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Editors :

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Dr. M. Sakthivel, President,
Aquaculture Foundation of India
4/40, Kapaleeswarar Nagar,
Neelankarai, Chennai - 600 041.

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15, Hawker Jesson Lane,
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STATUS OF MARINE PEARL CULTURE OF INDIA

K.K. Appukuttan

Central Marine Fisheries Research Institute, Cochin, Kerala

ABSTRACT

The pearls produced by the Indian pearl oyster *Pinctada fucata* have been acclaimed globally as the Oriental Pearls. During the last five years, the Institute has made concerted efforts to upgrade pearl production methodology by developing new techniques for pearl production through tissue cultured pearl at the Tuticorin Research Centre of CMFRI. Efforts were also made to produce large pearls (>6 mm), which are highly priced in the international market. The technique for *mabe* pearls production has also been developed in *P. fucata*. The advances made in research and development of marine pearl culture in India with a note on the problems faced by the industry and the potential for development of pearl culture in India is presented in the paper.

INTRODUCTION

Natural pearls were the earliest known gems and the reference to pearls in the Vedas date these gems to at least 1000 BC. The history of pearl is unparalleled and the world's greatest literature has extolled the value and virtues of pearls. We find references of pearls in most ancient Chinese books, ancient sacred books of Hindus, Bible, the Talmud, the Koran, Dante, Shakespeare, writings of Roman historian and Pliny. In the modern world also, pearls continue to evoke a sense of awe and wonder due to our understanding of how the pearls are formed. We do not know exactly when or where the pearl was discovered, but we know the pearl has been referred since the beginning of recorded history. However cultured pearls were produced for the first time in early 1300 AD in the Chinese City of Titsin. Attached blister pearls were grown by hard shaped daups placed between the mantle and valve of the freshwater mussel. Small tin Buddhas were similarly implanted yielding 'Buddha Pearls' in China. Claim for production of the free or non-attached pearls was made by Carl von Linnaeus during mid 1700's but it was Miki Moto and Nishikawa's graft-nucleus experiments in the turn of the century that produced pearls by culture successfully for the first time using biotechnology. The Japanese succeeded in producing cultured spherical pearls for the first time and the credit for this should go to Tokichi Nishikawa and Tatsuhei Mise. Kokichi Mikimoto improved upon this method and commercialized pearl production and earned the title 'Pearl king'. Though the name of Mikimoto's name is the first that comes to mind when cultured pearls is mentioned, the Australian Saville-Kent is now believed to deserve the credit for the original development of technique for cultured pearls.

In India natural pearl fishery was known to exist from 1663. The Indian pearl fishery was equated at one time with the Persian Gulf Fisheries for the production of finest 'Oriental Pearls'. The fishery was existing in Gulf of Mannar in southeast coast and in Gulf of Kutch in northwest coast in early sixties. The natural pearl fishery in India dwindled gradually and came to a halt due to various environmental problems in the southeast coast in the 1960s and in the Gulf of Kutch from 1966 onwards. At this stage India had seriously taken up pearl culture research scheme under the

Central Marine Fisheries Research Institute with support from Indian Council of Agricultural Research.

PEARL CULTURE RESEARCH IN INDIA

Pearl production by culture is being done at present on commercial scale in Japan, China, Australia, Indonesia, Myanmar, French Polynesia (Tahiti), Namdrick (Marshall Island), Manihiki (Cook Island), Hawai and India.

India has entered into the field of pearl production by culture methods in the early 1970s by the efforts made by the Central Marine Fisheries Research Institute. About 60 years back pioneering efforts were made by the Department of Fisheries of the erstwhile Madras State to rear the pearl oysters in captivity and induce them to produce pearls, but spherical pearls were not formed. The technology for pearl production based on the Japanese method was tried in Tuticorin Shellfish Laboratory successfully in the Indian pearl oyster *Pinctada fucata*. An organized research programme by the Central Marine Fisheries Research Institute in collaboration with the Govt. of Tamilnadu funded by ICAR during 1973 to 1978 succeeded in developing a technology for pearl production by culture. Utilising the spatfall observed in the southern part of Kerala, the Govt. of Kerala also executed a pilot project on pearl culture at Vizhinjam during 1976-79. Though the technology of pearl oyster farming and pearl production was perfected indigenously there were doubts about the application of technology due to dearth of pearl oysters in the wild for pearl production. At this stage CMFRI launched a project for production of pearl oysters under hatchery condition and large-scale seed production was achieved in 1981. All these research activities made CMFRI the nucleus of pearl culture research and development in the country.

The need to develop pearl culture as a rural upliftment programme was recognized only in the early nineties. One of the successful programmes involving fishermen was carried out at Valinokkam, a small coastal village of Tamil Nadu in the southeast coast of India in 1992. Twenty five fishermen of the village were selected and given training in various aspects of pearl culture. Though there was initial reluctance among the fishermen, with proper motivation, active participation of the fishermen and their family members was ensured, and farming was undertaken from the fabrication of grow-out structure to pearl harvest. Part of the pearls produced was given to the fishermen as an incentive. The scope for large-scale pearl production through village level community participatory programmes with proper technical and financial support from the developmental organizations was clearly indicated by the 'Valinokkam Bay Programme'.

Many of the pearl producing countries are facing production and market related problems in commercial pearl production. Some of the common problems for the pearl trade in recent years are overfishing of the wild stock, little attention paid to maintenance of genetic diversity in farmed stock, water quality maintenance in farms, overstocking and high mortality, high nuclei rejection rates, low pearl yields and poor quality and sudden fluctuation in the pearl price. In India the targeted research efforts of scientists have shown various innovative changes in the pearl culture research and development activities.

Along the Tamil Nadu coast, M/s. Tamil Nadu Fisheries Development Corporation Ltd. (TNFDC) and M/s. Southern Petrochemicals Industries Corporation Ltd. (SPIC) took up a joint commercial project on pearl production in 1983 with technical know-how from CMFRI. This was a laudable pioneering effort by the government and the industry. The technical problems faced when the technology was commercialized were duly solved. The Department of Fisheries, Gujarat with the natural pearl oyster resource in the Gulf of Kutch has also done experimented pearl production trails. Later, to enhance the depleted stock, pearl oyster spat were also supplied from the shellfish hatchery of CMFRI at Tuticorin. However, commercial ventures by industrial houses were restricted to the areas around the natural pearl oyster beds in India.

After a gap of nearly a decade, other firms also started pearl culture programmes. They are ITAP Ltd. Tuticorin, Orkay Company, Mandpam, Master Pearls Ltd., Chirala and Pearl Beach Hatcheries, Visakhapatnam. Some of the pearl farms are located in the Krusadai Island while others are in the Palk Bay, Gulf of Mannar and in Andhra Pradesh. What started as an experiment in 1972, supported the growth and development of an industry. While India has been a net importer of raw pearls during the early nineties, from 1996 onwards it has also been able to export cultured pearls, albeit in small quantities.

In 1997, ICAR provided Rs. 30 lakhs to CMFRI to demonstrate the profitability of pearl culture venture to the industry. This activity is successfully going on at Mandapam Regional Centre of CMFRI and income worth Rs. 13 lakhs has been realized. The pearls produced in this project are offered for sale in the international market. Besides, pearl oyster spat are regularly supplied to the industry on cost basis from this project. Based on the success of the Valinokkam Bay experiment, the M.S. Swaminathan Foundation has also embarked on an ambitious rural programme in the coastal villages bordering the Gulf of Mannar with the technical support of the CMFRI.

Recognizing the merits and prospects of pearl culture, the Department of Biotechnology of the GOI came forward to fund a research programme on tissue culture of nacre secreting cells of *P. fucata* for production of pearls in in-vitro conditions. The projects have made many inroads into the basics of invertebrate tissue culture and started showing positive results. The CIFA has also been able to establish a National Centre for freshwater pearl culture under the DBT programme.

The Department of Ocean Development (DOD) and ICAR also supported new programmes of on-shore pearl farming at Mandapam Camp and this method is being standardized at the Visakhapatnam Centre of CMFRI. In 1999, the National Agricultural Technology Programme (NATP) of ICAR provided funds. This multi-pronged programme aims to initiate pearl production in the state of Gujarat, initiate black pearl production in A&N islands, improve the percentage and quality of pearl production during the post-surgery phase, make-up or coloured pearl production, upgrade tissue culture technology, produce indigenous shell bead nucleus, improve farm structures and on-farm spat collection.

Upgradation of open sea farming system using improved anchoring methods, FRP coated floats for rafts mounted on aluminium sections as raft structure has given longer life. Different types of cages for stocking pearl oysters were tested for durability and fouling in various places. Natural spatfall of *P. fucata* in the west coast was monitored and the successful seasons were identified.

Larger pearls of 6-8 mm comparable to Japanese Akoya pearls were produced from *P. fucata* grown in the southwest coast and efforts are being made through segregated breeding to develop stock of oysters with greater body cavity which can accommodate larger nucleus for pearl production. Mabe or image pearls are produced in India by freshwater mussels. Using images made of shell powder and resin 10 mm² mabe pearls are produced from *Pinctada fucata* in the southwest coast of India. The production period is significantly (60-70 days). To increase the survival and recovery improved surgical techniques for seeding operation such as treatment of graft tissue with appropriate stains, use of tetracycline hydrochloride, succinyl chitosan and polyethylene glycol 6000 coating on nucleus and treatment of oyster with antibiotics were adopted. These are the thrust areas where further researches are to be done for better production. Preliminary attempts for production of mabe pearl's through metal enrichment in the medium and diet have shown good results in the shellfish hatchery at Tuticorin. Iron enrichment changed the colour of the nacre to shades of violet and mercury. Another breakthrough in tissue culture of marine pearls by *in situ* production of pearls was also achieved at Tuticorin Shellfish Culture Laboratory recently. The indigenous nucleus production technology developed by the Central Institute of Fisheries Technology is another significant achievement in pearl research in India. Locally available molluscan shells were used for the production of nucleus (2-10 mm size) with indigenous machines. The CMFRI has also taken up a research project on black pearl production in Andaman and Nicobar islands using the black lip pearl oyster resources of the Island with a funding from Department of Ocean Development from 2003 onwards.

PROSPECTS

The pearl culture technology evolved by the Central Marine Fisheries Research Institute in 1970's has been tested through demonstration programmes in Tamilnadu, Kerala and Gujarat in subsequent years in collaboration with the concerned maritime state governments and the results are encouraging. Location testing experiments at Vizhinjam (1976), Mandapam (1988), Lakshadweep (1986), Gujarat (1987), Calicut and Kochi (1994) also provided successful results. In 1981, production of pearl oysters under hatchery condition for large-scale pearl oyster seed production was achieved by the CMFRI. The feasibility of developing pearl farming a societal programme with active participation of fishermen of Valinokkam Bay in Tamilnadu also gave positive results. Since 1976 the Central Marine Fisheries Research Institute has followed a open policy of training the candidates in pearl culture and hatchery technique from various government agencies and entrepreneurs with in the country and also from outside the nation. Even with all these efforts the commercial pearl farming has not been seriously adopted in the country since the product quality of cultured pearls and the economics of operation have not been proved for a commercial venture. Globally the pearl trade is a US\$ 1.5 million industry with major exports from Tahiti, Australia, Indonesia and Japan. India is importing pearl worth US\$ 4 million annually. The First Indian Pearl Congress and Exposition held at Cochin in February, 2003 has recommended that for better farming activities and commercialization of pearl culture in India the following aspects are to be effectively implemented by government agencies and related institutions.

At present there are no comprehensive database on the distribution and abundance of marine pearl oyster resources in the country. Extensive surveys should be made by the CMFRI in collaboration with CARI in the Andaman Sea to locate *P. maxima* resources and take up the necessary R & D work for commercial silver pearl production. Conservation of pearl oyster resources of Palk Bay, Gulf of Mannar, Gulf of Kutch and Andaman and Nicobar Islands, which can be considered, as a national heritage should be given top priority. Sea ranching programme using the marine pearl oyster hatchery facilities available with the CMFRI, GAU, Sikka and CARI are to be taken up. In order to create confidence among entrepreneurs to invest in pearl culture, the state governments and Central administrations for islands have to develop proper licensing and leasing policies as well as demarcate zones where such activities should be carried out without anthropogenic interferences. Nodal departments of the Central Government should take an active role in organizing the deliberations for evolving a public policy on pearl farming.

Multiple use of the pearl sac has been reported in *Pinctada margaritifera* and *P. maxima* from Southeast Asian countries. Research should be directed towards development of techniques for repeated pearl production in *P. fucata* without sacrificing the animal. The technique of pearl surgery should be simplified and refined to improve the percentage of pearl production and reduce mortality. There is an urgent need to direct research toward production of quality pearls of larger dimension, which have an international market. Modern biotechnological methods should be used for identification of the genes responsible for various factors such as luster, size, fast growth, large body girth and colour.

The potential benefits to coastal fishers envisaged by the newly initiated pearl farming programme through community participation being executed by the M.S. Swaminathan Research Foundation in collaboration with CMFRI is a model for popularizing pearl farming in the rural coastal areas of India giving employment opportunity.