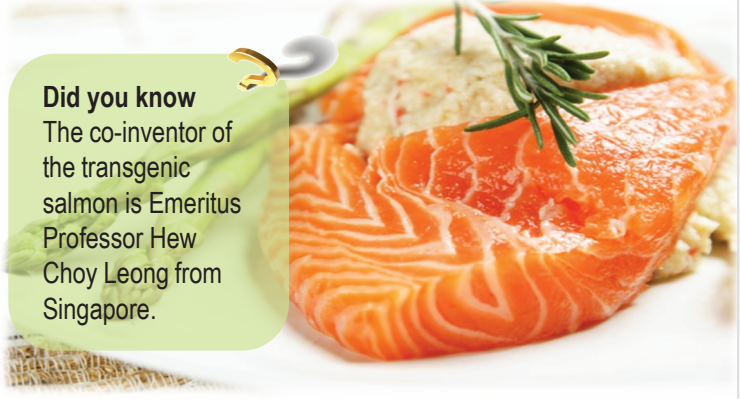
What are some current efforts in the field of GM?

❖ Golden Rice

- Deficiency in dietary micronutrients such as vitamins and minerals is a key cause of morbidity and mortality in the world, especially among the poor.
- Where the population cannot obtain a diverse, well-balanced diet, specially modified crops have the potential to relieve these deficiencies.
- Golden Rice – rice modified to contain a higher level of β-carotene (pro-vitamin A) – could help alleviate incidences of blindness and susceptibility to disease in under-privileged, rice-based societies.

❖ AquAdvantage ® Salmon

- AquAdvantage ® Salmon includes a gene from the Chinook salmon and ocean pout and has the potential to grow to market size twice as fast as conventional salmon.
- Discussions were initiated with the US FDA in 1993 and a formal application submitted in 1995.

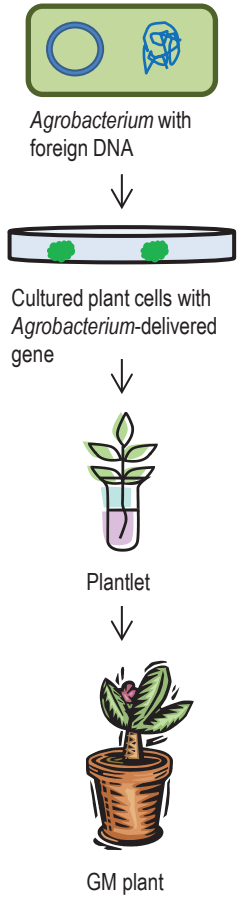


Did you know
The co-inventor of the transgenic salmon is Emeritus Professor Hew Choy Leong from Singapore.

What are some of the common genetic modification techniques?

❖ *Agrobacterium*-mediated

- *Agrobacterium tumefaciens* is a soil bacterium used commonly in delivering genes into plants.
- A foreign gene is inserted into the *Agrobacterium* using a 'cut and paste' method.
- Plant tissue is incubated with the *Agrobacterium* to allow the transfer of genes.
- Plant cells which have successfully received the gene can be regenerated into a GM plant.



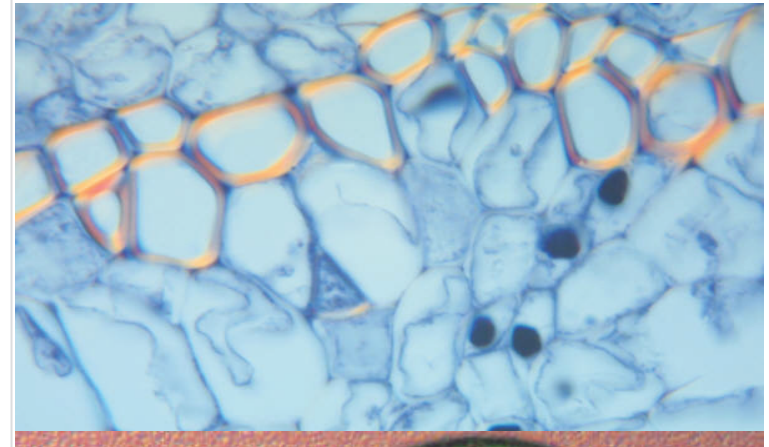
❖ Microinjection

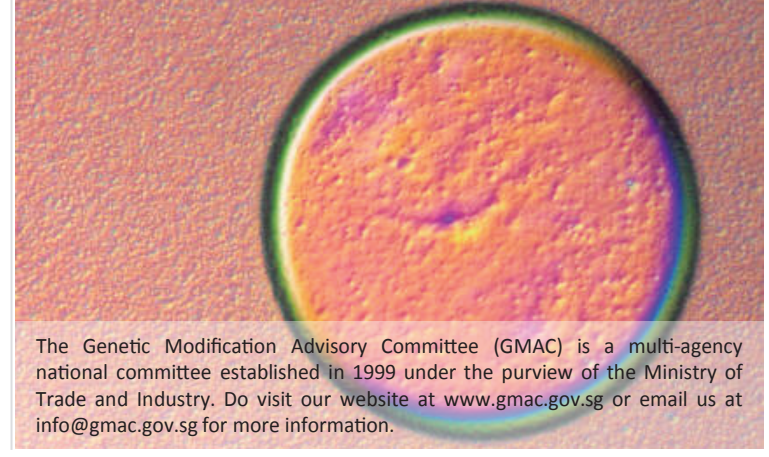
- This involves the injection of genetic material directly into a recipient cell.
- The recipient cell (usually an egg cell or embryo) will then give rise to a GM organism.

GMAC SINGAPORE

GENETIC MODIFICATION

The basics

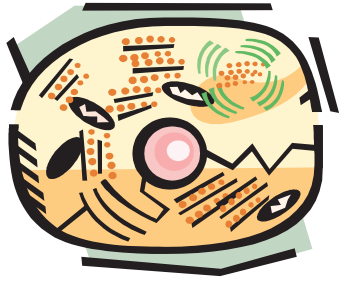




The Genetic Modification Advisory Committee (GMAC) is a multi-agency national committee established in 1999 under the purview of the Ministry of Trade and Industry. Do visit our website at www.gmac.gov.sg or email us at info@gmac.gov.sg for more information.

What is DNA?

- DNA stands for deoxyribonucleic acid.
- It is the molecule within a cell nucleus that contains the genetic instructions which are required for the function of a cell.



What are genes?

- Genes are segments of DNA that code for proteins which are vital to the development of a cell.
- All living organisms have genes – animals, plants and even microorganisms!
- These genes largely determine the characteristics of the organism.
- Genes are what living organisms pass on to their offspring for the continuation of the species.

Did you know
The first GMOs were bacteria. Today, GM bacteria are used in the synthesis of pharmaceutical proteins, bioremediation etc.

What is genetic modification (GM) and what are GM organisms?

- Genetic modification is a form of technology that involves direct alteration of DNA of an organism.
- An organism which has had its DNA altered by molecular techniques is termed a genetically modified organism (GMO).
- With the advancement of biotechnology, scientists have developed special biochemical scissors and glue which enable them to "cut" and "paste" genes from one living thing to another. The newly introduced DNA brings new characteristics to the resultant GMO.

Going Back in Time – A Brief History of GM

- 1860s: Gregor Mendel, an Austrian monk, analysed pea plants and published his work with an outline of the laws of genetics.

Did you know
Gregor Johann Mendel is known as the "Father of Modern Genetics" for his work on the pea plants.

- 1953: Watson and Crick determined the double helix structure of DNA.
- 1973: The first GMOs were bacteria and were the combined efforts of Herbert Boyer and Stanley Cohen from University of California at San Francisco and Stanford University respectively.
- 1986: The United States Food and Drug Administration (US FDA) approved the first vaccine made with GM technology which was against Hepatitis B.
- 1990: The US FDA approved the first food created by GM bacteria – the enzyme chymosin, used in cheese production.
- 1994: The US FDA approved the Flavr Savr tomato, which was genetically modified to have a longer shelf life.