

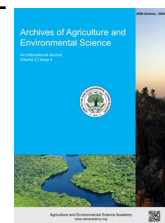


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A REVIEW



## Artificial propagation of Asian catfish, *Clarias batrachus* (Linnaeus, 1758) in Asia: A review

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### ABSTRACT

*Clarias batrachus* (Linnaeus, 1758) is a popular food fish of Indian sub-continent due to its high nutritional value. Earlier many workers have carried out studies on feeding and breeding biology of this fish species but convulsive information on the same is not available. So, a survey of published literatures on the induced breeding of *C. batrachus* has been carried out to consolidate the available information. Environmental factors play an important role in regulating reproduction in fishes. Pituitary gland extract, HCG and synthetic hormones viz., ovaprim and ova tide are successfully being tested for the induced breeding of fishes by various researchers under different climatic conditions, with varying degree of success. Chasm of information has been pointed out for further study mainly on age group wise variation in food preference and correlation of breeding periodicity with hydrological parameters and photoperiod.

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### INTRODUCTION

Global warming is a minatory denunciation to the human civilization with excessive population together with. Food surety and its upheld production have got notable remark throughout the world for fending the sequential pursuance. High production in a sustainable way can be a probable measure for recent consequences. For example, in Bangladesh fish has been a major source of protein, contributing about 60% of the animal protein in the daily diet of the people (DoF, 2021). Induced breeding is a process where the fish, which do not breed in stagnant water bodies, will do so under the influence of some stimulants or hormones injected in their bodies. Induced breeding, also called *hypophysation* or artificial propagation, has now overcome the problems of fish seeds production for the particular fish which do not breed in captivity. In this process, some stimulating agents or hormones are injected into the ripe brood fish and hence the stimulation promotes the releasing of eggs and milk from these ripe breeders timely in captive condition. Fin fish hatchery was first established in Jessore by Mohoshin Master in

1967. Among the freshwater fishes, catfish is one of the most important groups of fish in this delta and is getting increasingly popular showing a promising future for commercial culture (Khan *et al.*, 2021).

Due to natural and manmade hazards, biodiversity of fish and other aquatic organisms in open water have been declining so much and with such rapidity that the aquatic animals, especially fish are unable to cope with (Mollah, 2005). Nowadays, due to the degradation of the ecological balance, changing catchments, construction of drainage structures and flood control, siltation, soil erosion, washing of industrial pollutants and agrochemicals, the capture fisheries in open waters of Bangladesh is under great danger. Nowadays, due to the degradation of the ecological balance, changing catchments, construction of drainage structures and flood control, siltation, soil erosion, washing of industrial pollutants and agrochemicals, the capture fisheries in open waters of Bangladesh is under great danger. That's why the dependency on hatchery produced fry has increased rapidly to protect the species from being extinct.

The walking catfish, *Clarias batrachus* (Linnaeus, 1758) is a potential species for aquaculture. Availability of quality seed is one of the important pre-requisites for successful culture of any species. So induced spawning is always advisable for getting optimum quantity and quality of the stocking material. Bangladesh is one of the world's leading fish producing country with a total production of 4.621 million MT in 2020-2021 (FAO, 2021). Fisheries sector alone contributes 1.35% of the total export earnings and this sector also contributes 3.52% to the Gross Domestic Product (GDP) and 26.37% to the agricultural GDP in 2020-21 (FRSS, 2021). Fish culture is increasing very quickly with the increase in demand. As the people have started aquaculture business in Bangladesh, the demand of fish seed is increasing gradually. Bangladesh is blessed and enriched with vast water resources, which show a wide range of variation in nature. As a consequence, natural fisheries resources are scattered all over the country. *Clarias batrachus* (Linnaeus, 1758) is commercially valuable, widely distributed and cultured in India, Bangladesh, Pakistan, Indonesia, and other Asian countries (Sahoo *et al.*, 2016; Ferose Khan *et al.*, 2021). *Clarias magur* is a neotype of *Clarias batrachus* (Linnaeus, 1758) belongs to the Clariidae family (Ng and Kottelat, 2008; Mir *et al.*, 2018). The hardy nature and tolerance to adverse ecological condition enable its high density culture with a high production per unit area. The basic requirement of the controlled fish culture industry is the fish seed but now spontaneous captive breeding, short supply of quality seed and dependency on wild seeds, which is unreliable, time consuming and uneconomical are major constraints for culturing this fish. To overcome such problems, induced spawning is thought to be the only alternative method for quality seed supply and production (Sharma *et al.*, 2010). The small catfish species are noteworthy for their size, taste and market value. They are distributed in lentic and lotic water bodies and breed naturally in perennial rivers during monsoon. Though breeding and larval rearing of certain catfishes has been done successfully for their commercial production is yet to be achieved. Hence, maintenance of catfishes plays a key role in achieving successful induced breeding. Therefore, proper techniques of induced breeding and larval rearing for large scale production of fry are the most crucial factors in expanding culture practice for this species. Although, some works have previously been conducted on its induced breeding, the techniques available have not been standardized to be recommended at farmer's level. The main purpose of this review work is to consolidate those scattered information and to highlight the gaps in the knowledge for further research work on this particular fish species. This review speculates the induced breeding hormone composition of magur around the world. We have covered an extensive study and information on induced breeding of magur with special reference to its hormone administration.

## MATERIALS AND METHODS

Different literature on *C. batrachus* artificial propagation was perused from search engines such as Google Scholar, Web of

Science, Academia and Scopus. This lesson reconnoitered broodstock management, conditioning, inducing agent, hormone administration, fertilization and hatching rate based on different hormones and conservation. This review article will help to find out the induced breeding technique and hormone preparation of *C. batrachus* at farmer's level so that they can produce the definite amount of quality seed.

## RESULTS AND DISCUSSION

### Broodstock management

Sahoo *et al.* (2009) stated that *C. batrachus* broods were raised in earthen ponds (0.01 ha) and were fed with pelleted feed containing 30% crude protein at 2% of their body weight daily. The female broods of 120-130 g weight range were selected for induced breeding during July-August. The farmers collected brooders of magur raised in captive conditions in earthen ponds in Nalbari district, Assam. Brooders were fed twice daily with fish meal based feed containing 30-35% protein @3-5% of the body weight. The broodstock of magur, 150 g body weight, were used for breeding. Farmers maintained ideal sex ratio 1:2 (male and female) for higher rate of fertilization although sometimes it depends on the release of egg (Rajbongshi *et al.*, 2020). Khan *et al.* (2021) mentioned that magur fishes were cultured at a stocking density of 100 fish  $\text{m}^{-2}$  in the earthen ponds of the hatchery for broodstock development. The fishes were intensively cared by applying high protein (32%) commercial diet enriched with vitamin (A, B, C and E) twice daily at the rate of 3-5% body weight to make them sexually mature. Magur become sexually mature at the age of 1 year when the weight reached around 100 g. During breeding season females were easily identified by their soft and swollen abdomen due to presence of mature bulky eggs. On the other hand, males are identified by their flat abdomen and long protruded genital papillae (Taslima and Ahmed, 2012). Healthy and gravid brood fishes were collected during the breeding season (July-August) from a local fish farm of West Bengal, India. The males were selected on the basis of pointed and reddish genital papilla, while females by a round and reddish papilla, softness of abdomen and uniform size of intra-ovarian oocytes (Roy *et al.*, 2018).

Dhara and Saha (2013) smeared with disease free healthy gravid male (average length  $26 \pm 1.5$  cm and average weight  $160 \pm 5$  gm) and female (average length  $25 \pm 2.7$  cm and average weight  $220 \pm 7$  gm) *Clarias batrachus* (Order: Siluriformes; Family: Clariidae) were used for induced breeding. The selection of the gravid fish was made on the basis of external morphological features. Gravid female fish were identified by the presence of soft swollen belly with short, round, button shaped and slit like genital papilla along with reddish vent. Prime maturity of the female was determined by examining the size uniformity of the eggs released by the gentle pressure on the swollen abdomen. Fully gravid males were identified by their slender and streamlined body with conical and elongated genital papilla having pointed reddish tip.

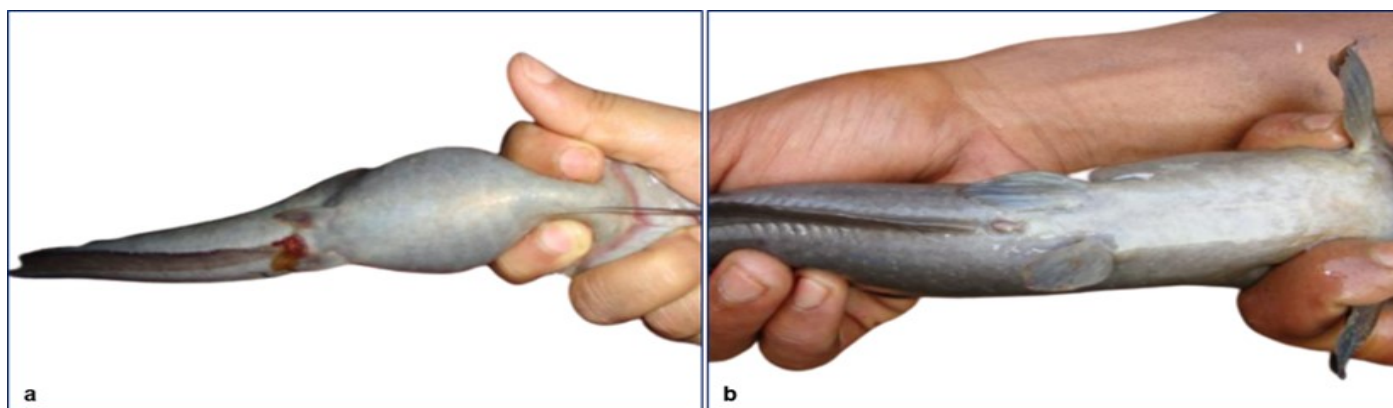


Figure 1. Mature brood (a) Female with swollen; and (b) male with normal abdomen (Khan et al., 2021).



Figure 2. Inducing agent (Ovaprim) for induced breeding of fish.

#### Hormone administration

Table 1 delimited the comparative study of induced breeding administration of *Clarias batrachus* by carp pituitary Extract (CPE) and various synthetic hormones by various authors. The Asian catfish, *Clarias batrachus* locally known as magur fish, is an important air-breathing catfish with good markets price. The scarcity of marketable fish as well as seed from the natural ground has been felt in this catfish. The potential to obtain magur seed from natural sources has become low due to the increasing use of pesticides in the paddy fields which are the main breeding grounds of this fish. The breeding performance is an important parameter to evaluate the breeding success in captive condition which depends on the type of hormone used and its potency, dose of hormone and maturity status of the fish. Human chorionic gonadotropin (HCG) at 14-23 h latency in combination with 3000-4000 IU HCG dose was one among them and was reported successful in catfish during induced ovulation. Appropriate combinations of the proper dose of inducing agent and stripping time always yield maximum egg output during induced breeding. A single injection of 0.6 ml/kg body weight of ovaprim was the most effective.

The males were given a single dose of 0.1-0.2 ml/kg body weight. Again administration of fish PG of dosage varied from 12 to 30 mg/kg weight of fish was given in two doses, a provocative dose of 5-10 mg /kg and a final dose of 8-20 mg/kg, 5-6 hours interval was found successful in spawning. In hapa nursing of magur, the average survival was 51% while feeding with rice bran and mustard oil cake mixture at 1:1 ratio and termite twice

daily (Datta, 2016). Before the female were stripped male fish with gravid testis were sacrificed and testes were taken out and macerated in normal saline (0.9% sodium chloride). The spermatozoa became inactive in this medium and this extract could be maintained for few hours in refrigerator. After 16 hours of latency period, female fish were stripped and ova were collected in to dry enamel tray. Before fertilization milt (spermatozoa) extract medium was activated by addition of fresh water. Sperms became active and motility of sperms was confirmed in microscope. In this way, Sperm preparation was sufficient to fertilize the ova stripped from 2 females. Sperm extract was sprinkled over the ova and gametes were mixed gently with bird feathers and allowed to 2 to 3 minutes for fertilization. After repeated washing with fresh water fertilized eggs were transferred to hatching trays for incubation (Datta, 2016). Chakraborty (2022) reported the plasma steroid profiles during oocyte maturation and LHRHa pimozone induced ovulation in the Asian catfish, *C. batrachus* and opined that the levels of estradiol-17 $\beta$  and estrone rapidly increased reaching a peak during the vitellogenic phase, while a decline was observed during the spawning phase. A dose of 1.50 ml/kg ovaprim was also found to be effective to induce ovulation in *Clarias batrachus* by Hussain et al. (2021). Hossain et al. (2006) found 10.0 mg PG/kg body weight in first dose and 45.0 mg in second dose successfully ovulation in *Clarias batrachus*. On the other hand, 30-60 mg PG/kg body weight which enhanced the breeding response of 140-260 g catfish reported by Rao and Karamchandani (1986).

An experiment was also encountered while using HCG at the rate of 4000 IU/kg of body weight during breeding operation (Naser et al. 1990). Khan et al. (2021) conducted experiment to monitor the three growth hormones viz., Ovupin (100 mg domperidone and 0.2 mg S-GnRH $\alpha$ ) at the rate of 1 ml.kg<sup>-1</sup> body weight, Flash (20 mg S-GnRH $\alpha$ , 10 mg domperidone and propylene glycol) at the rate of 1 ml.kg<sup>-1</sup> body weight and Human Chorionic Gonadotropin (HCG) hormone at the rate of 2272 IU.kg<sup>-1</sup> body weight on breeding performances. Sahoo et al. (2005) demonstrated that *C. batrachus* could be successfully induced to spawn with an injection of SGnRH $\alpha$  in combination with domperidone. Srivastava et al. (2012) observed the breeding and larval rearing of Asian Catfish, *Clarias batrachus* fed with live and/or artificial feed for 21 days in an indoor

**Table 1.** Comparative study of induced breeding administration of cat fish *Clarias batrachus* by carp pituitary extract (CPE) & synthetic hormones by various authors.

S.N.	Hormone	Dose	Fertilization rate (%)	Hatching rate (%)	References
1	Ovaprim	1.0-2.0 ml/kg	70.6-72.8	55.3-66.7	Srivastava et al. (2012)
2	Ovatide	1.0 ml/kg	83	71	Sahoo et al. (2005)
3	Ovaprim	1.0-1.5 ml/kg	-	-	Sahoo et al. (2007)
4	Ovatide	1.0 ml/kg	82.33	55.35	Sharma et al. (2010)
5	Ovaprim	1.50 ml/kg	79.48	63.17	Rajbongshi et al. (2020)
6	GnRHa	1.5 ml/kg- 1 <sup>st</sup> dose 2 ml/kg- 2 <sup>nd</sup> dose	-	-	Chakraborty (2022)
7	Pituitary gland extract	50 mg/kg- Male 120 mg/kg-Female	80	71	Dhara and Saha (2013)
8	Ovaprim	0.4-1.0 ml/kg- Male 0.8-2.0 ml/kg-Female	77	65	Dhara and Saha (2013)
9	Ovaprim	0.5-1.0 ml/kg- Male 1.0-2.0 ml/kg-Female	70.6-72.8	55.3-60.7	Srivastava et al. (2012)
10	Ovaprim	1.50 ml/kg	78	84	Hussain et al. (2019)
11	Pituitary gland extract	5 mg/kg- 1 <sup>st</sup> dose 15 mg/kg- 2 <sup>nd</sup> dose	40.65	20.33	Taslima and Ahmed (2012)
12	HCG	5000 IU/kg	60.47	50.65	Taslima and Ahmed (2012)
13	Ovaprim	0.02 ml/100 g- Male 0.08 ml/100 g-Female	78.10	89.65	Hossain et al. (2006)
14	Ovupin	1 ml/kg	78.20	54.93	Khan et al. (2021)
15	Flash	1 ml/kg	93.09	75.77	Khan et al. (2021)
16	HCG	2272 IU	81.60	64.41	Khan et al. (2021)
17	Ovatide	1 ml/kg	80±2.1	75±2.5	Jagtap and Kulkarni (2015)
18	Ovaprim	0.6 ml/kg	93.16	55.10	Das (2002)
19	HCG	3000-4000 IU	-	-	Sahoo et al. (2009)
20	Ovaprim	2.0 ml/kg	97.08±2.6	87±2.1	Sahoo et al. (2010)
21	Ovaprim	2.0 ml/kg	91.06	79.18	Bordoloi (2014)

hatchery. They reported that fishes were successfully induced breed using ovaprim @ 1.0–2.0 ml/kg body weight to females and 0.5–1.0 ml/kg body weight to males. Fertilization, hatching and survival percentages at spawn stage were respectively recorded 70.6–72.8, 60.7–55.3 and 54.3–56.2. Dhara and Saha (2013) conducted breeding experiments on *Clarias batrachus* with pituitary gland extracts (40 and 120 mg/kg. body weight for female and 25 and 50 mg/kg. body weight for male) and Ovaprim (0.8 and 2.0 ml/kg body weight for female and 0.4 and 1.0 ml/kg body weight for male) at 26°, 28° and 30°C. The highest rates of fertilization (80%) and hatching (71%) of eggs were recorded in *Clarias batrachus* injected with carp pituitary gland extracts @ 50 mg/kg body weight of male and 120 mg/kg body weight of female at 28°C with a latency period of 15 hours. The fertilization and hatching rates were 77% and 65% respectively at 28°C at the higher doses of Ovaprim. Jagtap and Kulkarni (2015) experienced the appraisal of the breeding performance of *Clarias batrachus*, at different doses of ovaprim in laboratory condition. Different doses of ovaprim were tried on male and female fish, the optimum response was showed at dose 1 ml/kg body weight of female and 0.5 ml/kg body weight of male. The brooders weight range was 250–450 g. Breeding response studied under different parameters and showed latency period (h), fecundity, fertilization and hatching (%), 12±1.2, 4500±150, 80±2.1 and 75 ± 2.5, respectively.

## Conclusion

The production of good larvae of *Clarias batrachus* was

obtained by using CPE, HCG, ovaprim and ovatide. Sustainable conservation of the genetic resources of *C. batrachus* for food and aquaculture is to be achieved. Non-availability of fish seeds and also scarcity of matured brood fishes are the major limitation in the culture of this species. To overcome this problem seed production and culture as well in aquatic environment through induced breeding. The use of synthetic inducing hormones for successful ovulation followed by stripping is a common practice and has been studied by several researchers in Bangladesh. According to FAO estimates the demand for catfishes throughout the world is increasing and *Clarias batrachus* with its several beneficial aspects remain as a hit among the Asians in particular. Besides in order to protect the genetic resources of this species from unwanted hybridization, which the species is very much vulnerable, the fish genetists and the government bodies should work together.

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## Conflicts of interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.



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