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12

PROSPECTS FOR SELECTIVE BREEDING OF PEARL OYSTERS IN INDIA

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INTRODUCTION

Recently a variety of approaches has been introduced in the field of genetics of molluscs, including Mendelian genetics, cytogenetics, quantitative genetics, biochemical genetics and hybridization. Wada (1975 a, b, 1985) has estimated the response to selection for several attributes of *Pinctada fucata* for shell variance of full siblings. He analysed the genetic variability and gene frequencies at three loci in two strains selected for four to five generations. The change of frequencies of colour of nacre in the selected lines of pearl oyster to yellow prismatic layer for five generations has been studied (Wada, 1985). Wada (1976, 1985) and Wada and Komaru (1985) have studied the chromosome morphology of different species of bivalves.

VARIATIONS IN INDIAN PEARL OYSTER POPULATION

In India, Alagarswami *et al.* (1983) artificially produced pearl oysters from wild brood. Alagarswami and Chellam (1977) have reported the change of form and dimensional relationship in the pearl oyster *P. fucata* from Tholayiram, Pulipundu and Kudamuthu paars and compared the regressions of different shell characters in young and adult oysters from the three paars which indicated the heterogenous nature of the population. Hornell (1922) stressed the need for a knowledge of the special growth peculiarities of pearl oysters from the different beds since some paars by reason of abundant food supply hasten the growth of oysters to surprising degree, while others where less favourable conditions prevail have oysters of an unhealthy appearance and stunted size. Herdman (1905) reported that the pearl oysters from Cheval paar (Sri Lanka) were fairly evenly distributed and in quality they proved to be best of all those examined or fished. They were all well grown, healthy and richer in good pearls than any other. For pearl culture an accurate knowledge of the various traits of the oysters from different paars is necessary in order to pick up the necessary traits to be developed in the brood stock.

The pearl oysters *P. fucata* and *P. sugillata* were successfully crossed at the Central Marine Fisheries Research Institute and viable spat were produced. *P. fucata* without black lamellar growth on the outer shell were produced by inbreeding. Attempts have also been made to produce cent percent *P. fucata* with black lamellar growth on the outer shell by inbreeding.

SELECTIVE BREEDING AND HERITABILITY OF PEARL OYSTER

Acoording to Wada (1975 a, b, 1985) the estimated heritability of the shell size of *P. fucata* was greater at one year of age than at two years but not much difference was observed in the shell shape. Wada (1985) has mentioned the heritability of the shell trait to be about 0.22-0.25 and that selective breeding of the trait would be effective for other shell traits such as shell height and shell width also. Wada has reported the change of frequencies of colour of nacre in the selected lines of pearl oyster to yellow prismatic layer for 5 generations. No significant difference was observed in the mortality of pearl oysters and the rate of low grade pearls between two groups such as white and yellow prismatic layer secreting forms. Wada (1985) specifically mentioned the frequency distribution of shell weight of three year old pearl oyster of back crossed (TNT, NTT and the selected TL) lines in the

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third year. Wada (1975 a, b) conducted crossing experiments between DD and DD as well as with heterozygotes DF and DF. In the former only DD bands appeared and in the latter three band types DD, DF and FF segregated. And he explained the Namako Lagoon of Kamikashijma Island may be geographically separated from other habitats of pearl oyster, but it should not be assumed that the samples consisted of two or more populations with different gene frequencies as in the case of excess homozygotes and he doubted whether negative heterosis operated. He illustrated the zymogram of maleate dehydrogenase (MDH) of crude extract from digestive diverticulum showing mobility of each MDH band population.

Wada (1976) studied the morphology of chromosomes of the oyster *P. fucata* (Gould) collected from the two regions of Japan. Wada and Komaru (1985) explained the karyotypes in 5 species of Pteridae. Haley (1977), as reported by Newkirk (1980) has been following the frequency of changes in the 5 fullsib families of *Crossostrea virginica*. Matsui (1958), in *Pinctada martensii* the right shell is slightly convex, whereas the left shell is more strongly so. The degree of convexity of shells is very important from the practical point, because oysters with more strongly convex shells harbour larger pearls. Haley (1978), as reported by Newkirk (1983) explained that the sex determination of these oysters was a three locus (two alleles each) model with certain genotypes as fixed males and others as fixed females and the remaining with potential sex change.

From the studies on chromosomes of different species of pearl oysters, it is clear that there are possibilities for cross breeding of those bivalves which are having same number of chromosomes. Singh and Green (1984) have reported that the relative mortality of the heterozygotes (faster growers) of *Macoma balthica* during the larval period is expected to vary from year to year depending on the environmental conditions, particularly the relative abundance of the phytoplankton blooms and faster growing heterozygotes with higher food requirements have relatively higher mortality. This may account for the poor spat years where relatively few larvae grow into spat and in such years there are also slow growers which take longer time to reach market size (Galtsoff, 1964).

From the experimental results obtained in his observation and other studies Wada (1975) stated that the pearl oyster of Namako Lagoon may be a form of *P. fucata* (Gould) more or less generally differentiated from the species of other habitats in Japan.

An Approach to Pearl Oyster Genetic Studies in India

In animals with external fertilization meiosis takes place in the egg and artificial process can be applied to either gamete before fertilization or later to alter genetic characters to fertilized egg or at any period during the formation of zygote. Suppressing metaphase prevents replicated chromosome sets from separating into daughter cells and it can be achieved either by physical means such as pressure or temperature shock or by use of chemicals such as colchicine or its analogue colcimid. The more phenotypic variation in a trait the more intense the selection from the natural populations. The selected oysters are then mated according to a prearranged plan. Unless there are sufficient numbers of spawners, at least 50, significant inbreeding may occur and a number of stocks can be taken and performance evaluation could be done during the first generation.

With very little or no information as guidance in choosing stocks there are several approaches that can be used. First, a simple stock based on available information can be chosen. This can be risky if the information on which the decision relies is incomplete. Taking all our eggs from one source is really ' putting all our eggs in one basket.'

Second, one can take a number of stocks and do performance evaluation during the first generation. This will require maintaining stock identity and performance records.

The third approach is to cross males and females from different populations to form mixed base population. This can be done if parents from a number of stocks spawned together. We have produced pearl oysters without black lamellar growth on the shell in the laboratory. *P. fucata* and *P. sugillata* were crossed and spat were produced. Maintenance of broodstock is useful to keep the identity of the progeny groups. If we keep each generation (50 males and 50 females) of each stock or line, the inbreeding rate will be 0.5% per generation and total accumulation of inbreeding after 5, 10 and 20 generations of 1, 3 and 5% respectively (Newkirk, 1983). More control can be exercised and consequently less inbreeding will occur if separate lines are maintained. If the founding stock has been derived from a small number of parents (10-20) it is strongly recommended that separate families should be maintained at least in the first generation. Thereafter a number of pooled lines can be formed by careful crossing of the original families. At present the crossing of *P. fucata* and *P. sugillata* is not continued

due to the fear of the problem of interbreeding and adverse effect on the local strains. The wild stock is used as brood for increasing the farm stock. And now we are using the hatchery stock also as one of the lines for stock improvement. In the larval period as well as adult stage we face many problems such as slow growth, mortality etc. To increase the quality of pearls and growth and survival of oysters we have to adopt some genetic approaches to raise the quality of stock. From the natural stocks, these qualities have to be identified and the broodstock with necessary traits could be used for producing pearl oysters of desired traits. The genetic diversity of different populations of pearl oysters of India has to be identified to improve the quality of the product for aquaculture.

The pearl oysters collected from different paars have to be examined for the rate of pearl production, quality, mortality, growth variance, shell size, shell weight, meat weight and colour of nacre. Along with this, hatchery development of stocks from the required paars has to be carried out. The heritability of pearl oyster has to be studied. The genetic variability of the pearl oyster *P. fucata* (Gould) collected from Gujarat, Lakshadweep, Andaman Islands, Vizhinjam and Tuticorin has to be determined by studies on the number and gross morphology of chromosomes in pearl oysters collected from the above regions. Experiments should also be carried out on the electrophoretic markers for different traits of pearl oyster species in India. Crossing experiments using different strains from Gujarat, Vizhinjam, Lakshadweep, Andamans and Tuticorin to produce hybrids, production of hundred percent yellow and white nacre producing oysters on a large scale by inbreeding and the raising of faster growing and quality pearl producing oysters for commercial operations are some of the areas which require attention.

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