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The effect of *Lemna perpusilla* Torr. (Araceae) as fodder in the growth of *Osphronemus goramy* Lacépède, 1801

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ABSTRAK

Produksi ikan gurami sebagai ikan konsumsi tergolong lama, karena mencapai ukuran komersial dalam waktu 1—2 tahun, lebih lama dibandingkan ikan komersial lainnya. Oleh karena itu, produksi ikan terhambat oleh biaya pakan yang lebih tinggi. Merupakan praktik umum dalam pemeliharaan ikan gurami, bahwa petani melengkapi pakan komersial dengan pakan yang tersedia secara alami, terutama dari bahan seperti daun talas. Namun, beberapa bahan mungkin mengandung lebih sedikit nutrisi, dibandingkan dengan yang lain. Itulah sebabnya kami mengusulkan penggunaan Lemna perpusilla*, aroid air yang tersebar luas sebagai suplemen pakan ikan gurami. Kami mengukur pertumbuhan benih ikan gurami, yaitu panjang (cm) dan berat (g) dan menemukan bahwa ikan dengan pelet* L. perpussila *mencapai panjang dan berat lebih tinggi dibandingkan dengan yang menggunakan pelet komersial. Penelitian berpotensi bermanfaat untuk pengelolaan gulma air tawar serta produksi ikan dengan modal rendah, yaitu produksi pedesaan.*

Kata kunci aroid, gulma air, kombinasi pakan

ABSTRACT

Production of gourami as consumption fish is rather lengthy, as it attains commercial size in 1—2 years, longer than other commercial fish. Therefore, fish production is hampered by higher fodder costs. It is a normal practice in gourami rearing, that farmers supplement commercial fodder with naturally available fodder, especially from material such as taro leaves. However, some materials may contain less nutrients, compared to others. It is why we propose the use of Lemna perpusilla*, a widely distributed water aroid as gourami fodder supplement. We measured the growth of gourami fries, which are length (cm) and weight (g) and found that fishes with* L. perpussila *pellet attain higher length and weight compared to those using commercial pellet. This research may be beneficial for freshwater weed management as well as fish production with low capital, i.e. village production.*

Keywords**: **aroid, fodder combination, water weed

INTRODUCTION

In Indonesia, fresh waters is major arable fishing farming area. There are several species of fresh water fishes locally familiar as consumption fishes as tilapias, carps, catfishes, gouramis, tambaqui, etc. One major species is a native fish species, the gourami (*Oshpronemus goramy* Lapecede, 1801), which is one of the leading species in

Indonesian fresh water fish consumption (Virnanto et al., 2016). Gourami is a popular species, because it reproduces quickly, consume wider range of fodder, and sold at a commercially lucrative price (Bhattacharya et al., 2016). In the wild, gourami consume specific foods specific to the growth stage. Gourami's larva and fries eat microorganisms such as phytoplankton, zooplankton, *Chlorella*, water fleas, insect larvae and adult water insects. Meanwhile, adult gouramis tend to prefer plants (Andriani et al., 2018). While gourami has very delicious meat, thus popular in Indonesian cuisine, it has relatively limited production due to its long rearing period, which takes up between 1 to 2 years to be harvested and consumed (Slembrouck et al., 2020). This slow growth inflicts farmer's high production cost as the more fodder needed to achieve commercial body size. Therefore, there are many research and application available to find alternative cheaper fodder in reducing production cost.

Various ways to stimulate the growth of gourami have been done, such as providing natural fodder as taro leaves (locally *sente*) as substitute fodder, but it has little effect on growth because the main fodder for gourami fish is so far the commercially produced pellets. One of the alternatives to reduce production costs by modifying fish fodder through the utilization of locally available materials that are relatively cheap but contains good nutrition, easy to obtain, and easy to process (Bano et al., 2020). Complete fish fodder must contain nutrients such as protein, fat, carbohydrates, vitamins and minerals in sufficient quantities for the growth of fish. Among which, protein is the most important component (Bano et al., 2020).

One of the alternative raw materials used in making modified pellets is *Lemna perpusilla* (Araceae). *L. perpusilla* is a small aquatic aroid grows floating on water with a very wide distribution. Native to Meso-America, it has spread widely to Europe and Asia, including Indonesia (POWO, 2024) and potential as a source of high quality fodder for pisciculture. Eventhough *L. perpusilla* is sometimes regarded as water weed difficult to control (Nopriani et al., 2014), this plant contains high protein, so it is often used as processed forage, easy to find, and obtained. This plant contains many important minerals that support fish growth, as well as protein, carbohydrates, fat, fiber, and fat (Chrismadha et al., 2016).

L. perpusilla can absorb nutrients from water, such as nitrogen and phosphorus, thereby reducing water pollution and preventing excessive algae growth. Thus, *L. perpusilla* can help maintain good water quality for the growth of gourami (Anggraini et al., 2017). The benefits of *L. perpusilla* can also be used to provide oxygen, increasing the concentration of dissolved oxygen in water. The oxygen produced is important for gourami respiratory system and encourages healthy fish growth. *L. perpusilla* is used as a potential fish feed because it is easy to grow, has high yields, and is cheap to produce (Nopriani et al., 2014). This is reflected in its cheaper price compared to the price of one kilogram of fish feed. The price of *L. perpusilla* is cheaper than the price of one kilogram of fish feed or even in certain areas. This *L. perpusilla* is easy to get with less money spending.

METHODOLOGY

Tools and materials

The tools used during this research were plastic buckets, blenders, measuring cups, trays, digital scales, and ruler. Tools and materials for preparing ponds consist of a knife, hammer, cable ties, wire, cages, nails and ropes. Ingredients used to make artificial feed are fermented tofu dregs, rice bran, daphnia, and *L. perpusilla* (**Figure 1**).

FIGURE 1. *L. perpusilla* used in this research.

Research site

Data collection was carried out at PPISHP (Production, Inspection and Results Certification Center Fisheries), Ujung Menteng Fish Seed Center, Jl. Irrigation, RT.1/RW.8, Ujung Menteng, Kec. Cakung, East Jakarta City, Special Capital Region of Jakarta, 13960. Field work was done from August to October 2023.

Pond Preparation

Before the testing research begins, do it first container preparation. The research containers used were 16 ponds with each measuring 60 x 60 x 40 cm. All ponds are connected using cable ties on a mine that has been stretched and tied from the right side of the pool to the left side of the pool use wooden stakes. Each pond is distanced of 5 cm so that it is not too close together. For treatment P0 is located on the left side of the pool while treatment P1 is located on the right side pool. In treatments P0 and P1, they were separated by wooden stakes installed in the pond. The distance between each treatment was 60 cm. Water quality on each pond is ensured to maintain uniformness.

Gourami preparation

The gourami fries used were obtained from local semi-intensive breeder. The fries are sorted by according to similar weight alength. One fry is put in a pond in two treatment groups.

Control fodder and *L. perpussila* fodder

The control fodder used was commercially PF 781-2 (Central Proteina Prima) pellets, while our *L. perpussila* pellets consist of *L. perpusilla* 40%, rice bran 20%, fermented tofu dregs 20%, and daphnia 20%. All the ingredients except rice bran is processed in a blender. Once it is homogenous, rice bran is added to knead the mixture. Small pellet granules is made by pushing the knead through a sieve. Pellets are dried in the sun for three days.

Rearing and observation

Rearing and observation of the fishes was carried out for 8 weeks total 16 ponds with 2 treatments and 3 repetitions. Rearing is carried out by providing regular fodder with dose of about 4 grams/day (10% body mass) for each treatment. Fish are given their designated fodder (*L. perpusilla* and PF 781-2 pellets), two times a day, every 08:00 and 16:00, by scattering the fodder on water level. The fodder given as much as 10% of fish's body weight.

1. Weight

The weight growth of gourami fish is measured using a digital scale with an accuracy of 1 g. The absolute weight of gourami fish is measured using the following formula:

$$W = Wt - W0$$

W : absolute weight growth (grams)
Wt : final body weight (grams)
W0 : initial body weight (grams)

2. Length

Absolute length growth measurements are carried out periodically from the beginning until the end of the study by measuring the total length of the fish snout to tailend using a ruler. The formula used to measure length fish are:

$$Lm = Lt - L0$$

Lm : Absolute length growth (cm)
Lt : Body length at the end of the study (cm)
L0 : Initial body length of the study (cm)

Data analysis

The data analysis technique used was Complete Randomized Design (CRD) using ANOVA test was used to determine the effect of providing control (P0) *and L. Perpusilla* pellet (P1) and followed by Duncan post-hoc test to determine the comparison of the average weight and length of gourami. The test was performed in SPSS.

RESULTS AND DISCUSSION

ANOVA test of gourami fish weight

TABLE 1. ANOVA test of gourami fish weight

Tests of Between-Subjects Effects					
Dependent Variable: Weight					
Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	54.550[a]	15	3.637	57.633	.000
Intercept	1845.988	1	1845.988	29255.203	.000
Variety	54.251	7	7.750	122.824	.000
Fodder	.046	1	.046	.223	.014
Variety * Fodder	.053	5	.036	.173	.033
Error	2.019	32	.063		
Total	1902.557	48			
Corrected Total	56.569	47			

a. R Squared = .964 (Adjusted R Squared = .948)

Table 1 shows that the average weight in treatment P0 is 0.46 and P1 is 0.53. The sig. weight value of 0.033 is smaller than 0.05, which signify a significant effect on the growth of the weight of gourami fish given pellet PF 781-2 and of *L. perpusilla* pellet.

ANOVA test of gourami fish length

In this ANOVA test of gourami fish length using the SPSS, the following results were obtained:

TABLE 2. ANOVA test of gourami fish length

Tests of Between-Subjects Effects					
Dependent Variable: Length					
Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	59.900[a]	15	3.993	678.390	.000
Intercept	2007.318	1	2007.318	341006.066	.000
Variety	58.009	7	8.287	1407.800	.000
Fodder	1.437	1	1.437	244.109	.035
Variety * Fodder	.454	7	.025	11.021	.048
Error	.188	32	.026		
Total	2067.406	48			
Corrected Total	60.088	47			

a. R Squared = .997 (Adjusted R Squared = .995)

Table 2 shows that the average lenght in treatment P0 is 1.437 and P1 is 0.454. The sig. lenght value of 0.048 is smaller than 0.05, meaning that there is a significant effect on the growth of the lenght of gourami given PF 781-2 and *L. perpusilla* pellets. Based on the table data, it can be seen that the P0 treatment has an average weight of 0.47 grams. While the P1 treatment has an average weight of 0.50 grams. Based on the results of the difference test that has been carried out, the sig. weight value of 0.033 is smaller than 0.05. So it can be concluded that the growth of gourami weight with different feeding has a significant average comparison. This calculation is proven by the average value and different symbols from the Duncan test results.

Duncan test of gourami fish length

Based on the long anova test above, the SIG value. below 0.05. Therefore, this research needs to be carried out further tests with a real difference test by Duncan test as stated in **Table 3**.

TABLE 3. Duncan test of gourami fish weight and length

No.	Treatment (Weight)	Average (Symbol)
1.	P0 = Pellet pf 781-2	0,47 (a)
2.	P1 = *Lemna perpusilla*	0,50 (b)
No.	**Treatment (Length)**	**Average (Symbol)**
1.	P0 = Pellet pf 781-2	0,49 (a)
2.	P1 = *Lemna perpusilla*	0,52 (b)

Table 3 showed that the P0 treatment has an average length of 0.49 cm. Whereas the P1 treatment has an average length of 0.52 cm. Based on the results of the different tests that have been carried out, the Sig value. length of 0.048 is smaller than 0.05. Then it can be concluded that the growth of the length of the gourami with different feeding has a significant average ratio. The results of observations and research data show that the growth of weight and length of gourami increases when given an artificial feed P1. During maintenance, the feed given to aquaculture must be sufficient and timely and contain sufficient nutrition. This is in accordance with information from the Department of Food and Fisheries Security (2018) which states that fish also need protein (essential amino acids), essential fatty acids, minerals, vitamins, and energy from various feed ingredients consumed by fish. Balanced nutrition in feed is an important factor in the fish farming business. Therefore, the nutritional needs for fish must be met in a balanced manner. If the feed is lacking in nutrition, the growth of the weight and length of the fish will be inhibited or can even cause symptoms of malnutrition.

Based on the ANOVA test it is known that the average weight of the P0 treatment was 0.46 and P1 of 0.53 Sig value. The weight of 0.033 is smaller than 0.05. While the average length of P0 treatment is 1,437 and P1 of 0.454. Sig value. length of 0.048 is smaller than 0.05. Then it can be concluded that there is a significant effect on the growth of weight and length of the gourami given PF 781-2 and *L. perpusilla* pellet.

Duncan test (table 3) showed that the P0 treatment has an average weight of 0.47 g. Whereas the P1 treatment has an average weight of 0.50 g. Based on the results of the different tests that have been carried out, the Sig value 0.033 is smaller than 0.05. In addition, the P0 treatment has an average length of 0.49 cm. Whereas the P1 treatment has an average length of 0.52 cm. Based on the results of the different tests that have been carried out, the Sig value 0.048 is smaller than 0.05, it can be concluded that the growth of weight and length of gourami with different feeding has a significant average ratio.

From the two testss it can be concluded that there is a significant effect and average ratio on the growth of the weight and length of the gourami feeding PF 781-2 pellet and *L. perpusilla* pellet.

The study was in accordance with research conducted by Wicaksono, et al (2018), where *L. perpusilla* added to the pellet can increase the growth of milkfish, both in length and weight. With the administration of *L. perpusilla* flour by 40%, milk fish showed the fastest and most efficient growth. *L. minor* states that the administration of fermented *L. minor* can increase the speed of specific growth, live survival, and efficiency of tilapia growth compared to control (Herawati et al., 2020). In addition, Patra (2015) states that the use of unknown species of *Lemna* sp. as a suplement powder for catfish can incrase relative growth rate of 4.60 ± 0.31%/day (Asriyanti et al., 2018). The use of *Lemna* flour (unknown species) fermentation in tilapia artificial fodder can increase total fodder consumption, efficiency of fodder utilization, and the rate of fish growth (Herawati et al., 2020). The use of fermented Lemna leaves in fodder can substitute soy flour and affect the growth rate of gourami (Khairudin et al., 2021). Substitution of 20% fermented *Lemna* leaf is the best treatment, producing 70.23% feed digestibility, 81.41 protein digestibility, 40.31%feed efficiency, protein retention of 31.05%, specific growth rate of 3.77%, and survival by 98.33%.

This research highlighted the utilization of weedy water aroid for consumption fish rearing. This will act as a alternative solution for environmental problem, as there is a high cost posed to river and lake managements in cleaning weeds. The use of weeds as fish fodder is potential means of reducing the weed problem in Indonesian native freshwater, even though its application may need further investigation.

Secondly, this research also highlighted the use of alternative high nutrient fodder source for consumption fish rearing. Especially in gourami which commercial size is attained longer than other fishes as tilapia or catfish, this alternative fodder may pose as a solution for the longer rearing time in reducing production cost.

CONCLUSIONS

The use of *L. perpusilla* in the mix fodder is proven to facilitate higher weight and length in the growth of gourami reared in artificial small pond, compared to the commercially available fish pellet.

AUTHOR CONTRIBUTIONS

SS, VZ, H: project conception; SS, VZ, H: methodology; SS: field work. SS, VZ, H: data analyses; SS, VZ: original manuscript draft; SS, VZ, H: manuscript review and editing.

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CONFLICTS OF INTEREST STATEMENT

There are no conflicts to declare.

DISCLOSURES AND ETHICS

As a requirement of publication author(s) have provided to the publisher signed confirmation of compliance with legal and ethical obligations including but not limited to the following: authorship and contributorship, conflicts of interest, privacy and confidentiality and (where applicable) protection of human and animal research subjects.

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