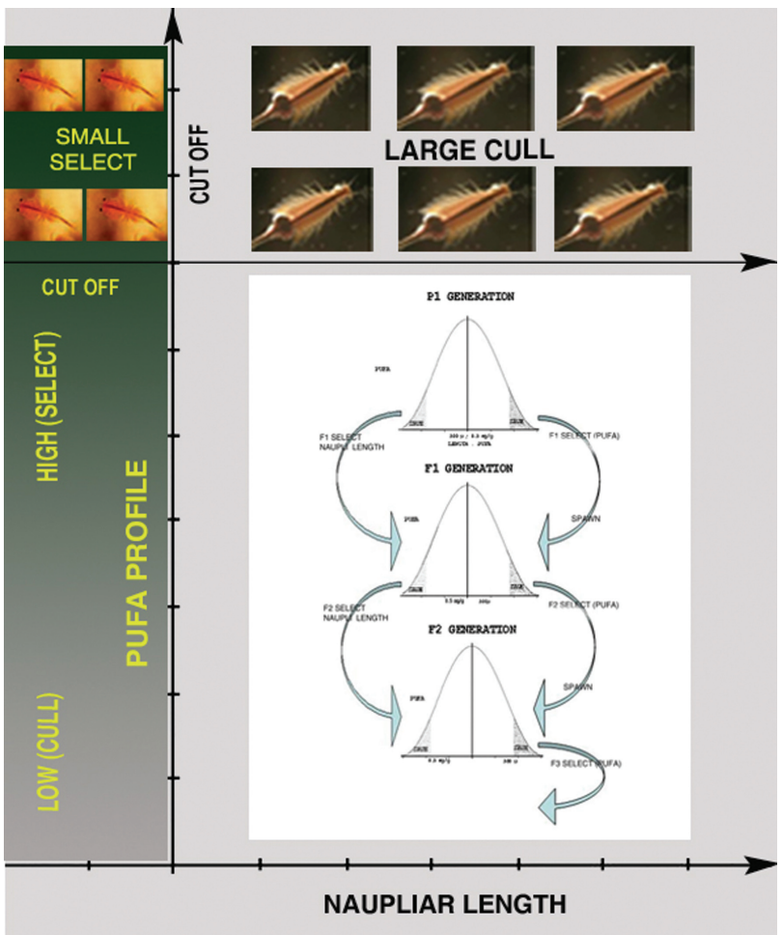
ISSN No.0972-386

CMFRI
NEWSLETTER

No. 109 January - March 2006

APPLICATION OF QUANTITATIVE AND MOLECULAR GENETICS FOR THE DEVELOPMENT OF NATIVE BRINE SHRIMP LINES FOR INDIAN AQUACULTURE

A major problem encountered by the aquaculturists is the availability of the right kind of food, especially the live food, for rearing larvae and juveniles of finfish and shellfish under controlled systems. The brine shrimp *Artemia*, especially its freshly hatched nauplii, is the most extensively used live food across the globe. *Artemia* is a crustacean thriving in hypersaline waters with a global distribution. Annually, over 2000 t of dry *Artemia* cysts are marketed worldwide for on-site hatching into <0.4 mm nauplii. In India the entire *Artemia* cyst requirement is met from import and the annual import is to the tune of US $ 40 million. Indeed, the unique property of the small branchiopod crustacean *Artemia* to form dormant embryos, the so-called 'cysts', with its nutrient compatibility may account to a great extent to the designation of a convenient, suitable, nutritive larval food source.



Ingestibility of food, especially the live feed by the larval or the juvenile fish and shellfish, is determined to a great extent by the size of food particle in relation to the mouth size of the predator. The small size and nutrient compatibility qualify the *Artemia* nauplii as the right live food choice for larval rearing of most of the aquacultured fish and shellfish. Since the demand for *Artemia* cyst for production of nauplii continues to increase with the development and growth of aquaculture, there is great need for developing lines/strains of *Artemia* of different size specifications to suit the requirements of various candidate species used in aquafarming.

Availability of native strains will be a boon to aquaculture as this will help in increasing the quality and bringing down the cost. Lipids, in the form of fatty acids, are the components essential for the proper growth and development of both marine and freshwater fishes. However, there is a differing need in these acids between the two, with marine species requiring eicosapentaenoic and docosahexaenoic acids, while fresh water species requiring fatty acids more along the line of the n-3 unsaturated fatty acids. Although essential fatty acids are present in *Artemia* nauplii, there is considerable variability within and between *Artemia* strains in its fatty acid profile. *Artemia*, depending on the variety, may contain eicosapentaenoic in the nauplii stage, making it suitable for marine species (marine-type *Artemia*), or n-3 unsaturated fatty acids such as 18: 3n-3 (but lacking eicosapentaenoic), making it suitable for freshwater organisms (freshwater-type *Artemia*). Though the types of fatty acids found in certain strains of *Artemia* are influenced by the type and quality of food items, the exact cause for this variability in fatty acids is unknown. The heritability of the essential fatty acids is an area needing research to consider the possibility of their genetic improvement. The second aspect is the size of the freshly hatched nauplii, as it should be compatible to the mouth size of the larval stages of fish and shellfish. The native strains of India generally have naupliar size larger than the required size, making them unsuitable for larval rearing. Selective breeding of the native strains could produce strains with smaller naupliar

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sizes and suitable fatty acid profile, suitable for fish and shellfish larval rearing.

Rationale of the Genetic Approach

There are two ways in which one can bring about changes in the size and nutritive quality of *Artemia* nauplii. The first approach is through environmental manipulation which includes biotic factors such as feed, as well as the abiotic factors like temperature, salinity and other water quality parameters. The second is by genetic manipulations. The improvement achieved through biotic and abiotic methods cannot be transmitted to the next generation and is limited by the genetic make up of the population in question. The genetic improvement, on the other hand is, inherited by the next generation and therefore, more important and viable method. Wide variations exist among the different strains of *Artemia* with respect to the size of cysts, nauplii and adults. The existence of this natural genetic variation can be exploited for the development of *Artemia* lines/strains of increased nutritive quality such as poly unsaturated fatty acids and of different size specifications to suit the various fish larval rearing requirements.

A number of techniques are available for the genetic manipulations. Quantitative genetic techniques such as, selective breeding have been successfully used for improvement of all the major crops and livestock. The classical selective breeding is the time-tested genetic manipulation technique which can be applied in developing genetically modified Artemial lines also. However, an in-depth knowledge of the genetics of Indian strains of *Artemia* is a pre-requisite for the formulation of the appropriate techniques for their genetic improvement.

Hypothesis

Knowledge of the genotypic (genetics related) and phenotypic (morphology related) parameters is vital for any quantitative genetic improvement programmes. Estimates of parameters such as genetic variation, heritability, phenotypic and genetic correlations, heterosis, genotype environment interactions etc. are essential for planning breeding strategy. Scientific breeding programme could be formulated only after careful consideration of these parameters. As for example when there is relatively larger additive genetic variance, simple selection methods like individual/mass selection should yield good progress. On the other hand, if non additive genetic variance is predominant, special selective breeding schemes are to be formulated to exploit them. When over dominance is important for a trait, reciprocal or recurrent reciprocal selection needs to be employed. If heterosis is found to be high, cross breeding programmes could be given priority. Higher levels of environmental interactions among genotypes calls for developing different strains to suit each environment.

Breeding is the applied science of genetics. Use of selective breeding and marker assisted selection has been recently introduced in crustacean improvement programmes. There is ample scope for the development of genetic markers which could be used for marker-assisted selections of brood stock. Genetic diversity is in fact the raw material in the hands of the geneticist for developing superior stock, with faster growth rate, disease resistance etc. With out variation in the population, no genetic improvement is possible. In India, abundant genetic diversity exists among the indigenous strains of *Artemia* with respect to size, life history traits and essential nutrients. Use of the exotic

Artemia cyst over the years in India has created numerous exotic gene pools adapted to the local conditions and enhancing the Indigenous Artemial germplasm diversity. This rich genetic resource of *Artemia* could be exploited through marker assisted selective breeding and in-crossbreeding programmes to develop lines/strains of different size and nutrient specifications, to suit the requirements of various finfish and shellfish species used in Indian aquaculture.