

Determination of Suitable Size of Shell Image for Better Quality Image Pearl through Inoculation in Native Mussel (*Lamellidens marginalis*)

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Abstract

This experiment was set to find out the suitable size of shell image for better quality image pearl by inserting different size of shell image in freshwater mussels. A total of six hundred mussels (*Lamellidens marginalis*) reared at BFRI pond complex from October 2017 to May 2018 were operated with shell made image of different size (T_1 - $3 \times 1.5\text{cm}^2$, T_2 - $2.5 \times 1.5\text{cm}^2$, T_3 - $2 \times 1.5\text{cm}^2$, and T_4 - $1.5 \times 1.5\text{cm}^2$). Only one shell made image was inoculated in each of the 600 mussels (*Lamellidens marginalis*). Operated mussels were stocked at 80/decimal and cultured with four treatments. Physicochemical parameters (temperature, DO, alkalinity, pH, ammonia, calcium ion, phytoplankton and zooplankton) were recorded at 15 days interval and found within suitable range for mussel culture. Monthly sampling was observed to know the survival rate of mussel. After 8 months of rearing, highest survival rate (15.3%) of mussel with highest deposition nacre layer (0.38 ± 0.01 mm) and shiny luster image pearl was found through the insertion of $2 \times 1.5\text{cm}^2$ (T_3) size shell image. On the other hand, deposition of nacre layer was found 0.21 ± 0.01 mm, 0.25 ± 0.01 mm and 0.41 ± 0.01 mm for $3 \times 1.5\text{cm}^2$ (T_1), $2.5 \times 1.5\text{cm}^2$ (T_2), and $1.5 \times 1.5\text{cm}^2$ (T_4) with low and medium shiny luster of shell image, respectively. From this experiment, thick nacre layer, shiny luster of image pearl with highest survival rate of mussel was found in $2 \times 1.5\text{cm}^2$ (T_3) size shell image. Therefore, it can be said that $2 \times 1.5\text{cm}^2$ (T_3) size shell image is suitable for shell image pearl production in $9\text{-}10\text{cm} \times 4\text{-}5\text{cm}$ size of freshwater mussel (*Lamellidens marginalis*).

Keywords: Shell image, size, freshwater mussel, image pearl.

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I. Introduction

Pearls, one of the most prehistoric gems, are esteemed around the globe because of their cool and soft emergence, pastel hue and recognition to diverse disposition as compared to the other jewels. Previously Japan, China, Australia and French Polynesia have had exclusive authority on pearl culture techniques. Bangladesh is bestowed with a rich and diverse group of mussel fauna. The genus *Lamellidens* and *Parreysia* is represented by six species (Barman *et al.*, 2018). Every mussel has the ability to produce a pearl of some sort, however only those possessing a lustrous mother of pearl layer can form a gem quality pearl (Alagarswami 1977 and Misra *et al.* 2005, 2009). Natural pearl formation is instigated when a foreign particle such as a piece of sand, shell piece or parasite make its way into particular region of mollusk and cannot be expelled. As a defense device, the animal secretes a calcium carbonate material known as nacre to coat the foreign body. So many layer of this coating is deposited on the irritant, resulting in a shimmering and iridescent creation of a pearl. Image pearl is the kind of pearl which is produced after insertion of image made with different materials like shell image can be produced using mussel dead shell. Market price of shell image pearl is higher than that of paraffin image pearl due to its consistency, shiny luster, durability etc. Different size of shell image can be inserted in mussel body but all size is not suitable. For this reason, this study was set to determine the suitable shell image size for image pearl production.

II. Materials and Methods

Pond preparation and mussel rearing

A pond having 8 decimal was selected to culture the operated mussels. From 8 decimal areas, 7.5 decimal was separated for mussel culture by bamboo fence (*bana*). Another pond was also selected for stocking the collected mussels. The pond having sandy soil, clean water, pollution free bottom was selected. Ponds were prepared following standard procedure. Water was totally drained out and dried from the selected ponds. Then

lime and salt were applied at the rate of 1kg/decimal to remove the insect and earthworm. After 6-7 days liming, water was supplied to the ponds.

Collection, selection and rearing of mussel for operation

Disease-free, healthy mussels having a yellow edge on the outer part of the shell were collected from diverse areas of the country. *Lamellidens marginalis* was selected for image operation. The average length and width of the selected stocked mussels were 9-10 cm and 4-5 cm for operation. *L. marginalis* was identified as the suitable species based on survival rate and pearl production capacity (Hossain *et al.*, 2004). This species was also chosen for image pearl culture due to its size, availability, and suitability to operate. After selection, mussels were stocked in a prepared pond, reared, and nourished to make healthy and eligible for the operation.

Pre conditioning of selected mussels

Selected mussels were preconditioned without feeding in a disinfected cistern for 7 days. Water was changed on regular basis to remove the clay from the outer shell and inner soft body of the mussel. Before the operation, mussels were brought to the laboratory and kept them in a downward position on a porous basket for two hours to reduce the water from the internal organ of the mussel.

Instrument for making shell image

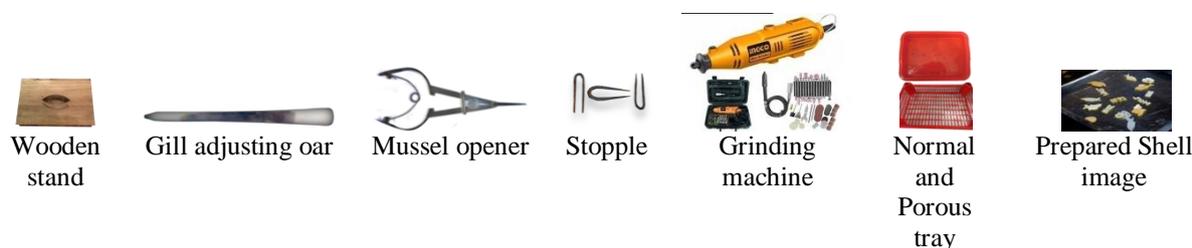


Fig. 1: Operational tools for shell image preparation and operation

Shell image preparation

First the desired design was drawn on the shell with a pencil. Then image was created by cutting with grinding machine according to the design. The finishing image was prepared by smoothing the edges of the image.

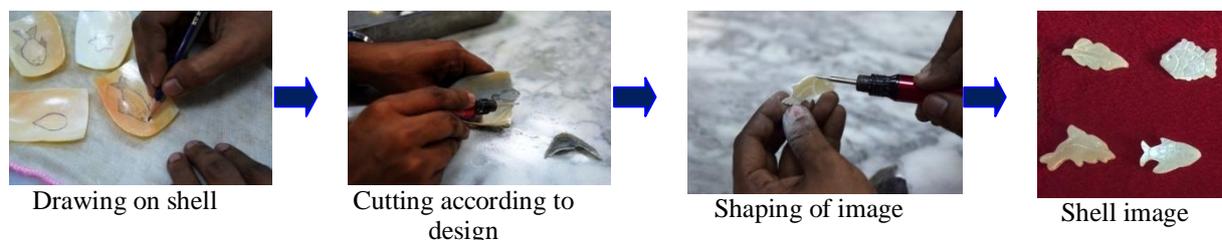


Fig.2: Shell image preparation

Shell image operation procedure

Shell images were washed by distilled water. The selected live mussel was opened about 8 mm with the help of a mussel opener. Attached mantle was detached a little from the shell by a spatula cautiously to make a pocket as the size of inserting the image. Then the image was inserted into the pocket between the shell and the mantle of the mussel. After insertion, the image was adjusted in the cavity and gently removed the air from the pocket area. Finally, the operated mussels were kept at an upward position on the tray till transfer to the cistern so that the image cannot come out. Different size and shape (T_1 , T_2 , T_3 and T_4) of shell images were inserted into the mussel. Operated mussels were kept in cistern for one week without feeding and then kept in another cistern for three weeks with necessary feeding.

Culture Method

Mussels were cultured in pond in net bag hanging method. Six operated mussels were stocked in six pockets of a rectangular shaped net bag and hanged by rope till 30-35 cm depth with a float. The rope stretched across the pond on the surface of the water. The distance between two bags was 25-30 cm and rope to rope distance was 1.5 m. Stocking density of mussels was 80/decimal and fish 30/decimal. The fish were stocked

with mussels to ensure maximum utilization of pond. Ponds were fertilized with organic and inorganic fertilizers like organic manure at the rate of 5 kg/decimal, T.S.P 0.125 kg/decimal and Urea 0.1 kg/decimal at 15 days interval. Lime was applied at 0.5 kg/decimal at 15 days interval. Water depth kept at more than 1-1.5 meter. Water temperature, pH, plankton growth, NH₄-N, alkalinity and DO parameters were monitored fortnightly. After 8 month culture, the shell image pearls were harvested and data were recorded.

Table 1: Design of the experiment for shell image pearl production

Treatment	Size of shell image (cm ²)	Length of mussel (cm)	Width of mussel (cm)	Name of culture technique	Mussel for pearl production
T ₁	(3.0 × 1.5)	9-10	4-5	Hanging in cistern and pond	<i>Lamellidens marginalis</i>
T ₂	(2.5 × 1.5)				
T ₃	(2.0 × 1.5)				
T ₄	(1.5 × 1.5)				

III. Results and Discussion

Six hundred mussels were operated with different size of shell image, like T₁- 3.0×1.5cm², T₂- 2.5×1.5cm², T₃- 2.0×1.5cm² and T₄- 1.5×1.5cm². One hundred and fifty mussels were used for each and every size of image. Operated mussels (9-10 cm×4-5 cm size) were cultured by net bag hanging method in cistern and pond. After 8 months of culture, highest survival rate and pearl production rate was found 18.5% after insertion of 2.5×1.5 cm² of shell image while second highest were found 15.3% with 2×1.5 cm². On the other hand, deposition of nacre layer was found highest (0.41 mm) in 1.5 ×1.5 cm² size of shell image, while second highest nacre layer (0.38 mm) found from 2×1.5 cm² size of shell image. Luster is an important criterion for grading a pearl. High and medium shiny luster with highest nacre accumulation was found from 2×1.5 cm² with second highest survival rate and pearl production rate, indicates that 2×1.5 cm² size shell image is suitable for shell image pearl culture in 9-10 cm×4-5 cm size native mussel (*L. marginalis*) (Table 1). Most of the mussels just die due to operation stress which is the main obstacle of freshwater pearl production (Li and Li, 2009). During the culture period of *Parreysia corrugate* for pearl culture, mortality was found 20% in June and then lowered after August (Suryawanshi and Kulkarni, 2015) while, 55-95% survival rate in freshwater mussel (*Margaritifera falcate*) was found by Fernandez (2013). The success rate of pearl formation in mantle cavity was recorded at 60-70% (Janakiram, 1997). In mantle cavity implantation, nacreous layer was found 0.35 and 0.20 mm, respectively for nucleus (Image/design) pearl (Pandey and Singh 2015).

Table 2: Shell Image pearl production with suitable image size

Treatment	Nacre layer(mm)	Survival rate (%)	Pearl producing rate (%)	Luster	Pearl color
T ₁	0.21±0.01	10	10	Low shiny (10%)	White, Ash, Pink, Orange
T ₂	0.25±0.01	18.6	18.6	Low shiny (7.6%) Medium shiny (11%)	
T ₃	0.38±0.02	15.3	15.3	High shiny (13%), Medium (2.3%)	
T ₄	0.41±0.01	12	12	Medium (12%)	

Table 3: Water quality parameter of pond during experimental period

Temperature (°C)	DO(mg/l)	pH	Ammonia (mg/l)	Alkalinity (mg/l)	Ca ²⁺ (mg/l)	Phytoplankton (×10 ³ cell/l)	Zooplankton (×10 ³ cells/L)
27.5±1.8	5.42±0.2	8.48±0.8	0.01±0.0	165±11.2	15.32±2.3	60.29±5.5	5.51±0.5

Water quality parameter

Water quality parameters were monitored at 15 days interval and these were found within suitable range. Temperature was found 27.5±1.8⁰C, DO 5.42±0.2mg/l, alkalinity 165±11.20 mg/l, pH 8.48±0.8, ammonia 0.01±0.0, Ca⁺² 15.32±2.3 and phytoplankton (×10³ cell/l) 60.29±5.5. Dan *et al.*, (2001) reported ideal range of water temperature as 15-30⁰C, pH 6.5-8.5, DO 5-8 mg/l, alkalinity 50-300 mg/l, ammonia 0.03-0.1mg/l, phytoplankton (×10³ cell/l) 50-100 and calcium over 10 mg/l. For Pearl culture, Janakiram (1997) found pH 7.5-8.5 and alkalinity 75-150. Rathor (2017) recorded similar levels of water quality parameters during culture of *Lamellidens corrianus* for pearl production (temperature 25.3±1.55 ⁰C, pH 6.4±0.21, dissolve oxygen 5.63±0.17 ml/l, Alkalinity 22.44±0.34 mg/l).



Fig. 3: Produced Shell image pearl

IV. Conclusion

According to survival and pearl production rate, $2.5 \times 1.5 \text{ cm}^2$ and $2.0 \times 1.5 \text{ cm}^2$ size shell image is suitable for pearl culture but considering the accumulation of nacre layer and shining of luster, $2.0 \times 1.5 \text{ cm}^2$ image size was found more suitable. So, it can be concluded that for shell image pearl culture in *Lamellidens marginalis* ($9-10 \times 4-5 \text{ cm}^2$ size), $2.0 \times 1.5 \text{ cm}^2$ size of shell image is most suitable.

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