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Breeding Strategy of Ornamental Fish, Sword Tail *(Xiphophoru shelleri*) & Sawdust Molly (*Poecilia sphenops*) under Captive Condition

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Authors' contributions

This work was carried out in collaboration among all authors. Authors PD and PD designed the study, collected the data, performed the analysis and interpretation of results, and wrote the manuscript. All authors read and approved the final manuscript.

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Short Research Article

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ABSTRACT

An experiment was conducted over a period of 4 to 6 weeks (February to April 2023) in glass aquariums and tanks within the laboratory of the Forestry and Fisheries Department to study the comparative breeding techniques of two ornamental fish species: Swordtail (*Xiphophorus hellerii*)

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and Sawdust Molly (*Poecilia sphenops*). Breeding pairs were introduced at ratios of 2:1 for Swordtail and 2:3 for Sawdust Molly. Successful breeding of Swordtail was recorded in March 2023, with the observation of 8 live fry in the aquarium. These fry were subsequently transferred to a separate tank equipped with a bubble diffuser to facilitate respiration and were fed crushed feed suitable for their size. The first mortality of a pregnant Swordtail was observed in April 2023. Upon dissection, 38 undeveloped fry were recovered. Breeding in Sawdust Molly was observed later in April 2023, yielding a total of 14.

Keywords: Ornamental fishes; dissection; fry; capitive breeding; breeding technique.

1. INTRODUCTION

An aquarium is a recreational display that houses ornamental fish and other aquatic life, appreciated for their aesthetic value. The term *aquarium* was coined by English naturalist Philip Henry Gosse, combining the Latin word *aqua* (meaning "water") with the suffix *-arium*, indicating a place associated with a specific function (Khanna, 2011). Aquariums can be constructed from various materials such as glass, concrete, wood, fiberglass, and acrylic sheets (Venugopalan, K. M. (2015).), with the choice depending on factors like location, cost, and durability (Ngucku, 2014). Aquarium tank construction is a practical skill that can be acquired with just a few days of hands-on experience (Mahapatra, 2014).

Ornamental fish species, popularly known as aquarium fish, play a vital role in the aquarium trade (Laha & Das, 2007). In India, around 90% of the ornamental fish trade involves freshwater species, of which 98% are cultured and 2% captured from the wild. The remaining 10% includes marine species, where 98% are wild-caught and only 2% are cultured (Mahapatra & Lakra, 2014). Most Indian breeders focus on exotic ornamental species, with relatively little emphasis on breeding indigenous, marine, or brackish water fish (Nair, S. G., Vidhya, V., & Gopukumar, S. T. (2020)

Goldfish (*Carassius auratus*) remains the most favoured species among hobbyists, dominating the Indian ornamental fish sector. In total, approximately 150 varieties of ornamental fish are exploited commercially, including both freshwater and marine species (Murty, 1996). Given its rich diversity of indigenous fish with ornamental features, India holds immense potential to expand its ornamental fish trade and generate significant foreign exchange. West Bengal, in particular, has emerged as a leader in this sector (Mahapatra & Lakra, 2014).

Among live bearing ornamental fishes, mollies (*Poecilia sphenops*) are especially popular. Known as the common or short-finned molly, *P. sphenops* is native to freshwater streams and coastal brackish and marine waters from Mexico to Colombia. Wild mollies are typically dull and silvery in colour(Olivotto.at.al,2003) However, through hybridization and selective breeding, numerous colourful varieties have been developed. Mollies can produce fertile hybrids with several other *Poecilia* species, including the sailfin molly. Male mollies often exhibit mild aggression in aquarium settings and require a varied diet that includes high-quality flake food and vegetables (Divya, 2018). Swordtails (*Xiphophorus hellerii*) are another widely recognized ornamental species, known for their distinct tail extensions. They are one of the most commercially important freshwater tropical fish after goldfish due to their aesthetic appeal, dietary flexibility, and reproductive efficiency. Swordtails are reported to reach sexual maturity at a total length of 25–30 mm or at 10–12 weeks of age (Milton & Arthington, 1983; Dawes, 1991, Morial, 2024). Most ornamental varieties of swordtails and platys have arisen through hybridization of *X. hellerii*, *X. maculatus*, and *X. variatus*. Feeding is a critical aspect of ornamental fish care. Key factors when selecting feed include particle size and nutritional composition. In this study, two primary feeds were used: Optimum Feed and Freeze-Dried Tubifex Worms (Ashqolani, M. M., Haetami, K., Maulina, I., & Mulyani, Y. (2023). Optimum Feed is a commercially available pellet feed that includes fish meal, corn protein meal, soybean meal, cassava pellets, fish oil, lecithin, symbiotics, vitamins and minerals, astaxanthin, food colouring, and antioxidants (Ghosh, S., Sinha, A., & Sahu, C. (2008). Its nutritional composition is as follows:

- Crude Protein: 28% (min)
- Crude Fat: 3% (min)
- Crude Fiber: 4% (max)
- Moisture: 10% (max)

Freeze-Dried Tubifex Worms, a popular live feed alternative, are rich in crude protein and fatty acids, making them highly nutritious and cost-effective (Yanar et al., 2003; Görelşahin et al., 2018; Debnath et al., 2022). Their composition includes:

- Crude Protein: 52% (min)
- Crude Fat: 12% (min)
- Crude Fiber: 2% (max)
- Ash: 12% (max)
- Moisture: 5% (max)

Swordtails, being omnivorous, consume both live and artificial feeds (James & Sampath, 2003). Their optimal diet includes higher protein (60–65%), moderate lipid (8–9%), and lower fiber (4–5%) content (Sharma, 2020), which supports their rapid growth and reproductive health.

2. MATERIALS AND METHODS

An experiment was conducted over a period of 4 to 6 weeks (February to April 2023) in glass aquariums and tanks within the laboratory of the Forestry and Fisheries Department.

Aquarium fish are broadly classified into two categories based on their reproductive strategies: egg layers and livebearers. Egg layers deposit eggs in the aquarium environment, whereas livebearers give birth to fully formed, free-swimming young. Among the most popular livebearers in the aquarium trade are mollies (*Poecilia sphenops*), valued for their prolific breeding and ease of care (Divya, 2018).

Swordtail fish (*Xiphophorus hellerii*), another widely favoured livebearer, reach sexual maturity at a total length of 25–30 mm (1.0–1.2 inches) or at 10–12 weeks of age (Milton and Arthington, 1983; Dawes, 1991). For effective breeding, a sex ratio of 2 females to 1 male (2F:1M) or 4 females to 1 male (4F:1M) is typically recommended to reduce male aggression and maximize reproductive success.

During copulation, sperm is transferred into the female and fertilizes the eggs. Remarkably, swordtail females have the ability to store viable sperm in the oviduct walls for extended periods. This adaptation allows a single mating event to result in five to nine consecutive broods over a span of up to two years (Siddiky & Mondal, 2016). It is essential to select healthy breeding pairs—typically one robust male and one or more healthy females—to ensure successful reproduction and the production of viable offspring (Roy, P. E. Y. (1996)

Aquarium Formula =

L×W×D = cubic feet

Cubic feet× 7.47= Gallons.

1.42×1.50×0.98×7.47= 15.59 equal to 59 litres(Water).

(1 Gallon = 3.785 liters.)

Where, L= length (1.42 ft), W= width (0.98 ft), D= depth (1.50 ft).

$$\text{Specific growth rate (SGR\%/day)} = \frac{\text{In Wt} - \text{In Wi}}{T} \times 100$$

Where, Wt = mean final weight, WI = mean initial weight and T = total experimental days.

Brood survival rate 100%
Male female ratio = 4:6

Identification of sex in swordtail molly: For breeding the most important thing you kept in mind is differentiation in male and female swordtail and knows its characteristic.

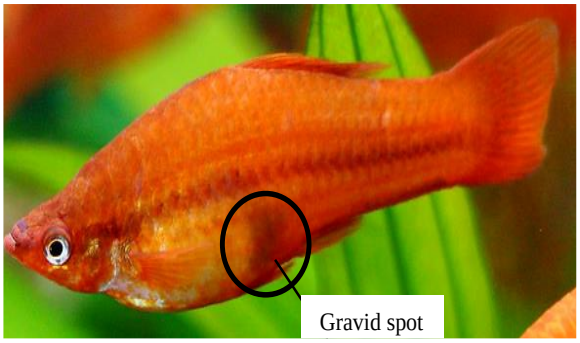

Fig. 1. Mature female swordtail molly

Fig. 2. Mature male swordtail molly

Table 1. Classification of embryo stages during Embryonic Development

Embryonic Stages (Days)	Duration (Days)	Description
Early Development	1-12	12 Embryo less than 1.5 mm, seen as a pale strip on the surface of the ovum
Early-eyed Embryo	13-16	Some retinal pigment, no body pigments
Late-eyed Embryo	22-24	Distinct neck strap of receding extra embryonic membranes
Mature Embryo	25-26	Neck strap absent, preparturition stage with fully developed fins

Male molly fish tend to be much smaller than female mollies, have a specialized anal fin called a gonopodium. Males have larger fins and are more torpedoes shaped than females. For reproductive purposes female mollies have bulkier proportions than males. She will have a bulging and dark spot appearance in belly region while she is pregnant. Her anal fins are triangular and she has shorter fins. (Durgude, et al., 2020).

Embryonic Development: According to (Milton & Arthington 1983), reports of embryonic development vary from 26 to 63 days (Table 1). They demonstrated that temperature is the major factor in the rate of development while photoperiod plays a minor role. The gestation time of a molly is approximately 40 to 70 days.

(Milton and Arthington (1983) the number of fry a female fish can give birth to numbers of fry depending up the sizes of the fishes. A large pregnant fish can give birth up to 100 fry, whereas a small pregnant fish can give birth up 65- 80 fry (Divya, 2018). Changes in the type and quality of feed, feeding rate, ammonia and dissolved oxygen levels, disease, and age of broodstock are all factors that can affect fry production. The average swordtail fish lifespan is around three to five years.

3. RESULTS

The breeding cycle in mollies usually remains for approximately 3 to 6 weeks (20 to 40 days). Before the fry are born a dark triangle shaped patch around the anal vent known as 'gravid spot' showed the gravid condition of fish which becomes larger and darker as it matures as was also observed in the present study (Swain *et al*., 2010). The gestation period for gravid female molly fish is between 28-35 days and their fry can swim after birth A matured female molly fish can produce around 20-60 fry/broodstock. Their movement tends to become slow and they start hiding under the plants of an aquarium. After 35-45 days, the fry hatch. Once a female is fully formed it can produce up to 30-70 young ones per female, though you may not get them all to survive (Ayyapan, 2018). The young ones need to be separated from the adults or they will get eaten. One option is to put pregnant mollies in a breeder's box before they give birth, the young ones are free to leave the box through small holes but the adults stay trapped. Mollies take 12-16 weeks to mature.

The fish was brought from market from 27th February 2023 after completing the fabrication process where the ratio of the female and male taken was 3:1. The successful breeding of swordtail molly was observed in 23March 2023, where a total of 8 fries was found in the aquarium. The fry was < 0.5 cm in length. After the fry were found they were put in a separate tank with only bubble diffuser, to allow them to breathe easily. Fry was provided with crushed feeds, so it is easy for them to intake in their mouth.The 1st mortality of pregnant fish was observed on 10 April2023. A total of 38 undeveloped fry were found when it was dissected.

A similar study was done by Siddiky and Mondal (2016) for 3 to 4 weeks in a glass aquarium and tanks to study on Breeding technique of goldfish (Carassius auratus), molly (Poecilia sphenops), guppy (Poecilia reticulata), (Sudha, 2012).

Similar studies were done by Naik (2020) on three different species of molly, Black, White and Sailfin Poecilia species originating from Central and North- Eastern South America, required for the experiments were obtained from ornamental fish traders of Ratnagiri and Mumbai during the months from April 2016 to March 2017. Another experiment was conducted for 3 to 4 weeks in glass aquarium tanks to study the Breeding technique of molly (Poecilia sphenops) by Divya (2018). Molly starts breeding at the age of 4 months. The sex ratio was taken slightly differently in jars of three sets that are 1 female 2

male, 1 female, and 2 males and 2 females with one male. The molly can produce fertile hybrids with many Poecilia species, most importantly the sailfin molly. The male mollies generally tent to be mildly aggressive. I take mixer of molly fish species (gold dust molly, platinum molly, and common molly) in my aquarium and 12 numbers of species. 4 are male and 6are female species. My molly fish average length is 4- 5 cm.

4. DISCUSSION

In live-bearing species like *Poecilia sphenops* (commonly known as mollies), the young are born fully formed and free-swimming. At birth, fry typically sink to the bottom of the tank and remain inactive briefly. To protect them from predation, especially by adult fish, floating breeding units equipped with a slotted grid are often used. These units allow the newborn fry to fall through the grid to a separate compartment, minimizing the risk of being eaten by the adults (Divya, 2018).

Maintaining clean water conditions is essential for fry survival. A dosage of one teaspoon of salt per gallon is often recommended to prevent infections and improve fry health. In the early stages, fry should be fed highly digestible and nutrient-rich foods such as specialized fry flake food, finely chopped lettuce, the soft inner portion of cucumbers, and small portions of boiled egg yolk. These feed types support rapid growth and development in the initial weeks post-birth (Divya, 2018).

5. CONCLUSION

Livebearer breeding is simple because they release fry immediately, but the fry may need to be raised in a separate environment to avoid cannibalism from their parents. Both the ornamental fish belong to same family i.e. Poecilliadea, life span of both fishes i.e. sawdust & sword tail fish are 3-5 years. The number of fry are also more or less same in both the species.

But with this comparative study, we able to conclude that as compared to swordtail fish, survivability of common fish was 100%. Still, both have same breeding cycle. Sawdust or common molly are genetically more improved as compare to sword tail.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that generative AI technologies such as Large Language Models, etc have been used during writing or editing of this manuscript. This explanation will include the name, version, model, and source of the generative AI technology and as well as all input prompts provided to the generative AI technology.

Details of the AI usage are given below:

1. I hereby declare generative AI technologies ChatGPT have been used during editing of this manuscript.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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