

Designer Pearl Production in freshwater: An upcoming technology

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Now-a-days pearl culture has emerged as one of the most attractive remuneration generating aquaculture farming enterprises. Many farmers and entrepreneurs have shown their keen interest to know the state of art technology of pearl farming. It is also one of the world's largest aquaculture activities in terms of value. The ICAR-Central Institute of Freshwater Aquaculture (ICAR-CIEA), Kausalyaganga, Bhubaneswar, India has developed a base technology of growing pearls in freshwater environments. The Institute has taken the lead to disseminate the technology of freshwater pearl culture to the fish farming communities, entrepreneurs, state government officials, researchers and students of the country. In recent years Tisya Aquaculture field School, Balasore, Odisha and Tulsi Krishi Vigyan Kendra, Deen Dayal University, Chitrakoot, Uttar Pradesh have come up with good harvest of pearl produced in their own firm. It is also important to note that wider application of this skillful technology requires a well-planned strategy at national, regional, institutional, farm levels and entrepreneurial involvement.

Key words: Designer pear, Fresh water, Mussel, Pond culture

FRESHWATER pearl farming is one of the most lucrative businesses. It is alluring the stake holders as it is one of the largest aquaculture activities in terms of value. The basic fundamental reason behind pearl formation is that whenever any parasite or irritant such as sand grains, molluscs' eggs, parasites, detritus, and other foreign particle. enter inside the mussel cell by external or internal stimuli and lodged within it then mantle (i.e. the skin) of pearl mussels/oysters secretes nacreous substance in response to irritations and create the layer by layer coating of nacre over the foreign body. Nacre is just 80-90% of CaCO₃ and a protein called conchiolin. So pearl is a natural gem and is produced by molluscs which have a worldwide demand. Pearls emanate certain warmth and glow do not found in other gems, due to their unique beginnings. Pearls have been known to mankind since the beginning of civilization. They are highly esteemed as gems for their

beauty and splendor. Many attempts have been made to culture pearls in freshwater mussels. In the 13th century the Chinese fixed small Buddha figures inside freshwater mussels which became covered with a pearly layer. After considerable perseverance and study on the mode of pearl formation, success was achieved in Japan on the production of spherical cultured pearls. The Japanese grafted a piece of mantle with a small bead in a pearl oyster and reared the oyster in protected coastal waters with favourable environmental conditions.

In India, basically in freshwater, pearl culture is going on three species *Lamellidens marginalis*, *Lamellidens corrianus* and *Parreysia corrugata*. The genus *Lamellidens* is represented by nine species and two sub-species, while the genus *Parreysia* is represented by 35 species and 6 sub-species under two sub-genera. These mussels are unique resource in Indian subcontinent not only for pearl-making capabilities, but also for

multifaceted roles viz., as human food, feed for lower animals, uses of shell in button, pharmaceutical, cosmetic, decorative and lime industry. It also acts as bio filter or living filters and often studied as models to assess and evaluate the



Fig. 1. Designer pear produced in freshwater mussel

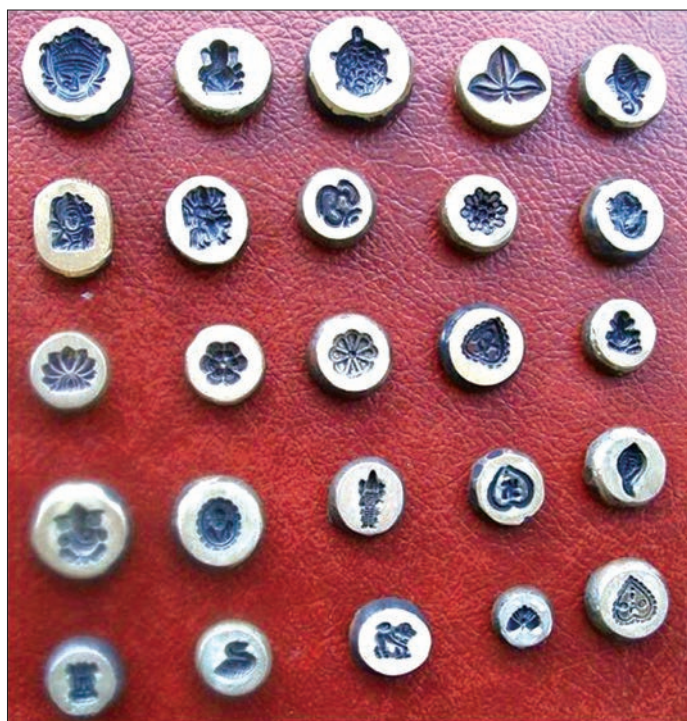


Fig. 2. Designer mould



Fig. 3. Designer beads from mussel shell

effects of exposure to various toxins and heavy metals. Pearl mussels are most commonly found in rural as well as in urban belts of the country.

Pearl cultivation is a lucrative venture because of towering cost of finished product. One of the main advantages of pearl production is that the final product is lightweight and non-perishable. The product range, through farming practice is regular round pearls, baroque pearls and shell attached mabe pearls. Although pearls possess a large gradation depending on the size, lustre and uniformity in nacre deposition, among the regular round gonadal and irregular mantle tissue pearls, designer pearls with perfect uniformity and lustre can demand good market value because of its uniqueness. For these reasons, pearl culture is one of the opportunities for industry development in many rural areas for establishment of cottage industry.

Mabe pearls, especially the designer product, have a lot of potential in cottage industry setup and may be one of the sources for generating extra income to farmers who adopted the technology. The technology is quite simple and surgery to obtain a designer pearl is not so intricate.

Fundamental steps involved in designer pearl production

The techniques involved in freshwater pearl farming differ depending on the surgery performed on internal structure of the pearl mussel and the variety of desirable pearl product. Six fundamental steps are involved in designer pearl production - collection of mussels, pre-operative conditioning, surgical implantation of nuclei, post-operation care, pond culture of implanted mussels and harvest.

Details of methodology

Collection of mussels

Mussels are hand-picked and collected from natural resources with water for short distance transportation, preferably in the early hours of the morning by skilled workers. The size criteria of mussels are to be taken care of during collection. It has been observed that the pearl mussels of the size 8-12 cm in shell length and weight of 35 g and above are suitable for pearl culture operations.

Pre-operative conditioning

Pre-operative conditioning ensures proper relaxation of adductor muscles and keeps metabolic rate of animal in

reduced state to get the best possible result during the surgical implantation process. Prior to surgery, after collection from the freshwater bodies the indigenous pearl mussel species are subjected to pre-operative conditioning for 24 to 48 hours. The mussels are stocked in aged tap water at a density of one mussel/L of water. Lingering this period may hamper the health status of the mussel to undergo the operation. They should be provided with green water as feed.

Surgical implantations

For the production of designer pearls mantle cavity method of surgery is followed, which is comparatively a hassle free and easy to monitor. Operation can be performed any time of the year besides the hot summer.

Mantle cavity insertion

Mantle cavity insertion method is a simple surgical technique and involving less risk. Prior to surgery, the indigenous freshwater healthy mussel species of required shell length are collected. They are carefully opened and nucleus of desired size and shape (up to 1 cm² size) is inserted into the mantle cavity and pushed further deep to avoid

rejection. Two implantations in opposite cavities can be made per mussel targeting two designer shell as internationally popular.

Post-operative care

Post-operative care is an important step in freshwater pearl culture operation, which is required for the implanted mussels to recuperate. The implanted mussels are subjected to careful observations for a period of 7-10 days. Sufficient care is taken to allow free opening and closing of the shell valves for respiration. Treatment of the water in post-operative care units with broad spectra antibiotic, tetracycline, at the rate of 1-2 ppm as a prophylactic measure is beneficial for the survival and wound healing of the implanted mussels. The mussels under post-operative care are supplemented with cultured green algae. One should remember that proper post-operative care minimizes extrusion of the nuclei soon after implantation and reduces the occurrence of abnormal pearls.

Pond phase

In India freshwater mussel implantation is carried out throughout the year, except during the peak summer (May to June) to minimize post-operative mussel mortality and rejection of nucleus beads. Traditional carp culture ponds (2.5 m deep) with clay-soil base and slightly alkaline waters are suitable for pearl culture operation. Ponds without aquatic macrophyte and algal bloom such as *Microcystis* and *Euglena* are ideal for pearl culture farming. The ponds are provided with bamboo poles as rafts for hanging the implanted pearl mussels. The implanted mussels at a density of 50,000 to 75,000/ha are placed in nylon bags (30 cm × 13 cm; mesh size 1.5 cm) @ 2 mussels per bag and reared.

Careful pond management, particularly in terms of natural food production and management of water quality through liming or fertilization is utmost importance during the culture period as it affects the quality and quantity of pearl production. Periodic addition of green water (*Chlorella* sp., *Chlorococcum* sp. and *Scenedesmus* sp.) at regular intervals



Fig. 4. Harvested freshwater mussel

into the pearl culture ponds as direct mussel feed is observed to be an ideal practice for proper up-keep of the pearl bearing mussel standing crop. The green algae can be developed by 'open culture method' in ferrocement tanks (200 litres) kept all along the pond dyke. The water in the tanks is fertilized with cattle manure (10,000 kg/ha/yr), urea (100 kg/ha/yr) and single super phosphate (100 kg/ha/yr) in equal monthly installments. When the fertilizers degrade in 10 to 15 days and green water develops, the enriched water is channeled into the pearl culture ponds. It is reported that some species of algae belonging to *Chlorophyceae* (green algae), *Bacillariophyceae* (diatoms) and *Cyanophyceae* (blue green algae) are normally used as feed by the freshwater mussels. The commonly preferred algal species by the freshwater mussel, *L. marginalis* are diatoms, green algae (*Chlorella*, *Chlorococcum*, *Scenedesmus* etc.) and blue-green algae (*Spirulina*). The mussels by virtue of being mucoid filter feeders can accept a variety of particulate organic materials as feed. A regular health checkup of the cultured mussels must be done at fortnight intervals as there are many chances of mortality of operated mussels due to internal incision, less

availability of food and parasitic infection. Hence the quality as well as quantity of pearl is also lost in time. Mussels should be taken off from the net bags, checked and cleaned before replacing. Sometimes due to heavy nutrient loads, algal growth is observed on the mussels as they are sedentary and static inside the enclosures. Attention should be given to avoid this condition. The physico-chemical parameters and water level of the ponds are monitored throughout the culture period. The optimum temperature ranges from 25 to 30 °C.

Harvest of Pearls

The pond culture of operated mussel varies from twelve months or more depending upon the methods of implantation made, size and number of nuclei implanted, the health of the mussels and the condition of the pond environment. At the end of the culture period, harvesting is done. The mussels are individually sacrificed to obtain the designer pearls after 12 months. Pearls are produced by a biological system through a natural process. Freshwater pearl mussels identified are capable of producing gem quality pearls. As the pearls are produced through a natural process they show a wide range of variation in their

appearance and quality. To maintain uniformity in coloration and quality, the pearls after harvest are subjected to value addition through surface cleaning or bleaching and dyeing or both cleaning and bleaching which may enhance their marketability.

Circuitous benefits

In the production of designer pearl the by products are the calcareous shell materials and the soft mussel meat. The shells have been prized as raw material for manufacturing tools and ornaments. The use of shell material in fabricating buttons and pearl in lays cannot be ignored. Its role in preparation of lime and handicraft souvenirs, ornaments for inlaying pearl, furniture, nuclei for pearl culture industry is much valued for cottage industry. Mussel meat is an affluent source of protein and is used for edible purposes in some tribal belt of our country like West Bengal, Bihar, Jharkhand, Chhattisgarh, North Eastern States and Odisha. In shrimp, freshwater prawn and catfish hatcheries, it is also used as a traditional feed.

The farmers can utilize their time judiciously by taking interest in engineering useful handicraft items prepared from shell material. Utilization of shell material is not new to the world. Since ancient period it is use as knife, scraper, spoon, utensil etc. is quite popular. Many more items, like candle and mobile stand, oil lamp, key etc. can also be fabricated as ethnic beauty for popular use. The rural youth and women can be engaged to create such items and be self-sufficient. Creating awareness about such eco-friendly handicrafts is necessary by hands on training practices. Rural as well as youth with an entrepreneur mindset can make a remunerative business in non-maritime regions. Thus pearl culture has tremendous potential for socio-economic development of farming communities and ultimately benefits to national economies.

Current status of freshwater pearl production

Cultured pearls have become a billion-dollar industry and experienced a tremendous boom in recent decades in Asia, particularly in China, which has not only a very long history of pearl culture, but is also the largest freshwater pearl producer in the world, with a total culture area of over 57,000 ha. The annual output of freshwater pearl production is over 1,800 tonnes, which accounts for 95% of world production. China has more than 140 mussel species, however; only *Hyriopsis cumingii* and *Cristaria plicata* have been successfully utilized for freshwater pearl production. They are also utilizing hybrid mussel (*H. cumingii* × *H. schlegelii*) for producing superior quality of freshwater pearl.

In India commercial production of freshwater pearls is meager. However, the Central Institute of Freshwater Aquaculture regularly organizes training programs for farmer, entrepreneur and researcher on various aspects of pearl farming. Some of the farmers from different parts of the country after getting training have also started their pearl farming venture. In recent years Tisya Aquaculture field School, Balasore, Odisha; Tulsi Krishi Vigyan Kendra, Deen Dayal University, Chitrakoot, Uttar Pradesh; and Garwa Pearl farm, Rajasthan have come up with good harvest of pearls produced in their own firm. At present, in India the major demand is for the round pearl and designer pearl of different shapes such as goddess Laxmi, Holy cross, Ganesha and different fancy shapes etc.

SUMMARY

With the growing demand for freshwater pearl technology among farming communities, it is the need of the hour to give impetus in advance research and developmental activities at a national and regional

level. Appropriate research and policy intervention and value-addition can ensure better return to the growers and livelihood security. Though, with the exception of the grafting process, pearl farming is a relatively simple form of aquaculture, because pearl mussels do not need artificial feeds, complicated farm structures or constant attention. On the other hand, increase of cultured freshwater pearl quality is the key to pearl aquaculture viability and one of the biggest challenges for research and development. The greater the proportion of high-quality cultured pearls in a harvest, the more likely an aqua farm will be in profit. Now-a-days it is an established fact that pearl culture in freshwater system can generate more remuneration and farmers can generate extra income from their ponds. Further, the incubation time of pearl formation can also be used for many other purposes like nuclear material preparation, culture unit cleaning, preparation and cleaning the dead shell materials, and fabricating them into various handicraft merchandise, which is very enterprising screening a path to shape a cottage industry along with the designer pearl. If properly managed, pearl farming will not harm the environment and can increase the pearl production over a period of years. For these reasons, pearl culture may be the best opportunity for business development. Freshwater pearl culture has the significant economic, social and environment impact. It is further expected that this pearl farming technology will be one of the most important integral component of freshwater aquaculture in India in future.

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