Transgenic Fish:

A transgenic fish is one that contains genes from another species. A transgenic fish is an improved variety of fish provided with one or more desirable foreign gene for the purpose of enhancing fish quality, growth, resistance and productivity.

Typically, genes of one or more donor-species are isolated, and spliced into artificially constructed infectious agents, which act as vectors to carry the genes into the cells of recipient species. Once inside a cell, the vector carrying the genes will insert into the cell's genome.

A transgenic organism is regenerated from each transformed cell (or egg, in the case of animals), which has taken up the foreign genes. And from that organism, a transgenic variety can be bred. In this way, genes can be transferred between distant species, which would never interbreed in nature.

With the advancement in the field of genetic engineering, the application of its commercial use has also increased. Aquatic animals are being engineered to increase aquaculture production.

The use of genetic engineering and rDNA technology has done miracles in medical and industrial research. The transgenic fish are being promoted as the first marketable transgenic animals for human consumption.

Using the gene transfer technology, scientists now have created a genetically engineered variety of Atlantic salmon that grow to market size in about 18 months, otherwise the fish takes about 24-30 months for becoming market size fish. It is also hoped that we can now modify a large number of fishes with fast growing characteristics and bring Blue Revolution.

The following are the important points needed for genetic engineering (gene transfer) to produce transgenic fish:

1.A gene sequence is to isolate for the particular characteristics; for example, growth hormone

2.These genes (gene sequence) are then inserted into a circular DNA known as plasmid Vector (enzymes endonucleases and ligases are used).

(3) Plasmids are harvested in the bacteria to produced billions of copies.

(4) Plasmids are introduced into linear DNA. The linear DNA is sometimes called a gene cassette because it

contains several sets of genetic material in addition to new inserted gene; for example, growth hormone gene. The technology is available to integrate genes in germ line of developing individual (fish) and finally transmitted into further generations.

(5) Making the cassette a permanent part of fish's genetic makeup.

Development of Transgenic Fishes:

Development of transgenic fish has focused on a few species including salmon, trout, carp, tilapia and a few others. Salmon and trout are cash crops while the others primarily provide sources of protein. Currently, about 40 or 50 labs around the world are working on the development of transgenic fish.

About a dozen of them are in the U.S., another dozen in China, and the rest in Canada, Australia, New Zealand, Israel, Brazil, Cuba, Japan, Singapore, Malaysia, and several other countries. Some of these labs are associated with companies that expect to commercialize their fish in a few more years.

Many of the fish under development are being modified to grow faster than their wild or traditionally bred aquaculture siblings.

Faster growth is usually accomplished by transferring a fish growth hormone gene from one species of fish into another. The faster growing fish not only reach market size in a shorter time, they also feed more efficiently. Trout growth hormone (GH) was used to produce transgenic carp with improved dressing properties. Such transgenic carp are recommended for production in earthen ponds.

Transgenic Salmon:

The Atlantic salmon is engineered with a pacific salmon, growth hormone driven by the arctic antifreeze promoter gene. The rapid growth of that transgenic salmon is achieved, not so much by the transgenic growth hormone as by the antifreeze gene promoter that functions in the cool water desirable for salmon flavour.

Devlin (1994) research scientists with Fisheries & Oceans, Canada, in West Vancouver, British Columbia has modified the growth hormone gene in Coho salmon by developing a gene construct in which all the genetic elements are derived from sockeye salmon.

The transgenic Coho grew on average 11 times faster than unmodified fish and the largest fish grew 37 times faster. The growth hormone levels in the transgenic fish are high year-round, rather than falling off in the winter as occurs in ordinary salmon Devlin (2001). The modified salmon are large enough to be marketed after one year, in contrast to standard farmed salmon that do not reach market size for at least three years.

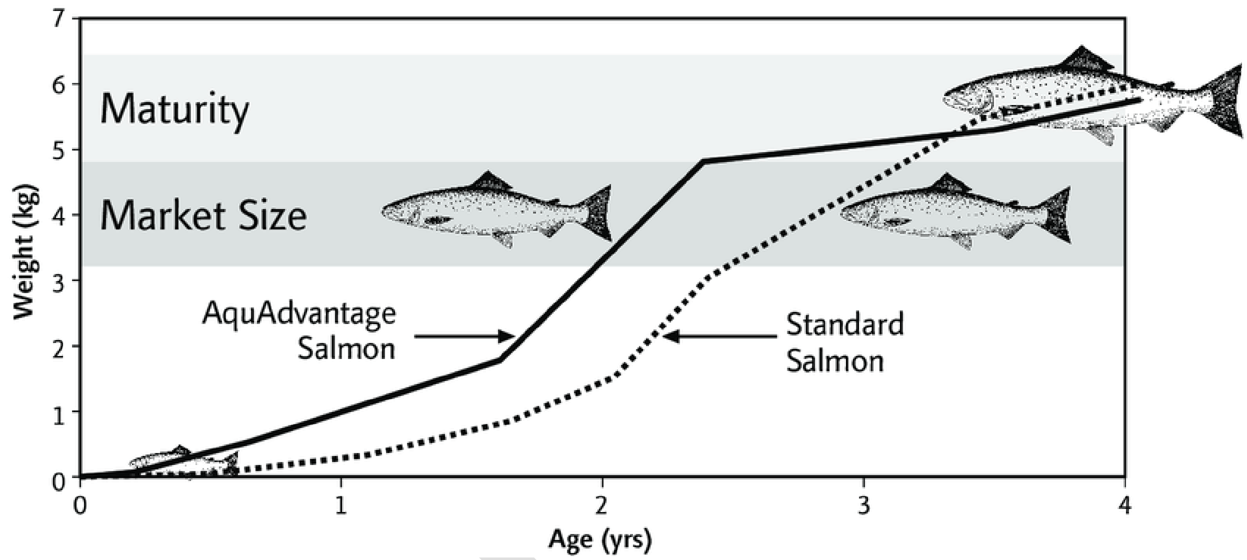
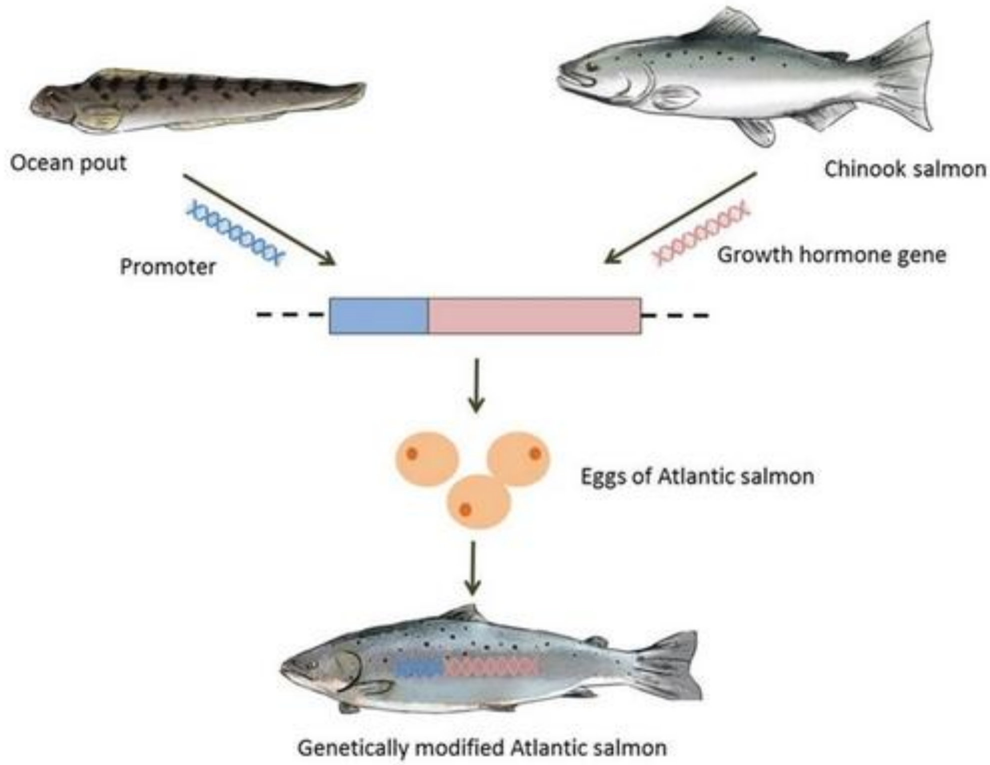


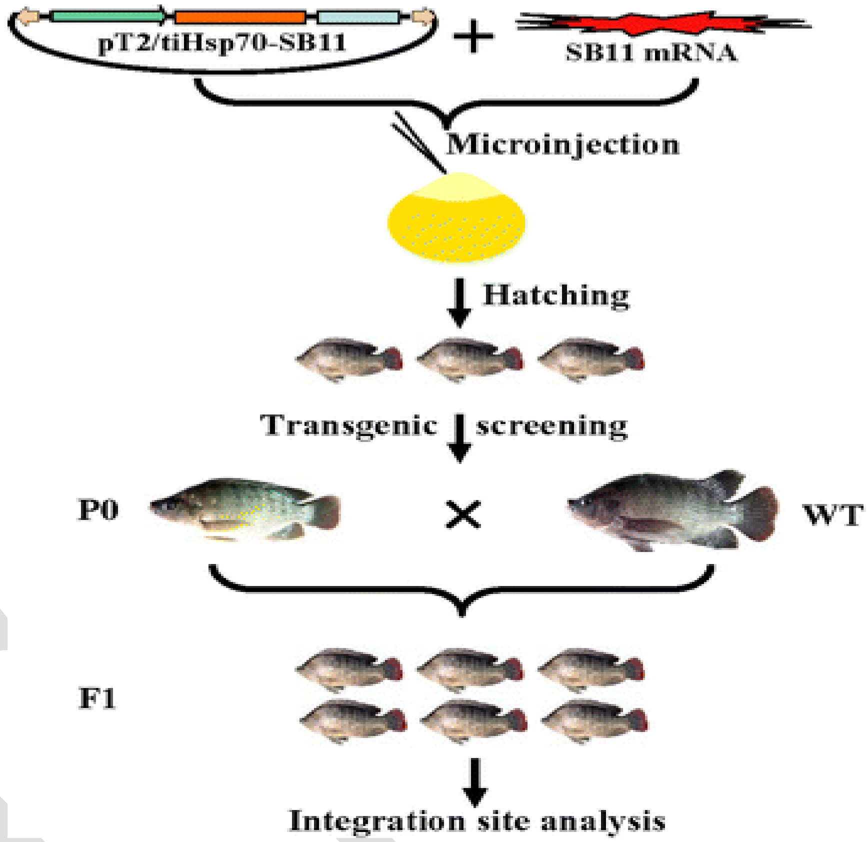
Fig. Comparison of growth GM and Non-GM Salmon .



Transgenic Tilapia:

Tilapia fish, native to Africa, are cultured world-wide as “poor man’s food”, second only to carp as warm water food fish, and exceeding the production of Atlantic salmon (whose market value is twice that of tilapia). Tilapia has been extensively genetically modified and promoted as a transgenic fish exclusive for isolated or contained production.

Transgenic tilapia, which is modified with pig growth-hormone, has three times larger than their non-transgenic siblings. Tilapia genetically modified with human insulin grew faster than non-transgenic siblings, and could also serve as a source of islet cells for transplantation to



human subjects.

Transgenic Zebra Fish:

The tiny zebra fish (Brachydanio rerio) that lives in aquariums, was genetically modified to produce a fluorescent red pigment, and is being promoted for sale as a household aquarium pet, the "goldfish".

The goldfish caused a stir in the United States because regulation of such transgenic pets is murky and none of the major regulatory agencies: Food and Drug Administration (FDA), United States Department of Agriculture (USDA) or Environment Protection Agency (EPA), has been willing to take the lead in regulating the goldfish (even though USDA does deal with pet animals).

Gong (2003) developed novel varieties of the Zebra fish. Three "living colour" fluorescent proteins, green fluorescent protein (GFP), Yellow fluorescent protein (YFP), and red fluorescent protein (RFP or dsRed), were expressed under a strong muscle-specific mylz2 promoter in stable lines of transgenic zebra fish.

These transgenic zebra fish with vivid fluorescent colours (green, yellow, red or orange) fluorescent proteins can be seen with naked eyes under both daylight and ultraviolet light in dark. The green fluorescent protein (GFP) is originally isolated from the jellyfish (Aequorea tictoria).

The goldfish is available for sale from January 5, 2004 without regulatory approval in United States (Fig.).