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ADDITION OF PHYTASE IN ARTIFICIAL FEED GIVEN TO GIANT GOURAMI FISH FRY (*Osphronemus gouramy*)

PENAMBAHAN FITASE DALAM PAKAN BUATAN YANG DIBERIKAN PADA BENIH IKAN GURAMI (*Osphronemus gouramy*)

Andi Nikhlani*, Henny Pagoray, Agus Riang
Study Program of Aquaculture, Faculty of Fisheries and Marine Sciences, Mulawarman University,
Jl. Kuaro PO Box 1068, Samarinda 75119, East Kalimantan, Indonesia
*Corresponding author: andi.nikhlani@fpik.unmul.ac.id

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ABSTRACT

Efficient feed is very important to understand the quality and quantity of feed concerning fish growth, if the fish consumes feed with the proper nutritional requirements for the fish's body needs. The amount of nutrients used by the fish's body will be minimal. One of the common problems in the process of making artificial feed is the use of vegetable protein in suboptimal feed due to the presence of anti-nutritional factors called phytic acid, which can reduce the amount of nutrients such as protein and minerals, and will affect the growth of the organism. This study aims to analyze the transformation and efficiency of feed in giant gourami fish fry by adding phytase enzymes to artificial feed. The data collected were displayed in tables and bar charts and analyzed using descriptive methods. The findings of the study stated that the addition of 3 mg/kg phytase to the feed produced better results than the control and other phytase doses (1 g/kg feed and 2 g/kg feed) in terms of feed conversion (1.02), feed utilization efficiency (97.77%), increased in total length (7.22 cm), and increased in absolute weight of giant gourami fish fry (197.44 g). During the study, water quality was measured at a temperature of 27-28°C, pH 6-7.3, oxygen levels of 4.8-6.3 mg/L, and ammonia levels of 0.02-0.08 mg/L.

Keywords: feed, giant gourami, phytase, seeds

ABSTRAK

Pakan yang efisien sangat penting untuk memahami kualitas dan kuantitas pakan sehubungan dengan pertumbuhan ikan jika ikan mengonsumsi pakan dengan keperluan nutrisi yang pas pada kebutuhan tubuh ikan. Jumlah nutrisi yang digunakan oleh tubuh ikan akan minimal. Salah satu masalah umum dalam proses pembuatan pakan buatan adalah penggunaan protein nabati dalam pakan suboptimal karena adanya faktor anti-nutrisi yang disebut asam fitat, yang dapat mengurangi jumlah nutrisi seperti protein dan mineral, dan akan memengaruhi pertumbuhan organisme. Penelitian ini bertujuan untuk menganalisis transformasi dan efisiensi pakan pada benih ikan gurami dengan memasukkan enzim fitase ke dalam pakan buatan. Data yang dikumpulkan ditampilkan dalam bentuk tabel dan diagram batang, dan dianalisis memanfaatkan metode deskriptif. Temuan penelitian menyatakan bahwa penambahan 3 mg/kg fitase ke dalam pakan menghasilkan hasil yang lebih baik daripada dengan kontrol dan dosis fitase lainnya (1 g/kg pakan dan 2 g/kg pakan) dalam hal konversi pakan (1,02), efisiensi penggunaan pakan (97,77%), peningkatan panjang total (7,22 cm), dan peningkatan berat mutlak benih ikan gurami (197,44 g). Selama penelitian, kualitas air diukur pada suhu 27-28°C, pH 6-7,3, tingkat oksigen 4,8-6,3 mg/L, dan tingkat amonia 0,02-0,08 mg/L.

Kata kunci: benih, fitase, gurami, pakan

INTRODUCTION

Giant gourami fish (*Osphronemus goramy*) is a major commodity in freshwater aquaculture, with production and demand continuing to grow year by year. The Ministry of Marine Affairs and Fisheries (2022) stated that fish cultivation will reach 56,539 tons in 2022. The high production level reflects the high demand for giant gourami fish products. The cultivation of the fish in Indonesia is currently very promising, with selling prices ranging from Rp 36,000 to 40,000/kg for consumption size, while the price of 3-5 cm (razor size of fish fry) is Rp 3,000 (Djamil *et al.* 2023).

The very slow growth of giant gourami compared to other freshwater fish commodities is one of the many challenges that continue to be faced by the giant gourami fish aquaculture entrepreneurs. It takes about 1.5 years for 2-3 cm seeds to reach an edible size of 500 g per fish (Wibawa *et al.* 2018; Pio *et al.* 2023). The low digestibility (or efficiency of material and energy use) in the feed given contributes to the low growth rate of the fish, with insufficient energy for growth (Monalisa *et al.* 2022).

Until now, the main source of plants in feed has been grains, including soybeans. Anti-nutrients, including phytic acid, are found in the grain group, including rice, nuts, and coconut (Rachmawati and Samidjan 2014). Phytic acid at pH 7.4 will form a complex with the minerals Cu^{2+}, Zn^{2+}, Co^{2+}, Mn^{2+}, Fe^{2+}, and Ca^{2+}, which results in salt precipitation. This process interferes with the assimilation of nutrients by blood.

Phytic acid reduces the bioavailability of nutrients, such as minerals and proteins. Phytic acid forms complexes with calcium, magnesium, copper, zinc, carbohydrates, and proteins until the digestibility of these nutrients is reduced (Suprayudi *et al.* 2012). Phromkunthong *et al.* (2002) stated that some plant materials contain fibre that is difficult for fish to absorb, which causes inefficient feed utilization and hurts fish growth. Fahlevie *et al.* (2023) indicated that heating can reduce phytic acid levels, but this process can also reduce the nutrient content in the feed. The incorporation of enzymes into the feed is very important to reduce the concentration of phytic acid in the feed while maintaining nutritional integrity and increasing nutrient absorption in fish. Rachmawati *et al.* (2017) stated that the phytase enzyme in feed increases nutrient absorption and manages the excretion of nutrients such as phosphorus, nitrogen, and minerals. The phytase enzyme effectively reduces anti-nutritional factors, especially phytic acid, thereby increasing feed capacity and promoting growth.

Research has been conducted on the function of the phytase enzyme in feed conversion and efficiency, as well as its impact on fish survival and growth. Fahlevie *et al.* (2023) stated that the administration of phytase enzymes with different doses had a significant impact on total length, weight, feed efficiency, and proportion of feed transformation in snakehead fish (*Channa striata*) fry. Research conducted by Restianti *et al.* (2016) showed that the use of phytase doses in artificial feed had a significant impact on the relative growth rate (RGR), feed utilization efficiency (FUE), and feed conversion ratio (FCR) in tilapia (*Oreochromis niloticus*) fry. The best dose determined to increase growth and feed application efficiency was 1,200 mg/kg, creating a relative growth rate (RGR) of 12.2% per day, protein utilization efficiency (EPP) of 68.4%, and protein efficiency ratio (PER) of 2.25%. This did not have a significant impact on fish survival.

The phytase enzyme is expected to release essential minerals from phytate bonds in feed ingredients. It also plays a role in the capacity of feed enzyme supplements, increasing the absorption and use of nutrients that are blocked by anti-nutrient compounds. This study aims to analyze the transformation and efficiency of feed in giant gourami fish fries by incorporating a phytase enzyme into artificial feed.

METHODS

Time and location

This research was conducted for two months (May-July 2023) at the Experimental Pond Laboratory (feed production and maintenance) and the Aquaculture Environment Laboratory (water quality monitoring) of the Faculty of Fisheries and Marine Sciences, at Mulawarman University, Samarinda, East Kalimantan.

Research design

This study utilized 100 g of PF-800 pellets, which were then added with 0.5 g of progol (calcium lignosulfonate) and phytase enzyme according to the specified dosage.

Furthermore, 12.5 cc of water was added to the mixture. The feed that had been given water was homogenized to obtain consistency and then placed in a tray to be dried at a temperature of 50°C for approximately 24 hours. The dosage of phytase enzyme in artificial feed is described as follows: P1 is feed without phytase enzyme (control), P2 consists of test feed with a phytase enzyme concentration of 1 g/kg, P3 contains a phytase enzyme concentration of 2 g/kg, and P4 contains a phytase enzyme concentration of 3 g/kg.

Research procedures

Fish fry rearing

The gurami fish fry used a ceramic tub measuring 4.8 m x 3.3 m x 1 m in which 12 green hapas were installed as a place to maintain the green hapas with dimensions of 1 x 0.5 x 0.5 m^2, and the ceramic tub was filled with water to a height of 60 without changing the water during the study. The gurami fish fries were kept in as many as 10 individuals/happa net with a weight of ± 8-10 g and a length of ± 8-10 cm.

Initial length and weight measurements

The body length of the fish was measured using a ruler placed on styrofoam. The mass of the fish seeds was measured using a scale with an accuracy of 0.01 g. The total weight of the fish seeds included the cumulative weight of the 10 fish that were spread, then the average was calculated to determine the weight of the seeds per individual. The body length and weight of the fish fry were measured at the beginning and end of the study.

Water quality measurement

Throughout the rearing of giant gourami fish fry, water quality parameters, including temperature, pH, and dissolved oxygen, were measured twice a day (morning and evening). Ammonia measurements were carried out weekly.

Data collection and processing

Feed conversion rate

The calculation of feed conversion was calculated using the Zonneveld *et al.* (1991) formula, as follows:

$$FCR = \frac{F}{(Wt + D) - Wo}$$

Where:
FCR = Feed conversion ratio
F = Total amount of feed consumed during maintenance (g)
Wt = Total weight of fish at the end of the study (g)
D = Total weight of dead fish in the study (g)
Wo = Total weight of fish at the beginning of the study (g)

Feed utilization efficiency

The efficiency calculation formula based on Zonneveld *et al.* (1991) is as follows:

$$FE = \frac{Wt - Wo}{F} \times 100\%$$

Where:
FE = Feed utilization efficiency (%)
Wt = Total weight of fish at the end of the study (g)
Wo = Total weight of fish at the beginning of the study (g)
F = Total amount of feed consumed (g)

Total length growth

Total length growth is the difference between the average total length at the end of the study and the average total length of the fish at the beginning of the study. The calculation was carried out according to the formula established by Zonneveld *et al.* (1991), as follows:

$$L = Lt - Lo$$

Where:
L = Total length growth (cm)
Lt = Standard length of fish at the end of the study (cm)
Lo = Standard length of fish at the beginning of the study (cm)

Specific growth rate (SGR)

The specific growth rate (SGR) was calculated using the formula from Zonneveld *et al.* (1991) as follows:

$$SGR = \frac{(\ln Wt - \ln Wo)}{t} \times 100\%$$

Where:
SGR = Specific daily growth rate (%/day)
Wt = Fish weight at the end of the study (g)
Wo = Fish weight at the beginning of the study (g)
t = Length of study (days)

Water quality

Water quality measurements for temperature were carried out twice a day, in the morning and evening, while pH, dissolved oxygen, and ammonia measurements were carried out weekly.

Data analysis

Information on the ratio of feed conversion, feed efficiency (in percentage), total length growth (in centimeters), absolute weight gain (in grams), and water quality was included in the data collected during the study. The results of the calculations on the data were displayed in the form of tables and histogram graphs and analyzed descriptively.

RESULTS AND DISCUSSION

Feed conversion rate

Temperature measurements for water quality were carried out twice a day, namely in the morning and evening. Feed conversion refers to the feed yield required to produce 1 kg of fish meat. Feed conversion is often used to assess feed quality concerning fish growth (Amin *et al.* 2020). In addition, it was emphasized that many conditions affect feed conversion. Isnawati *et al.* (2015) stated that feed digested by fish is metabolized by the body, allowing the absorption of nutrients into body tissues, which facilitates growth. Escalation of feed efficiency values indicates that the feed utilized is of high quality. Measurements of pH, dissolved oxygen, and ammonia are carried out every week at night.

The quantity of feed given can be known by calculating the feed conversion ratio (FCR), which compares the amount of feed given with the amount of fish weight gain. The feed conversion rate showed that the provision of phytase enzyme was not significantly different (P>0.05) (Figure 1).

Figure 1 shows the feed conversion ratio during the 60-day maintenance period for giant gourami fry, with a high average value in treatments P1 and P2, both containing 1 g/kg of feed phytase enzyme, resulting in an identical value of 1.08. In treatment P3, with the addition of 2 g/kg of feed phytase enzyme, the average value was 1.05, but the feed conversion ratio in treatment P4, with the addition of 3 g/kg of feed phytase enzyme, was relatively lower at 1.02.

This may occur in the P4 treatment, where the feed conversion value was higher compared to the other three treatments because the fish fry was able to use the phytase enzyme added to the artificial feed effectively. The increase in phytase enzyme in the feed content catalyzes the hydrolysis reaction of phytic acid contained in the plant components in fish feed, as shown in the P4 treatment. Phytase enzymes can hydrolyze phytic acid, regulate the excretion of minerals, phosphorus, and nitrogen, and absorb nutrients (Kosim *et al.* 2016). Ardita *et al.* (2015) found that when the feed conversion ratio (FCR) is low, fish utilize the food they eat well, leading to faster growth. Meanwhile, according to Hutagalung *et al.* (2024), the combination feed treatment is effective in suppressing FCR, which is 0.58 (in tilapia) and 1.77 (in catfish). This means that the lower the FCR value obtained, it shows how well the fish can digest and utilize the nutrients obtained from the feed given to increase their body weight.

Feed utilization efficiency

Feed utilization efficiency is the ratio of fish weight growth to the quantity of feed used throughout a certain cultivation period, which is represented as a percentage. Fish feed utilization efficiency depends on the type and quantity of feed given, fish size, and water quality. Figure 2 illustrates the results of research on feed utilization efficiency in giant gourami fish seeds during the study.

The results of the study for 60 days, after further testing, showed that feed utilization efficiency was not significantly different between the treatments (P>0.05). Figure 2 illustrates that the highest average feed utilization efficiency was recorded in treatment P4, which contained 3 g/kg phytase enzyme, with a value of 97.77%. This was followed by treatment P3, with 2 g/kg phytase enzyme, which reached 95.52%. Treatment P2, which used 1 g/kg phytase enzyme, produced a value of 92.52%, while treatment P1 (control), without phytase enzyme, produced a value of 92.76%. Giant gourami fish fry is believed to be able to digest commercial feed added with phytase enzyme. This study aims to determine the best dose of phytase enzyme for giant gourami fry. Mukti *et al.* (2021) stated that increased feed utilization efficiency correlates with increased feed utilization. Afrianto and Liviawaty (2005) stated that the utilization of fish feed is influenced by various factors, including the quantity of feed, type of feed ingredients, content of nutrients, type of digestive enzymes in the fish digestive system, dimensions and age of fish, and physical and chemical properties of water. Liao *et al.* (2015) stated that the existence of enzymes and the level of digestive enzyme activity in the fish alimentary system are additional factors that influence feed utilization.

Total length growth

Growth indicates changes in fish dimensions, including weight, length, or volume, over a certain duration, caused by tissue modification due to muscle and bone cell division, which are the largest parts of the fish's body, causing an increase in weight and length (Effendie 2002).

The results of total length growth were obtained by determining the difference in seed length at the end of the study compared to the beginning of the study. Figure 3 illustrates the total length growth of giant gourami fish fry throughout the study.

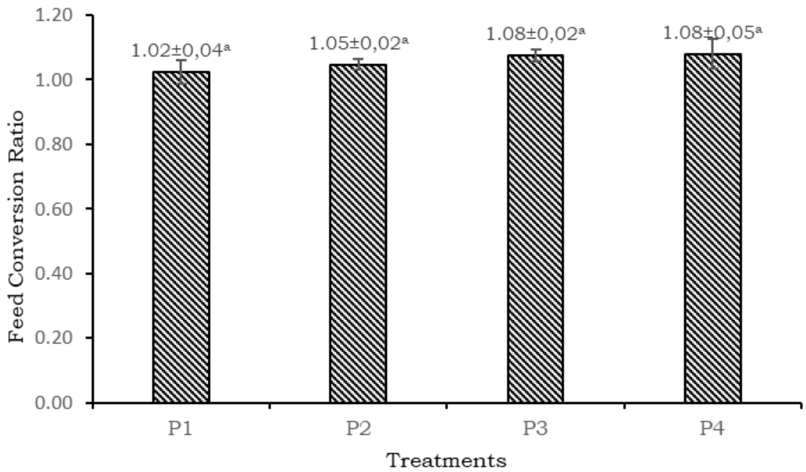

Figure 1. Feed conversion ratio of giant gourami fish fry during the study.

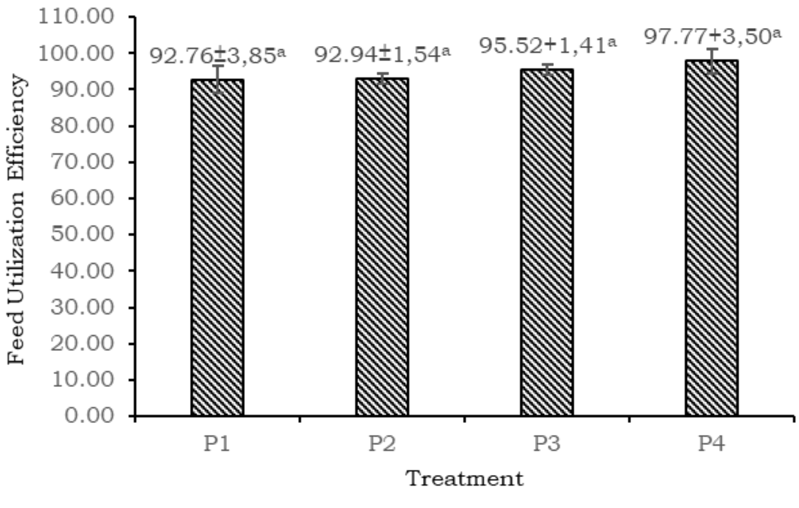

Figure 2. Feed utilization efficiency of giant gourami fish fry during the study.

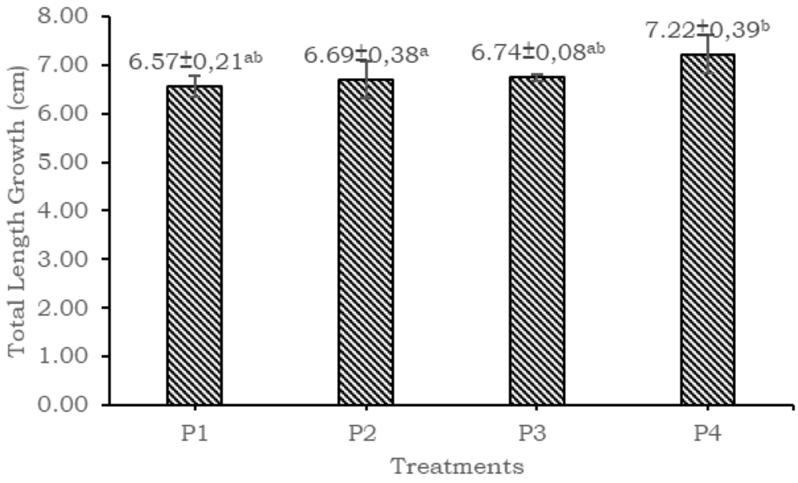

Figure 3. The total length growth of giant gourami fish fry throughout the study.

The results of the study on the total length growth of giant gourami fish fry during 60 days of maintenance stated that the P4 treatment achieved the highest measurement of 7.22 cm, followed by treatment 3 of 6.74 cm, treatment 1 (control) of 6.69 cm, and the lowest measurement of 6.57 cm in treatment 2. The results of the analysis of variance (ANOVA) stated that the provision of phytase enzyme in the fish fry did not have a clear impact on the total length growth of giant gourami fish fry. The results of the analysis of variance (ANOVA) stated that the provision of phytase enzyme in the fish feed did not affect the overall length growth of fish fry. The results of the analysis of variance (ANOVA) showed that the provision of phytase enzyme in artificial feed had no significant impact on the total length growth of giant gourami fish fry (P>0.05). However, the results of the DMRT (Duncan's Multiple Range Test), which can be seen in Figure 3, stated that the P4 treatment was significantly different from the P2 treatment, while there was no relevant discrepancy in the P1 and P3 treatments. The total length growth of fish showed a positive correlation with the increase in the dose of phytase enzyme. The addition of phytase enzymes to feed is believed to reduce the levels of phytic acid in vegetable raw materials, thus affecting the digestion process in the intestines of fish and having an impact on growth in length. Anggani *et al.* (2021) stated that optimal feed utilization in fish can increase length and weight. Sani (2014) stated that the addition of phytase enzyme to artificial feed will increase the hydrolysis reaction; however, at a certain threshold, excessive addition of phytase produces a constant amount of hydrolysate due to the ineffectiveness of the enzyme.

Specific growth rate

The percentage of the specific growth rate of giant gourami fish fry with the addition of a phytase enzyme to the feed during the study can be seen in Figure 4. Figure 4 shows that treatment P1 showed the highest average percentage of the specific growth rate of the fish fry, which was 3.36% per day, followed by treatment P4 at 3.25% per day, then treatments P2 and P3 at 3.19% per day. The addition of the phytase enzyme did not have a significant effect on the specific growth rate of giant gourami fish fry (P>0.05).

Analysis of variance (ANOVA) states that giving of phytase enzyme to fish does not affect the specific growth rate of fish seeds. Figure 4 states that the specific growth rate in this study is greater than the study of Zulaeha *et al.* (2015), which was able to increase the specific growth rate of humpback grouper by 2.24/day, and also in the study of Pratama *et al.* (2015), which was only able to increase the specific growth rate of saline tilapia by 1.96/day. The addition of phytase enzyme to the feed increases growth by increasing the availability of nutrients and minerals, which is facilitated by the division of phytic acid and complex minerals through the phytase enzyme (Orisasona and Ajani 2015). The phytase enzyme degrades phytic acid in the feed to increase protein utilization. In addition, this enzyme can break down bonds in phytic acid and protein, as well as complex minerals, thus affecting enzymatic activity, especially those involved in the hydrolysis of protein into amino acids (Rachmawati and Samidjan 2014). According to Subhan (2014), the rate of fish growth is influenced by the availability of feed and environmental conditions.

Water quality

The water quality in the maintenance media for each treatment is classified as good and met the requirements for giant gourami life. The water temperature observed throughout the study ranged from 26 to 30°C, which is considered optimal for that fish's growth. Kordi and Tanjung (2007) stated that good water quality parameters for giant gourami fish cultivation are at a temperature of 26-33°C.

During the study, the pH of the water in the maintenance container fluctuated between 6.1 and 8.7. These conditions remain conducive to the growth of fish fry. According to Muflikhah *et al.* (2008), fish have a wide tolerance to acidity levels ranging from 5 to 9, but the optimal acidity level for the growth of giant gourami fish is 6.0 to 8.5.

The concentration of dissolved oxygen during the maintenance phase of giant gourami fish fry ranged from 5.2 to 5.3 mg/l, which is very good for the survival and growth of the fish. Schmittou and Emeritus (1993) indicated that the concentration of dissolved oxygen during the maintenance period ranges from 4.1 to 5.8 mg/l. This value is considered appropriate for the life needs of the fish fries. Rahmawati *et al.* (2015) stated that the ideal dissolved oxygen content for fish growth is 3-8 mg/l.

Ammonia measurements were carried out every five days in the morning, with concentrations in the giant gourami seed maintenance container ranging from 0.013 to 0.072. Ammonia in this study was maintained at an ideal concentration for the survival of the fish. Jumaidi *et al.* (2017) confirmed that the ammonia content in the fish cultivation containers has a tolerance value of less than 1 mg/l.

CONCLUSION

Adding phytase enzyme into artificial feed for giant gourami fish fry did not produce significant differences (P>0.05) in feed conversion ratio, feed utilization efficiency, and specific growth rate. The results of the analysis of variance (ANOVA) stated that there was no significant effect on total length growth. Based on the results of the DMRT (Duncan's Multiple Range Test), the P4 treatment was significantly different from the P2 treatment, but not significantly different from the P1 and P3 treatments.

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