GENETICS MANIPULATION OF CULTURED INDIGENOUS FRESHWATER FISH SPECIES TO IMPROVE GROWTH AND DISEASE RESISTANCE

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Introduction

Mystus nemurus is rapidly becoming one of the most popular and important fresh water food fish species for aquaculture in the country. Its importance and popularity is attributed to its tender meat and good growth. Intensive farming of this species is still at its infancy due to its limited ability to reproduce in captivity. Broodstocks are mostly taken from the wild and there are few hatcheries operating in the country through induced breeding programme. Information on *Mystus nemurus* is very limited with reports on some aspects of its reproductive biology (Bhatt, 1971; Khan, 1988), on induced breeding (Harmin et al. 1995) and on its genetic aspect (Siraj et al. 1995). Genetic improvement in cultured fish using chromosome manipulation such as gynogenesis, androgenesis and triploidy have been developed for the last decade. Triploidization is a genetic tool found to be effective for producing sterile fish suitable for aquaculture in which deleterious effects associated with gonadal maturation on growth, survival and meat quality are eluded (Siraj et al. 1993). Our studies aimed to determine genetic variations in *Mystus nemurus* populations and to induce triploids in *Mystus nemurus.*

Materials and Methods

Seven populations of *M. nemurus*, from Kelantan, Terengganu, Johor, Kedah, Perak, Selangor and Sarawak were collected and brought back to our laboratory. Tissue samples (heart, liver, muscle and kidney) from 280 individuals (40/population) were excised and analysed using horizontal starch gel electrophoresis (Taniguchi and Numachi, 1978). Twelve enzymes and a sarcoplasmic protein coding for 25 loci were examined. Analysis was carried out using BIOSYS-1 computer package. In the case of triploidization, two min post-fertilisation, eggs of *M. nemurus* were subjected to cold (0°C, 2°C, 5°C and 7°C) and warm (35°C, 38°C, 40°C and 42°C) water temperature shocks for duration of 2, 5, 7 and 10 min for cold and 0.5, 1.0, 1,5, and 2.0 min for warm shock. Triploids appeared in fertilized eggs subjected to cold shock (0°C, 2°C and 7°C at 5, 7 and 10 min durations and 5°C at all duration tested) and only at 38°C at 2 min duration for warm shock.

Results and Discussion

Out of 25 loci examined 16 (64%) were found to be polymorphic (at P = 0.95) namely AAT-1*, AAT-2*, ACP-1*, ACP-2*, EST-2*, GPI-1*, IDH-1*, IDH-2*, LDH-1*, MDH-1*, MDH-2*, ME-1*, PGM-1*, SP-1* and 6-PGD*. Gene frequencies of these M. nemurus populations were largely in Hardy-Weinberg equilibrium with high genetic variability and observed heterozygosities ranged from 0.004 to 0.104. Dendrogram derived from the genetic distances based on the allele frequencies showed genetic similarity among populations of M. nemurus except for Terengganu population, indicating a substantial level of differentiation from the rest of the seven populations. Cold shock at 10 min duration produced 100% triploid whilst warm shock at 38°C produced 59% triploid at 2 min duration exposure. Triploidy was verified by erythrocyte nuclei size measurement which was found to be significantly ($P<0.05$) larger than the diploid. This has been revealed by earlier findings in other fish species. Mean total length from week 1-7 did not show any significant difference ($P>0.05$) between diploid and triploid M. nemurus and so was at 6-month of growth (Siraj et al. 1993), however histological analysis of the gonads showed that there was a marked disruption in gonad development with undeveloped testes and ovary in the triploids which lead to its sterility (Siraj et al. 1993).

Conclusions

The results indicated a remarkably small amount of genetic differentiation among geographically distant localities of *M. nemurus* populations. Successful results on the induction and production of triploid *M. nemurus* were established using cold and heat temperature shock treatments on fertilized eggs of *M. nemurus*. Triploid that leads to sterility is beneficial to the growth of *M.nemurus*. On going research is being carried out to analyse its performance on growth and resistance to diseases.

References

Bhatt, V.S. 1997. Study on the biology of some freshwater fishes. Part V. *Mystus nemurus* (Bloch). *J. Bombay of Nat. Hist. Soc.* 69: 32-34.

Harmin, S.A., Siraj, S.S. and Sulaiman, K. 1995. Breeding technology of *Mystus nemurus* (CandV). Proceedings of the Malaysian Science and Technology Congress '95, Kuala Lumpur. p. 299-303

Khan, M.S. 1988. Some aspects of the biology of ikan baung, *Mystus nemurus* (CandV) with reference to Chenderoh Reservoir. M.S. Thesis, UPM, Malaysia. p. 192.

Siraj, S.S., Daud, S.K. and Ang, K.J. 1993. Growth performance and gonad development in diploid and triploid *Clarias batrachus* (Linnaeus). Universiti Pertanian Malaysia Press. *Pertanika J. Trop. Agric. Sci.* 16: 167-171.

Siraj, S.S., Harmin, S.A., Christianus, A., Somga, S.S., Chandana, A.K. and Salimah, S. 1995. The status of reproductive biology and genetic research of river catfish, *Mystus nemurus* (CandV) at Universiti Pertanian Malaysia. Paper presented at the First Asia-Australasian Fish Genetics Workshop, Institute of Advanced Studies, University of Malaya, Kuala Lumpur. 15-16 November 1995.

Taniguchi, N. and Numachi, K. 1978. Genetic variation of 6-phosphogluconate dehydrogenase, isocitrate dehydrogenase and glutamic oxaloacetic transminase in the liver of Japanese eel. *Bull. Japan. Soc. Fish.* 44: 1351-1355.

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