Biological aspects of *Pangasius hypopthalmus* reared under controlled photoperiod

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**Abstract.** A study aims to understand the effects of photoperiod manipulation on the biological aspects of *Pangasius hypopthalmus* was conducted in June 2019. There were 3 treatments applied, namely control (natural light); 24 hours dark (24D) and 18 hours dark (18D). The treated fishes were reared in tarp ponds (75 x 50 x 60 cm) and kept under dark blue plastic tents 24 hours (24D) and 18 hours (18D) continuously. There were 20 fishes/tank and they were fed on commercial fish feed 2 times/day, 5% of total fish body weight. Data on fish growth were collected 3 times, just before the treatment, in the 2nd and 4th weeks after the photoperiod treatment. Data on the fish behavior were collected during the 2nd week, by monitoring fish behavior hourly for 72 hours continuously. Data on blood condition were collected from the fish 2 times, before the treatment and in the 4th week. Results indicates that the 24D provided the best results in fish growth, by the 4th week, the fish TL value was 123.5 mm and BW was 5.6 gr. The blood condition of fish in all treatments were normal and there was not significantly difference, with hematocrit value was 30%, 1.5% of leucocrite levels, 70% of lymphocyte and 30% of other leucocyte types. The shortened photoperiod duration positively affects the growth of *P. hypopthalmus* growth, but it does not affect the biological aspect of the fish in general.

**1. Introduction**

*Pangasius hypopthalmus* or “patin” fish has relatively high economic value and it serves as main ingredient for several Riau’s traditional cooking. The demand of *P. hypopthalmus* is fulfilled mainly by cultured fish [16]. In fish culture, however, the highest cost is allocated for fish feed [14]. The longer fish culture period, more feed needed as a consequence, more money spent for fish feed. To increase the effectiveness of fish culture, a technique needed in order to shorten the culture duration as well as to reduce the cost spent for fish feed.

One of the simple, low-cost techniques that may be used to obtain faster growth during the intense production of *P. hypopthalmus* juveniles is photoperiod manipulation. Photoperiodism is one of the physical factors that are known to increase the growth and survival of fish it may affects the behavior and gonad maturation in fish [2, 9, 12, 13].

Results of several studies shown that the photoperiod manipulation affect the growth of fish. In nocturnal fish such as *Clarias gariepinus* ([13]. While *Ompok hypopthalmus* reared in 24 hour darkness provided best results in growth [18]. The minimum photoperiod increase the aggressiveness of fish in feeding. The high growth increase recorded in the 24 hours dark was attributed to better food conversion efficiency and the suppression of swimming activity, aggression, and stress in the
dark. All these enabled more energy to be converted to body weight. In contrast, the exposure of C. gariepinus under continuous light causing low growth rate [13]. The continuous illumination may increase locomotory activities on the fish. This made them expend energy which could have otherwise been used for growth. The increased locomotory activities brought about stress, aggression, and cannibalistic behavior among the fish population in the tank, all of which consume energy. The diurnal fish Oncorynchus mykiss [5] that are reared under longer light period shown the best growth and the best Food Consumption Rate (FCR). Growth rate increment was also shown by Oreochromis aureus that are reared under a 12 hours photoperiod [1]

In fish culture, the photoperiod manipulation can be categorized as “natural method”. It is cheap as there is no veterinary medicines needed, environmental friendly and it is very effective for certain species. The effect of photoperiod manipulation on biological aspects of P. hypophthalmus has never been reported. As the lighting systems should take into account the biological sensitivities of the species, it may be difficult to determine the optimum photoperiod regime for specific species, including P. hypophthalmus. To understand the effects of manipulated photoperiod on P. hypophthalmus biological aspects and behavior, this study is need to be conducted. By conducting this study, the sensitivity of P. hypophthalmus toward the shortened photoperiod might be obtained and the results may be used as a basis for designing the effective, healthy and environmental friendly P. hypophthalmus culture.

2. Materials and Methods
This study was conducted from May 2019, in the Fishery and Marine Science Faculty, Riau University, Pekanbaru. There were 3 treatments and 3 replication tanks /treatment, namely:
• Natural : Under natural photoperiod
• 18D6L : 18 hour dark and 6 hours light
• 24D : 24 hours dark

The fish were reared in the tarp ponds tanks (75 x 50 x 60 cm), filled with water and completed with circulating the water. The tanks were put out door, under natural photoperiod. The control ponds were covered with transparent plastic, while the treated ponds were covered with dark blue plastic. In the 24D treatment, the ponds were covered continuously, while the cover of 18D6L ponds were removed for 6 hours/ day, from 07.00 am to 01.00 pm (Figure 1).

The fish used in this study was juveniles of P. hypophthalmus, around 8 cm total length and 2.8 grams body weight. Fifteen fishes (females and males) were kept in each tank. The fish was feed on commercial fish feed pellets 3 times/ day (morning, noon and evening), 5% of total fish body weight.
Before being monitored for biological aspects and behavior study, the fish was adapted to fish feed and research site environment for 3 days.

Parameters of biological aspects monitored were Total Length, Body Weight, and blood condition including the hematocrit and leucocrit levels, the percentage of lymphocyte and other types of leucocyte cells. Fish samplings were conducted 3 times, prior to the treatment, and in the 2nd and 4th week of experiment. Fish behavior was monitored hourly for 72 hours continuously. By using a torch that was covered by dark colored cloth to reduce the light intensity, the fish behavior was studied. The fish behavior was scored, as follow:

Table 1. Score of fish behavior

| Score | Swimming activity | Swimming position | Schooling activity | Response to food          |
|-------|-------------------|-------------------|--------------------|--------------------------|
| 1     | No special pattern, fins moving slowly | In the bottom of the pond | No schooling (distributed well) | Not aggressive in taking the food |
| 2     | Facing the water drops, fins moving slowly | In the middle area of the water | Forming 2 or more groups | Aggressive in taking the food |
| 3     | Facing the water drops, fins actively moving | In the water surface | Forming 1 schooling group | Very aggressive in taking the food |

Based on the hourly activities scores, the fish behavior pattern during a day period was then described and analyzed in order to understand the effect of controlled photoperiod in *P. hypopthalmus* behavior.

3. Results and Discussion

In this study, *Pangasius hypopthalmus* were kept in the pond that were completed with circulated water. As *P. hypopthalmus* used to live in the stream with running water, water tank that is completed with circulating water serve as a proper place for the fish.

*P. hypopthalmus* that were reared under different photoperiod grew differently. Figure 2 shown that the 24 hours dark provided the best results. By the end of the experiments, the fish size was 123.5 mm TL and 5.6 gr BW. While those of other treatments were 116.8 mm TL and 5.3 gr BW in 18D treatment and 101.3 mm TL and 5.0 gr BW in control. Similar results were also obtained in *P. hypopthalmus* fingerlings reared in continuous darkness that grow better than fingerlings reared under longer photoperiod [16]. Another catfish such as *Clarias gariepinus* [10] and *Ompok hypopthalmus* [18] growing best under short photoperiod, 18 hours dark and 24 hours dark respectively. As a nocturnal fish, dark condition may improve the feeding ability of the fish and as a result the growth of the fish is increase. The swimming activities of fish reared in the dark was less than fish reared in other treatment. As a consequence, energy allocated for swimming was low and it can be used for growing.

Study on blood condition of blood of the fish, however showing no difference (Table 2). The blood was in normal condition. In all fish, the hematocrit level was around 30% and the leucocrit level was around 1.5%. The hematocrit level indicates that the fish was healthy and well fed. As well as the hematocrit level, low leucocrit level also indicates that the fish was not infected by pathogen microorganism. The health of the fish was also shown by high amount of lymphocyte, it was around 70% of total white blood cells. Other white blood cells, including monocyte, thrombocyte and eosinophil was only 30 %. In the healthy fish, the amount of lymphocyte was around 70% [7]. The lymphocyte amount in the treated fish in this research indicates that changing in photoperiod do not affect fish health and fish blood condition in general.
Figure 2. Growth and body weight of *P. hypopthalmus* reared under controlled photoperiod

| Treatments | Hematocrit level (%) | Leucocrit level (%) | Lymphocyte (%) | Monocyte (%) | Thrombocyte (%) |
|------------|----------------------|---------------------|----------------|--------------|------------------|
| Natural (Control) | 28.67% | 2.02% | 67% | 33% | 0% |
| 18D6L | 32.76% | 1.90% | 70% | 30% | 0% |
| 24D | 28.67% | 2.02% | 67% | 33% | 0% |

*P. hypopthalmus* that were reared under different photoperiod showing various behavior. It seems that different photoperiod affects the fish behavior in swimming, schooling, response to light and also response to feed provided. The fish response to photoperiod manipulation indicates that the photoperiod length directly affects the fish physiology. Results of other research also proved that photoperiod affects fish behavior [11, 17]. Besides the behavior, photoperiod also affects fish feeding habit [4] and reproduction [6]. Photoperiod is the principal proximate cues in many fish and that is entrains endogenous rhythm which is in turn control reproduction [2]. The behavior of *P. hypopthalmus* that were reared under different photoperiod is presented in Table 2.

Table 3. Behavior of *P. hypopthalmus* reared under different photoperiod

| No | Treatments | Swimming | Fish position | Schooling activity | Response to feed |
|----|------------|----------|---------------|-------------------|-----------------|
| 1  | 24D        | No special pattern in swimming direction, fins slowly moving | In the water surface, almost never in the bottom of the tank | No schooling, distribute evenly | Very aggressive, catch the feed given quickly, almost no feed remains |
| 2  | 18D6L      | Mostly facing the water drops, fins slowly moving | In the middle-water surface, almost never in the bottom area | Divided into 2 or more groups | Aggressive in catching the feed, but not as fast as fish reared in the continuous dark, few feed remain |
| 3  | Natural    | Always facing the water drops, fins actively moving | In the bottom | Divided into 2 or more groups | The fish react positively to feed, but they were not aggressive, many feed remain |
The behavior of *P. hypophthalmus* in this research is strongly affected by the photoperiods. In swimming activity, it is clear that there is an impact of photoperiod in swimming pattern. Fish in all experiment units, except the fish reared under continuous dark showing a positive rheotactic behavior. The fish commonly stay under water drops and the fins are moving actively. The fish reared in continuous dark, however, did not show any special pattern in swimming nor rheotactic behavior. The fish did not facing the water current and the movement of the fins are slow. These fishes mostly stay in the water surface and almost never settle in the bottom. In contrast, the fish that were reared in natural photoperiod tend to be more active swimming, moved their fins actively and stay in the pond’s bottom.

The swimming behavior of *P. hypophthalmus* in this research may be related to its natural behavior. As *P. hypophthalmus* is a nocturnal fish that is active at night, the presence of light reduce the activity of the fish in general. Fish behavior is affected by its biological clock. In nocturnal fish, the light exert a negative masking effect and thus inhibit their daily activities such as feeding and foraging [8]. In diurnal fish such as Atlantic salmon, however, the presence of light increase their swimming speed [11]. Fishermen that used to catch *P. hypophthalmus* in the Kampar River, Riau stated that *P. hypophthalmus* used to hide under immersed object in the water during day time and start to occur in the water at dusk. It is indicate that the the behavior of *P. hypophthalmus* in this research is affected by the light and any changing in light duration may affect the fish behavior.

Results of continuous monitoring of *P. hypophthalmus* reared under manipulated photoperiod are clearly shown that the swimming activity as well as the position of fish in the rearing tanks was affected by the presence of light. Figure 2 shown that in the rearing tank with no light (24D) the fish was less active and stay in water surface. On the other hand, fish reared in the pond with natural light prefer to stay in the bottom of the pond and shown active swimming. Behavior changing was present in the fishes that were reared in 18D6L tanks. The fishes were staying in the bottom of the tank when there was a light, but then they were moving to the water surface when there was no light. This fact indicates that *P. hypophthalmus* is negatively response to light and staying in the bottom of the tank is an effort to avoid the light. Similar result was obtained in African catfish *Clarias gariepinus* [15]. The light plays an important role in the African catfish behavior and its wellbeing. The fish that were reared in 24 hours light were more stressed and aggressive, compared to those under a reduced number of light hours. Rearing the fish in the continuous darkness was also reduce aggressiveness and canibalism in *C. gariepinus* fingerlings [17].
Figure 3. Swimming activities and position of *P. hypophthalmus* in the rearing tarp ponds, under manipulated photoperiod.

**Note:**

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* fish swimming activity

1. No special pattern, fins moving slowly
2. Under water drops, fins moving slowly
3. Under water drops, fins moving actively

* Fish position

1. The fish is in the bottom of the tank
2. The fish is in the middle of the tank
3. The fish is in the water surface

The presence of light is also greatly affect the feeding habit of *P. hypophthalmus*. In this study, fish reared under continuous dark and 18D6L showing aggressiveness in taking the feed provided. The fish directly catch the food as soon as the fish feed pellets entering the water. On the other hand, fish that were reared under natural light showing slower response toward the feed provided. Rearing cat fish in the continuous dark is increase the feeding ability of *C. gariepinus*, and thus increase the food conversion efficiency and speed up the growth [17]. The high growth increase in *C. gariepinus* reared in continuous dark was attributed to better food conversion efficiency and the suppression of swimming, activity, aggression, and stress in the dark. All these enabled more energy to be converted to body weight. As *P. hypophthalmus* feeding habit increase in the dark, rearing the fish in dark condition may be applied for culturing the fish in the future.

4. Conclusion

Behavior of *Pangasius hypophthalmus* is greatly affected by the photoperiod. Continuous dark improved the feeding habit of the fish, but reduced its swimming activity. The presence of light, in contrast, increase the activity of the fish but it is not improve the feeding of the fish.

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