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Induced breeding of oranda goldfish (*Carassius auratus*) by using ovafish

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Abstract

The present study investigated the induced breeding of Oranda goldfish (*Carassius auratus*) using Ovafish hormone under controlled conditions at the Meghalaya State Fisheries Research and Training Institute (MSFRTI), Mawpun, Meghalaya, from July to December 2023. Brooders were conditioned for 25 days in disinfected and pre-prepared tanks, and fed a high-protein diet comprising bloodworms and TetraBits. Physico-chemical parameters of both brood and breeding tanks were closely monitored, maintaining optimal ranges for temperature (28–31°C in brood tanks; 20–26°C in breeding tanks), dissolved oxygen (5–6 ppm), pH (7.3–7.6), alkalinity (140–200 mg/L), and hardness (100–120 mg/L). Hormonal induction was carried out using Ovafish at dosages of 0.5 ml/kg for females and 0.2 ml/kg for males. The treatment resulted in a significantly higher fertilization and hatching success rate (~93%) compared to natural breeding (~65%). Fertilized eggs were identified by their transparent shells with grey or black spots, while unfertilized eggs appeared opaque. The study concludes that Ovafish is effective in enhancing reproductive success in *C. auratus*, suggesting its potential application in ornamental fish hatcheries to improve breeding efficiency.

Keywords: Induced breeding, Ovafish hormone, Carassius auratus.

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1 Introduction

Aquaculture is the farming of aquatic organisms such as fish, crustaceans, molluscs, and aquatic plants. It involves the controlled cultivation of both plants and animals in water environments. According to the FAO (1990), aquaculture implies some degree of human intervention in the rearing process to enhance production. This may include practices such as regular stocking, feeding, and protection from predators. The scope of aquaculture encompasses husbandry, management, nutrition, breeding, and multiplication of useful aquatic species. Much like how traditional farming replaced hunting and gathering, aquaculture is progressively replacing the wild capture of aquatic animals, helping meet the growing demand for aquatic products.

India is a global leader in aquaculture, ranking as the third-largest fish-producing country and the second-largest in aquaculture fish production, contributing approximately 7% to global fish production. Among the various aquaculture practices, catfish farming is considered one of the highest-yielding activities within the primary production sector, with global average yields ranging from 250 to 400 tonnes per hectare per crop (Ayyappan et al., 2006).

The technique of induced breeding was first developed in Argentina, where pituitary extracts were used to stimulate ovulation in fish. Houssay (1931) was among the pioneers who observed that viviparous fishes injected with fresh fish pituitary extracts gave birth prematurely. This technique was further refined in Brazil by 1934, and by the mid-20th century, it had been adopted widely in the United States, Russia, and other countries. Notable contributions include those of Houssay (1931), Iherring (1937), Fontenele (1955), and Gerbilsky (1938). Induced breeding is a reliable method for artificial propagation and mass production of fish seed, especially during the off-breeding season. The technique involves the administration of pituitary gland extracts or synthetic hormones to ripening fish in confined water conditions, triggering spawning. Unlike natural spawning, which depends heavily on monsoon conditions and is unpredictable, induced breeding ensures a steady supply of fish seed, thus supporting consistent aquaculture production.

In recent years, the keeping of ornamental fish has become a popular global hobby. Millions of enthusiasts around the world enjoy watching these vibrant creatures in aquariums, which also enhances the aesthetic appeal of homes. The global ornamental fish trade is valued at approximately $9 billion, with freshwater species making up 85% of the trade and marine species accounting for the rest. The sector is one of the fastest-growing in fisheries, witnessing an annual growth rate of over 10% globally and around 20% domestically.

There are around 300 varieties of freshwater ornamental fish available in the market, each with unique trade names and appeal. Among them, the goldfish (*Carassius auratus*) stands out as the most popular and widely kept species. Belonging to the family Cyprinidae and the order Cypriniformes, goldfish are known for their wide range of colors, body shapes, fin types, and sizes.

Although they resemble carp (*Cyprinus carpio*), goldfish can be distinguished by their lack of barbels and the absence of dark spots at the base of their scales. They are omnivorous, feeding on both live and

prepared foods, and can swim at all water levels in a tank. They accept both floating and sinking feeds, making them easy to care for. Goldfish can generally live for 10–12 years, with some even reaching 43 years in captivity. They are typically divided into two categories: fancy and common. Fancy goldfish grow up to 6–8 inches, while common goldfish can reach lengths of up to 14 inches. Their peaceful nature and compatibility make them ideal for community aquariums.

A. Methods and Materials

The present study was conducted between July and December 2023 at the Meghalaya State Fisheries Research and Training Institute (MSFRTI), located in Mawpun, Meghalaya. Brooders used for the experiment were collected from the Institute's pond using scoop nets and small hand nets. To ensure the health of the brooders and to minimize stress or potential infections, they were treated with a mild potassium permanganate ($KMnO_4$) solution for 3–4 minutes. Following this treatment, the brooders were transferred to pre-prepared tanks for broodstock management.

Before the introduction of the brooders, the breeding tanks were thoroughly cleaned. The tanks were first washed with clean water, followed by disinfection using $KMnO_4$, and finally rinsed again with water to eliminate any residues. This cleaning process was essential to prevent the presence of germs or harmful bacteria that could affect the health and breeding performance of the broodstock. The broodstock management phase lasted for 25 days during the breeding season, specifically from September to October 2023. During this period, special attention was given to the diet and overall health of the brooders. They were fed a high-protein diet that included nutritious bloodworms and TetraBits, ensuring a balanced and supplementary nutritional intake to support reproductive development.

Throughout the experimental period, both the brooders' tank water and hatchery water were monitored for various physical and chemical parameters. These included flow rate, temperature, pH, dissolved oxygen (DO), free carbon dioxide (CO_2), total hardness, alkalinity, nitrate, nitrite, total ammonia, phosphate, iron, and calcium. The analyses were conducted following the standard procedures outlined by the American Public Health Association (APHA, 2005).

B. Aquarium preparation

Two aquariums were prepared before, that is brood tank and the breeding tank.

1. Brood tank

Two separate tanks of the same measurement (40x30x30cm) were prepared for stocking both the male and female brooders. Separately, both tanks were sterilized by cleaning them with $KMnO_4$ for the removal of any infections and bacteria. After cleaning, the brooders were released separately to attain better results for the breeding.

2. Breeding tank

A relatively big tank with measurements 90x45x45cm was prepared to allow proper movement of the brooders inside the tank. Since the eggs of *C. auratus* are adhesive in nature, locally available grass was

added to the tank for the eggs to stick. Both the male and female brooders were released after being injected with hormones that allow them to reproduce.

3. Hormones Preparation

Brooders were injected using the syringe injection made with 0.5 mm ovafish hormone and 9.5 mm distilled water in a 1 ml syringe, depending on the length and weight of the fish.

2 Results and Discussion

A. Physio-chemical parameters

1. Temperature

In the present study, Oranda goldfish were observed to breed within specific temperature ranges. During the brood stock management phase, the temperature of the brood tanks ranged between 28–31°C, while in the breeding tanks, the temperature was maintained between 20–26°C. These ranges supported optimal physiological conditions for maturation and spawning.

2. DO

In this study, the dissolved oxygen concentration was approximately 5 ppm in the brood tanks and ranged between 5–6 ppm in the breeding tanks, ensuring sufficient oxygen for both brooders and eggs.

3. pH

The pH of the brood tanks was maintained between 7.3–7.4, while the breeding tanks had a slightly higher pH range of 7.5–7.6, which is considered ideal for spawning.

4. Alkalinity

Alkalinity serves as a buffer against rapid pH fluctuations and contributes to overall water stability. During the study, the total alkalinity of the brood tanks ranged from 140 to 170 mg/L, while in the breeding tanks, it was slightly broader, ranging from 140 to 200 mg/L.

5. Total Hardness

Water hardness is another important factor that affects the physiology and reproduction of fish. In both the brood tanks and breeding tanks, the total hardness was consistently maintained between 100–120 mg/L, providing a stable environment conducive to successful breeding and egg development.

The range of physico-chemical parameters of the brood tank during the broodstock management is presented in Table 1

Table 1 Physico-chemical Parameters of Brood Tank during broodstock management

Water Temperature (°C)	**20-31 °C**
Dissolved Oxygen (DO)	**5-6ppm**
Water pH	**7.3-7.6**

Total Alkalinity(mg/l)	**140-200 mg/l**
Total Hardness (mg/l)	**100-120 mg/l**

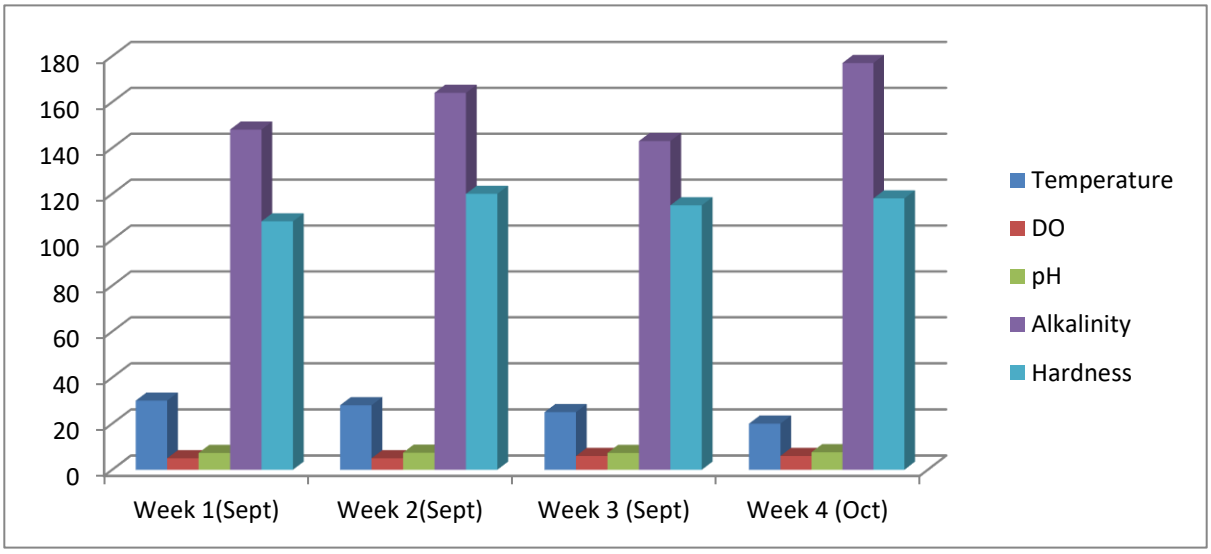

Figure 1 Physiochemical parameters recorded for brooders during broodstock management.

Length-Weight of Brooders

The measurement taken of the *C.auratus* brooders after 4 weeks of broodstock management were found to be ranging from 100-120 gram of weight and the length ranges from 22-24cm in females, while both the weight and the length of the males were measured to be lower than the females with a weight that ranges between 80-100grams and a length that varies between 18-20cm.

Table 2 Length-Weight of Brooders

Sex	**Length(cm)**	**Weight(g)**
Male		
1.	18	85
2.	20	92
Female		
1.	23	115
2.	24	119

Hormone Doses for Brooders

From the study, it was found that the given dosage, 0.5 ml/kg body weight for females and 0.2 ml/kg body weight for males of Ovafish hormone, showed satisfying results.

Table 3 Doses of Ovafish hormones for male and female brooders

Species name	Sex	No. of species	Dose (mm/g body weight)	Spawning period(in Hours)	Hatching period (in Hours)
Carassius auratus	**Male**	3	0.2	7	-
	Female	3	0.5	7	47

Table 4 Determination of Fertilization Rate

Species	Ovulation (%)	Fertilization rate (%)	Survival rate (%)
C. auratus auratius	70%	75%	65%

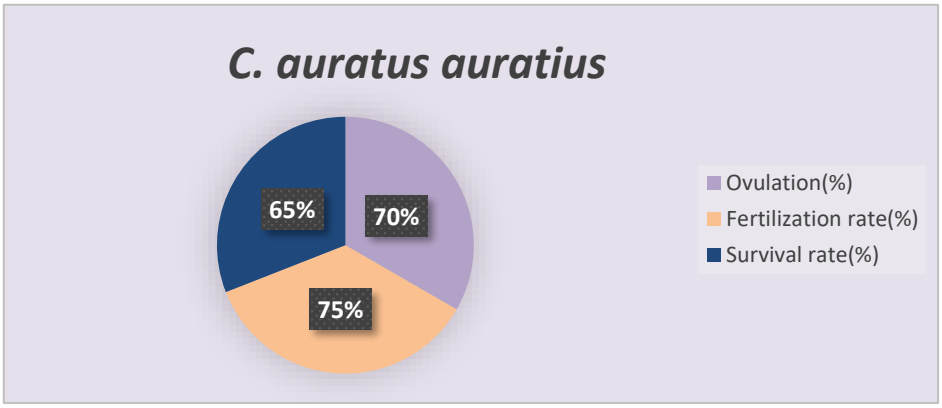

Figure 2 *C. auratus auratius*

After a certain period (1- 2 hours), the eggs were examined to observe the fertilization rate. The fertilized eggs were easily separated from the unfertilized eggs by the presence of a transparent shell with a grey or black spot within the egg shell, while the unfertilized eggs were opaque. The fertilization rate was determined using the following formula-

$$Fertilization\ rate\ (\%) = \left(\frac{No.of\ Fertilized\ eggs}{Total\ no.of\ eggs}\right) \times 100$$

$$= \left(\left(\frac{2200}{3400}\right)\right) x\ 100$$

$$= 65\%$$

3 Discussion

Goldfish have long been one of the most popular ornamental fish species among aquarium enthusiasts worldwide, especially in tropical regions. Many of the goldfish varieties available today trace their origins to parent stocks developed by breeders in China, Korea, and Japan, and these varieties are now known by various commercial names. In India, however, the technology for breeding the diverse types of goldfish is still in its early stages. Given the strong demand for goldfish in both domestic and international markets, there is a need to focus more on the breeding of multiple goldfish varieties. Breeding techniques for different goldfish types are generally straightforward and quite similar. Based on existing literature and my own research on both induced and natural breeding of comet fish, it has been found that using the appropriate hormone dosage and maintaining favorable environmental conditions significantly improves fertilization and hatching rates. It is important to avoid using steel plates for fertilization, as they can lower fertilization success and lead to the spoilage of a large number of eggs.

Using high-quality hormones in induced breeding is crucial for better outcomes. The main aim of this study was to evaluate the effectiveness of the Ovafish hormone in the induced breeding of Oranda goldfish. The experiments were carried out during September and October under controlled conditions with temperatures ranging from 20–30°C, with the ideal temperature being around 23°C. Comet goldfish breed best when this temperature range is maintained, along with light rainfall. Proper aeration was ensured in the breeding tanks. In the experiment, a single dose of Ovafish hormone was administered at a rate of 0.5 ml/kg of body weight for females and 0.2 ml/kg for males. Induced breeding occurred within six hours, while the control group females underwent natural breeding. Several factors, such as temperature, water flow rate, and water quality, can influence hatching success. The optimal temperature range for breeding goldfish is 20–28°C. Both fertilization and hatching rates were found to be slightly affected by environmental conditions and hormone concentrations.

The findings of this study suggest that induced breeding using hormones resulted in increased fertilization and hatching rates. The duration of egg incubation is heavily influenced by water parameters like salinity and temperature. At a temperature of 29°C, hatching time varied by several hours. Additionally, the condition of the broodstock also played a role in determining fertilization and hatching success.

4 Conclusion

In this study, the hormone Ovafish was used to induce breeding in *Carassius auratus*, a widely favored and economically significant ornamental fish, under controlled conditions in a cement tank. The results clearly indicate that induced breeding using Ovafish at a dosage of 0.5 ml/kg for females and 0.2 ml/kg for males led to a significantly higher breeding success rate of about 93%, compared to only 65% in natural breeding. Moreover, both the number of eggs laid and the hatching rate were notably higher in the induced breeding method. Although some commercial breeders report successful breeding without

the use of hormones, the findings of this study suggest that incorporating hormonal induction could greatly enhance their results.

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