Asian Journal of Aquatic Sciences, August 2025. Vol 8, Issue (2) 310-318
e-issn: 2716-4608
p-issn: 2655-366X

CONTROLLING CANNIBALISM OF ASIAN REDTAIL CATFISH (*Hemibagrus nemurus*) LARVAE USING PASTE FEED SUPPLEMENTED WITH TURMERIC FLOUR

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ABSTRACT

Cannibalism is a significant issue during the early stages of Asian redtail catfish (*Hemibagrus nemurus*) culture, as it negatively affects survival rates. This study aimed to investigate of turmeric (*Curcuma longa*) flour supplementation in pasta feed to control cannibalism in Asian redtail catfish larvae and the potential to replace silk worm as a feed. A completely randomized design (CRD) was employed, consisting of five treatment groups with four replications each. The larvae were fed pasta diets supplemented with varying doses of turmeric flour (0, 5, 10, and 15 mg/kg), along with a comparative feed using *Tubifex sp.* The parameters assessed included cannibalism rate, survival rate, and growth performance. The results showed that the highest survival rate (93.33 ± 1.33%) and lowest cannibalism index (2.67 ± 0.94%) were observed in the group fed *Tubifex* sp. The highest weight gain (24.22 ± 0.53 g) and specific growth rate (9.35 ± 0.03%) were also recorded in this group. However, supplementation of turmeric flour at a dosage of 15 mg/kg in pasta feed was able to reduce cannibalism and improve the growth of Asian redtail catfish larvae. This treatment resulted in a cannibalism index of 11% and a survival rate of 82.67%. In terms of growth performance, larvae under this treatment exhibited a weight gain of 6.13 g, a length gain of 3.58 cm, a specific growth rate (SGR) of 6.07%/day, and a particular growth rate of length (SLR) of 4.25%/day. Pasta feed supplemented with 15 mg/kg turmeric flour can serve as an alternative to replace silk worms, achieving 25% of their weight gain and 63% of their length gain.

Keywords: Asian Redtail Catfish, Turmeric Flour, Cannibalism, Behavior Control

1. INTRODUCTION

Asian redtail catfish (*Hemibagrus nemurus*) is a freshwater aquaculture commodity with high economic value and significant farming potential across Southeast Asia, including Indonesia[1]. In Indonesia, this fish is primarily obtained through capture from natural habitats[2] and aquaculture practices, with market prices ranging from IDR 60,000 to 120,000 per kilogram[3]. The availability of seeds plays a crucial role in supporting sustainable aquaculture development[2]. The cultivation of fish remains underdeveloped, primarily due to various issues, including the low fish survival rate[4]. The survival rate of Asian redtail catfish larvae ranges between 30% and 50%[5]. This low larval survival rate is primarily attributed to the high incidence of cannibalism[6].

Cannibalism is a frequently occurring and harmful behavior seen during the early life stages of numerous fish species, especially among carnivorous and predatory types. It involves attacking and consuming individuals of the same species[7]. In aquaculture, cannibalistic behavior can greatly due lower the survival of fish larvae, thereby impacting the overall profitability and long-term sustainability of fish farming

Received: 18 July 2025
Accepted: 11 August 2025

operations. The Asian redtail catfish is a species that tends to exhibit cannibalism during its early larval stages[8]. The onset of cannibalistic behavior in these larvae typically arises from factors such as stocking density[6,9], nutritional deficiencies[10], and hormonal[11]. Consequently, controlling cannibalism in these larvae is critical to improving aquaculture practices and ensuring the viability of Asian redtail catfish farming.

Several methods have been investigated to mitigate cannibalism in Asian catfish larvae, including environmental modifications, stocking density management[2-3], and feed supplementation[6,11,12]. Nutritional interventions have gained considerable attention for their potential to influence both behavior and growth. Until now, Asian redtail catfish larvae have primarily relied on silkworm as their primary feed source. However, the use of silk worm often poses challenges due to its limited availability and dependence on natural sources[6]. One alternative approach is to replace silk worm with pasta-based feed.

Nevertheless, the use of pasta feed has not yet yielded satisfactory results in controlling cannibalism or promoting optimal growth among these. An alternative measure that can be taken is to supplement the diet with bioactive compounds is one promising avenue. Turmeric (*Curcuma longa*), a widely known herb in both traditional medicine and cuisine, contains curcumin, a polyphenolic compound that has been reported to possess anti-inflammatory, antioxidant, and behavioural-modulating properties[13-14] In aquaculture, curcumin has been found to reduce stress and aggression in fish, which may indirectly help in mitigating cannibalistic tendencies[15].

The use of turmeric flour as a supplement in feed has been proposed as a natural and cost-effective strategy to alleviate the adverse effects of cannibalism in fish larvae. Studies on various species, including tilapia (*Oreochromis* spp.) and carp (*Cyprinus carpio*), have shown that the inclusion of turmeric in their diets improves both behavioral responses and physiological health[16]. However, limited research exists on the application of turmeric flour supplementation in *H. nemurus*, particularly concerning its effect on larval cannibalism.

The study seeks to determine whether paste feed supplemented with *C. longa* extract can effectively suppress cannibalism and improve the growth of *H.nemurus* larvae, and to assess its potential to replace silk worm.

2. RESEARCH METHOD

Time and Place

The study was conducted over 40 days, from March to May 2024, at the Fish Hatchery and Breeding Laboratory, Faculty of Fisheries and Marine Sciences, Universitas Riau.

Method

This study employed a completely randomized design (CRD) with five treatments and four replications. The treatments involved the addition of turmeric (*C. longa*) powder to the paste feed. Based on Heltonika et al.[17], the doses were:

T1: 0 mg/kg feed
T2: 5 mg/kg feed
T3: 10 mg/kg feed
T4: 15 mg/kg feed
T5: *Tubifex* sp (control).

Procedures

Experimental Fish

Asian Redtail catfish larvae used as test specimens were obtained through artificial spawning conducted at the Fish Breeding and Genetics Laboratory, Faculty of Fisheries and Marine Sciences, Universitas Riau. Sexually mature broodstock were induced using sGnRH combined with a dopamine antagonist (Ovaprim; Syndel Lab) at doses of 0.25 ml/kg for males and 0.5 mL/kg for females. Twelve hours after injection, male and female broodstock were stripped to collect eggs and sperm, which were then mixed for fertilization. The larvae were reared for 15

days and fed *Tubifex* sp. On the 15th day post-hatching, the larvae were used for experimentation and subjected to treatments.

Feed Preparation

Commercial feed with a nutritional composition of 40% protein, 6% fat, 3% fiber, 12% ash, and 12% moisture was used as the base feed. The feed was ground and mixed with water to form a paste. Turmeric powder was then added according to the respective treatment dosage. The prepared feed was stored in a freezer to preserve its quality before use.

Maintenance of Test Fish

Asian redtail catfish larvae were reared in glass aquaria measuring 45 × 30 × 25 cm^3 with a water volume of 20 L per tank. Continuous aeration was provided in each tank to maintain adequate oxygen levels. Each aquarium was stocked with 60 larvae, equivalent to a density of 3 fish/L. The larvae used had an initial average length of 0.8 cm and a weight of approximately 0.59 g. Fish were fed four times daily (*ad libitum*) at 06:00, 12:00, 18:00, and 24:00 hours using the formulated paste feed according to the treatment groups. The feeding regime aimed to ensure that all fish had enough access to feed to reduce competition and potential cannibalism. To maintain water quality, feces and uneaten feed were removed daily by siphoning. This routine cleaning helped reduce the accumulation of organic waste and prevent water quality deterioration that could affect larval health and survival. Growth performance was evaluated by measuring the length and weight of the larvae at 10-day intervals, specifically on days 10, 20, 30, and 40 of the rearing period. These measurements were used to monitor growth trends and assess the impact of turmeric supplementation in the feed.

Measurement of Test Parameters

Fish length and weight measurements were taken every 10 days. In the morning, measurement or sampling is performed by taking a sample of test fish, which constitutes at least 50% of the total fish population, in one maintenance container. Blood glucose levels were measured twice, namely at the beginning and end of maintenance.

Research Parameters

The number of each cannibalism type was recorded daily. The incidence of cannibalism was calculated using the following formulas by Król & Zakes[18]:

$$\text{Cannibalisme Type A (\%)} = \frac{\text{Number of dead or injured seeds}}{\text{Initial seed count}} \text{X } 100$$

$$\text{Cannibalisme Type B (\%)} = \frac{\text{Number of missing seeds eaten}}{\text{Initial seed count}} \text{X } 100$$

The cannibalism index was calculated using the following formulas by Obirikorang et al.[19]:

$$\text{Cannibalisme Index (\%)} = \frac{\text{Number of cannibalism dead fish}}{\text{Number of initial fish}} \text{X } 100$$

Normal mortality refers to fish deaths that occur without any visible signs of cannibalism. Normal mortality was calculated using the following formulas by Król & Zakes[18]:

$$\text{Normal mortality (\%)} = \frac{\text{Number of normal dead fish}}{\text{Number of initial fish}} \text{X } 100$$

Survival rate was calculated using the following formulas:

$$\text{Survival Rate (\%)} = \frac{\text{Number of seeds at the end of the study}}{\text{Number of fish at the beginning study}} \text{X } 100$$

The growth performance of the experimental fish was assessed by absolute weight, absolute length, Specific growth rate (SGR), and specific length growth (SLR):

$$\text{Absolute Weight} = Wt - W0$$

$$\text{Absolute Length} = Lt - L0$$

$$\text{SGR (\%/day)} = \frac{\text{LnWt-LnW0}}{t} \text{X } 100$$

$$\text{SLR (\%/day)} = \frac{\text{LnLt-LnL0}}{t} \text{X } 100$$

Information:

Wt	:	Average weight of fish at the end of the study (g)
W0	:	Average weight of fish at the beginning of the study (g)
Lt	:	Average length of fish at the end of the study (cm)
L0	:	Average length of fish at the beginning of the study (g)

Data Analysis

Data on cannibalism, larval growth, larval hormone, and water quality were tabulated with Microsoft Excel 2010 and statistically analyzed using SPSS version 27

3. RESULT AND DISCUSSION

Mortality and Cannibalism Rate

The results of the study indicate that the addition of turmeric powder to the Asian redtail catfish larval paste feed effectively reduced mortality and cannibalism rates. Detailed data on survival and cannibalism rates are presented in Table 1.

Table 1. Cannibalism in Asian redtail catfish larvae reared on paste feed supplemented with turmeric powder

Treatments	Cannibal Types A (%)	Cannibal Types B (%)	Normal mortality (%)	Cannibal Index (%)	Survival Rate (%)
T1	8.00 ± 0.94^{b}	6.67 ± 0.94^{c}	11.00 ± 1.45^{d}	14.67 ± 1.63^{c}	74.33 ± 1.73^{a}
T2	8.00 ± 0.94^{b}	5.33 ± 0.94^{bc}	8.67 ± 0.67^{c}	13.33 ± 0.94^{bc}	78.00 ± 1.49^{b}
T3	8.67 ± 0.67^{b}	5.00 ± 1.11^{bc}	7.00 ± 1.11^{bc}	13.67 ± 1.11^{bc}	79.33 ± 2.00^{b}
T4	6.67 ± 0.94^{b}	4.33 ± 1.11^{b}	6.33 ± 1.11^{b}	11 ± 1.73^{b}	82.67 ± 2.49^{c}
T5	2.67 ± 0.94^{a}	0.00 ± 0.00^{a}	4.00 ± 0.94^{a}	2.67 ± 0.94^{a}	93.33 ± 1.33^{d}

Notes: Different superscripts in the same column indicate significant differences ($P<0.05$).

Based on Table 1, the supplementation of turmeric powder in the larval paste feed had a highly significant effect on the Type A cannibalism index ($P<0.01$). The lowest Type A cannibalism index was observed in treatment T5 (*Tubifex* sp) with a value of 2.67, while the highest was recorded in T1, with a value of 8.00. Meanwhile, the lowest incidence of Type A cannibalism in the turmeric flour-supplemented pasta feed treatment was observed in treatment T4 (15 mg/kg), with a value of 6.67. The study also demonstrated a highly significant effect ($P<0.01$) on the Type B cannibalism index. Treatment T5 resulted in the lowest index value (0.00), whereas the highest value was found in the T1 at 6.67.

Meanwhile, the lowest incidence of Type B cannibalism in the turmeric flour-supplemented pasta feed treatment was observed in treatment T4 (15 mg/kg), with a value of 4.33. Furthermore, the turmeric supplementation had a significant effect on the overall cannibalism index. Treatment T5 showed the lowest total cannibalism index (2.67), while T1 showed the highest (14.67). Meanwhile, the lowest incidence of cannibalism index in the turmeric flour supplemented pasta feed treatment was observed in treatment T4 (15 mg/kg), with a value of 11. In addition, turmeric powder in the paste feed had a highly significant effect ($P<0.01$) on normal mortality of Asian redtail catfish larvae. The lowest mortality rate was recorded in treatment T5 (4.00), and the highest in T1 (11.00).

Meanwhile, the lowest incidence of normal mortality in the turmeric flour supplemented pasta feed treatment was observed in treatment T4 (15 mg/kg), with a value of 4.00. The inclusion of turmeric powder also significantly improved the survival rate of Asian redtail catfish larvae ($P<0.01$), with the highest survival rate observed in T5 (93.33%) and the lowest in T1 (74.33%). Meanwhile, the lowest incidence of survival rate in the turmeric flour-supplemented pasta feed treatment was observed in treatment T4 (15 mg/kg), with a value of 82.67.

Overall, the pasta feed has not yet outperformed *Tubifex* sp. in terms of effectiveness. This is evident from the cannibalism parameters of Asian redtail catfish larvae, where *Tubifex* consistently yielded the most favorable results. Nevertheless, this study reveals the potential of incorporating turmeric flour into pasta feed, with the 15 mg/kg dosage (T4) producing the best outcomes among the pasta feed treatments. These findings confirm that turmeric supplementation in the

feed not only reduces specific types of cannibalism but also helps to control the overall cannibalism rate in Asian redtail catfish larvae, thereby enhancing their welfare and survival during early developmental stages.

According to Naumowicz et al.[20], cannibalism is aggressive behavior, caused by stress, variance, and environmental factors that occur in most life phases. This result aligns with the findings of Siagian & Heltonika[12], who reported that turmeric powder supplementation in feed can reduce the cannibalism index in Asian redtail catfish juveniles. The reduction in cannibalistic behavior is believed to be related to the bioactive compounds in turmeric, particularly curcumin, which has estrogenic properties and may suppress aggressive behavior in fish. Similarly, a study by Putri et al.[21] demonstrated that the administration of estradiol-17β effectively reduced aggressive behavior in catfish juveniles, supporting the observations of the present study. A similar finding was reported by Siregar et al.[22], who conducted a study on the effect of estradiol on cannibalism in African catfish.

The addition of turmeric powder also had a significant effect on the normal mortality rate of the larvae. The treatment with 15 mg/kg turmeric powder (T5) resulted in the lowest mortality rate (4.00), while the control group (T1) exhibited the highest mortality (11.00). This reduction in mortality suggests that turmeric supplementation enhances larval resilience to stress and environmental conditions, thereby improving their overall survival during the early stages of development.

The most striking result was observed in the survival rate of Asian redtail catfish larvae. The supplementation of turmeric powder in the paste feed significantly increased survival. The treatment with 15 mg/kg of turmeric powder (T5) yielded the highest survival rate (93.33%), whereas the control group (T1) showed the lowest survival rate (74.33%). This indicates that turmeric powder not only reduces cannibalism and mortality but also directly contributes to improving larval survival, which is crucial for successful aquaculture practices. Pridayem et al.[23] report that the addition of turmeric powder to fish paste feed has been shown to increase lymphocyte cell counts in fish, thereby enhancing their antibody production.

Production Performance

The growth performance of Asian redtail catfish obtained from this study is presented in Table 2.

Table 2. Weight and length growth of Asian redtail catfish (*H.nemurus*) larvae

Treatments	Weight Growth (g)	Ability to Replace Weight gain of Silk	Length Growth (cm)	Ability to Replace Length gain of Silk	Specific Growth Rate (%)	Specific Length Rate (%)
T1	5.24 ± 0.29^{a}	22	3.39 ± 0.13^{b}	60	5.72 ± 0.12^{a}	4.14 ± 0.08^{b}
T2	5.04 ± 0.61^{a}	21	3.16 ± 0.07^{a}	56	5.62 ± 0.28^{a}	4.00 ± 0.05^{a}
T3	4.97 ± 0.23^{a}	21	3.19 ± 0.03^{a}	56	5.61 ± 0.10^{a}	4.02 ± 0.02^{a}
T4	6.13 ± 0.67^{a}	25	3.58 ± 0.15^{c}	63	6.07 ± 0.24^{b}	4.25 ± 0.08^{c}
T5	24.22 ± 0.53^{b}	100	5.67 ± 0.07^{d}	100	9.35 ± 0.05^{c}	5.22 ± 0.03^{d}

Notes: Different superscripts in the same column indicate significant differences ($P<0.05$).

Weight gain is a key indicator in evaluating feed performance in fish. Based on the data obtained, pasta feed did not fully achieve growth rates comparable to those of silkworm feed. However, the dose of turmeric powder in the paste feed significantly increased growth, with the T4 treatment achieving a weight gain of 6.13 g, compared to only 5.24 g in the paste feed without turmeric powder (T1). Length

growth is another crucial parameter reflecting the effectiveness of the feed in supporting larval body development. The data show that treatment T5 resulted in the highest length gain at 5.67 cm. This is similar to the weight gain results, indicating that pasta feed has not fully achieved the growth potential of silkworm feed.

However, the addition of turmeric flour to the pasta feed significantly increased length growth, with the T4 treatment achieving a length gain of 3.58 cm, compared to only 3.39 cm for the pasta feed without turmeric flour (T1). This indicates that the addition of turmeric powder has the potential to promote linear growth in Asian redtail catfish larvae. According to the analysis of the ability to replace weight gain of the silk worm, the supplementation of pasta feed with 15 mg/kg of turmeric flour resulted in the highest replacement ability, achieving 25% for weight gain and 63% for the ability to replace length gain of the silk worm.

Specific Growth Rate (SGR) reflects the efficiency of fish body growth over a given period. In this study, treatment T5 yielded the highest SGR at 9.35%, outperforming all other treatments. Specific Length Growth Rate (SLR) indicates the rate of fish length growth per unit of time relative to the initial length. In this study, treatment T5 also demonstrated the highest SLR value at 5.22%, surpassing the other treatments.

The results of this study indicate that pasta-based feed has not yet fully surpassed silk worm in promoting growth. However, the enrichment of pasta feed with 15 mg/kg of turmeric flour highlights the potential role of turmeric in enhancing the performance of pasta feed for Asian redtail catfish larvae. A study by Jahan et al.[24] reported that the inclusion of natural ingredients such as turmeric extract can enhance fish body weight, primarily due to its antioxidant and anti-inflammatory properties that support fish health and metabolism. Turmeric is known to contain bioactive compounds like curcumin, which can improve digestion and nutrient absorption in fish[25]. Accordingly, the increased weight gain observed in treatment T5 of the present study aligns with these findings, reinforcing the potential of natural additives like turmeric powder in promoting fish growth.

Fish length growth is influenced by factors such as nutrient availability and feed quality. Giri et al.[26] reported that natural ingredients containing antioxidants, such as turmeric, can enhance length growth by improving nutrient absorption and supporting the physiological condition of fish. The inclusion of turmeric powder in the feed likely contributed to optimizing larval metabolism, thereby supporting better linear body development.

This finding is consistent with the study by Wani et al.[27], which reported that active compounds in turmeric, such as curcumin, can modulate metabolic activity and accelerate growth by enhancing the digestive system of fish. Turmeric supplementation may influence protein and carbohydrate metabolism two critical components for somatic growth thereby contributing to the improvement of specific growth rate (SGR) in fish.

A study by Kurniawan et al.[28] demonstrated that turmeric extract supplementation can enhance fish body length by influencing metabolic processes that support tissue formation. Turmeric is believed to improve digestive conditions and enhance nutrient absorption, both of which are essential for promoting linear body growth. Therefore, the increased SLR observed in treatment T5 in this study may be explained by these underlying mechanisms.

Water Quality

Water quality is a crucial factor in fish farming activities. Water quality must meet the specific criteria required by the fish being cultured. The results of the water quality measurements taken during the study are presented in Table 3.

Table 3. The results of measuring the water quality of Asian redtail catfish during the study

Parameters	T1	T1	T2	T3	T5
Temperature (°C)	27-29	27-29	27-29	27-29	27-29
Dissolved Oxygen (mg/L)	6.3-7.3	6.3-7.3	6.3-7.3	6,3-7.3	6.3-7.3
pH	6-6.5	6-6.5	6-6.5	6-6.5	6-6.5

Overall, the water quality in each treatment showed favorable conditions for the growth of Asian redtail catfish larvae. According to Aryani[29], the recommended temperature for rearing Asian redtail catfish larvae ranges between 24-26°C. Sukendar et al.[30] reported that an optimal pH range for the growth of Asian redtail catfish juveniles was between 6 and 7. Yudha et al.[31] reported that an optimal dissolved oxygen range for the growth of Asian redtail catfish juveniles was 5-7 ppm.

4. CONCLUSION

The results of this study demonstrate that *Tubifex* sp feed continues to yield the best performance in minimizing cannibalism and enhancing growth compared to other treatments in Asian redtail catfish larvae. However, the supplementation of turmeric flour in pasta feed at a dosage of 15 mg/kg was able to reduce cannibalism and improve the growth of Asian redtail catfish larvae fed with pasta-based diets. This treatment yielded a cannibalism index of 11% and a survival rate of 82.67%. In terms of growth performance, larvae under this treatment exhibited a weight gain of 6.13 g, a length gain of 3.58 cm, a specific growth rate (SGR) of 6.07%/day, and a particular growth rate of length (SLR) of 4.25%/day. These results showed that pasta feed can be an alternative substitute for silk worms, with the ability to replace the weight gain of silk worms by 25% and the ability to replace the length gain of silk worms by 63%.

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