Pocket K No. 55
Biotech-improved Animals

Over twenty years ago, the first biotech crop was placed in the market to benefit farmers and the consumers. Varieties of high yielding important crops were improved to contain traits such as insect resistance, herbicide tolerance, and drought tolerance among others.[1] In 2016, 185.1 million hectares of biotech crops were planted by 18 million farmers in 26 countries worldwide.[2] Aside from benefits to agricultural crops, genetic engineering has also been applied to animals such as insects, fish, and livestock to address different concerns such as disease spread, food production, and environmental pollution.

GM Mosquitoes

Mosquitoes are known to be vectors of detrimental diseases such as Malaria, Dengue fever, Chikungunya, and Zika. Since only female mosquitoes bite, scientists have devised ways to combat the mosquito-borne diseases by significantly reducing the number of female population.

Scientists at Imperial College London used genetic engineering to distort the gender ratio of mosquitoes by reducing the number of females. They used I-PpoI, an enzyme that cuts specifically within the mosquito's ribosomal gene sequences (rDNA), which are located in a single cluster on the X chromosome. They developed a transgenic strain of mosquitoes that expresses I-PpoI in sperm cells to cleave the X chromosome and produce mostly Y chromosome-bearing sperm and thus, male offsprings. These male mosquitoes would inherit the I-PpoI endonuclease gene, leading to generations of about 95 percent male offspring.[3]

Researchers at the Oxford biotechnology company known as Oxitec developed Friendly™ Aedes mosquitoes, genetically modified mosquitoes with a gene that kills the progeny insects at the larval stage. GM male mosquitoes that do not consume human blood mate with wild female mosquitoes to produce unviable larvae that die before adulthood. [4]

After field tests in different locations, Friendly™ Aedes mosquitoes were launched in Piracicaba, Brazil in April 2015. A 91% reduction in dengue fever cases in the CECAP/El Dorado District was recorded in 2016. Dengue fever cases decreased to just 12 in 2015/2016, compared to the 133 cases in the previous year.

According to Epidemiologic Surveillance, the rest of the municipality saw a 52% reduction in Dengue fever incidence during the same period: from 3,487 cases in the 2014/2015 period to 1,676 cases in 2015/2016. The report also showed that in 2015/2016 dengue-year, the rate in CECAP/El Dorado was 45% lower than the rest of the municipality, whereas it was 195% larger in the previous year. The latest data roundup also reports zero cases of Zika and Chikungunya in CECAP/Eldorado. [5]

Friendly™ Aedes mosquitoes were also used to wipe out the spread of Zika virus, which causes microcephaly in children in Brazil. [6]

GE Salmon

Aside from insects, fishes were also genetically modified to provide benefits to consumers. After almost three decades since its development, the first genetically engineered fish in the market, the AquAdvantage salmon, became available in Canada in August 2017. The GE salmon is developed by AquaBounty Technologies to grow twice the size of non-GE salmon for the same growing period. It contains a growth hormone gene from Chinook salmon which is activated by another gene from ocean pout.[7]

The same variety of salmon was also approved by the US Food and Drug Administration (US-FDA) in 2015. The US-FDA determined that food from AquAdvantage Salmon is as safe to eat and as nutritious as food from other non-GE Atlantic salmon and there are no biologically relevant differences in the nutritional profile of AquAdvantage Salmon compared to that of other farm-raised Atlantic salmon. [8]

Glowing Fish

GloFish (glowing fish) is a genetically engineered fish initially developed not for consumption but for pollution detection.

Bioluminescent fishes naturally occur in the oceans, usually inhabiting the deepest and darkest parts of the sea. Several years ago, scientists in Singapore developed fluorescent fishes to help detect environmental pollutants. They added naturally-derived fluorescence gene to the fish to quickly and easily know when a waterway is contaminated. The initial step in the experiment was to make the fish glow all the time. The constantly glowing fish captured the interest of the public, which led to its commercialization as home aquarium pet in 2003 under the license of Yorktown Technologies.

To date, there are 12 lines of GloFish in the market, including tetras, zebra fish, and barbs, in such colors as Electric Green, Moonrise Pink, and Cosmic Blue. GloFish now takes up a significant percentage of aquarium fish industry sales.[9]

Though its impact is not as significant as other GE animals, its long history of safe use indicates the great potential of GE animals to provide benefits.

Eco-friendly Pig

Pigs excrete a significant amount of phosphorus in their manure, which is notorious for leaching into groundwater under piggery farms, which further causes algal growth in freshwater ponds, streams, and lakes. In 1999, scientists at the University of Guelph in Ontario, Canada, developed a genetically enhanced line of Yorkshire pigs with improved digestion of plant phosphorus. This line called Enviropig produce phytase enzyme in their salivary glands. When the enzyme mixes with the feeds in the stomach, phytase degrades the indigestible phytate in the feed, which accounts for 50-75 percent of the grain phosphorus. [10]

After several years of research, the enhanced trait was proven to be stable for more than nine generations and that phytase expression was only present in the salivary glands, with only trace amounts in other tissues. The developers submitted the Enviropig for regulatory review by the U.S. and Canadian government in 2007 and 2009, respectively. Preliminary data showed positive results. [11] Unfortunately, the research was discontinued because of lack of funds, even so, the completed research indicate that genetic engineering works in modifying the animal pig to make it eco-friendly.

Bird-flu resistant Chicken

U.K. scientists have developed transgenic chickens that have resistance to the most devastating disease of birds and fowls, the bird flu (influenza). This technology then has the potential to stop the global threat of bird flu in poultry production as well as in human health.

University of Cambridge scientists and partners generated chickens with a short-hairpin RNA that work as decoy that inhibits and blocks the spread of the influenza virus. Further tests showed that transmission of the virus to both transgenic and nontransgenic birds was prevented. [12]

Conclusion

Aside from transgenic animals, modern biotechnology techniques have been applied to produce other products to improve human and animal health. These include production of therapeutic compounds such as hormones, antibodies, vaccines, and growth factors.

Similar to the development of GM crops, use of genetic engineering in animals has faced public criticisms stalling development and commercialization. Thus, even if development of GM animals has started in 1980s, to date, very few have reached commercialization. More improvements in the animal sector are expected in the near future, and hopefully would reach the market to fulfill their potential benefits to humans and animals. Effective and responsible science communication among the scientists, government, industry and other stakeholders is also necessary to achieve a consensus on the use of modern biotechnology in animals.

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