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EFFECT OF *Curcuma xanthorrhiza* ENRICHED FERMENTED PASTE FEED ON GROWTH PERFORMANCE AND SURVIVAL OF GIANT GOURAMI *(Osphronemus goramy)* LARVAE

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ABSTRACT

The growth of gourami (*Osphronemus goramy*) larvae is often hampered by the limited availability of natural food such as tubifex worms. The use of fermented paste feed enriched with *Curcuma xanthorrhiza* Roxb is expected to be an effective alternative. The research was conducted from June to August 2024 at the Fish Hatchery and Breeding Laboratory of Universitas Riau. This study aims to evaluate the effect of fermented paste feed enriched with *C.xanthorrhiza* on the growth performance and survival of *O. goramy*. A 40-day experiment was conducted using a completely randomised design (CRD) with five treatments: P1 (*Tubifex*/control), P2 (0 g/kg), P3 (6 g/kg), P4 (9 g/kg), and P5 (12 g/kg) temulawak. Growth, survival, feed response, and water quality were analyzed. The results showed that P3 significantly improved growth and survival compared to the other paste treatments, with weight gain (0.31 g), length gain (2.11 cm), specific growth rate (7.86%/day), and survival (76%). The best feed response was observed in P1 and followed by P3. Higher doses (P4 and P5) had a negative impact on performance. Fermented paste feed enriched with 6 g/kg *C.xanthorrhiza* showed potential as a partial alternative to Tubifex in rearing gourami larvae.

Keywords: Fermented Feed, Larval Growth, Survival Rate.

1. INTRODUCTION

The Giant gourami (*Osphronemus goramy* Lac.) is one of Indonesia's leading freshwater aquaculture commodities. It is known for its high nutritional value and widely favoured taste. In addition, this species holds high economic value, with demand steadily increasing in line with population growth and rising public awareness regarding the importance of protein consumption, particularly from fish. This growing demand has encouraged farmers to intensify production efforts[1].

However, a significant challenge in gourami farming lies in the high mortality rate during the larval stage, often caused by inadequate nutrition due to the larvae's underdeveloped digestive systems[2]. *Tubifex* worms are a primary natural feed for fish larvae, rich in essential nutrients such as protein and amino acids. However, the supply of *Tubifex* sp still relies heavily on natural harvests and has not been widely cultivated, making its availability inconsistent throughout the year[3].

As an alternative, fermented paste feed offers a promising solution. Paste feed is a semi-wet feed composed of organic ingredients, including fishmeal, bran, and other protein-rich ingredients. It is processed into a soft dough and is easily consumed by fish larvae[4].

Feed fermentation with micro-organisms such as EM-4 has improved growth and survival in several freshwater fish species. As with freshwater pomfret larvae, fermenting PF-0 commercial feed using EM-4 can increase the growth rate by 16.23% and survival by 84.44%[5]. In addition, enrichment with bioactive

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ingredients such as temulawak (*Curcuma xanthorrhiza* Roxb) is a promising approach because temulawak contains bioactive compounds, including curcumin, xanthorrhizol, beta-turmerone, ar-turmerone, and essential oils, which function as antioxidants, anti-inflammatory agents, and immunostimulants[6].

Previous studies have shown that feed enriched with *C. xanthorrhiza* can improve fish's feed efficiency, growth, and immunity. For example, the addition of *C. xanthorrhiza* at 8% in feed resulted in absolute length growth of 4.7 cm and a weight of 2.33 g in carp fry (*O. goramy*)[7]. However, research on using fermented paste feed enriched with *C. xanthorrhiza* in gourami larvae remains limited.

Therefore, this study aims to explore the effect of *C. xanthorrhiza* enriched fermented paste feed on the growth and survival of gourami larvae and determine the optimal dosage. This alternative feed is expected to be a viable solution to the limited and unstable availability, such as *Tubifex* sp.

2. RESEARCH METHOD

Time and Place

The research was conducted over 40 days, from June to August 2024, at the Hatchery and Fish Breeding Laboratory, Faculty of Fisheries and Marine Science, Universitas Riau.

Method

This study employed a Completely Randomized Design (CRD) with five treatments and three replicates, resulting in 15 experimental units. Treatments included P1 (control: *Tubifex*), P2 (0 g/kg Curcuma), P3 (6 g/kg), P4 (9 g/kg), and P5 (12 g/kg).

Procedures

Larvae of *O.gouramy* (4 days old, n = 450) were acclimated for 5 days and reared in 15 aerated glass aquaria (30×30×30 cm³, 15 L). Stocking density was two larvae/L. Fermented paste feed was prepared by mixing PF-0 feed with activated EM-4 (20 mL EM-4, 20 mL condensed milk, and 200 mL mineral water) and left to stand for 3 days. Dried *C. xanthorrhiza* powder was added according to the treatment level.

Feeding was conducted four times daily (07:00, 12:00, 17:00, 22:00) for 40 days to achieve satiation. Daily siphoning was done to remove waste. Growth (in terms of weight and length), survival, feed response, and feed replacement efficiency were measured. Using appropriate tools, water quality (temperature, pH, and DO) was monitored three times (early, mid, and end).

Parameters Measured

The data collected included growth performance (absolute weight growth, absolute length growth, specific growth rate), survival rate, larvae response to feed, feed replacement ability, and water quality. The formula used to calculate absolute growth and feed replacement ability was based on Zonneveld et al.[8]:

Absolute Weight Growth (w)= Wt-Wo

Description:

W_t : final weight (g);
W_o : initial weight (g)

Absolute length growth (L) =Lt-Lo

Description:

L_t : final length (cm);
L_o : initial length (cm)

The specific growth rate was calculated based on Effendie[9] using the following formula:

$$SGR = \frac{Ln\ Wt - Ln\ Wo}{t} \times 100\%$$

Description:

SGR : Specific Growth Rate (% per day)
Wt : Final average body weight of larvae (g)
Wo : Initial average body weight of larvae (g)
T : Duration of rearing (days)

Larval survival was calculated at the end of the rearing period based on Effendie[9] using the following formula:

$$SR = \frac{Nt}{No} \times 100\%$$

Description:

SR : Percentage of larval survival
N_t : Number of surviving larvae at the end of the experiment (individuals)
N_o : Number of larvae at the beginning of the experiment (individuals)

Larval Feeding Response

Larval responses to feed were observed for 40 days and assessed using a 3-point scale (1 = poor, 3 = moderate, 5 = good) adapted from Heltonika et al.[10]. Parameters included feeding aggression, feed attraction, and feed residue. Higher scores indicated better acceptance and feeding efficiency.

Replacement Ability of Feed Based on Weight Gain (α)

The replacement ability of fermented feed compared to *Tubifex* sp, based on Heltonika et al.[10], was calculated using the formula:

$$\alpha = \frac{W\ treatment}{W\ tubifex} \times 100\%$$

Description:

$W_{treatment}$: weight gain in treatment (g)
$W_{tubifex}$: weight gain with *Tubifex* (g)

Replacement Ability of Feed Based on Length Gain (β)

The ability of fermented feed to replace *Tubifex* sp, based on Heltonika et al.[10], length gain was calculated using

$$\beta = \frac{L\ treatment}{L\ tubifex} \times 100\%$$

Description:

$L_{treatment}$: Length gain in treatment (cm)
$L_{tubifex}$: Length gain with *Tubifex* (cm)

Replacement Ability of Feed Based on Survival Rate (γ)

The survival replacement ability based on Heltonika et al.[10] was calculated as:

$$\gamma = \frac{SR\ treatment}{SR\ tubifex} \times 100\%$$

Description:

$SR_{treatment}$: SR in treatment (%)
$SR_{tubifex}$: SR with *Tubifex* (%)

Water Quality Measurement

The water quality parameters measured are temperature, pH, and dissolved oxygen (DO). Measurements of temperature, pH, and DO are conducted in the morning. The instruments used are a thermometer, a pH meter, and a DO meter. Measurements are taken three times at the study's beginning, middle, and end. The method for measuring water quality is at the beginning, middle, and end of the experiment.

Data Analysis

Data were analyzed using SPSS version 23. One-way ANOVA was used to determine treatment effects, followed by the SNK post-hoc test if significant. Water quality data were analyzed descriptively.

3. RESULT AND DISCUSSION

Larvae's Response to Feed

Table 1 shows that P1 (*Tubifex* sp.) produced the best response regarding feed consumption, feeding behaviour, and larval attraction to feed. Larvae fed with silk worms showed very active feeding behaviour, where larvae quickly swam towards the feed and consumed it immediately without remaining at the bottom of the aquarium. Silkworms, as a natural food source, are known to have a texture, odour, and taste that are highly preferred by fish larvae, thus increasing larval responsiveness to feeding[1].

In the P2 (0 g/kg), the larvae showed slower feeding behaviour, and the paste without *C. xanthorrhiza* was less attractive than in the other treatments. The paste without added temulawak lacked an attractive aroma and taste to the larvae, resulting in less responsiveness to the feed.

Table 1. Larvae's response to feed

Observation	Treatment				
	P1	P2	P3	P4	P5
How larvae take feed	5	3	3	1	1
Attraction of Larvae	5	1	3	1	1
Leftover feed	5	3	3	1	1
Total	15	7	9	3	3

Notes: *value 5: the way the larvae take food, the attraction to the food is very aggressive, and the food given is not left. *value 3: the way the larva takes food, the attraction to the food is aggressive, and the food given has little left. *value 1: the way the larva takes the food, the attraction to the food is not aggressive, and the food given always has some left

In P3 (6 g/kg), the larval response to feed was also quite good. Gourami larvae in this treatment still showed active eating activity, although not as aggressive as in the P1 treatment. This can be explained by the addition of temulawak to the feed, which has a distinctive aroma, thereby increasing the larvae's attraction to the feed. Temulawak contains curcumin, which not only functions as an antioxidant but can also stimulate the appetite of fish[11].

The larval response was not optimal in the treatment of fermented paste feed with 9 g/kg temulawak (P4) and fermented paste feed with 12 g/kg temulawak (P5). High doses of temulawak caused a decrease in larval attraction to feed, indicated by slow feeding behaviour and high levels of residual feed that settled to the bottom of the aquarium. Temulawak in high concentrations can affect larval appetite due to the presence of secondary metabolites that alter the perception of feed as bitter[12]. As a result, fish larvae in this treatment tended to consume less feed and took longer to complete the given feed.

Growth Rate of Gourami Larvae

Table 2 shows that the absolute weight growth of gourami larvae ranged from 0.18 to 1.02 g, absolute length growth between 1.85 and 3.07 cm, specific growth rate between 6.57% and 10.76%/day, and survival between 67.77% and 92.22%. The differences between treatments were significant ($P < 0.001$).

The results of measuring the absolute weight growth of gourami larvae were highest in the P1 treatment at 1.02 g, followed by P3 with a value of 0.31 g, P2 with a value of 0.21 g, P5 with a value of 0.19 g, and the lowest was in the P4 treatment with a value of 0.18 g (Table 2).

Table 2. Growth and survival of gourami larvae

Treatment	Weight Gain (g)	Length Gain (cm)	SGR (%/day)	Survival (%)
P1 (*Tubifex*)	1.02 ± 0.06^{c}	3.07 ± 0.03^{c}	10.76 ± 0.16^{c}	92.22 ± 6.93^{b}
P2 (0 g/kg)	0.21 ± 0.01^{a}	1.92 ± 0.04^{a}	7.23 ± 0.42^{ab}	68.88 ± 5.09^{a}
P3 (6 g/kg)	0.31 ± 0.05^{b}	2.11 ± 0.09^{b}	7.86 ± 0.39^{b}	76.66 ± 3.33^{a}
P4 (9 g/kg)	0.18 ± 0.02^{a}	1.85 ± 0.05^{a}	6.57 ± 0.32^{a}	67.77 ± 5.09^{a}
P5 (12 g/kg)	0.19 ± 0.04^{a}	1.90 ± 0.02^{a}	6.75 ± 0.52^{a}	71.11 ± 5.09^{a}

Notes: Mean values in the same column followed by different letters indicate significantly different results ($P<0.001$), while mean values in the same column followed by the same letter indicate results that are not significantly different ($P>0.001$).

Ability to Replace *Tubifex* sp.

Based on Table 3, the ability to replace the role of *Tubifex* sp. ranged from 17.64 to 30.39% for weight growth, 60.26 to 68.72% for length growth, and 73.48 to 83.12% for survival. The value of weight growth is relatively lower, but the rate of length growth is better than the previous research results. Revealed that the ability of fermented pasta feed to replace weight

growth was 69%, while non-fermented pasta was only 47% compared to Tubifex sp. Likewise, the ability to compensate for the increase in length was 71% in the fermented pasta treatment, whereas it was only 56% in the non-fermented pasta treatment[10].

These results underscore the importance of accurately determining the proper herbal dosage in feed formulations to maximise replacement potential without compromising performance.

Table 3. Feed replacement ability compared to *Tubifex* sp

Treatment	α (%)	β (%)	γ (%)
P1 (*Tubifex*)	100.00	100.00	100.00
P2 (0 g/kg)	20.58	62.54	74.69
P3 (6 g/kg)	30.39	68.72	83.12
P4 (9 g/kg)	17.64	60.26	73.48
P5 (12 g/kg)	18.62	61.88	77.10

Notes: α (Ability to replace the weight growth of silkworms); β (Ability to replace the length growth of silk worms); γ (Ability to replace the survival of silk worms)

Water Quality Assessment

Measurements of water parameters were carried out 3 times during the experiment, namely at the beginning, middle, and end of the study, namely measurements of temperature, pH, and DO. Measurements were taken in the morning. The water quality values obtained during the study are presented in Table 4.

The water temperature during the experiment ranged from 26.1°C to 27.0°C, which is within the optimal range for gourami growth. This temperature supports optimal metabolism and development of gourami larvae[13], which states that the ideal temperature for gourami growth is between 25-30°C. Stable temperatures within this optimal range enable fish larvae to utilise energy from their feed to support efficient growth in body weight and length.

The pH value of the water during the study ranged from 6.8 to 7.1, which is also suitable for the needs of gourami fish farming. SNI[13] Explains that the optimal pH for gourami fish is in the range of 6.5 - 8.0, where a pH that is too acidic or alkaline can cause stress and affect the ability of larvae to absorb nutrients from feed. The pH stability maintained during the study helped the larvae maintain osmoregulatory balance and support physiological functions, thereby improving the growth and survival of gourami larvae.

Table 4. Water quality observations

Treatment	Start			Mid			End		
	Temp (°C)	pH	DO (mg/L)	Temp (°C)	pH	DO (mg/L)	Temp (°C)	pH	DO (mg/L)
P1 (*Tubifex*)	26.1	6.6	4.3	26.3	6.8	4.8	27.0	6.2	5.7
P2 (0 g/kg)	26.2	6.7	4.6	26.5	6.7	5.0	27.2	6.4	5.9
P3 (6 g/kg)	26.3	6.7	4.8	26.6	7.0	5.4	27.3	6.6	6.2
P4 (9 g/kg)	26.6	6.8	4.9	27.0	7.1	5.7	27.4	7.1	6.1
P5 (12 g/kg)	26.5	7.0	5.1	26.7	7.2	5.9	27.4	7.2	6.5

Dissolved oxygen levels during the study ranged from 3.6 to 5.2 mg/L, which is still within safe limits for the survival of gourami larvae. According to Sulistyo et al.[14] the optimal oxygen level for fish growth is 4.0 - 7.1 mg/L, and a decrease in DO can cause stress and inhibit fish metabolism. In this study, oxygen levels near the minimum

limit in the higher *C. xanthorrhiza* dose treatments (P4 and P5) may have contributed to decreased larval growth and survival due to the accumulation of organic matter and feed residues, which increase oxygen consumption by decomposing bacteria.

4. CONCLUSION

Based on the results of the study, it is known that the enrichment of fermented pasta feed with *C. xanthorrhiza* has a very significant effect (P<0.001) on the growth performance and survival rate of giant gourami larvae. The best treatment in research on the enrichment of fermented paste feed with *C. xanthorrhiza* on the growth and survival of gourami larvae resulted in absolute weight growth of 0.31 g, absolute length of 2.11 cm, specific growth rate of 7.86% / day, survival rate of 76.66%, The ability to replace the role of Tubifex sp by 30.39% for weight growth, 68.72% for length growth, 83.12% for survival and water quality parameters during the study were temperature ranging from 26- 27.0°C, pH ranging from 6.8-7.1 and Dissolved Oxygen 3.6 - 5.2 mg/L.

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