

## THE USE OF FERMENTED COCONUT MEAL (*Cocos nucifera*) USING EM4 IN FEED ON THE GROWTH OF GORAMI (*Osphronemus gouramy*)

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### ABSTRACT

Copra meal flour is used as a fish feed ingredient with a fairly high protein content of 18–24%. However, its crude fiber content is high, which can reduce its digestibility. Therefore, fermentation is needed to improve the quality of copra meal. This study aims to determine the percentage of copra meal flour fermented with EM4 in feed to produce the best feed efficiency and growth of gorami fish. This study employed an experimental method with a completely randomized design (CRD). Five types of feed were formulated to contain 32% protein, with feed P0 containing 100% soybean meal (control feed), and feeds P1, P2, P3, and P4 replacing soybean meal with fermented copra meal at 25%, 50%, 75%, and 100%, respectively gorami fish fry (with an average body weight of  $2.08 \pm 0.11$  g) were stocked in floating net cages measuring  $1 \times 1 \times 1$  m<sup>3</sup> at a density of 25 fish per cage. The experimental feed was given at 10% of the test fish biomass frequency three times a day at 08.00, 12.00, and 16.00 WIB, for 56 days. Feed digestibility was measured by giving the test feed three times a day to satiation, mixed with Cr<sub>2</sub>O<sub>3</sub> and protein. The results showed that the use of TBKF in the feed significantly improved feed efficiency and gorami fry growth. Based on the results, it can be concluded that the use of 75% fermented copra meal can replace soybean meal in gorami feed, with feed digestibility (57.63%), protein digestibility (80.08%), protein retention (37.56%), feed efficiency (52.31%), and specific growth rate (4.05%).

**Keywords:** Gorami fish, Copra meal, Fermentation, EM4, Fish feed

### 1. INTRODUCTION

Mangrove Gorami fish are highly nutritious, containing protein (18–24%) and omega-3 fatty acids, and are widely popular among the public<sup>1</sup>. The advantages of gorami fish include their ability to reproduce naturally, their ease of care, and their tolerance for stagnant water<sup>2</sup>. Fish farmers still rely on commercial feed (manufactured feed) for gorami fish farming, while the price of such feed tends to rise year after year. This results in high feed procurement costs<sup>3</sup>.

Soybean meal is an imported source of plant-based protein, making it relatively expensive. One way to reduce soybean meal use is to substitute it with other ingredients

that are high-quality yet relatively inexpensive, have guaranteed availability, and do not compete with human food needs. One alternative feed ingredient that has not yet been widely utilized is copra meal (*Cocos nucifera*).

Based on the background of this study, the objective is to examine copra meal, a byproduct of the coconut kernel that has been sun-dried or otherwise dried, with potential as an animal feed ingredient. Coconut meal contains 18–24% protein and a relatively high crude fiber content of 13–16%, but tannins are the primary antinutritional factor<sup>4</sup>. The fat content of coconut meal is quite high, reaching 11%, making the material prone to rancidity.

Therefore, fermentation is necessary to increase the protein content and reduce the crude fiber and fat content of the copra meal<sup>5</sup>, to determine the optimal amount of coconut meal (*Cocos nucifera*) as a substitute for soybean meal to enhance growth and feed efficiency in gorami (*Osphronemus goramy*) fingerlings.

## 2. RESEARCH METHOD

### Time and Place

This study was conducted from June 2025 to August 2025 at the Fish Nutrition Laboratory, Faculty of Fisheries and Marine Sciences, Universitas Riau; the Agricultural Products Analysis Laboratory, Universitas Riau; and the Fish Nutrition Laboratory, Faculty of Fisheries and Marine Sciences, Bogor Agricultural University.

### Method

This study employed an experimental design using a completely randomized design (CRD) with one factor, five treatment

levels, and three replications This treatment is based on the research by Farizaldi<sup>6</sup>, which found that the use of 20% copra meal resulted in the best feed intake, absolute body weight, absolute body length, feed conversion ratio, survival rate, protein retention, and fat retention in catfish (*Clarias* sp.) The treatment levels used in this study were:

- P0 = Fermented Coconut Meal 0% + Soybean Meal 100%
- P1 = Fermented Coconut Meal 25% + Soybean Meal 75%
- P2 = Fermented Coconut Meal 50% + Soybean Meal 50%
- P3 = Fermented Coconut Meal 75% + Soybean Meal 25%
- P4 = Fermented Coconut Meal 100% + Soybean Meal 0%

## 3. RESULT AND DISCUSSION

### Digestibility of Gorami Fish

The data on feed digestibility and protein digestibility are presented in Table 1.

**Table 1.** Feed and protein digestibility of gorami

Treatment (% TBKF)	Feed digestibility (%)	Protein digestibility (%)
P0 (0)	57,56	78,63
P1(25)	60,94	79,98
P2 (50)	62,12	82,00
P3 (75)	74,36	87,95
P4 (100)	69,14	84,86

Table 1 shows that feed digestibility ranged from 57.56% to 74.36% across treatments. Feed digestibility in P4 (feed containing 75% fermented copra meal) was 74.36%, meaning that the gorami fish digested 74.36% of the feed provided. The high feed digestibility is due to the use of fermented copra meal, which improves feed quality. The fermentation process breaks down complex compound bonds into easily digestible compounds, thereby improving feed digestibility. The feed digestibility value indicates the amount of feed digested by the fish and not excreted in feces<sup>7</sup>. Easily digestible feed is utilized more efficiently by the fish. Ningsih et al.<sup>8</sup> state that the higher the digestibility of the feed consumed by the fish, the greater the amount of nutrients

available for utilization and the fewer nutrients are lost through feces.

P4 (feed containing 75% fermented copra meal) produced the highest feed digestibility compared to other feeds for gorami fingerlings. The crude fiber content of this feed is relatively low (6.20%) compared to other feeds, allowing it to be digested and utilized by gorami fish, which require a maximum crude fiber content of 8%<sup>9</sup>. This aligns with Nurfitasari et al.<sup>10</sup> statement that high digestibility is associated with a feed's crude fiber content; the lower the crude fiber content, the easier it is for the fish to digest and absorb the feed's nutrients.

Table 1 shows that protein digestibility ranged from 78.63 to 87.95% across treatments. Protein digestibility in this study

ranged from 78.63 to 87.95%. The highest protein digestibility was observed in P3 (feed containing 75% fermented copra meal), at 87.95%. The higher the protein digestibility, the more protein can be utilized by fish for growth<sup>11</sup>. The high protein digestibility in P3 is due to the use of fermented copra meal in the feed. The fermentation process produces amylase, protease, and lipase enzymes that break down protein into amino acids, making it easier to absorb and digest in the digestive system<sup>12</sup>. The lowest protein digestibility

was observed in P0 (0% fermented copra meal), at 78.63%. The low protein digestibility in P0 is due to the high crude fiber content in the feed, making it difficult for the fish to digest the feed provided; undigested crude fiber carries the digested protein out with the feces, so only a small amount of protein can be utilized by the fish<sup>13</sup>.

### Feed Efficiency in Gorami

The data on feed efficiency calculated during the study are presented in Table 2.

**Table 2.** Feed efficiency of gorami

Test	Treatment (TBKF%)				
	P0 (0)	P1 (25)	P2 (50)	P3 (75)	P4 (100)
1	39,54	42,74	44,28	52,76	45,88
2	40,68	42,37	44,57	52,85	45,97
3	39,93	42,85	44,24	52,71	46,38
Average	40,05±0.57 <sup>a</sup>	42,66±0.25 <sup>b</sup>	44,36±0.18 <sup>c</sup>	52,77±0.07 <sup>e</sup>	46,08±0.26 <sup>d</sup>

Description: The values shown are means ± standard deviation; different letters in the same column indicate a significant difference between treatments

**Table 3.** Protein retention in gorami

Test	Treatment (TBKF%)				
	P0 (0)	P1 (25)	P2 (50)	P3 (75)	P4 (100)
1	23,48	28,03	29,06	37,56	31,17
2	23,56	28,15	30,53	37,62	31,53
3	24,41	26,95	30,31	37,51	30,14
Average	23,82±0.51 <sup>a</sup>	27,71±0.66 <sup>b</sup>	29,97±0.79 <sup>c</sup>	37,56±0.05 <sup>d</sup>	30,95±0.72 <sup>c</sup>

Description: The values shown are means ± standard deviation; different letters in the same column indicate a significant difference between treatments

The results of the analysis of variance (ANOVA) indicate that the inclusion of fermented copra meal treated with EM4 in the diet has a significant effect on the feed efficiency of gorami fingerlings ( $P < 0.05$ ). Post-hoc tests showed that P3 (75% fermented copra meal flour in the feed) resulted in the highest feed efficiency and was significantly different from P0, P1, P2, and P4. P0 (without fermented copra meal flour) resulted in the lowest feed efficiency and was significantly different from P1, P2, P3, and P4.

Table 3 shows that the highest feed efficiency was observed in P3 (52.31%), while the lowest was observed in P0 (0%; 40.05%). The P3 diet is the best formulation, as it is optimally utilized by gorami and

exhibits high feed digestibility. Feed efficiency is influenced by good feed digestibility and sufficient, balanced nutrients, enabling the fish to utilize the feed for growth. According to Mustofa et al.<sup>14</sup>, high feed efficiency indicates that the feed provided is of good quality. The better the quality of the feed, the higher the feed efficiency. This aligns with the statement by Jhena et al.<sup>15</sup>, who noted that feed digestibility is one of the key indicators determining feed efficiency. Analysis of variance (ANOVA) revealed that fermented copra cake meal had a significant effect on protein retention in gorami ( $P < 0.05$ ).

Table 4 shows that protein retention in gorami fish ranged from 23.82% to 37.56%. The highest protein retention was observed

in P3 (75% fermented copra meal in the diet), at 37.56%. This is because the diet containing 75% fermented copra cake flour has the highest protein digestibility, allowing the fish to retain more dietary Protein as body protein. This aligns with the findings of Setiawati et al.<sup>16</sup>, who stated that protein retention values influence increases in fish body protein and growth rates.

The high protein retention rate in P3 (the use of 75% fermented copra meal in the diet) is due to gorami's ability to utilize dietary Protein more efficiently, as indicated by the diet's high protein digestibility and feed efficiency. This is consistent with Setiawati et al.<sup>16</sup>, who noted that high protein retention in feed is typically due to the

protein content being effectively utilized and absorbed by the fish. Additionally, Setiawati et al.<sup>17</sup> stated that the protein content in fish feed has a direct relationship with protein synthesis in the body. An increase in protein levels in the body indicates that fish can make optimal use of the protein provided through feed to meet their body's needs, such as metabolism, repair of damaged cells, and increased body protein.

### Specific Growth Rate of Gorami Fish

Growth is the increase in length and weight of an organism over a unit of time<sup>18</sup>. The weight gain of gorami fish fry during rearing is shown in Figure 1, and the specific growth rate data are presented in Table 4.

**Table 4.** Specific growth rate of gorami fish

Test	Treatment (TBKF%)				
	P0 (0)	P1 (25)	P2 (50)	P3 (75)	P4 (100)
1	3,19	3,70	3,78	4,05	3,88
2	3,31	3,65	3,69	4,04	3,80
3	3,26	3,68	3,69	4,05	3,89
Average	3,25±0.06 <sup>a</sup>	3,68±0.02 <sup>b</sup>	3,72±0.05 <sup>b</sup>	4,05±0.01 <sup>d</sup>	3,85±0.27 <sup>c</sup>

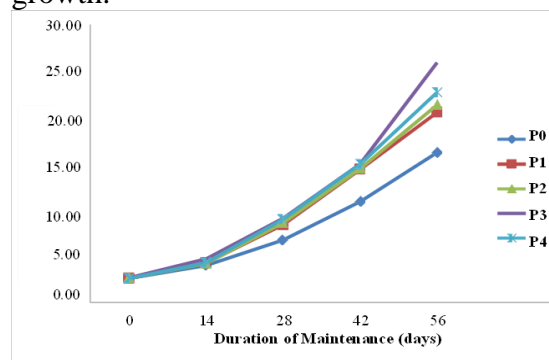
Description: The values shown are means ± standard deviation; different letters in the same column indicate a significant difference between treatments

The study found that after rearing gorami for 56 days, the use of fermented copra meal in the test diets resulted in varying increases in gorami weight. The average weight of the gorami fish increased with the duration of the rearing period. The use of fermented copra meal in the feed (P1, P2, P3, and P4) resulted in different and higher increases in gorami fish weight compared to the treatment without fermented copra meal (P0) (Figure 1).

Table 4 shows that the specific growth rate of gorami fry during the study ranged from 3.25% to 4.05%. The highest specific growth rate was observed in treatment P3 (4.05±0.00%), and the lowest was in treatment P0 (3.25±0.06%). The results of the Analysis of Variance (ANOVA) test indicate that the use of fermented copra meal significantly affects the specific growth rate of gorami fish fry ( $P < 0.05$ ).

The highest specific growth rate was obtained in P3, at 4.05 ± 0.00%. The high

specific growth rate in P3 was due to the gorami's ability to utilize feed effectively, which aligns with feed digestibility, feed efficiency, and high protein retention. High feed efficiency indicates efficient feed utilization, meaning that only a small amount of nutrients is broken down to meet energy needs, with the remainder available for growth<sup>14</sup>. Islamiyah et al.<sup>19</sup> state that high fish growth rates are driven by efficient feed utilization, which provides energy for better growth.



**Figure 1.** Weight gain of gorami fish fry

### Survival Rate

The survival rate of gorami fry during rearing ranged from 90.7% to 100%. This figure indicates that the survival rate of gorami fry during rearing is good, as reported by Karimah & Samidjan<sup>20</sup>, who noted that survival rates > 50% are good, 30–50% moderate, and < 30% poor. The high survival rates of gorami fry in P1, P2, P3, and P4 indicate that TFBK can replace soybean meal as a feed ingredient, as it is effectively utilized by gorami for survival

and growth. According to Gaol<sup>21</sup>, fish survival is influenced by two factors: external and internal factors. External factors include abiotic factors such as competition between species, increased fish populations within the same habitat, increased predators and parasites, and food shortages, as well as other biological factors. Meanwhile, internal factors consist of the age and ability of fish to adapt to their environment. The survival data for gorami fry during the study are presented in Table 5.

**Table 5.** Survival rate of gorami fish fry

Test	Treatment (TBKF%)				
	P0 (0)	P1 (25)	P2 (50)	P3 (75)	P4 (100)
1	92	92	92	100	96
2	88	96	100	100	100
3	92	92	100	100	92
Average	90,7± 2,30 <sup>a</sup>	93,3± 2,30 <sup>ab</sup>	97,3 ± 4,61 <sup>ab</sup>	100± 0,00 <sup>b</sup>	96,0± 4,00 <sup>ab</sup>

Description: The values shown are means ± standard deviation; different letters in the same column indicate a significant difference between treatments

### 4. CONCLUSION

The use of coconut meal fermented with EM4 in the feed significantly improved feed efficiency, protein retention, and the specific growth rate of gorami fry. The use of 75% fermented copra meal (P3) yielded the best results for feed digestibility (57.63%), protein digestibility (80.08%),

protein retention (37.56%), feed efficiency (52.31%), and specific growth rate (4.05%).

It is recommended that further research be conducted on the use of fermented copra meal using different fermenters to determine the optimal quality of copra meal after fermentation.

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