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Research Article

Incaptive culturing of Goldfish and Koi carp in Punjab, Pakistan

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Abstract

This study observed the captive culture of Carassius auratus and Cyprinus carpio in the Potohar region, Punjab, Pakistan. Captive culturing of both species was conducted up to one-month post hatchlings. The sample size was 180 (90 goldfish and 90 koi carp) and kept in cemented raceways under optimum conditions. The study period was from October 2019 to April 2020. The natural breeding season for Carassius auratus and Cyprinus carpio was from 25th January to 5th February and the end of February to 11th March, respectively. The induced breeding duration for goldfish and koi carp was from 6th to 25th February and for koi carp from 12th to 30th March, respectively. For artificial breeding, the synthetic hormone Ovaprim C was injected intra-peritoneally at 0.5 ml/kg and 0.1 ml/kg body weight of females and males, respectively. Both the species were fed a 30% crude protein diet. Hydrilla plants were used for the adhesion of eggs. The female to male ratio was 2:3. Approximately 4500 to 5000 eggs of goldfish and 17000 to 18000 eggs of koi carp were laid. Fertilization, hatching, and survival rates observed for both were approximately 74%, 57% and 42.5%, respectively.

Keywords: *Carassius auratus*, *Cyprinus carpio*, Ovaprim C, captive culture, natural breeding, induced breeding, fertilisation rate, hatching rate, survival rate.

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1. Introduction

The fishes which are usually lesser in size, about 20 cm in length, are kept in aquariums and valued for their appealing nature and rarity are called as ornamental fish (fishes). Ornamental fish keeping is one of the most predominant hobbies and an emerging commercial activity in the world nowadays (Usman *et al*., 2015). Above 2500 species are involved in the universal ornamental fish industry, 60% of which have a freshwater origin. The ornamental fish sector is small even though a vital part of the international fish trade. It contributes positively to rural development in many developing countries (Mahadevi *et al*., 2018).

Ornamental fish keeping in its present form was made possible by the beginning of air transport, permitting the utilization of fish in distant parts of the world and their transportation to markets in developed countries nowadays (Malik *et al*., 2014). So, the fish must not only be attention-grabbing but also healthy enough to resist long air transportation (Podlesnykh *et al*., 2015). Import and export of ornamental fish are approximately handling up to one and a half billion fishes. Shipment and handling of fishes impose wide range of stressors that can result in high death rates up to 73%. These rates vary enormously however, can be as little as 2%, as they are most commonly not based on experimental work but rather on assessed data. Given the number of ornamental fishes traded so far, any of the estimated mortality rates potentially sustain significant economic losses and very serious health issues (Stevens *et al*., 2017).

The profession of ornamental fish rearing has the potential to boost the economic growth of concerned countries and the viable development of water resources but also has the capability of facing upcoming encounters regarding environmental and social problems (Dey *et al*., 2014). The induced breeding technique is used for the artificial propagation of fish. From the mid of 1960s induced breeding of common major carps has been considered as a reliable source of fish seeds in hatcheries for the production of fry or fingerlings in Bangladesh. This enhances the overall aquaculture production significantly (Szabó *et al*., 2019*)* of Bangladesh. The vital goal of every selective breeding program is to improve the breeding worth of the fish population to influence a fish's genes to produce an improved phenotype. It will result in better fish production. Throughout the world currently, more than 300 species of fishes are cultured, which is frequently increasing agreeing to the advancement of cultivation methods and to the methods of bulk production of food (Szabó *et al*., 2019).

Ornamental fish keeping is now emerging as an important commercial activity. The koi carp culture is still not famous in Pakistan because of deficiency of superior seed and also insufficient awareness on their culture and breeding methods. At present, no published information is available on the efficiency of Ovaprim hormone on spawning in commercially and economically important fish, koi carp from Pakistan. Therefore, the present experiment was conducted to observe the efficiency of the Ovaprim hormone on stimulation, ovulation of *Cyprinus carpio* in captive conditions.

2. Materials and methods

2.1. Profile of the study area

The research was conducted in Local Fish farm located in Mera Abadi F12 Islamabad, Potohar region, Pakistan. All groundwork needed for Natural and artificial (induced) breeding of

ornamental fish was done in the fish farm. The major requirements i.e., the setup of raceways, facilities of water supply, space for working, aerators, feed supplements and instruments required for the maintenance and measurement of water quality parameters etc. were made available before the breeding program to be started. The study period was from October 2019 to April 2020.

2.2. Experimental design

For natural and induced breeding cemented raceways were used for the cultivation and spawning of both fish species. A total of 14 cemented raceways were constructed comprising of 5 race ways size 5x30x3 ft. (W.L.D), 3 raceways size 4x30x3 ft. (W.L.D), and 6 raceways size 10x10x3ft (W.L.D). The raceways were provided with filters, continuous air pump and continuous water supply etc. All the broods were kept in a large raceway size 10x10x3ft (W.L.D) collectively and for breeding, they were transferred to separate smaller raceways size 5x30x3 ft. (W.L.D). After fertilizing the fertilized eggs were also kept in the separated smaller raceways for both the fish used in the experiment. There were two extensive sessions of this experiment. The first session of the experiment was concerned with the collection of brood stock of both the goldfish and koi carp from the local market, other fish farms and also some brood stock was prepared in the fish farm. The second session of the experiment was to carry out the natural and induced breeding program, and development of larvae. Both sessions were performed in the fish farm located in Mera Abadi F12 Islamabad, Potohar region, Pakistan (Figure 1).

Figure 1: Raceway for brood stock management and larval rearing

2.3. Procurement of brood stock

10 to 15 pairs of brood stock were collected from the fish farm and 20 to 30 pairs from local fish farmers for each fish species. 2 raceways 5x30x3 ft. (W.L.D) stocked acclimatized for 5 days separately. Mature healthy single-tailed goldfish and koi carp brooders age of 2+ years (150-250g male/female and 800-1500g respectively), were selected by sexual dimorphism for breeding experiments. The brood fish were selected based on size, age and colour pattern. Females are usually easier to spot because the female goldfish and koi carp in breeding season will have a noticeably deeper body shape than a male fish also their bodies are filled with eggs.

While males in their breeding season, have breeding tubercles on the covers of their gills, and along the edge of their pectoral fins. Males breeding tubercles look similar to white pimples. The use of these tubercles is during the breeding time when the male nudges the female with its head and fins to encourage her to spawn. Males are more streamlined.

Goldfish and koi carp females are more brightly coloured than males. From the local fish market, 30 brood's pairs (35 males and 25 females) of both fishes were collected. These fishes were then carried to the fish farm within thirty minutes and retained in the raceways 10x10x3ft (W.L.D). Then the broods were released into the well-aerated raceways size 5x30x3 ft. (W.L.D), (dissolved oxygen (D.O) of 4.7-5.8 mg/l; Temperature: 18-22°C; pH: 7.2-7.4). These broods were kept 4 to 5 days here before introducing them into the raceways for spawning.

2.4. Preparation of brood stock

For brood stock preparation 30% crude protein diet composition shown in was used (Table-1). For 8 weeks both goldfish and koi carp were fed with an artificial diet to get the best quality brood stock. Continuous aeration was provided through air pumps. Their weight was recorded fortnightly with an electric balance.

Table-1: Composition and proximate analysis of diet containing 30% CP levels

Ingredients	Percentage Amount (%)
Fish meal	30.00
Soybean meal	10.00
Sunflower meal	5.00
Canola seed meal	5.00
Rice polishing	22.00
Gluten 30%	19.00
Wheat bran	5.00
Vitamin C	0.50
Vitamin premixes	1.50
Soybean oil	2.00
Total	100.00

3. Results

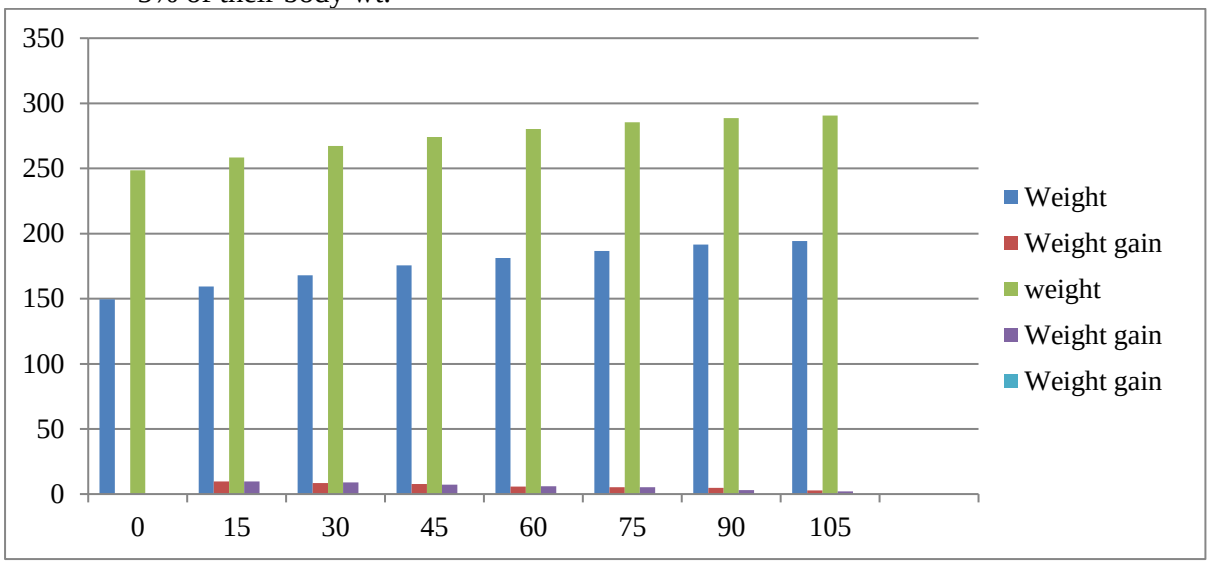
3.1. Brood stock management of single-tail goldfish

Brood stock of single-tail goldfish *Carrassius auratus* was prepared in three months from October 2019 to December 2019. During this duration, weight was measured every fortnightly and net gain in weight was measured by electric balance and recorded by using equation 1. The recorded values are mentioned in Figure 2.

Weight gain (g) =Initial weight (g) – Final weight (g) ……. (1)

Along with the weight gain sexual maturity was also observed fortnightly by observing their physical characteristics specific for breeders. Male and female ready for breeding can easily be distinguished by the female belly filled with eggs while it is ready for breeding and male having tubercles more prominent in its breeding season.

Figure 2: Wt. gains in single-tail goldfish in cemented raceways after feeding at 30% CP level at 5% of their body wt.

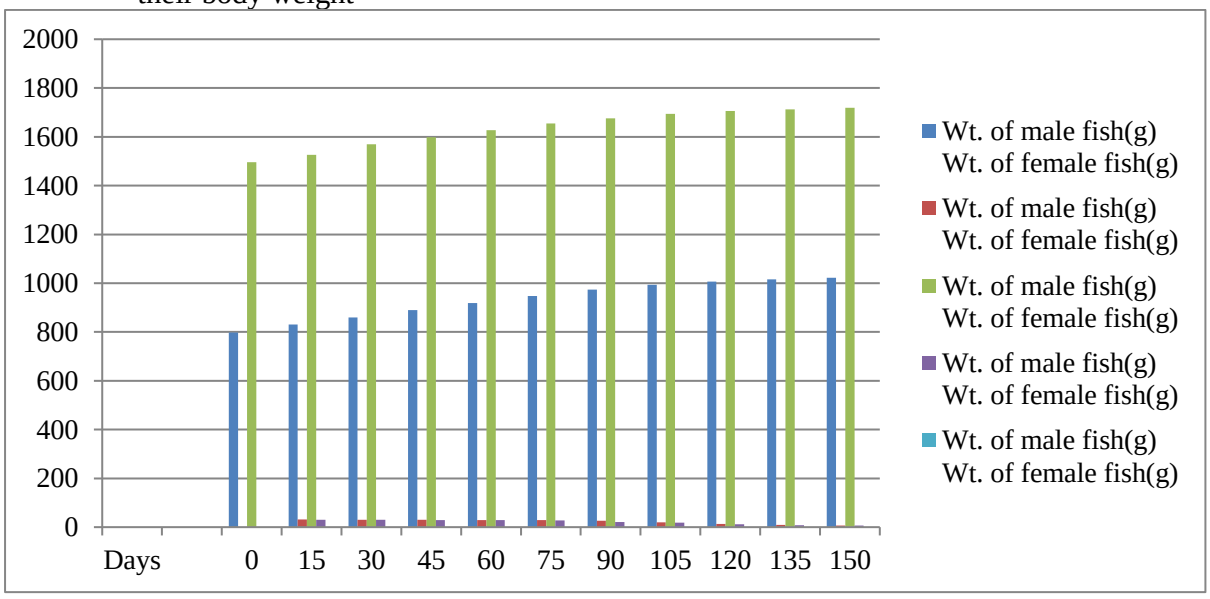


3.2. Brood stock management of fish koi carp

Brood stock of ornamental fish koi carp *Cyprinus carpio* was prepared in five months from October 2019 to February 2020. During this whole session weight was measured every fortnightly by electronic balance and net weight gain was recorded by using equation 1 (Figure 3).

Along with weight gain, sexual maturity was also observed fortnightly by observing their physical characteristics specific for breeders. Male and female ready for breeding can easily be distinguished by female belly filled with eggs, specific colouration and male having tubercle with body slimmer than female.

Figure 3: Weight gain in koi carp in cemented raceways after feeding with 30% CP level at 5% of their body weight



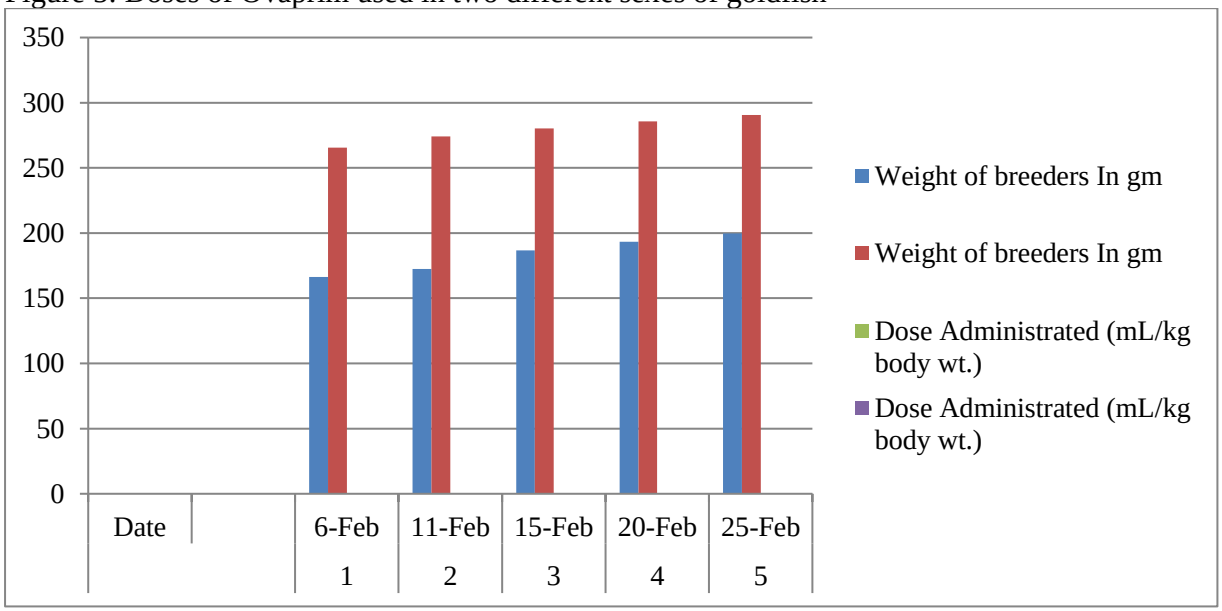
Along with weight gain sexual maturity was also observed fortnightly by observing their physical characteristics specific for breeders Figure 4.

Figure 4: (a) Goldfish and Koi Carp, and (b) Mature Goldfish *(Carrassius Auratus)*

3.3. Natural and induced breeding of goldfish

Goldfish was introduced with ratio of 2:3 females to male to the raceways. Natural breeding of goldfish was observed from 25 of January to 5th of February 2020. Most probably the best time for breeding is early morning at the time of sunrise between 7:00 to 8:00 am. Hydrilla plants were kept in the raceways for the hiding purpose and adhesion of eggs laid by fish. As these fish eat their own eggs so, eggs attached to Hydrilla plants were immediately transferred to the rearing raceways to get accurate results. Induced breeding activity of goldfish was performed from 6th February to 25th of February 2020 with the same sets of fishes selected for natural breeding. For induced breeding the brood stock was injected intra-peritoneally with (Ovaprim C) as per recommended dose of 0.5 ml/kg of weight for female and with 0.1ml/kg of concentration for male. The hormone was administrated at 2 pm (Figure 5).

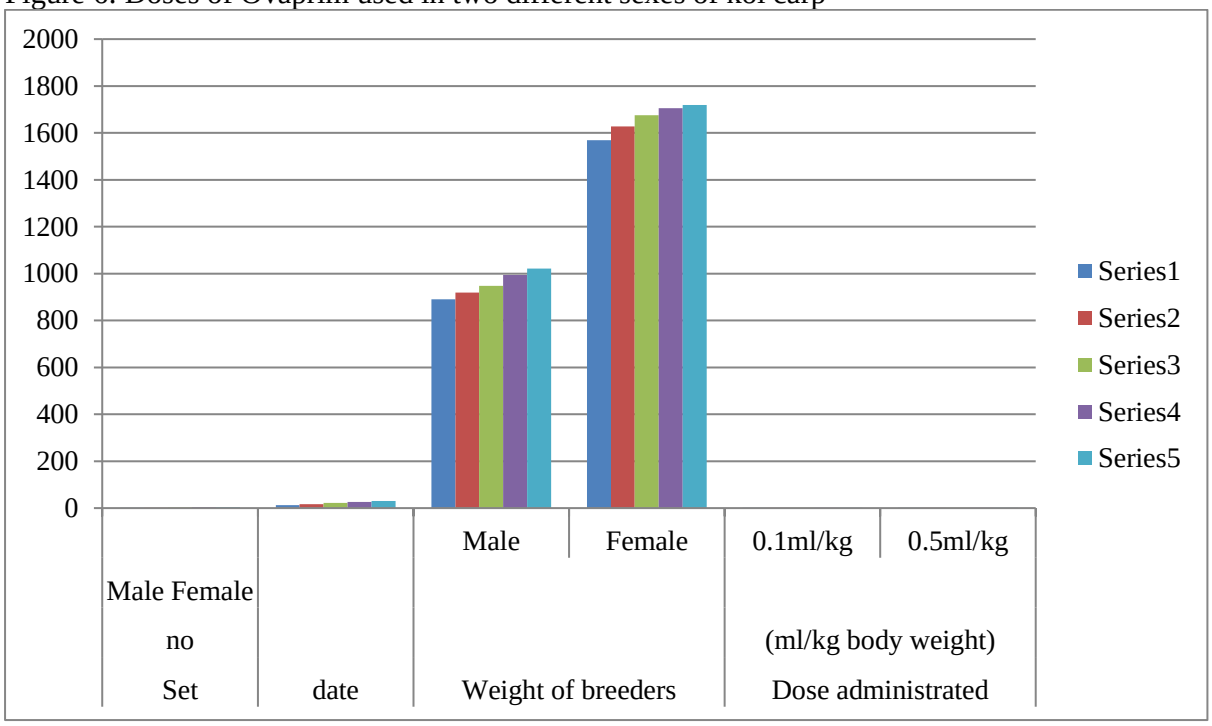
Figure 5: Doses of Ovaprim used in two different sexes of goldfish



3.4. Natural and induced breeding of koi carp

For breeding experiments mature healthy koi carp brooders (800-1500 g), in the ratio of 2:3 for females and males were selected by sexual dimorphism The time period of natural breeding was approximately from end of Feb to the 11th of March 2020. Koi fish generally prefer to spawn early in the morning but they may also spawn all over the day. Induced breeding of koi carp was done from 12th to 30th March 2020 with the same brood pairs used for natural breeding. For induced breeding the brood stock was injected intra-peritoneally with (Ovaprim C) as per recommended dose of 0.5 ml/kg of weight for females and with 0.1ml/kg of concentration for males. The hormone was administrated at 2 pm. Water quality parameters (D.O: 5.4-5.8 mg/l, pH: 7.2-7.4; temperature: 26-28°C) were maintained.

Figure 6: Doses of Ovaprim used in two different sexes of koi carp



3.5. Larval rearing of goldfish and koi carp

The freshly hatched larvae of goldfish were approximately 2024 in number while that of koi carp were approximately 2570. Both sets of the larvae hatched were kept in separate raceways. For the first four days, the larvae were nourished by yolk present in the yolk sac of both species. After complete yolk absorption larvae were started to feed with the boiled yolk egg till their 8th day. On the 9th day, both groups of the larvae were started to feed with a commercial feed of 30% crude protein in powdered form. Powdered form feed facilitated the engulfing and digestion process of the larvae and enhanced the feed consumption ratio. The time period for larval rearing was approximately one month for both groups of larvae. After one month the fertilization, hatching and survival rate were observed. Survival rate was observed by using equation 2 (Table-2 and 3).

$$\text{Rate of Survival (\%)} = \frac{\text{Number of fish larvae stay alive x 100}}{\text{Number of fish larvae brought into}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (2)$$

Table-2: Survival rate of goldfish

No of fishes	No eggs Layed	Fertilization (%)	Hatched eggs (%)	Survival (%)
90 (60 males and 30 females	4500-5000	74%	57%	40-43%

Table-3: Survival rate of koi carp

No. of fishes	No eggs Layed	Fertilization (%)	Hatched Eggs (%)	Survival (%)
90 (60males and 30 females)	17000-18000±20	74%	57%	43-47%

4. Discussion

Goldfish and koi carp have been one of the most demanding ornamental fishes by aquarium fish keepers all over the world, predominantly in tropical countries. Chinese, Korean and Japanese breeders have produced numerous varieties of these fishes available in the market today and are available at different commercial names in the fish market. With the enormous demand for goldfish both in national as well as international markets, the breeding of several varieties of goldfish and koi carp needs greater attention (Amin *et al*., 2015). The profession of ornamental fish rearing has the potential to boost the economic growth of concerned countries and the viable development of water resources but also has the capability of facing upcoming encounters regarding environmental and social problems (Pandey *et al*., 2017).

The ornamental fish trade is estimated to handle up to 1.5 billion fishes. Transportation and handling of fishes impose a range of stressors that can result in mortality at rates of up to 73%. These rates vary massively, however, and can be as little as 2%, because they are generally based on estimated data rather than on experimental based work. Given the numbers of ornamental fishes traded, any of the estimated mortality rates potentially sustain a significant economic losses and very serious welfare issues (Stevens *et al.*, 2017).

Artificial propagation is one of the most significant advancements in the field of aquaculture of commercially important ornamental fishes. The present study reveals the success in captive breeding and larval rearing of ornamental fish (*Carrassius auratus)* a single-tail goldfish and (*Cyprinus carpio)* koi carp in the Potohar region, Pakistan. The breeding process was conducted under natural and induced conditions. For induced breeding synthetic hormone Ovaprim C was used. Single dose of hormone was administrated to both of the species and their breeding response was observed and monitored. The survival rate of goldfish was 40-43% and that of koi carp was 43-47%. Synthetic food of 30% crude protein was given to both of the species.

According to Dey *et al.* (2014) these fishes eat their own eggs so, these eggs need to be removed and transferred to hatching raceways after every batch of spawning as soon as possible to avoid this auto egg-eating process. Also, this technique of in captive breeding and fish farming will save these species from extinction and help in the conservation of these fish species.

As for as an economic point of view is concerned this technique can be a helping hand in

increasing the gross income of the farmer and as a whole, a source of extra income for the people in this time of expense. The positive response to artificial breeding and the cost-effectiveness of the synthetic hormone to goldfish and koi carp breeding performance makes it potential to carry out the induced breeding of these species at a commercial scale (Mamun & Uddin, 2019).

5. Conclusion

It is concluded from the present study that ornamental fish culture can be successfully done in Pakistan with little expenditure and effort. In this study, natural and induce breeding of *Carassius auratus* (single-tail ornamental goldfish) and *Cyprinus carpio* (Koi carp) was studied. The synthetic hormone used for induced breeding was Ovaprim C acquired from the market was used to breed both of species in the cement tank under the captive condition in a suitable ratio. From the results, it is evident that induced breeding with Ovaprim C @ 0.5ml/Kg body wt. for female fish and 0.1ml/Kg body wt. for male fish shows tremendous breeding success of about 45%. The number of laid eggs and hatching rate for single-tail ornamental goldfish *Carassius auratus* were 4500-5000 and 43% respectively. While for the koi carp *Cyprinus carpio* the number of laid eggs and hatching rate were 17000-18000 and 44% respectively. It is clear from the experiment that synthetic hormones for induced breeding can be helpful for commercial breeders, and this can also be adopted as a small-level business in rural areas which can be proved helpful and a good step towards rural development and self-employment.

Declaration of conflict of interest

The author(s) declared no potential conflicts of interest(s) with respect to the research, authorship, and/or publication of this article.

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Ethics declaration

The ethics of the experimental animals were followed by the authors. The experimental protocol was approved by the Animal Ethics Committee of Abdul Wali Khan University, Mardan in 2019.

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References

Amin, M. R., Rahman, M. M., Aktar, S., Alam, M. B., & Alam, M. A. (2015). Induced breeding of Vietnames koi (Anabas testudineus) using pituitary gland (PG) and ovaprim at Tasty Fish and Feeds Industries Limited, Melandah, Jamalpur. *Asian Journal of Medical and Biological Research*, *1*(3), 607-611. https://doi.org/10.3329/ajmbr.v1i3.26484

Dey, S., Ramanujam, S. N., & Mahapatra, B. K. (2014). Breeding and development of ornamental hill stream fish Devario aequipinnatus (McClelland) in captivity. *International Journal of Fisheries and Aquatic Studies*, *1*(4), 01-07.

Mahadevi, S. F., Antony, C., Bhosale, M. M., Gopalakannan, A., & Gnanavel, K. (2018). Induced breeding of telescopic eye goldfish (Carassius auratus) using synthetic hormone (WOVA-FH). *Journal of Entomology and Zoology Studies*, *6*(3), 1368-1373.

Malik, A., Abbasi, A. R., Kalhoro, I. B., Shah, S. A., Narejo, N. T., & Kalhoro, H. (2014). Effect of Ovaprim Hormone (Syndel Laboratory, Canada) on Spawning of Koi Carp at Fish Hatchery Chilya Thatta, Sindh, Pakistan. *Sindh University Research Journal-SURJ (Science Series)*, *46*(3), 273-276.

Mamun, M., & Uddin, M. (2019). *Effects of Ovulin Hormone on breeding performance of Oranda Goldfish (Carassius).* Doctoral Dissertation, Chattogram Veterinary & Animal Sciences University. http://dspace.cvasu.ac.bd/handle/123456789/821

Pandey, P. K., & Mandal, S. C. (2017, May). Present status, challenges and scope of ornamental fish trade in India. In *Conference: Aqua Aquaria India, At Mangalore*, 1-10.

Podlesnykh, A. V., Brykov, V. A., & Skurikhina, L. A. (2015). Polyphyletic origin of ornamental goldfish. *Food and Nutrition Sciences*, *6*(11), 1005. http://www.scirp.org/journal/PaperInformation.aspx?PaperID=58907&#abstract

Stevens, C. H., Croft, D. P., Paull, G. C., & Tyler, C. R. (2017). Stress and welfare in ornamental fishes: what can be learned from aquaculture? *Journal of Fish Biology*, *91*(2), 409-428. https://doi.org/10.1111/jfb.13377

Szabó, T., Urbányi, B., Müller, T., Szabó, R., & Horváth, L. (2019). Assessment of induced breeding of major Chinese carps at a large-scale hatchery in Hungary. *Aquaculture Reports*, *14*, 100193. https://doi.org/10.1016/j.aqrep.2019.100193

Usman, I., Auta, J., & Abdullahi, S. A. (2015). Effect of monthly variation in water temperature on artificial breeding of common carp (Cyprinus carpio L.) in Zaria, Nigeria. *International Journal of Fisheries and Aquatic Studies, 3,* 353-356. https://www.fisheriesjournal.com/archives/2015/vol3issue2/PartE/3-2-46.pdf