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New Innovative Technologies used in Aquaculture

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Abstract

Technologies used in aquaculture have a huge role in increasing the productivity of fish farming. There are several new technologies which have revolutionized the aquaculture. Genetic tools and other reproductive technologies are being used regularly and have removed many challenges. Many problems associated with traditional aquaculture have been solved. The diseases in fish are controlled with the application of new techniques. More disease resistance, stress tolerance power have been incorporated in the fishes. Most of the diseases are now prevented successfully. A great progress has also been observed in fish feed processing. All these innovations have sustained the productivity as well as strengthened the economy of the fish farmers.

Keywords: Aquaculture, fish, technology

Technology, the application part of scientific knowledge has always helped mankind to make a better future. Technologies used in aquaculture are also not an exception to it. Rapid development has been observed for the last few decades in aquaculture. From very simple techniques to high technology systems have been evolved in a beautiful way. Many old techniques have been modified as well as several new methodologies have been developed. But, all this evolution has served a common purpose; increasing the productivity and betterment of farmers' economy. Solving the problems that the farmers face in fish cultivation; is the only target of all these technologies. It is true that we have successfully addressed many of the problems. In this article, we have discussed how the new innovative technologies used in aquaculture have changed the scenario of fish production and the livelihood of the farmers.

Innovations related to reproduction

Biotechnological and genetic tools have a huge capacity to increase productivity and enhance the sustainability of the ecosystem. These tools can be the best weapon to provide avenues for the purposes of improvement of reproductive success and endangered species growth and survival. Recent innovational technologies in aquaculture are very much helpful for the identification and conservation of aquatic biodiversity. One of the major segments of these technological innovations regarding reproduction is transgenic technology. These technologies have great contributions towards enhancement of growth rates and market size and feed conversion ratios, disease resistance, improvement of stress tolerance against extreme environmental conditions and improvement of sterility issues.

Transgenic shrimp have been invented in the shrimp aquaculture sector (Mialhe *et al.* 1995).But still, commercial culture is not successfully developed to date for proper application of transgenic organisms in aquaculture, consumer education and acceptance are very much important (Bachere *et al.* 1997; Benzie, 1998). Improvement of production from aquatic animals through the application of genetical innovational technologies is very less than their plant and livestock sectors.Genetic up-gradation programs are applied only in case of a very small section of farmed aquatic species (Gjedrem, 1997). Genetical research has contributed carp and tilapia culture in Asia in a number of areas, including genetic sequencing and the development of specific genetic markers. These markers help to locate those genes which are important tools for growth,sex determination factors or disease susceptibility (Kocher *et al.* 1998). These genetic markers are nothing but short unique pieces of genetic code. Genetic upgradations and improvements of some cultured fish species are largely induced by such genetical techniques.

Such techniques helped the farmers throughout Asia to overcome the drawbacks of traditional techniques. Fishes were selected in terms of desirable phenotypic characteristics for breeding, on the basis of an ad hoc which resulted in inbreeding depression and suppression of optimum production performances in most of the cases (Chen Defu and Shui Maoxing, 1995).

Vague genetic understanding in the Asia region is one of the major constraints in the path of genetic up-gradation of the farmed species. So, improvement of genetic understanding across many small-scale farms is the most difficult challenge as we know that improvement of core stocks have been focused on traditional approaches.

The Genetically Improved Farmed Tilapia (GIFT) program is a collaborative project between ICLARM (Malaysia) and research institutions in Malaysia, Philippines, UK and USA. This project was held in Asia.

The main objective of this project was to examine and understand the genetical sequence of some important farmed species of fish. Primary view of this project was to develop pure-bred lines and to distribute strains to farmers. This project has been dealing with Nile tilapia hybrids and strains.As production of fry and carps are more centralized than tilapia and spreading of improved stocks can be more rapidly, so some type of breeding projects with carp instead of tilapia would bring more benefits.

Disease management

Two complementary objectives of shrimp brood stock management programs are the production of specific pathogen-free(SPF) and Specific Pathogen Resistant (SPR) stocks. Specific pathogens are recognized for these are those are listed by OIE as "notifiable" and represent themselves as important threats to optimal production (OIE, 2000,2001).

Shrimp is very much vulnerable to infectious diseases. These infectious diseases represent current threats to the aquaculture sector, which are badly suffering from infectious diseases. Recently some emerging diseases create consequences over aquacultural productions.

Application of molecular techniques for pathogen screening, identification and isolation is considered as one of the best solutions to this problem. In most cases, traditional methods of disease control through the application of chemotherapeutics are very much ineffective due to the vast range of unknown pathogens. These molecular techniques not only contribute the disease control but also provide significant light upon the developmental process of diseases,potential control, prevention and treatment of diseases like DNA vaccines.

Various DNA or RNA based probes have great potential for easy and early detection of diseases and identification of their carriers of infections. Cultured species have also, been benefited through the direct effect of preventive management and control of disease of these nucleic acid-based probes. These probes have been very much successful especially in case of selection of shrimp brood stock and breaking their infection cycles, due to accidental transmission of viral pathogens of brood stock to developing offspring. Two commercially available molecular probes are IHHNV and type-A baculo virus in shrimp aquaculture (Durand *et al.* 1996), but in case of some other viral pathogens like SEMBV, MBV, TSV, HPV and YHV, availability of commercial probes are nil. They are still under development. Two major advantages of using microbial probes that, they are extremely sensitive and highly specific which made their use more suitable over non-molecular techniques (Walker and Subasinghe, 1999). Because of their high sensitivity and specificity, they can easily detect microbial infections in advance and can provide more accurate and rapid identification of pathogens respectively.

The wide-spread application of these molecular techniques helped to reduce dependency upon prophylactic treatment and active use of antibiotics for the purpose of disease control. So, their application helped to achieve better intervention of disease management and reduced cost for control. For many fish species, *in-vitro* tissue culture is available for many fish species (FAO and NACA, 2001; OIE, 2000; Groff and La Patra, 2000; Chi *et al.* 1999). This technique helped them to detect and isolate various pathogenic viruses and intracellular bacteria, but lack specialized maintenance and quality assurance. So, they should be equipped with some maintenance and quality assurance strategies, so that they can contribute to fish health at optimum level (Lorenzen *et al.* 1999; Ariel and Olesen, 2001). But there is no self-replicating call-lines exist for aquatic invertebrates currently.

In the case of, crustacean cell culture, considerable effort has given for maintenance and development,but success is not very impressive (Shimizu *et al.* 2001; Wang *et al.* 2000, Walton and Smoth., 1999; Ghosh *et al.* 1995; Toullec, 1995). Sometimes it becomes possible to develop a culture of the primary cell but the maintenance of their subcultures become quite difficult (Le Groumellec *et al.* 1995).

In case of molluscan cell-lines further research efforts are needed for the development and maintenance of their cell- culture (Bu Chanan *et al.* 1999, 2001; Cheng *et al.* 2001; La Peyre and Li 2000).

Trans-boundary movements of aquatic animals responsible largely for the spreading of aquatic animal diseases. But movements of live aquatic animals do not influence the dispersion of their pathogens much. Reliable and sensitive diagnostic techniques and standards are required to prove that. Field validated and refined DNA based tools are the best way to ensure that purpose (FAO 2000). For, an example application of appropriate DNA probes against specific shrimp pathogens, promote confidence in shrimp culture and make wider international markets accessible for cultured shrimp.

Not only pathogen screening, but biotechnological methods also have other applications for estimations of various health parameters, including hematocrits, leucocytes,oxidative radical production myeloperoxidase activity and phagocytic functions.

Feed technology

Currently, the most important issue related to aquacultural and fisheries development is to judge the suitability of fishmeal and other animal-related proteins in aqua-feeds (Naylor *et al.* 2000; Forster and Hardy, 2001). Inspite of containing high-quality protein contents, high cost and instability of supply are the most primitive barrier against using a fish meal. So, there is an obvious need for the replacement of fish meal with vegetable protein. Biotechnology here, provide greatest opportunities to develop a suitable alternative to fish meal, with a commitment to enhancing production and processing techniques. As plants do not contain much phosphorus, so the use of plant proteins has significant capacity to remediate the problem of phosphorus pollution, which is the major drawback of using animal protein in fish feed. Pressure on wild fish stock can be reduced by the use of plant-protein in aquafeed. So, investigation of various plant species and plant-animal protein mixes as new sources for shrimp protein is getting focused (Mendoza *et al.* 2011). In the case of mollusks and finfish, the same tradition can be followed. But the only problem of using plant protein is the presence of anti-nutritional factors which can harm the fishes which are fed. So, by using enzymes like Phytase, researchers counteract the negative impact of those antinutritional factors, which helped to cause the optimal utilization of phosphorus present in plant-based protein feeds (Papatryphon and Soares, 2001; Vielma *et al.* 2000; Van weerd *et al.* 1999). Mass production of most of the aquatic species, depends largely upon some selected species of micro-algae, are rotifer, Brachionusandartemia. Butlabour intensive live-feed production systems poses several problems of consistent mass production,which include the problem of adequate nutritional quality. So, in this case, also biotechnological tools offer a great avenue to find cost-effective and efficient supplements to live-microlagae.

Biotechnological tools

Implementation and understanding of gene regulation and expression can be possible through the biotechnological studies (Alcivar-Warren., 2001; Agresti *et al.* 2000; Davis and Hatzel, 2000). Improved cryopreservation of gametes and embryos, transgenic manipulations can also be achieved through the application of biotechnological tools.

Bioremediation

Bioremediation is another promising approach through which degradation of hazardous waste to environmentally safe level can be possible through the use of various aquatic organisms or various other filtering macro-organisms (Rao and Sudha, 1996).

Various enhancement technologies related to aquaculture

Sea-ranching is a technology where production of juveniles occurred in the hatcheries but they are released to the sea to grow. In case of Japanese flounder, we got notable success but instances of failure have also got, as because basic factors were not properly understood (Howell *et al.* 1999). To promote better understanding of the factors, affecting the success of ranching programmes 1st international symposium on stock Enhancement and Sea ranching was organized in Norway in 1997 (Howell *et al.* 1999) and second symposium was held in kobe, Japan in 2002 January. If we can provide adequate habitat and properly regulated fishing, sea ranching can be the best approach to increase overall landing of fish (Welcomme and Bartley, 1998).

CONCLUSION

It is very clear from the above discussion that new innovative technologies have contributed a lot to aquaculture. It has a multifaceted role impacting on different corners of fish cultivation. Some innovations have revolutionized the reproduction of fishes. It has increased production and helped the farmers. We can now easily achieve the desired productivity. Several economic traits like growth rate, feed conversion ratio, etc., have been improved. Besides, other characteristics like disease resistance, stress tolerance have also made better. A number of diseases have been eradicated. Drugs have been developed against many diseases. Strategies for prevention of diseases have been formed. All these technological progress have resulted in better productivity. The fish production profession is also gaining interest day by day among the new generation. This has been possible due to the continuous development of new techniques, methodologies in aquaculture. Finally, the producers or the fish farmers have been benefited. The economical improvements of all the fish farmers have become truly possible through the use of new innovative technologies in aquaculture.

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