
- This offers some promise in helping to correct a worldwide Vitamin A deficiency.



Ordinary rice (left) and golden rice (right). The latter is rich in provitamin A, which can save up to 500,000 children from going blind each year. (Photo: [www.goldenrice.org](http://www.goldenrice.org))

## 4) Efficient Drug Delivery

- Inserting genes into plants/animals to produce essential medicine or vaccines.
- “**Biopharming**”



# Many Unpatented Examples

- A cow with the genetic equipment to make a vaccine in its milk could provide both nourishment and immunization to a whole village of people now left unprotected because they lack food and medical help (in progress).
- Bananas and potatoes make hepatitis vaccines (done).
- Making AIDS drugs from tobacco leaves (done).
- Harvest vaccines by genetically altering hydroponically grown tomato plants to secrete protein through their root systems into the water (done).

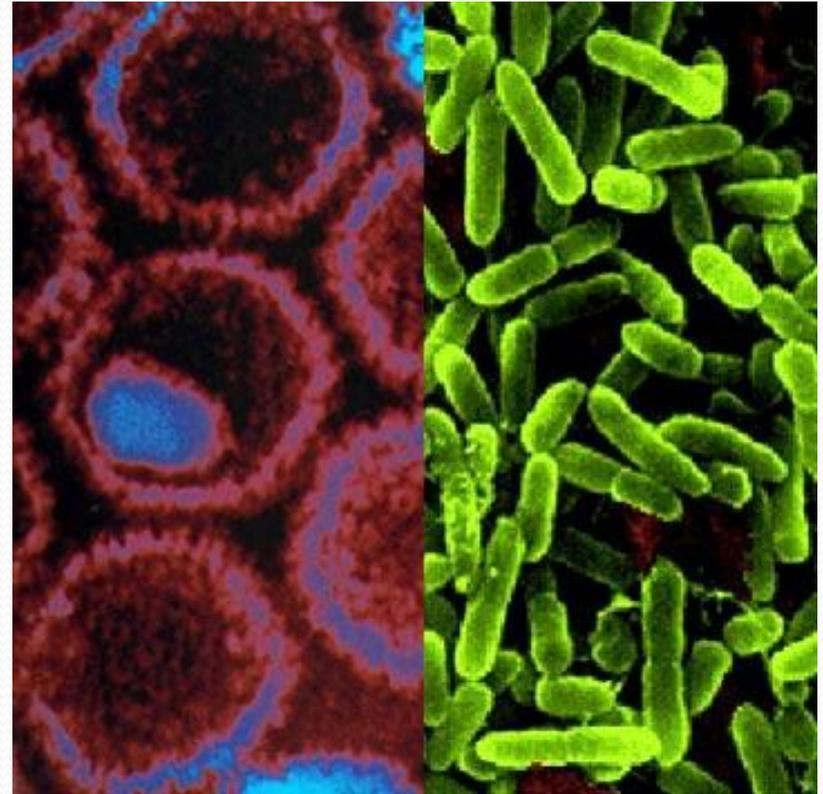
# Potential Problems???

- With every technology there is an associated risk involved.
- The following are some examples of potential problems associated with food biotechnology.



# 1) Creating “Superbugs”

- Since many of the “vectors” used to introduce genes to plants and animals are bacteria and viruses, it is realistic to think there is a chance they could undergo a mutation and prove harmful or become recombinant like the H1N1 virus and thus more virulent.
- However, the bacteria and viruses used in these procedures are usually non-pathogenic.



Viruses

Bacteria

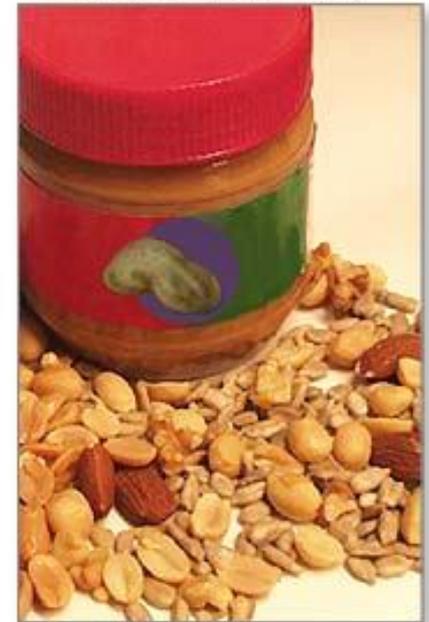
## 2) Negative Affects on Human Health

- Most of these food products undergo testing to see if any adverse health effects occur.
- However, allergies were not thought of in one case where a gene from a brazil nut was transferred to soy bean plants!
- Thankfully a food product was not pursued as someone came to their senses!
- Important to note that not all genes from a potential allergenic food will cause an allergy.

Shellfish



Peanuts and nuts



# 3) Ethics

- How many human genes would an organism have to have before you consider it human???
- The following food types have a variety with human genes added: rice (immune system genes that prevent diarrhea), baby food (lactoferrin and lysozyme) and any farm animal (Human growth hormone).



# Homework

- 1) What is the best reason for genetically modifying food?
- 2) What is a potential problem that you feel should be studied further before advancing farther into food biotechnology?
- 3) What food item would you genetically engineer? Why? For what purpose? What genes would you transfer?