The effect of feed larvae *Chironomus* sp. and high pellet protein to seedling goldfish (*Carassius auratus*)

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Abstract: Goldfish production increase in four years, specifically 66,823,000 in 2010 to 72,997,000 in 2014. The increment of goldfish production growth altogether with problems which is a discontinuity of fry stock. The solution for this problem is the purpose of this study, which is understood techniques in Goldfish (*Carassius auratus*) hatchery. The feed given to goldfish brood is blood worms (*Chironomus* sp. larvae) and pellets with a ratio of 50:50 as much as 3% of the biomass. Goldfish hatchery techniques involve broodstock cultivation, spawning techniques, larval development observation, and larval cultivation. Two kinds of Goldfish used, namely Oranda and Mutiara Goldfish. The results of Oranda goldfish spawning and Mutiara goldfish spawning consecutively are Fecundity 875 eggs, FR 94%, HR 91.83%, SR 93.04% and Fecundity 3850 eggs, FR 93.66%, HR 92.48%, and SR 91.10%. Larval development observation includes embryogenesis until post-hatched larval. Larval cultivation consists of giving various types of feeds, which are artemia nauplii (for 3-7 days old larval), Moina (for 7-14 days old larval), and blood worm or tubifex (> 14 days old larval). Fertilized goldfish eggs will develop through several phases, including zygotes, initial cleavage, blastula, gastrula, segmentation, pharyngula, egg hatching, and development of larvae after hatching.

1. Introduction

One of the most popular fisheries commodities in Indonesia is ornamental fish. KKP statistical data in 2015 showed that there was a rapid increase in the number of ornamental fish production, from 605,502,000 heads in 2010 to 1,140,318,000 tails in 2014. The ornamental fish commodity that was in great demand was goldfish (*Carassius auratus*). Goldfish are the dominant commodity in ornamental fish production in Indonesia after Koi and Betta fish. The production of Goldfish is known to be 66,823,000 heads in 2010 to 72,997,000 in 2014 [1].

Increased production of goldfish is caused by a relatively uncomplicated cultivation process and a short spawning cycle (one to one and a half months) so that within one year can be done six to eight times the spawning. Goldfish also have a high economic value. Goldfish farming also has shortcomings besides a rapid increase in production. The disadvantage of Goldfish cultivation is in the hatchery activities, which are not optimal spawning due to the failure of gonad mature parent preparation and the availability of seed that is not continuous [2]. Discontinuity of seed stocks can be caused due to the failure not maximum spawning broodstock preparation of mature gonads. Failure in the seeding activity can be due to a lack of understanding surrounding farmers seeding technique of goldfish. The solution to these problems is to study the effect of feeding larvae *Chironomus* sp. and high protein pellets to the hatchery goldfish (*Carassius auratus*)
2. Material and methods

The method used is an experimental method by collecting data that is data aquarium construction, engineering maintenance of the broodstock, the broodstock selection techniques, types, and frequency of feed given, spawning techniques, the data embryogenesis, and larval rearing techniques and seeds.

2.1. Rearing condition for broodstock

Aquarium maintenance of aircraft used to measure a size of 80 x 40 x 40 cm$^3$ with water 25 cm high. Preparation aquarium aircraft maintenance includes cleaning the aquarium walls, installation of filters dacron, replenishment of water and the provision of aeration. Cleaning is done by rubbing the aquarium wall using sandpaper. Cleaning aquarium walls aim at eliminating water snails, insects, and algae attached. Giving Dacron filter made after the wall aquarium cleaning. Charging is done by using a hose of water flowing from the reservoir basin until the water reaches a height of 25 cm.

Aircraft maintenance aquarium is clean and filled with water mains included with a maximum density of 10-15 broodstock / m$^2$ aquarium. Aquarium of female and male broodstock separated to avoid spawning during maintenance [3].

2.2. Broodstock feeding

Broodstock goldfish were fed with a frequency of twice a day, morning and evening. The feed given to the broodstock goldfish is blood worms (larvae *Chironomus* sp.) Also, pelleted by a ratio of 50:50. The feed was given 3% of the total biomass. Feed with a dose of 3% referred to a study [4], which states the feed at a dose of 3% resulted in a high level of protein digestibility up to 90%. High protein plays a role ripen on the broodstock fish gonads [5].

| Type Broodstock          | Total Biomass (G) | Dosage Feed 3% (Grams) |
|--------------------------|-------------------|------------------------|
| Mas chef Oranda Males    | 326               | 9.78                   |
| Mas chef Oranda Betina   | 536               | 16                     |
| Mas chef Pearl Males     | 276               | 8.28                   |
| Mas chef Pearl Betina    | 414               | 12.42                  |

Larvae *Chironomus* sp. has a high protein content that is appropriate for the needs of the broodstock feed goldfish. Here are the proximate content of larvae *Chironomus* sp.

| Proximate womb          | Content (%) |
|-------------------------|-------------|
| Protein                 | 62.5        |
| Fat                     | 10.4        |
| Water content           | 11.6        |

Without Ekstak materials Nitrogen (BETN) 15.5

Source: [6]

The feed given in addition to natural feed is pelleted. The pelleted feed is given to the broodstock goldfish as a side feed to save on expenses as well as meet the nutritional needs of fish in addition to protein. Here are the proximate content of pellets:

| Proximate womb | Content (%) |
|----------------|-------------|
| protein        | 39-42       |
| Fat            | 5           |
| Crude fiber    | 6           |
| Ash            | 16          |
| Water content  | 10          |
2.3. Broodstock selection

Broodstock selected in advance for separating ripe stem gonads with immature stem gonads. Broodstock goldfish males and females have mature gonads can be seen physically. Here are the characteristics of the broodstock goldfish males and females have mature gonads

| Table 4. Characteristics of broodstock goldfish male and female mature gonads |
|-----------------|-----------------|
| Male            | Female          |
| Are relatively smaller than females | Relatively larger size than males |
| Hard abdomen when pressed | Flabby abdomen when pressed |
| Pectoral fins rough | Smooth pectoral fins |
| When in-stripping of the abdomen will discharge sperm | When in-stripping of the abdomen will come out of eggs |

Source: [7]

Figure 1. Comparison of Broodstock Size Goldfish Oranda; Males (a) and females (b)

Figure 2. Comparison of size Broodstock Goldfish chef Pearl; Males (a) and females (b)

2.4. Spawning

A. Preparation spawning aquarium

Goldfish spawning aquarium measuring 80 x 80 x 40 cm³ with a height of 25 cm water. Aquariums are used by the two, one is used for spawning inter aquarium goldfish Oranda, and the other is used for spawning aquarium goldfish among pearls. Preparation includes cleaning the aquarium spawning aquarium, water replenishment, providing aeration, laying the substrate, and the installation of mains. Aquarium cleaning aims to eliminate water snails and moss that grows on the wall of the aquarium. Replenishing water to a height of 25 cm and the provision of aeration is done after the aquarium clean. Laying on a substrate made after the spawning aquarium filled with water. Laying the substrate serves as a point of attachment of the egg goldfish that is adhesive [8]. The substrate can prevent the buildup of eggs in the aquarium. Stacking eggs can result in eggs squeezed, so that egg mortality is high.

The substrate used in the form of fibers is placed in the bottom of the aquarium. [2] adds that the substrate can be used for spawning goldfish apart the fibers are hyacinth and raffia. Ijuk selected as the substrate at a goldfish spawning eggs are sticky because of the opportunities at the higher-seeded fibers than in raffia and hyacinth. This is caused by inter-roofed large enough so that the sperm is not
challenged by the substrate to fertilize an egg, while the hyacinth rope and stable enough so that the sperm gets to fertilize eggs barriers. The barriers in question are when the sperm released by the male broodstock; then the sperm will move to look for eggs due to boost sperm tail. The substrate inhibits sperm movement is too dense to be at risk of dying before they could fertilize an egg. Both aquarium that has come with the substrate can be included each broodstock goldfish with a ratio of 2 males: 1 female then given aeration.

B. Spawning process
Spawning goldfish in Depok BRBIH done twice, the first spawning fish and spawning goldfish Oranda goldfish second with pearls with a ratio of each two males: one female. According to [9], the number of male broodstock at a better pool, more than one order of eggs spawning female fish can still be fertilized if one of the male broodstock can not fertilize an egg.

Fertilization of goldfish takes place externally. According to [10], a habit of spawning fish are males actively pursue females and females bring to the substrate that has been cleaned male fish. The female fish will lay eggs on the substrate, and then the male fish release sperm to fertilize an egg that has a sticky substrate. Fish that have been spawned eggs can be marked by images on the substrate and the water bubbling and murky [11].

Fertilization rate calculation performed after the completion of the calculation of the fecundity. Percentage fertilization rate can be calculated by knowing the number of eggs fertilized by the number of eggs a total of fecundity. According to [12] calculation of the fertilization rate is as follows

\[
FR = \frac{\text{Number of fertilized eggs}}{\text{The total number of eggs}} \times 100\%
\]

Information
FR: fertilization rate (%)

Calculation fertilization is done by the sampling rate of 100 eggs on a bowl diameter of 26 cm and 10 cm of water from the spawning pond and can be done more than three times of repetition. According to [3], results from one spawning fertilization rate is the average of several replications fertilization rate with the following formula

\[
\Sigma_{i=1}^{n} FR = \frac{FR1+FR2+...+FRn}{n}
\]

Information:
\[\Sigma FR: \text{Average of several replications fertilization rate}\]
\[n: \text{Number of replications fertilization rate}\]

Total egg fertilized if numbering in the thousands can be seen without having to perform calculations one by one by using the following formula.

The number of fertilized egg = \(\frac{\text{Fecunditas}}{100}\) x FR (average - average)

Information
FR (average): Average fertilization Rate (%) Of multiple replications

Eggs that hatch is left attached to the substrate. The substrate is removed from media if larvae have not a sticky substrate or spread on the bottom of the aquarium [13]. Calculation of hatching according [14] is as follows

\[
HR = X 100\% \times \frac{\text{The number of eggs that hatch}}{\text{Number of fertilized eggs}}
\]

Information:
HR: Hatching Rate
Hatching rate calculation was done one day after the eggs hatched by sampling 100 eggs with some replicates used for the calculation of fertilization rate. According to [3], results from one spawning hatching rate is the average hatching rate of several replicates. The formula of the average hatching rate of several replications are as follows:

$$\sum_{i=1}^{n} HR \frac{HR_1 + HR_2 + ... + HR_n}{n}$$

Information:
ΣHR: Average of several replications hatching rate
n: Number of replications hatching rate

Total eggs hatch when numbering in the thousands can be seen without having to perform calculations one by one by using the following formula:

$$\text{Number of Eggs hatch} = \frac{Tt}{100} \times \text{HR (average - average)}$$

Information
Tt: The total number of fertilized eggs
HR (average): Average Hatching Rate (%) Of all three basins

The calculation of life sustainability is displayed below, as follow:

$$\text{SR} = \frac{N_t}{N_o} \times 100\%$$

Notes:
SR: Survival Rate (%)
Nt: The number of an animal test at the end of the experiment (unit)
No: The number of an animal test at the beginning of the experiment (unit)

3. Result and discussion

3.1. Type Goldfish

Goldfish pearl is the result of a mutation of Japanese Fantail Goldfish (Ryukin) which contained a whitish color in the form of calcium carbonate deposits at the central part of the scales. Goldfish pearl has a characteristic rounded body with scales resembling pearls.

Goldfish Oranda is the result of the hybridization of Goldfish Lionhead with an additional organ on its head with Ryukin Goldfish. Goldfish Oranda has a characteristic roundness of the body with additional organs that grow on the dorsal side of his head.

![Image](a) ![Image](b)

**Figure 3.** Type Goldfish chef; Goldfish Pearl (a) and Goldfish Oranda (b)

3.2. Maintenance broodstock

Aquarium maintenance begins with the preparation of the broodstock. Preparation broodstock aquarium maintenance (size 80 x 40 x 40 cm³) includes cleaning aquarium walls, installation of filters dacron, replenishment of water, and the provision of aeration. Aircraft maintenance aquarium is clean and filled with water mains included with a maximum density of 10-15 broodstock / m² aquarium.
Aquarium of female and male broodstock separated to avoid spawning during maintenance [3]. The feed given to the broodstock Goldfish are blood worms (larvae *Chironomus* sp.) Also, pellets with a 50:50 ratio as much as 3% of the biomass. [4] state feed at a dose of 3% resulted in a high level of protein digestibility up to 90%. High protein plays a role ripen on the broodstock fish gonads [5].

3.3. Spawning

The spawning process begins with the preparation of spawning aquarium. Aquariums are used by the two, one is used for spawning aquarium between Oranda Goldfish, and the other is used for spawning aquarium between Goldfish pearls. Preparation spawning aquarium (size 80 x 80 x 40 cm3) includes cleaning the aquarium, water replenishment, providing aeration, laying the substrate, and the installation of mains. The substrate used in the form of fibers is placed in the bottom of the aquarium. [2] adds that the substrate can be used for spawning Goldfish apart the fibers are hyacinth and raffia. Ijuk selected as a substrate on breeding Goldfish for opportunities on the sticky eggs fertilized fibers is higher than in raffia and hyacinth.

Both aquarium which has been equipped with the substrate can be included each broodstock goldfish. Goldfish selected broodstock is the broodstock who ripe gonads with the following characteristics. Broodstock stocking density in each aquarium was two males: one female. Fish that have been spawned eggs can be marked by images on the substrate and the water bubbling and murky [11].

3.4. Fecundity, Fertilization Rate, Hatching Rate, and Survival Rate

Factors can cause fecundity differences in the two types of Goldfish as size, age, and the food given to the fish [15]. Goldfish pearls are cultivated known to have a larger body size than Oranda Goldfish. Goldfish heavy pearl reached 68.35 grams, while the weight of spawning Goldfish Oranda which only reached 52 grams. Oranda Goldfish were spawning seven months old and was first cultivated so that the cause of the low fecundity produced, while the pearls are cultivated Goldfish age reaches one year and has cultivated two or three times.

| Type   | Broodstock      | Fecundity | Fertilization Rate (%) | Hatching Rate (%) | Larvae Survival Rate (%) |
|--------|-----------------|-----------|------------------------|------------------|-------------------------|
| Goldfish Oranda | 875             | 94        | 91.83                  | 93.04            |
| Pearl Goldfish  | 3850            | 93.66     | 92.48                  | 91.10            |

Fertilization rate high on both spawnings is affected by the number of spawning males, as more and more males are cultivated with the female, the more eggs of females are fertilized by the male [13]. Fertilization rate also affected the quality of sperm from a male sperm cell that includes, the number of spermatozoa released, and sperm motility. Quality determined sperm from the male fish gonad maturity. The males are getting enough nutrients in their feed gonad will be more mature and better quality sperm [16].

Hatching rate high on both spawnings is influenced by several factors, among them the percentage of fertilization, the egg yolk volume, and environmental factors. The fertilization factor is determined by how many eggs can be fertilized by sperm. The eggs are fertilized by sperm the higher power. Factors affecting the volume of egg yolk of an egg hatchability, because the only energy source of embryos in the eggs to hatch is of yolk [17]. Environmental factors also play an important role in improving the hatching. A high-oxygen water environment will facilitate the growth of the embryo in the egg [2]. The temperature on the aquatic environment can also affect hatchability of eggs because higher temperature water, the faster the hatchability of eggs [18]. The optimal water quality influences a high survival rate for maintenance and the need for adequate food.

3.5. Development of goldfish larvae

Goldfish eggs that have been fertilized will develop through several phases, of which the zygote, early cleavage, blastula, gastrula, segmentation, pharyngula, hatching eggs and development of larvae after hatching [19]. Goldfish eggs observation table at the start of the phase of blastula (Figure A - B). Blastula phase characterized by clumps of cell division on the outside of the yolk will become a
candidate for the head of the larvae and organ growth blastodisc. Blastula phase followed by a phase characterized gastrula epiboly occurrence or spread movements embryonic ectoderm layer. Body larvae begin to look at epiboly 95% that would be heads and tails of lava began to grow as well as the boundary between the larvae and egg yolks begin to look [20].

**Table 6. Larvae goldfish**

| Picture | Phase | Picture | Phase | Picture | Phase |
|---------|-------|---------|-------|---------|-------|
| (A) 128-Cell | (G) 18 Somite Stage | (M) Hatches |
| (B) 512-Cell | (H) 22 Somite Stage | (N) 1 Hour After Hatching |
| (C) 45% Epiboly | (I) 25% OVC | (O) 1 Day After Hatching |
| (D) 85% Epiboly | (J) 35% OVC | (P) 3Days After Hatching |
| (E) 95% Epiboly | (K) 65% OVC | (Q) 7hari After Hatching |
| (F) Bud | (L) Just Before Hatching | (R) 14hari After Hatching |

The next phase is the phase that began interchangeable Bud head and larvae as well as the beginning of a phase of segmentation or larval organ development. The growth marks the segmentation phase and increases the number of somites. Phase segmentation in the table can be seen in the image GH. Somite development of 18 - somite to 22 - somite takes about 2 hours per somite. Notochord on larvae also began to look at the segmentation phase. Pharyngula phase is the final phase.
of segmentation that is perfecting the organ of the embryo goldfish. Phase pharyngula table can be seen in Figure I - K. The identification phase is called Otic vesicle pharyngula Closure (OVC). OVC 25% is characterized by the appearance of pigmentation of the retina, and the fish will grow pectoral fins.

Phase hatching eggs occurred 2 days after the fertilized egg in which the organ of the embryo is already highly developed. Phase hatching eggs on the table can be seen in the image LM. Newly hatched larvae still have yolk in large quantities (Figure N), and the yolks begin to decrease on a 3-day-old larva (Figure C). 7-day-old larvae (Figure Q) had been developed in the form of growing organs swim bladder, gastrointestinal tract start complete, and the growth of the dorsal and caudal fins [21]. 14-day-old larvae (Figure R) have had a complete organ that resembles the broodstock so it can be said to be the seed.

3.6. Maintenance larvae goldfish koki
Goldfish can be kept in an aquarium-sized 100 x 40 x 30 cm3 with a height of 10 cm of water. The stocking density of larvae in aquariums is 30 larvae per liter. Flyblow does with acclimation, which aims to reduce the level of stress [22]. The natural feed is a good feed for larval development because it is optimum in larval digestion and has a high nutrient content [23] [24] [25] [26] [27] [28]. Natural feeding on larvae when age Goldfish reached three days, in order to familiarize Goldfish with natural feed to prevent fish mortality due to the yolk is exhausted when entering the age of five days [2]. Larvae aged three to seven days may be given Artemia nauplii. Artemia nauplii have a size corresponding to the larval mouth opening making it suitable as initial feeding the larvae and give effect to the initial performance enzymes trypsin and amylase in the digestive tract of larvae [29].

Larvae can begin seven days granted Moina. They are giving Moina done until the larvae reach the age of 14 days. Artemia nauplii feeding frequency and Moina sp. is three times a day (morning, afternoon, and evening) ad libitum. Goldfish was 14 days can be considered as the seed because it has a complete organ that resembles the broodstock. This is following the statement [30] is generally larval fish has a perfect organ as its broodstock may be regarded as juveniles or seed. Goldfish seed over the age of 14 days given pelleted feed, powder, natural food such as silkworms (Tubifex sp.) Or blood worms (larvae Chironomus sp.). Silkworms and blood worms are given as natural food for Goldfish seed because it contains protein which is higher than Moina. Silkworm contains protein by 52, 49% [31], blood worms containing protein 62.5% [32], while Moina contain around 50% protein [33]. High protein needed for the seed grow to maximum, because protein required for the formation, growth, and development of the network as well as serve as a source of energy [34]. Goldfish seed feeding frequency is twice a day, morning and evening ad libitum.

4. Conclusion
Goldfish seeding techniques include maintenance, spawning (spawning and spawning an inter Goldfish Oranda Goldfish pearls), to the larval rearing. Oranda Goldfish fecundity (875 eggs) were lower than the fecundity of pearl Goldfish (3850 eggs). Goldfish Oranda has a 94% FR, HR 91.83%, 93.33%, and Goldfish SR pearl has FR 93.66%, 92.48% HR, SR 91.10%. The development of larvae of Goldfish includes embryogenesis from fertilized eggs to hatch and post-hatch larvae organ development and maintenance of larvae with Artemia nauplii feeding (3-7 days), Moina (7-14 days), and blood worms or worm tubifex (above 14 days).

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