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(RESEARCH ARTICLE)

Biotechnology tools are an important for improving the fish production

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Abstract

Aquaculture needs innovative biotechnological interventions to overcome challenges in terms of rapid disease diagnosis, production of disease-free or high health brood stock for seed production, suitable preventive and therapeutic measures to control disease outbreaks. Increased in growth rate of world fish's population demand. Aquaculture, therefore, remains the last hope for providing enough fish for the world, but with limited land and water space. Aquaculture biotechnology, therefore, has come to have a key role to play as it can make a great contribution to improving aquaculture yields. These techniques are potentially faster and more sensitive than traditional culture, serology and histology methods. The DNA-based techniques like Polymerase Chain Reaction (PCR), Real-time-PCR (qPCR), multiplex PCR, DNA probe-based in situ hybridization and microarray etc. there have a wide scope of applications in fish disease diagnosis. The application of biotechnology to various production systems does not come without its negative impacts but even still, the merits far outweigh the associated concerns because the techniques are constantly being developed thereby reducing the negative impacts thereof. Therefore, there is need to adopt biotechnological practices if the world is to stand any chance of achieving food security.

Keywords: Aquaculture; PCR; Biotechnology; DNA

1. Introduction

The world fisheries are in a period of crisis. Many major fish stocks are showing precipitous declines in productivity due to overfishing and further increases are not anticipated under the current global conditions and environment [1]. Aquaculture remains the last hope for providing enough fish for the world, being the cheapest source of animal protein [2]. But the aquaculture industry is currently faced with solving the simultaneous problems of developing economically viable production systems, reducing the impact on the environment and improving public perception while utilizing a lesser amount of land space.

With increase demand for aqua-cultured foods has come a need for more efficient production systems than the traditional systems faced with impediments to sustainability, such as slow growth of fishes, inefficient feed conversion, heavy mortality from disease and the associated use of polluted water with chemicals, loss of fish from poor oxygen conditions, inefficient harvest and low fecundity and reproduction [3]. The development of improved fish seed stocks that can contribute to increased fish production is seen as one of the key solutions to meeting the future food demands of the growing world population [4]. Biotechnology has opened a new window for development of genetic resources in aquaculture. Genetic technologies can be utilized in aquaculture for a variety of reasons, not just to improve production but also marketability, cultivability and the conservation of natural resources [5].

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2. Material and Methods

2.1. Biotechnology Techniques

Since the early 1980s, research in aquaculture and fisheries genetic biotechnology has steadily grown, and now research in this area is extremely active. Cultured fishes were being improved for a multitude of traits, including growth rate, feed conversion efficiency, disease resistance, tolerance of low water quality, cold tolerance, body shape, dress-out percentage, carcass quality, fish quality, fertility and reproduction and harvest ability [3]. The main vision of aquaculture biotechnology is to achieve improvements of aquaculture stock, preservation of genetic resources, disease diagnosis and control of microbial/micro algal genetic engineering [6]. In broad terms, biotechnology can be defined as any technological application that uses biological systems, living organisms or derivatives thereof, to make or modify products or processes for specific use [7]. This ranges from the use of synthetic hormones in induced breeding, hybridization, production of monosex, uniparental and polyploid population, molecular biology, transgenic fish to gene banking [8]. Biotechnology has the potential to enhance reproduction and the early developmental success of culture organism. The technology is used in several different ways in aquaculture and its application benefits both producers and consumers of aquaculture food products [2].

2.2. Induced Breeding

The artificial propagation methods constitute a major practicable means of providing enough quality seed for rearing in confined enclosure such a fish lakes, reservoirs and tanks [9]. Fish culture today is hardly possible without the artificial propagation of fish seeds of preferred cultivable fish species. Apart from being able to obtain quality seed the artificial propagation technique can also be used to develop strains superior to their ancestors by the methods of selective breeding and hybridization [10].

The most successful method of artificial reproduction in catfish is by induced breeding through hormone treatment followed by artificial fertilization and incubation of fertilized eggs and the subsequent rearing to fingerlings [11]. Hormonal stimulation allows year-round production of gametes and fry of economically valuable species. Hormone therapy is applied to improve and control of reproductive cycles during the domestication [12].

The induced breeding of fish is now successfully achieved by the development of Gonadotropin releasing hormone (GnRH) technology [13]. GnRH is the key regulator and central initiator of reproductive cascade in all vertebrates [14]. It is a decapeptide with the ability to induce pituitary release of luteinising hormone (LH) and follicle stimulating hormone (FSH) [15]. Channa striatus 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 cultivable fish, especially Channa species, in land locked water do not breed until the hormone induces them. Ovaprim is administered intramuscularly at 0.5ml per kg of fish body weight [11].

2.3. Trasgenics

The transgenic involves the transfer of certain preferable traits from one species into another species in this case of fishes. These traits may include improvement of growth rates, larger size, more efficient feed conversion and control of sexual maturation [38]. Transgenic technology provides a means by which such a quantum leap in production is possible [39]. Transgenic may be defined as the introduction of exogenous gene/DNA into host genome resulting in its stable maintenance, transmission and expression. The technology offers an excellent opportunity for modifying or improving the genetic traits of commercially important fishes, molluscs and crustaceans for aquaculture [13]. It is a short cut to achieving genetic change for fast growth, disease resistance, tolerant to low level of dissolved oxygen in the water and fish resistant to freezing temperature [40]. Some studies have revealed enhancement of growth in adult Channa stritaus to an average of 2-4 times the size of non-transgenic controls, with some individuals, especially during the first few months of growth, reaching as much as 10-30 times the size of the controls. Therefore, researchers have developed new strains of transgenic fish which naturally produce just the right amount of growth hormone to speed their growth [3].

A foreign gene can be transferred into fish in vivo by introducing DNA either into embryos or directly into somatic tissues of adults [43]. Direct delivery of DNA into fish tissues is a simple approach, providing fast results and eliminating the need for screening transgenic individuals and selecting germ line carriers. Gene transfer and expression following intramuscular direct injection of foreign DNA into skeletal muscles of fish has been achieved [44]. By microinjecting a fish growth hormone gene linked to a suitable fish promoter into freshly fertilized eggs, transgenic fish with remarkable growth rates have been obtained [39]. Electroporation involves the use of series short electrical pulses to permeate cell membranes, thereby permitting the entry of DNA molecules into embryos [6].

3. Results and Discussion

The overall rate of DNA integration in electroporation may be equal or slightly above that of microinjection and the amount of time required to handle large numbers of eggs in electroporation is way less than needed in microinjection [45]. In recent research, gene has been transferred by electroporation of the sperm rather than the embryo. Electroporation is, therefore, considered as an efficient and versatile massive gene transfer technology. An increased resistance of fish to cold temperatures has been another subject of research in fish transgenic for the past several years [46]. Coldwater temperature is a stressor to many fishes and few are able to survive water temperatures much below 0-1°C.

This is often a major problem in aquaculture in cold climates. Interestingly, some marine teleosts have high levels (10-25 mg/ml) of serum antifreeze proteins (AFP) or glycoproteins (AFGP) which effectively reduce the freezing temperature by preventing ice-crystal growth [13]. The isolation, characterization and regulation of these antifreeze proteins particularly of the winter flounder, Pleuronectes americanus, has been the subject of research for a considerable period in Canada. The introduction of AFPs to gold fish also increased their cold tolerance, to temperatures at which all the control fish died [47]. Similarly, injection or oral administration of AFPs to juvenile milkfish and tilapia led to an increase in resistance to a 26 to 13 °C drop in temperature [48]. The development of stocks harboring this gene would be a major benefit in commercial aquaculture in countries where winter temperatures often border the physiological limits of these species [13].

4. Conclusion

The rate of aquaculture production is increasing globally, but the question remains whether the industry can continue to grow in a sustainable manner and fast enough to meet the future projected fish demand. Local aquaculture practices alone cannot meet the ever widening demand-supply deficit resulting from the exponential increase in human population; therefore, there is need for new and improved scientific methods. Aquaculture biotechnology has a major role to play to ensure the continued expansion and intensification of aquaculture to meet the growing demand.

Compliance with ethical standards

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