BIOTECHNICAL ASPECTS IN MARINE PEARL PRODUCTION

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INTRODUCTION

India is one in the countries in the World having pearl oyster resource. The oysters are available in the Gulf of Mannar (southeast coast) in large numbers and in the Gulf of Kutch (northwest coast) in lesser numbers. From time immemorial, the oysters from these regions were fished for natural pearls. The famed "Oriental pearls" of the ancient times were the pearls produced from here and the middle-east Asia.

In India attempts were made in early 1950s to produce pearls, but only in 1972 the first spherical pearl was produced by the research workers of the Central Marine Fisheries Research Institute at the Tuticorin Research Centre. Then on, many improvements have taken place in the pearl oyster seed production, oyster farming and pearl production to suit the Indian condition. Now India has achieved a total package of pearl culture technology ready for implantation by the sea-farming entrepreneurs. To develop man-power in the specialized field, training programmes are conducted to the need of the technicians and managers.

Pearls are not a natural part of the living oyster, but a response to an irritation. Today the pearls in the market are all cultured ones. The process of their production is through the introduction of foreign material in live oysters. This requires a keen and skillful technology and hence the biotechnology of pearl production is very important as this determines the quality of a cultured pearl. The skill of technicians, the physiological condition of the oysters and the conducive environmental parameters do play vital role in the production of quality pearl.

Graft tissue

Graft tissue is a cut piece of the mantle epithelium. Healthy oysters, free from boring organisms with an active mantle are used as donor oyster for the preparation of graft tissue. The donor oyster is cut opened carefully and the mantle is removed without any damage to the tissue. The mantle piece is wiped gently with a sponge to remove the mucus and other sticking materials. The outer pigmented marginal mantle and the inner muscular portion are removed with a sharp knife to get the pallial part of the mantle as a ribbon. The ribbon is cut into bits of 2-3 mm size. Now the graft tissue is ready.

This tissue bits on insertion into the gonad portion of recipient oyster along with the nucleus, is grafted to it. On getting the required nutrients from the recipient oyster, the outer epithelial cells proliferate, grow and form a sac around the nucleus. This is called 'pearl-sac'. The inner epithelial cells and the muscular portion of the graft tissue gets disintegrated and absorbed. The secretion of the pearl sac, the 'nacre' or 'mother of pearl' gets deposited uniformly on the nucleus, resulting into a cultured pearl.

Nucleus

Spherical shell beads are used as nuclei to produce spherical pearls. Only the molluscan shell material is suitable as nuclei, because of their phylogenic affinity, chemical composition, binding strength and heat resistant properties which are closely similar to the calcite crystalline substance of pearl oyster shell.

The nucleus forms the core substance for pearl production. The technique of insertion of the nucleus along with the graft tissue and their placement in the appropriate manner in the gonad of the oyster is called the nucleus implantation.

Nucleus implantation

To produce spherical pearls, the nucleus is implanted into the gonad. Partially spent or spent oysters are ideal for nucleus implantation. The oysters are narcotized before operation to minimize the stress. It is mounted on the stand. The valves are kept opened by the speculum. The foot is carefully hooked and a sharp, narrow opening is made at the base of the foot. A piece of graft tissue picked up carefully, is inserted through the passage and placed at the site. A nucleus of the appropriate size is inserted in the same manner by picking it up in a nucleus cup and placed adjacent to the graft. Care is taken not to damage the internal organs / parts.

The oysters thus implanted are kept under mild aeration in a flow-through system. They oysters can recover form narcotization and slowly resume normal physiological functions. They are kept in the laboratory for 3-4 days under observation. The nucleus rejection, if any, can happen by now and are removed. The implanted oysters are transplanted to the farm in box cages with velon screen spread on the bottom of the cage for further rearing.

Post operation care

The formation of cultured pearl is biological process and is controlled by the pearl oyster itself. The quality of a pearl is controlled by several hydro-biological factors such as food organisms, water temperature, salinity, current, trace metal content of the water, etc. The physiological condition of the oyster and the place of implantation may also influence the colour. The inherited capabilities of the individual oyster can also influence the pearl colour. A calm and clear water body with depth of more than 5 m with good exchange of water offers a favourable farming site for the formation of a good quality pearl.

The pearl

The pearl is composed of calcium carbonate formed by transparent concentric layers of minute aragonite crystals. Pearls have unique colour and lustre and is due to the reflection and interference of light. The quality of pearl is judged by lustre, colour, shape, degree of scratches, size and weight. They are categorized as gold, cream, yellowish pink, silver, pinkish white, green, blue and black. The gold and cream

pearls contain more of copper and silver whereas pink pearls contain traces of sodium and zinc.

Aspects requiring further research

The normal pearl yield is about 60%, of which the best quality pearls constitute about 20%, the medial and inferior pearls about 40% and the rest are disqualified ones.

To improve the technology of pearl production further qualitatively and quantitatively, the following aspects of research are required:

1. Improvement in the environmental aspects of farming
2. Study on the biological requirements of the oyster
3. Improved biotechnological aspects like genetics and tissue culture.

Under environmental factors, different ecological sites with different climatic conditions have to be studied and the ideal conditions for the production of best quality pearls have to be assessed.

Food and feeding studies will give an idea of the suitable food for growth and formation of good quality pearls. Feeding the oysters with food enriched with the required amino acids and trace metals under controlled condition may throw light on the quality pearl production.

By applying biotechnological aspects, strains of oysters with improved characters in growth, resistant to diseases and good nacre production, are to be worked out. The production of polyploid pearl oysters may boost in the supply of mother oysters in all the seasons of the year to produce larger pearls. The application of tissue culture technology in pearl production is another field of study, which evinces keen interest. Study on the culture of mantle epithelial cells and *in vitro* production of pearls and injection of a few epithelial cells along with the implanted nucleus in the gonad are of great importance in the field of pearl culture in the 21st century.

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