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Induced breeding of Pacu fish (*Piaractus brachypomus*) under hatchery conditions

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Abstract

The induced breeding of Pacu (*Piaractus brachypomus*) plays a vital role in ensuring continuous and quality seed production for freshwater aquaculture. Pacu, a commercially important species, does not normally spawn under controlled conditions; therefore, artificial breeding techniques are essential. This article outlines the key stages of induced breeding, including broodstock selection, identification of mature males and females, hormone administration, fertilization, and egg incubation. Synthetic hormones such as GnRHa combined with Domperidone (e.g., Ovaprim, Ovatide) are widely used to stimulate final gamete maturation and synchronized spawning. Optimal breeding results depend on correct hormone dosage, proper injection methods, and maintaining suitable environmental conditions. Under ideal conditions, fertilization and hatching rates reach 80–90%. The article highlights that scientific and well-managed artificial breeding practices significantly improve seed quality, enhance survival rates, and contribute to the overall productivity and sustainability of Pacu aquaculture.

Introduction

Breeding plays a crucial role in fish culture, serving as the foundation for the production of quality fish seed. The success of aquaculture largely depends on the continuous and timely availability of healthy seed stock. While fish naturally breed during specific seasons in their natural environment, whereas the artificial breeding techniques have become essential in aquaculture to ensure seed production at desired times and in adequate quantities. With the advancement of modern aquaculture technologies, artificial breeding has enabled farmers to produce large numbers of fish seed within a short period, thereby increasing overall fish production and supporting the sustainable growth of the aquaculture industry.

Breeding characteristics of Pacu

The life cycle of pacu fish (*Piaractus brachypomus*), a freshwater species native to South America, is closely linked to seasonal rainfall and the flooding of river systems. In natural habitats, pacu generally breed during the onset of the rainy season when water levels rise and environmental conditions become favourable for spawning. Pacu typically spawn in slow-flowing waters, floodplains, and vegetated freshwater bodies. Their eggs are non-adhesive and pelagic, meaning they do not stick to surfaces but float freely in the water column. The eggs drift with the water current and develop as they move, eventually hatching into larvae under suitable environmental conditions.

Significance of induced breeding

Artificial breeding of pacu become an important practice in aquaculture, allowing for the control breeding cycles, ensuring the production of uniform and high-quality fry, and reducing dependence on natural seed collection. This practice also helps in maintaining genetic quality and meeting the increasing demand for fish seed throughout the year. By adopting scientific breeding protocols including

broodstock management, hormonal induction, fertilization, and incubation can enhance seed survival rates and contribute significantly to the productivity and profitability of freshwater fish farming systems.

Induced breeding of pacu fish

Prior to induced breeding, the pacu fish brooders are properly maintained in ponds conditions with proper supplementary feeding (Chatterjee and Mazumdar, 2009). To stimulate the maturation of their gonads (eggs/sperm) and induce spawning, synthetic hormones such as GnRHa combined with Domperidone (commercial preparations like Ovaprim, Ovatide, etc.) can be administered. Pacu fish generally do not breed naturally under controlled conditions. Therefore, hormones are administered to induce the breeding.

Selection of pacu brood fish for induced breeding

The proper selection of brood fish plays a vital role in the success of artificial breeding programs. Choosing active, fully mature and healthy brooders ensures good fertilization rates, higher hatchability, and ensures good quality seed production and higher survival rates of fry. Therefore, careful examination and selection of both male and female fish are essential before initiating the breeding process.

Female pacu fish can be identified by certain physical characteristics. During the breeding season, their abdomen becomes bulged and soft due to the presence of mature eggs. The abdominal skin appears thin and delicate. The genital opening turns reddish in colour, which is a clear sign of maturity. In addition, the adipose fin serves as an indicator to confirm male and female (looks sharp and triangle in male and blend and rounded in female). In well-developed females, the egg diameter (oocyte diameter) is usually around 1.0 mm, showing that the fish is ready for spawning.

Male pacu fish can be recognized by gently pressing the abdomen during which it releases a milky white fluid called milt and it contains sperm. This is a positive sign that the male fish is ready to participate in the breeding process. Males should also be healthy, active, and free from external injuries or infections.

Male (Above) and Female (below) Pacu fishes

Materials required for inducement

For hormone administration, disposable syringe with needle, handling cloth, hand net and inducing agents are recommended: Generally, a 3 ml disposable syringe graduated with 0.1 ml markings is used to ensure accurate dosing. In pacu fish artificial breeding practices, needle size 19/22 is commonly used for effective hormone delivery. A handling cloth is required to hold the fish tightly during injection. On the other hand, a hand net is required to collect and release the fish during injection.

Inducing Breeding Agents

Carp Pituitary Extract (CPE)

This extract is prepared from the pituitary glands of freshly killed carp or by sacrificing live carp (Chattopadhyay, 2016). The collected glands can be preserved in absolute alcohol for up to one year. Prior to use, the alcohol is filtered off using filter paper and allowed to evaporate. The glands are then homogenized using a homogeniser, and the resulting mixture is centrifuged to obtain the supernatant. Generally, 40 mg of the pituitary gland is mixed with 1 ml

of distilled water to prepare the extract. The carp pituitary extract is now ready as an inducing agent in induced breeding.

Synthetic Hormones

In general, the synthetic hormones are used to trigger egg/sperm release under controlled conditions which is crucial in captive fish breeding. As most of the fish breed in captivity, their breeding performance or spawn yield characteristics can be enhanced using synthetic hormones (Chaube, 2023). The commonly used synthetic hormones in induced breeding are ovaprim, ovatide, Gonopro and Wova-FH. These hormones are commercially available at a cost of approximately ₹400–600 per 10 ml vial.

Hormone administration during induced breeding

The following three injection methods are commonly practiced in aquaculture for hormone administration.

1. Intramuscular injection

Intramuscular injection is the simplest, safest, and most widely used technique for administering hormones to brood fish. In this method, the hormone is injected into the muscle located either at the caudal peduncle (tail region), or below the dorsal fin and above the lateral line. This method minimizes stress and risk to the fish.

Precaution: The injection should not be administered very close to the lateral line**,** as it may damage the sensory system of the fish.

2. Intraperitoneal injection

In intraperitoneal injection, the hormone is introduced into the body cavity near the base of the either pectoral fin, or pelvic fin. Although commonly used, this method is considered relatively risky, as improper injection may cause injury to vital internal organs such as the liver and gonads (reproductive organs). Hence, it requires careful handling by experienced personnel.

3. Intracranial injection

Intracranial injection involves administering the hormone close to the brain region of the fish. This method carries very high risk**,** as there is a possibility of damaging the brain tissue. Therefore, it is rarely used in routine fish breeding practices and is confined mainly to experimental or laboratory studies**.**

Inducement protocol of pacu fish

Generally, two dosage pattern is practiced in pacu fish breeding. For healthy female fish, a preparatory dose of 0.3 ml/kg body weight is administrated, which helps in uniform final gamete maturation. Followed by that, after 8-10 hrs of interval, a booster dose of 0.5–0.6 ml/kg body weight is given, which induces the synchronized release of all mature eggs. Parallelly, for male fish, a preparatory dose of 0.2 ml/kg body weight is given at the time of female's first injection. Then, during the second injection of the female, the males are also injected at a dosage of 0.3 ml/kg body weight.

Wova-FH synthetic hormone

Hormone administration

Egg collection

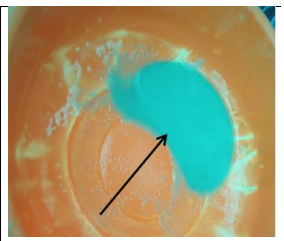
Spawning usually occurs 6–8 hours after the second injection, when the water temperature is 20–26°C. It is particularly important to monitor the females continuously after four hours of administering the second dose. Otherwise, the females may release eggs into the water column. If the eggs are not released naturally, the females are collected after eight hours, and dry stripping is performed by gently pressing the body from the pectoral fin region towards the genital opening to release the eggs. While egg collection, clean, smooth surfaced and dried tray must be used to avoid damage of eggs. After egg collection, milt from the male fish is collected following same stripping method. The collected milt was released directly over the eggs and it was mixed thoroughly using feather. Followed

by this, water is added to activate the milt which immediately fertilize the eggs. Generally, male : female ratio of 2 : 1 or 3:1 is used for fertilization, as male release very minimal quantity of milt. After gently mixing the eggs and milt with the feather for about 1 minute, the eggs are washed with clean water to remove excess milt. Then, they are transferred to a hatching pool with water circulation at 20–27°C for incubation.

Depending on the water temperature, the fertilized eggs hatch into larvae within 16 to 24 hours of incubation. After 30 to 40 hours of fertilization, the fertilization rate is assessed. Under suitable environmental conditions, the fertilization rate of the eggs is 80–90%, and the hatching rate is also 80–90%.

A healthy male pacu produces 5–10 ml of milt at the beginning of the monsoon season, but this reduces to 1–3 ml towards the end of the monsoon. Female fish produce about 1.5 lakh eggs per kilogram of body weight during the monsoon. The number of eggs varies between 270–300/ml. Towards the end of the monsoon, although the number of eggs produced by females does not decrease, the fertilization rate may drop to 0–5%. Among the brooders kept for breeding, only about one-third are used in a single breeding cycle. The remaining brooders are maintained for future use.

Collecting of eggs from female brood fish



Collected Eggs

Generally, fertilization rate (number of eggs were successfully fertilized by milt) and hatching rate (number of larvae were successfully produced from the fertilized eggs) are calculated to know the breeding performance of the fish and they are calculate using following formulae;

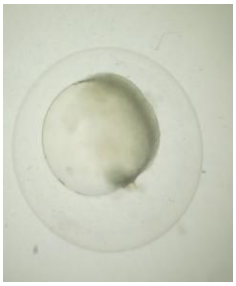
Fertilization Rate (%) = (Number of fertilized eggs / Total number of eggs) × 100

Hatching Rate (%) = (Number of hatched fry / Number of fertilized eggs) × 100

Differences in fertilization and hatching rates are observed during peak breeding season and off-season. During the peak breeding season, the fertilization rate and hatching rate are varies between 70–99% (average 86%) and 60–100% (average 88%), respectively, under favourable environmental conditions. During the off-season, the rate changes between 28–95% (average 71%) and 50–100% (average 77%).

Conclusion

Captive breeding is an important practice in aquaculture industry which involves various scientific protocols to for its successful operation. Through artificial breeding in pacu fish, it is possible to produce a large number of high-quality and healthy fish seeds. This increases the production potential of pacu and provides a strong foundation for commercial farming. The proper selection of broodstock, accurate hormone dosage, precise injection techniques, and proper management conditions are the key factors required for successful pacu breeding. Thus, artificial breeding of pacu fish using scientific techniques not only enhances pacu production but also contributes to the economic development of fish farming.



Fertilized eggs of pacu fish

Hatched larvae

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