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ORIGINAL ARTICLE



Advances in biotechnology and sustainable aquaculture in India

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Aquaculture biotechnology, as we all know that it plays a crucial role in contributing to achieve improvements of aquaculture yields, stock, preservation of genetic resources, disease diagnosis, and control of micro algal genetic engineering and developments in aquaculture research and management. India has been working to develop high-quality; effective, healthy, sustainable blue aquaculture and biodiversity conservation through the application of modern biotechnology. The two areas of modern biotechnology that has been expected to have most significant impact on genetic improvement of aquaculture species are DNA markers and transgenic.



Biotechnology provides powerful tools for the sustainable development of aquaculture fisheries, as well as in the food industry. Biotechnology allows scientists to identify and combine traits in fish and shellfish to revolutionize aquaculture production, productivity and improve quality. The science of biotechnology has endowed us with new tools and technology to modify and recombined genes and genotypes of plants, animals and fish.

The Biotechnological tools such as molecular diagnostic methods , use of vaccines and Immune stimulants for improving the disease resistance in fish and shellfish species ,use of synthetic hormones for stimulate breeding of fish, production of monosex, Chromosome Engineering, molecular biology and transgenesis, immunostimulants and antimicrobial peptides, bio-prospecting, biotechnology in aquaculture nutrition and health management, gene banking and the marine natural products are used all over the world.

BIOTECHNOLOGICAL TOOLS FOR SUSTAINABLE AQUACULTURE

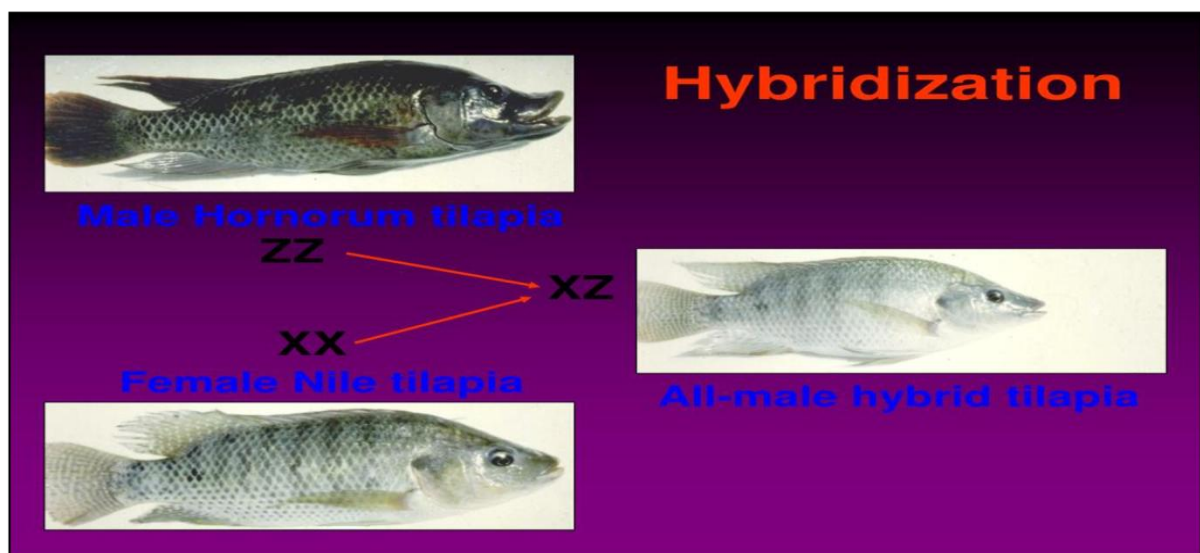
1. Induced breeding:

- The induced breeding of fish is now successfully achieved by the development of **Gonadotropin releasing hormone (GnRH)** technology. Salmon GnRH is now profusely used in fish breeding and marked commercially under the name of "Ovaprim" throughout the world.
- In fact, most of the economically important culturable fish, especially catfishes, in land locked water do not breed until the hormone induces them. The induced breeding of fish is now successfully achieved by development of GnRH technology.



2. Hybridization

- Hybridization attempts to produce fish that combines valuable traits from more than one species or high heterosis. Hybridization is aimed to evolve a hybrid or strain of superior quality than the parent species.
- An example is the hybridization of Nile tilapia, *Oreochromis niloticus* and the blue tilapia, *Oreochromis aureus* produces an all-male progeny which controls unwanted reproduction.



3. Transgenesis

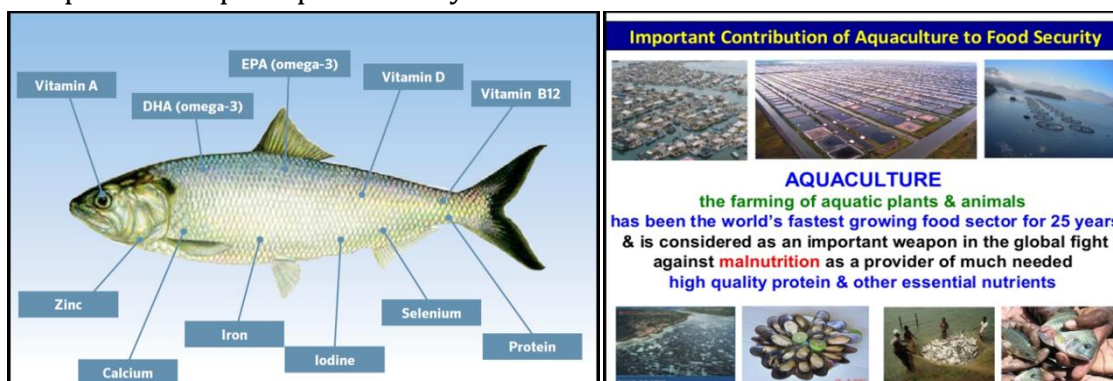
- Transgenesis or transgenics may be defined as the introduction of exogenous gene / DNA into host genome resulting in its stable maintenance, transmission and expression.
- Selected traits may include improvement of growth rates, larger size, more efficient feed conversion and control of sexual maturation, disease resistance, tolerant to low level of dissolved oxygen in the water and fish resistant to freezing temperature.
- In India transgenics as an emerging discipline will have an important role to play for increasing aquaculture productivity and for conservation and management of fisheries.

- Example: Transgenic ornamental fish popularly called as "glow fish".



4. Aquaculture nutrition

- Recently aquaculture has been contributing significantly to food security and poverty elevation.
- World aquaculture production will continue to increase and since nutrition and feeding play a pivotal role in sustainable aquaculture, use of nutritionally balanced and completely formulated feeds will, continue to play a dominant role in finfish and shellfish production.
- Hence, alternative and biotechnologically improved feed ingredients should be sought along with improvements in fish farming, pond management and manipulation of pond productivity.



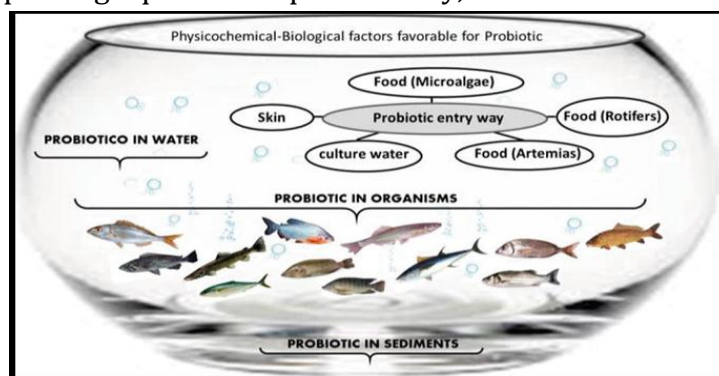
5. Cryopreservation of gametes or gene banking

- Cryopreservation is a technique, which involve preservation and storage of biological material at -196°C , the temperature of liquid nitrogen. It is based on the principle that very low temperatures tranquilizes or immobilize the physiological and biochemical activities of cell, thereby making it possible to keep them viable for very long period.
- However, the recent reports on the freezing shrimp's embryos look promising and also conservation of many threatened aquatic species. Therefore, it is essential that gene banking of cultivated and cultivable aquatic species be undertaken expeditiously.



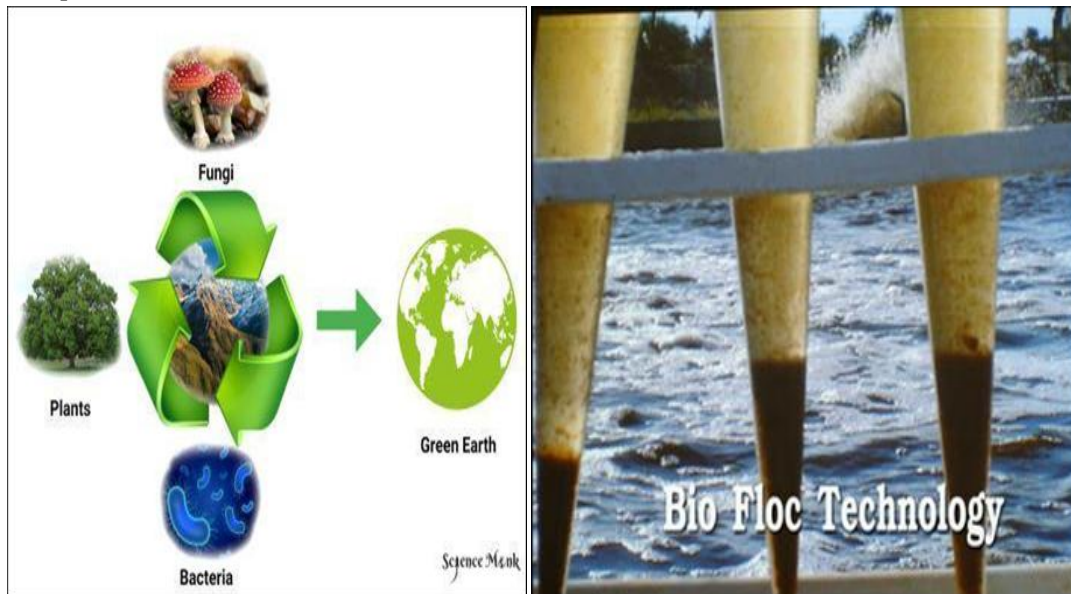
6. Molecular biology & microbial technology for aquaculture

- Now are days advances in molecular biology have provided unlimited number of genetic markers which have multiple applications in aquaculture and fisheries.
- Microbial technology for aquaculture comprising aspects of bio-fertilization, microbial processing of organic matter, use of probiotics and enhancement of feed digestibility, detritus enrichment and shortening of food chains for better energy transfer rates, genetic upgradation of bacterial strains, bio-filtration and waste recycling as also techniques pertaining to post-harvest technology hold great promise in improving aquaculture productivity, on a sustainable basis.



BIOTECHNOLOGICAL APPLICATIONS IN AQUACULTURE:

- ✓ Fish diagnostics and vaccines for major fish diseases
- ✓ Improvement culture technology in non-traditional species
- ✓ Fish transgenics for therapeutic and ornamental fish
- ✓ Fish genomics, proteomics, transcriptomics and vitro tissue/ cell culture system
- ✓ Feed development, fish nutrition, breeding and reproduction, post harvest management and value addition
- ✓ Bio-plastics, bio-sensors and bio-remediation



Note: All of these applications could help improve the selective breeding, hybridization, productivity, health, growth, nutrition, cryopreservation and conservation of genetic resources in aquaculture stocks for the benefit of mankind. There is also increasing concern about the impact of biotechnology on sustainable development in various fields. Therefore, this reveals that the advancements in biotechnology as how it is helping to revolutionize aquaculture development in India.

CONCLUSION

- It can be concluded that the application of biotechnology in the fisheries sector is a relatively recent practice. Nevertheless, it is a promising area to enhance fish production. The increased application of biotechnological tools can certainly revolutionize our fish farming besides its role in aquatic biodiversity conservation.
- The present and prospective use of biotechnology would lead to development of smart and high performing fish.