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Fish hybridization in some catfishes: A review

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Abstract

A review of hybridization of some catfishes shows that catfish hybridization among other aspects of biotechnology has continued to raise interest among researchers of various disciplines such as fish biologists, geneticists, aqua culturists, molecular biologists, nutrition scientists and so on. The studies so far reported were from seasoned researchers from several works of life and disciplines who have direct or indirect interest on fish hybridization (especially catfishes). It could be thus, concluded that though there is a dearth in literary work on catfish hybridization considering their numbers and diversities. However, several interesting works can be found across the continents (especially Africa, Asia, and North America) that show that catfish hybridization holds a very high potential for the future; a better catfish hybrid is equivalent to a better catfish aquaculture as well as it contribution to global food security.

Keywords: Hybridization, catfish, aquaculture.

Introduction

Fish production through aquaculture is an age long practice especially in Asia and Africa. For instance, production of the African catfishes *Clarias gariepinus* and *Heterobranchus longifilis* has been practiced for a long time in Africa. To ensure fish food security in Africa, increased production of fry and fingerlings with attributes of faster growth rates, high food conversion ratio and better environmental tolerance is greatly inevitable. Therefore, genetic techniques are needed to ensure the production of fish breed with faster growth rate, very high feed conversion ability, leading to a shorter production cycle as well as a greater tolerance for poor water conditions. According to Jothilakshmanan and Marx (2013) hybridization studies in fishes are very scanty and only very few reports are available. However, there are reports on artificial hybridization between catfishes viz, *Clarias gariepinus* x *Hetrobranchus* longifilis (Legendre, 1991); *C. batrachus* x *Heteropneustes fossilis* (Padhi, et al., 1995). *H. fossilis* x *H.* microps (Sridhar and Haniffa, 1999) and *Mystus cavasius* x *M. seenghala*, (Jesu et al., 2005). The African catfishes include fishes of the family Clariidae, it is widely distributed in tropical Africa, where it has gained prominence as important culturable fish species for fish farming (Teugels, 1986). Good seed stock is considered one of the major constraints to the development and expansion of the farming of Clariid catfish in most African countries (Haylor, 1992). Specifically, many authors have worked on the reproductive performance and growth of *Clarias gariepinus* (Nwadukwe1995, Haylor1992 and Yisa et al., 2006) yet, very few on the different strains of *Clarias anguillaris* (Moses et al., 2005).

Catfishes

Catfishes are the most diverse in the tropical South America, Africa and Asia. Catfishes are commonly referred to as mudfishes because they are restricted to the bottom of the water lying on the mud which forms substantial part of their diet (Teugels, 1982a). Catfishes are frequently exploited by fishermen and produced in farms. They are essential source of proteins of animal origin, and they have gained a major economic importance (Legendre, et al., 1992). Fagbuaro (2010) reported that *C. gariepinus* has high growth rate at high stocking densities under culture condition, high fecundity rate, resistance to diseases, ability to tolerate a wide range of environmental extremes. It accepts wide range of natural and artificial food and adapts to a variety of feeding mode in expanded niches, good meat quality and smoking characteristics as well as year round production. According to Food and Agriculture Organization (FAO, 1998) in 1996, the estimated production of catfish in aquaculture was 360,896 tons, with an associated value of 574.3 million USD. Fifteen catfish species from seven families are often exploited for aquaculture. The *Clariids* constitute an excellent food fish of high commercial value. In fact, the catfish species are very important to the sustainability of aquaculture industry in Nigeria (Owodeinde and Ndimele, 2011). According to Owodeinde et al. (2012) the feeding habit of Nigerians tend to support this assumption and this trend started manifesting from the late

1980s. Nigeria is by far the largest producer of farmed North African catfish in official statistics but the Netherlands, Hungary, Kenya, the Syrian Arab Republic, Brazil, Cameroon, Mali and South Africa also produce significant quantities (FAO, 2013).

Fish Hybridization

Generally, hybridizations simply refer to generating a new form of plant or animal either naturally or by human intervention by combining the genes of two different species or subspecies. Similarly, fish hybridization is when two different species, genera or families can be crossed and the first filial generation then crossed, backcrossed or outcrossed to give the hybrid of desired qualities. Fish hybridization is one of the genetic techniques which help to remove undesirable characteristics while retaining only the desirable ones. For instance, Legendre et al. (1992) investigated hybridization of the two African catfishes: *Clarias gariepinus* and *H. longifilis*. They reported viability in reciprocal hybrids with their survival rates being similar to those found in the maternal species. Moreover, Sahoo et al. (2003) investigated hybridization between two clariids: *C. batrachus* (Linn.) and *C. gariepinus* (Bur.) and performance of the offspring in rearing operations. Aluko (1995) reported that crosses between male *H. longifilis* and female *C. anguillaris* were significantly heavier and longer than the reciprocal cross.

Types of Hybridization in Catfishes

Several studies have demonstrated that *Clarias gariepinus* (♀) x *Heterobranchus bidorsalis* (♂) hybrid exhibit superior growth, improved survival and general hardiness than true breed of either *Clarias gariepinus* or *Heterobranchus bidorsalis* (Madu and Aluko, 1999; Nwadukwe, 1995). Most of these studies have focused on stock manipulations and growth performances at different dietary compositions in indoor and outdoor concrete tanks (Madu et al., 1993; Aluko, 1995).

Intraspecific Hybridization

Hybridization may involve combining different strains of a species (that is members of the same species with different characteristics). This is referred to as intraspecific hybridization. It is a hybridization exercise carried out between fish that belong to the same species; for example between strains within a species. A strain within a species is a population with common origin and history that possess a unique trait that distinguished it from other strains (Dunham, 1995). Onyia et al.,(2010) reported that cross-breeding of *C. anguillaris* strains could be advantageous because of the better performance of the progeny. They also reported high hatching success and survival rates of *C. anguillaris* from their study.

Interspecific Hybridization

Interspecific hybridization of different genetic type is an alternative to conventional selective breeding of fishes to produced qualitative or quantitative changes in commercial traits (Chevassus, 1983). Sometimes, an interspecific hybrid does not exhibit heterosis for any trait, but is still quite important for aquaculture application as it expresses a good combination of beneficial traits from both parent species (Hulata, 2001). Moreover, catfish hybrids were reported in *C. gariepinus* and *H. longifilis* (Hecht and Lublinkhof, 1985) *H. fossilis* and *C. batrachus* (Padhi et al., 1995) and *C. batrachus* ♀ *C. gariepinus*.. (Sahoo et al., 2003). Legendre et al. (1992) reported that the reciprocal intergeneric hybrid catfish between *C. gariepinus* and *H. longifilis* can be produced. Sogbesan et al. (2004) reported a positive net gain and Cost Benefit Ratio recorded in all the diets fed to "Heteroclarias," an interspecific hybrid. They also showed that *Heteroclarias* can be economically reared on all diets.

Limit of Hybridization

Many natural fish hybrids have been reported and numerous others have been produced in the laboratory (Aluko 1998). He recognized that hybridization success is correlated with close phylogenetic karyotypic affinities. That chromosome incompatibility is the primary block to any successful hybridization. Chromosome number in a species remains constant through successive generations and this result into constancy of characters. However, variations within the same organism have been reported (mosaicism—presence of two or more different cell lines in an organism). Variable chromosome number is a common phenomenon in some fish species. Richter et al. (1987) reported chromosome numbers of 52, 54, and 56 in *C. gariepinus*.

Producing Catfish Hybrid Fry

The primary constraint to commercial production of most catfish hybrids has been the lack of reliable, cost-effective methods for producing large quantities of fry. However, refinements of techniques for producing hybrids and general superiority of hybrids catfish have spurred renewed interest in use of hybrids for commercial production. Traditional pond-spawning, which is effectively used to produce some catfish fry, is ineffective for consistent, large-scale production of hybrid fry. Therefore, production of hybrid fry in most catfishes depends on the use of hormones to induce ovulation in females, manual "stripping" of eggs, and manual fertilization of the eggs with catfish sperm (Dunham et al., 2000). Hormone often used includes pituitary extract: common carp—CCP, or catfish CP; lutenizing hormone releasing hormone analog—LHRHa, human chorionic gonadotropin; and synthetic homorne-ovaprin, ovatide). Strategies for hormone-induced production of hybrids can be classified into two main categories: pair-spawning and group- pawning. Important factors for successful production of hybrid fry include: good brood-stock quality, proper calculation and administration of hormone dosage, proper testes collection and sperm preparation, accurate determination of the time of ovulation in females, good stripping and fertilization techniques, and aggressive egg treatment.

Conclusion

In conclusion, the literary works carried out so far revealed that there is an urgent need to carry out further research on some of the catfish species that has been worked upon and also to diversify research into species and strains which have never been

worked upon. Further study is required for large scale production of catfish hybrids that can be exploited for commercial catfish culture. The results from these research should be adoptable and the technology transferable from the laboratory or hatchery to the field/farm to enhance commercial production of the hybrids. Never give up on researching into catfish hybridization because the best breed is yet to be bred. Finally, global transformation in catfish aquaculture is only achievable when there are excellent catfish hybrids for the culture.

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