

## Addition of turmeric (*Curcuma longo* LINN) extract on artificial feed to increase feed efficiency and the growth of gourami (*Osphronemus goramy*)

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### ABSTRACT

Artificial feed consisting of anting spinach flour (*Acalypha indica* L) and mung bean sprout waste (*Vigna radiata*) with the addition of turmeric extract is a fish feed that has not been widely used as a source of vegetable protein raw materials. This study aimed to determine the effect of adding turmeric extract (*Curcuma longo* LINN) to the feed formula on increasing feed efficiency and growth of *Osphronemus gorami*. The test fish used was gourami with an average individual weight of  $5.04 \pm 0.5$  g/head. Feeding at 08.00, 12.00 and 16.00 with feeding at satiation. The test fish were reared with a stocking density of 13 fish/20 L, using a 30 liter bucket container with a maintenance period of 42 days. Completely Randomized Design (crd) was used 4 treatments and 3 replications. Each treatment contains 31.5-32.33% crude protein. The treatment is A: without spinach anting flour and bean sprout flour, B: 100% spinach anting flour and 0% bean sprout flour, C: 50% spinach anting flour and 50% bean sprout pulp flour, D: 100% test feed of bean sprout pulp flour and each treatment was repeated three times. The treatment tested was the same dose of turmeric extract added to the feed with treatments A, B, C and D, each dose was given the same (15 ml/kg feed). The result showed that feed consumption rate (TKP), feed utilization efficiency (FUE), protein efficiency ratio (PER), feed conversion ratio (FCR), protein efficiency ratio (PER), net protein utilization (NPU), relative growth rate (RGR), survival rate (SR) and water quality. The best EPP treatment was C  $95.92 \pm 2.49\%$ , and FCR value  $1.67 \pm 0.03$ . PER value  $3.00 \pm 0.077\%$ . net protein utilization (NPU) value  $1.78 \pm 0.02$ . The treatment with the best growth was treatment C, which was RGR  $6.11 \pm 0.07\%/day$ . The water quality in the rearing media was in the appropriate range for rearing the test fish.

**Keywords:** Spinach Earrings flour and bean sprouts waste; growth, gourami fish.

### Introduction

*Osphronemus goramy* has a higher economic value than other freshwater fish such as tilapia (*Oreochromis niloticus*), Freshwater Pomfret (*Collosoma* sp.) and catfish (*Clarias gariepinus*). People prefer gourami because the meat is more chewy and savory, but carp cultivators have not been able to use it optimally, considering its slow growth. The demand for gourami from year to year is increasing, this will also increase the need for artificial feed (pellets), and of course other feed raw materials such as soybean flour, soybean meal flour, fish meal, shrimp head flour whose needs are increasing over time, the price of raw material needs is also increasing. Several raw materials from the agricultural and livestock industries such as soybean meal, palm oil meal, rice bran, gluten, and others are also widely used. However, the

number is still limited. This condition causes the search for other fish feed raw materials. Some of the solutions are the use of anting spinach flour (*Acalypha indica*) and bean sprout waste (*Vigna radiata*), into the feed. Earring spinach flour and bean sprouts are rich in phosphorus, minerals and B-complex vitamins. Spinach Earrings flour (*Acalypha indica* L.), Anting spinach flour has water content of 7.09%, ash 16.87%, fat 5.07%, crude fiber 21.07%, and protein 19.64%. and Bean sprout waste contains 63.35% water, 7.35% ash, 1.17% fat, 13% - 14% protein, 49.44% crude fiber and 64.65% TDN (Puspitasari et al., 2018). Research on the use of anting spinach flour, bean sprouts waste, with the addition of turmeric extract in gourami fish feed needs to be investigated to stimulate the growth of gourami fry.

### Material and Method

**O. gouramy preparation.** Test fish were gourami with an average individual length of  $7 \pm 0.24$  cm and an average individual weight of  $5.04 \pm 0.5$  g. Feeding was conducted 3 times per

day *ad satiation*. The fish were cultured with a density 1 fish  $L^{-1}$  in the aquariums with volumes of 10 L. The experiment lasted 42 days. This research was conducted at the BPAP Mijen and

Aquaculture Laboratory, Faculty of Fisheries and Marine Sciences, Diponegoro University, Indonesia. The feed was adjusted to the size of the fish. According to Malaho et al (2016), razor-sized gourami (7-10 cm) need pellets of 1-2 mm diameter, with a crude protein content between 31-32%. This study used 1.3-1.7 mm diameter pelleted feed, with a protein content of approximately 32%.

The treatments in this study consisted in the addition of Indian nettle flour and mung bean sprouts to the artificial feed. The treatments were as follows: Treatment A: no Indian nettle flour or bean sprouts waste were added; treatment B: a content of 8% Indian nettle flour was added to the feed; treatment C: 3% Indian nettle flour and 3% mung bean sprout waste mung were added to the feed; treatment D: 8% mung bean sprout waste were added to the feed. Indian nettle and mung bean sprouts waste were dried in an oven at 50°C, 48 hours. The dried material was minced to obtain flour. The flour was weighed according to the specified feed formulation dose. Other ingredients (fishmeal, soy flour, rice bran, wheat flour, fish oil, palm oil, carboxymethyl cellulose - CMC, vitamin and mineral mix) were obtained from the market.

The ingredients were mixed evenly until the mix was homogeneous, starting from the smallest weight. The test feed formulations are presented in Table 1. Protein content was determined by the Kjendahl method (Nx6.25) and lipids were measured as ether extract. Ash was obtained after burning at 600°C for 14 h. The fish at the beginning of the stocking were taken samples for analysis of protein content and at each treatment at the end of the study the gouramy fish were analyzed for protein content (Laboratory of Animal Feed Nutrition and Food, Faculty of Animal Husbandry and Agriculture, Diponegoro University).

**Extract Making *Curcuma longo* LINN.**  
Making the extract begins with the process of sorting between turmeric and dirt, then washed and finely chopped to facilitate the drying process with the help of sunlight for 3-4 days then followed by the flouring process with the help of a blender. Weigh 500g turmeric powder then macerate with 70% ethanol for 3 x 24 hours at room temperature stir the solution to make it homogeneous, then filter it with paper strain. The filtrate was separated using a rotary vacuum evaporator at a temperature of 50°C with a speed of 100 rpm and a pressure of 0.7 bar (Oktavianto D, et al 2014)

Table 1. Feed formulation and chemical composition of the test feed, each feed added 15 ml/ 1 kg pakan

| Ingredients                 | Treatment (%) |        |        |        |
|-----------------------------|---------------|--------|--------|--------|
|                             | A             | B      | C      | D      |
| Fish meal                   | 25            | 25     | 25     | 25     |
| Indian nettle flour         | 0             | 8      | 3      | 0      |
| Mung Bean sprouts flour     | 0             | 0      | 3      | 8      |
| Soybean flour               | 40.8          | 39.1   | 39.8   | 36.2   |
| Bran flour                  | 24.4          | 18.1   | 18.8   | 20.9   |
| Fish Oil                    | 2.5           | 2.5    | 3.1    | 2.6    |
| Corn oil                    | 3.7           | 3.7    | 3.7    | 3.7    |
| Vit-Min mix                 | 2.8           | 2.8    | 2.8    | 2.8    |
| CMC                         | 0.8           | 0.8    | 0.8    | 0.8    |
| Total (%)                   | 100           | 100    | 100    | 100    |
| Crude protein (%)           | 31.5          | 32.02  | 32.33  | 32.03  |
| NFE (%)                     | 28.84         | 28.58  | 28.47  | 28.33  |
| Crude fat (%)               | 8.96          | 9.26   | 9.68   | 9.13   |
| Digestible energy (kkal) ** | 254.92        | 258.51 | 262.79 | 256.92 |
| E/P ratio **                | 8.09          | 8.07   | 8.13   | 8.02   |

Note: \* Based on DE (digestable energy) calculations with assumptions for protein = 3,5 kkal/g, fat = 8,1 kkal/g, NFE = 2,5 kkal/g (Wilson, 1982). \*\* According to De Silva (1987), the E/P value for optimal growth of fish ranges from 8-12 kkal/g. CMC - carboxymethyl cellulose; NFE - nitrogen free extract; E/P - energy per protein. The content of curcumin from turmeric extract by extraction using 70% ethanol 34,12 mg/g, with

maceration procedure. The results of the analysis of crude protein content of gourami at the beginning of the study 54,59% and at the end of each treatment A. 55,32%, B. 55,89%, C. 57,30% and D. 56,24%.

*Gourami fingerling stock.* The gourami used in this study were obtained from the same broodstock. 40 fingerlings were stocked, 10 for each treatment in 10 L aquariums. Before conducting the research, the gourami were acclimatized first in the new media for 7 days, so that fish were not stressed. The weighing was conducted at the beginning and end of the study, using digital scales to determine the growth rate. The individuals were also periodically counted to determine the survival rate.

**Total feed consumption.** The total value of feed consumption was calculated using the formula of Pereira et al (2007), as follows:

$$\text{Total} = F1 - F2$$

Where: total - feed consumption (g); F1 - total feed in the beginning of the experiment (g); F2 - total feed at the end of the experiment (g).

*Relative growth rate (RGR).* According to Takeuchi (1988), the relative growth rate of fish was calculated using the formula:

$$\text{RGR} = (\text{Wt} - \text{W0}) / (\text{W0} \times t) \times 100$$

Where: RGR - relative growth rate (% per day); Wt - total final weight (g); W0 - total initial weight (g); t - days of experiment.

*Survival rate (SR).* According to Effendie (1997), the survival rate can be calculated using the following formula:

Where: PER-protein efficiency ratio; Wt- final fish weight (g), Wo-Initial fish weight, Pi- the protein content of the feed eaten

Net protein utilization (NPU) =  $\text{Pb} - \text{Pa} / \text{Pi} \times 100\%$ .

According to Tacon (1987), the NPU can be calculated using the Following formula:

Where: NPU- Net protein utilization; Pb- total protein content of the final test fish (%); Pa-total protein content of the initial test fish (%); Pi- amount of feed protein consumed by fish (%).

**Water quality parameters.** Water quality data parameters measured include dissolved oxygen (DO), pH, temperature, and ammonia. DO, pH, and temperature were measured using a water quality checker (WQC) and ammonia

$$\text{SR} = \text{Nt} / \text{No} \times 100$$

Where: SR - survival rate (%); Nt - the number of fish at the end of the observation; No - the number of fish at the beginning of the observation.

*Feed utilization efficiency.* (FUE). According to Watanabe (1988), the efficiency of feed utilization can be calculated using the following formula:

$$\text{Feed utilization efficiency} = (\text{Wt} + \text{D} - \text{Wo}) / \text{F} \times 100$$

Where: Wt - final biomass (g); Wo - initial biomass (g); D - weight of dead fish (g); F - total fish feed administered (g).

*Feed conversion ratio (FCR).* According to Takeuchi T., 1988, the FCR can be calculated using the following formula:

$$\text{FCR} = \text{F} / (\text{Wt} - \text{W0} + \text{D})$$

Where: FCR - feed conversion ratio; F - total feed weight (g); Wt - final fish weight (g); W0 - initial fish weight (g); D - dead fish weight (g).

Protein efficiency ratio (PER) the According to Takeuchi T., 1988, the protein efficiency ratio can be calculated using the following formula:

$$\text{PER} = \text{Wt} - \text{Wo} / \text{Pi} \times 100\%$$

measurements were carried out in the Aquatic Resource Management Engineering Laboratory, UNDIP. DO, pH, and temperature measurements were carried out every 3 days. Ammonia was measured at the beginning, middle, and end of the study.

*Data analysis.* Data were verified with a normality test, homogeneity test, and additivity test to verify normal, homogeneous and additive properties (Steel RGD and Torrie JH, 1993). Data were analyzed by variance tests (F test) at a 95% confidence level to see its effect. If, in the analysis of variance, a significant difference was obtained ( $p < 0.05$ ), then Duncan's multiple region test was performed to determine differences between treatments.

## Results and Discussion

**Feed consumption.** Based on the average results of the total consumption of gourami during the study, the highest value was obtained in treatment C, with a mean of  $129,02 \pm 1,58$  g,

followed by treatments A, D and the lowest was treatment B, with averages of  $126,01 \pm 1,01$  g,  $127,71 \pm 0,92$  g, and  $127,65 \pm 0,49$  g, respectively (Figure 1).

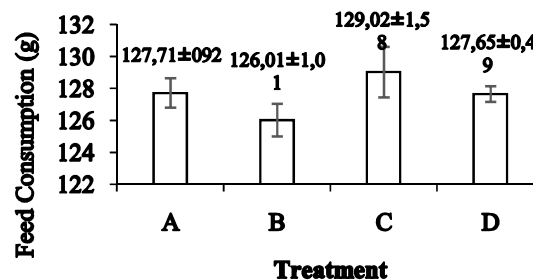


Figure 1. Feed consumption of *Osphronemus goramy* (different letters above bars show significant differences,  $p < 0.05$ ).

Treatment C was the best treatment, because during the research, fish had a high appetite. According to Aslamyiah and Karim (2012), a good test feed has raw materials with reliable attractants.

Treatment B experienced a low level of feed consumption, and there was leftover feed. It resulted in lower fish growth, and water quality pollution. Pinandoyo et al (2021) state that to increase feed consumption, feed utilization efficiency and growth, the time interval of stomach emptying should be considered.

According to Khasani (2013), the feed attraction is significant in the formulation of fish feed. The nutritional quality becomes less effective if the feed does not contain components that can

stimulate the fish response to the feed. The size of the total consumption of fish feed is influenced by several factors, including the physical properties of feed such as odor, taste, size, and color (Abidin et al 2015). Other influential factors are water quality parameters.

Feed utilization efficiency. Based on the average results of the utilization efficiency of gourami fish feed, the highest value was in treatment C, with a mean of  $84,33 \pm 0,50\%$ , followed by treatments A, D and the lowest was treatment B, with a mean of  $76,81 \pm 0,40\%$ ,  $82,04 \pm 1,70\%$ , and  $81,31 \pm 0,56\%$ , respectively. The efficient utilization of gourami fish feed during the study can be seen in Figure 2.

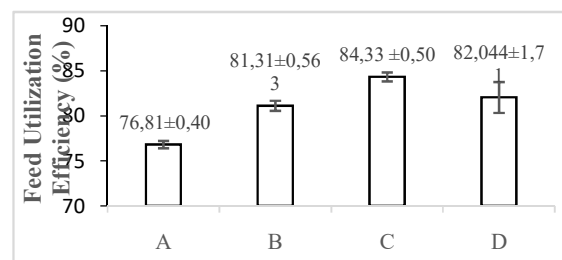


Figure 2. Feed utilization efficiency of *Osphronemus goramy* (different letters above bars show significant differences,  $p < 0.05$ ).

The feed utilization efficiency value for each treatment was close to 100%. The efficiency of feed utilization should be as close as possible to 100% (Puspasari et al 2015). According to Maulidin et al (2016), a good feed utilization efficiency value shows that the food consumed has a good quality, so it can be easily digested and

utilized efficiently by fish. The efficiency of feed utilization is closely related to the digestibility of the feed. The digestibility of a feed is influenced by several factors, namely the chemical nature of water, water temperature, type of feed, fish size and age, nutrient content of the feed, frequency of feeding and the amount of feed (Yanti et al

2013). The effectiveness of the utilization of gourami feed is also influenced by the metabolic rate.

According to Haetami (2012), feed energy is used by fish in metabolism processes, for growth, and reproduction. Satiated fish will experience a decrease in the body's metabolism rate. The thyroxine hormone can change the pattern of carbohydrate metabolism through increased activity of the amylase enzyme, so that the digestion and absorption of carbohydrates are high (Thalib 2012). Thyroxine also has an effect on increasing the digestive enzymes of protease

and lipase, so that fish can stimulate protein digestibility and increase absorption of amino acids and fatty acids through the intestine.

**Feed conversion ratio (FCR).** The lowest FCR value was obtained in treatment C, with a mean of  $1.91 \pm 0.01$ , followed by treatments A, B and the lowest was treatment D, with a mean of  $1.30 \pm 0.01$ ,  $1.23 \pm 0.01$ , and  $1.22 \pm 0.03$ , respectively (Figure 3).

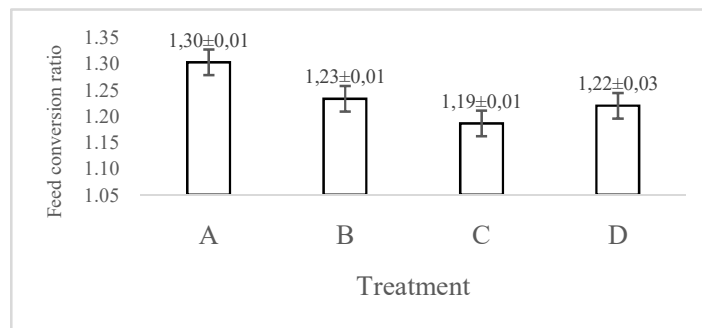


Figure 3. Feed conversion ratio of *Osphronemus goramy* (different letters above bars show significant differences,  $p < 0.05$ ).

A good feed quality can also be seen from the FCR value. The FCR value shows the efficient utilization of feed by fish. A lower FCR value shows a more efficient use of the feed (Purnomo et al 2015; Syaputra et al 2018). The FCR results of

all treatments during the study were considered good because they were less than 1.5. The results of research conducted by Safir (2012) showed a FCR value of gourami of 1.29-1.67.

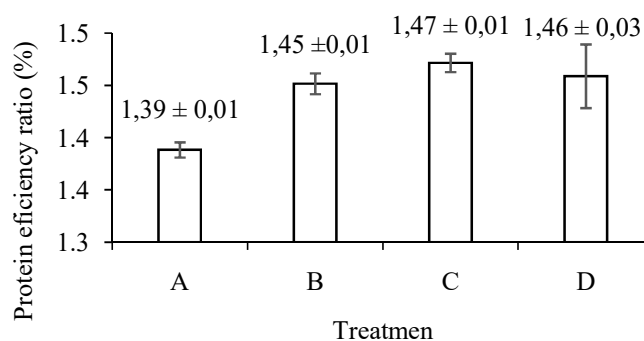


Figure 4. Protein efficiency ratio of *Osphronemus goramy* (different letters above bars show significant differences,  $p < 0.05$ ).

**Protein Efficiency Ratio (PER).** The highest PER was found in treatments C value was obtained in treatment C, with a mean of  $1.47 \pm 0.01$ , followed by treatments D  $1.46 \pm 0.03$ , B  $1.45 \pm 0.01$  and the lowest was treatment A with a mean  $1.39 \pm 0.01$ , respectively (Figure 4). The highest PER value was found in treatment C, namely feeding a combination of 50% and 50% artificial trash fish enriched with vitamin E at a

dose of 40 mg/kg of feed, this indicates that the protein content in treatment C best suits the needs is influenced by the quality of the protein present in the feed, and the quality of feed protein is influenced by the source of origin and by the amino acid content. This is in line with Pinandoyo et al (2021), who revealed that quality protein is protein that has a high digestibility value and has a pattern and number of amino acids that

are similar to the pattern and amount of essential amino acids found in cultivated species fed the diet. According to Tacon (1993), organisms use protein as an energy source along with carbohydrates, an excess level of protein or a high protein efficiency ratio in the feed results in **Net Protein Utilization (NPU)**. The highest NPU was found in treatments C value was obtained in treatment C, with a mean of  $1.94 \pm 0.04$ , followed by treatments D  $1.80 \pm 0.03$ , B  $1.79 \pm 0.03$  and the lowest was treatment A with a mean  $1.71 \pm 0.02$ , respectively (Figure 5). The highest NPU value was found in treatment C, namely feeding a combination of 50% and 50% this indicates that the protein content in treatment C best suits the needs *Osphronemus* protein and the most efficient

suppression of the growth rate, the energy remaining for growth, will increase in proportion to the increase in the energy given to feed until it finally reaches balance point, so that feed energy will be used for growth.

use of *Osphronemus* compared to other treatments were lower, presumably because the protein content in the feed consumed had not been optimally utilized for the formation of body protein of *Osphronemus*. According to Buwono (2000), net protein utilization (NPU) is the efficient use of feed protein deposits found in the liver which can be converted into protein in body tissues.

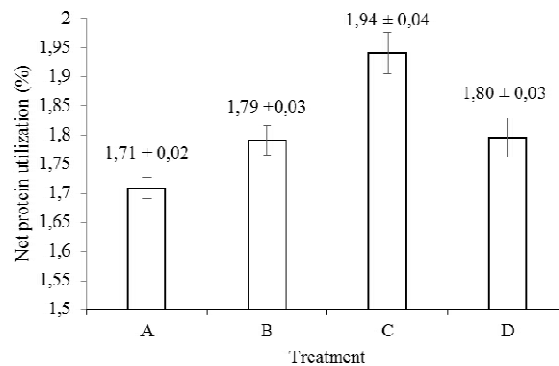


Figure 5. Net protein utilization of *Osphronemus goramy* (different letters above bars show significant differences,  $p < 0.05$ ).

**Relative growth rate (RGR).** The highest value of RGR was in treatment C, with a mean of  $3.82 \pm 0.07\%$  followed by treatments A, D and the

lowest was treatment B, with a mean of  $3.37 \pm 0.05\%$ ,  $3.18 \pm 0.03\%$ , and  $2.92 \pm 0.11\%$ , respectively (Figure 4).

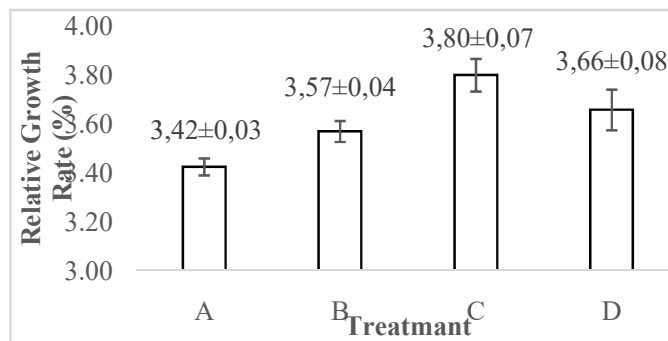


Figure 6. Relative growth rate of *Osphronemus goramy* (different letters above bars show significant differences,  $p < 0.05$ ).

Maloho et al (2016) stated that the growth speed depends on the amount of feed consumed, water quality and other factors such as heredity, age, endurance and ability of the fish to use feed. This is supported by Tribina (2012), who stated that, if

the need for maintenance exceeds the amount of feed administered, there will be a process of dismantling the energy in the body of the fish itself (catabolism). An adequate amount of feed should be suffice for body growth and daily activities of

fish; excess or lack of feed can result in decrease growth rate. Cui, et al., (2017) and Mahmoud, et al., (2017), reported that the addition of turmeric to feed increased the growth performance of tilapia. The rapid growth was also tested for goldfish Jiang, et al., (2016) and white snapper Abdelwahab and El-Bahr (2012), so that turmeric can be added to aquaculture production activities besides turmeric is a safe natural ingredient for fish. This is reinforced by Yonar, et al., (2019),

which states that turmeric improves the growth performance of salmon by increasing the digestibility of fish to feed and turmeric is safe to use on fish.

**Survival rate (SR).** Treatment C was the best treatment, with little mortalities  $87,18 \pm 4,44\%$ , followed by treatments A, D and the lowest was treatment B, with a mean of  $84,74 \pm 7,70\%$ ,  $82,05 \pm 4,44\%$  and  $79,49 \pm 4,44\%$ , respectively (Figure 6).

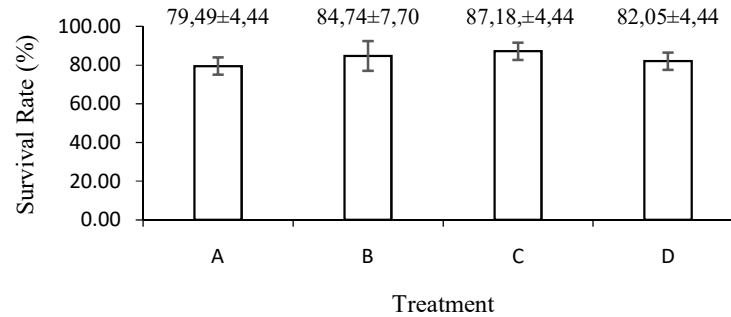


Figure 7. Survival rate of *Osphronemus goramy* (different letters above bars show no significant differences,  $p < 0.05$ ).

The survival rate of gourami showed significant differences between treatments ( $p > 0.05$ ). Death of some gourami at the beginning of the experiment is suspected to be due to stress. Stress was caused by moving the fish, uningested feed and weighing. According to Samsundari dan Wirawan (2013), the survival of fish is influenced by biotic factors, namely competitors, parasites, population density, and adaptability, and abiotic factors, physical and chemical parameters of the water.

Fish food has an important role in the growth and survival rate of fish. The high survival rate of gourami fingerlings is thought to be due to the fulfillment of nutritional requirements for survival, and suitable environmental maintenance conditions, so that stress was minimum.

**Water quality.** The measurement results of several water quality parameters including temperature, pH, DO, and ammonia are presented in Table 2

Table 2. Water quality parameters value

| Treatment     | Parameter values   |                      |                          |                           |
|---------------|--------------------|----------------------|--------------------------|---------------------------|
|               | Temperature        | pH                   | DO (mg L <sup>-1</sup> ) | NH3 (mg L <sup>-1</sup> ) |
|               | (°C)               |                      |                          |                           |
| A             | 28.3-29.45         | 7.2-7.9              | 3.8-4.8                  | 0.004-0.062               |
| B             | 28.5-29.9          | 7.2-8                | 3.8-4.4                  | 0.004-0.062               |
| C             | 28.2-29.2          | 7.2-7.7              | 3.8-4.6                  | 0.004-0.062               |
| D             | 28.6-29.6          | 7.2-7.8              | 3.8-4.5                  | 0.004-0.062               |
| Optimal range | 28-30 <sup>b</sup> | 6.5-8,0 <sup>c</sup> | 3-7 <sup>a</sup>         | 0-0.12 <sup>a</sup>       |

Note: DO - dissolved oxygen; a - Nirmala and Rasmawan (2010); b - Oktavianto et al (2014) c. SNI : 01-6485.3 (2000).

The temperature during maintenance was in the optimal range, the normal 25-30°C. Oktavianto et al (2014) stated that low temperatures below or above the normal limits can

cause gourami decreased appetite, susceptibility to disease, and even death. Temperature affects the resistance to disease and physiological processes of fish (Bangsa et al 2015).

The pH value in the maintenance media ranged from 6.5 to 8. The pH value was in the normal range. The DO during maintenance was in the range of 3.8-4.5 mg L<sup>-1</sup>. The DO level is in normal limits. According to Nirmala and Rasmawan (2010), DO content for the maintenance of gourami should be between 3-7 mg L<sup>-1</sup>. Gourami has an additional breathing device in the form of a labyrinth that allows it to take oxygen from the air directly, so that it can survive in waters with low DO concentrations. Pinandoyo et al., (2020), stated that the range of values for good water quality was caused by siphoning activities, water replacement and continuous aeration systems,

### Conclusions

The addition of Indian nettle and bean sprouts to feed significantly affected ( $p < 0.05$ ) the efficiency of feed utilization, growth, and survival of gourami. The best feed formula with the addition of Indian nettle flour and mung bean

### Suggestion.

it is recommended to use treatment C, and it is recommended to conduct further research on digestibility and increase fish immunity.

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- and is in accordance with what is stated in SNI:01-6485.3. (2000).
- The value of ammonia from fish feces and leftover food was in the range of 0.004-0.062 mg L<sup>-1</sup>. This value is within the tolerance range of gourami. The water was siphoned and changed every 3 days, to remove leftover food and feces that could have increased the value of ammonia. According to Nirmala and Rasmawan (2010), ammonia is toxic when it exceeds 0.2 mg L<sup>-1</sup>. Syahrizal et al (2013) state that ammonia is the end result of protein metabolism. Ammonia in its non-ionized form (NH<sub>3</sub>) is poisonous to fish even at very low concentrations.
- sprouts was in treatment C (3% Indian nettle flour and 3% bean sprouts). Treatment C total feed consumption during the study was 106.75±4.35 g and a relative growth rate of 6.11±0.07% per day. Moreover, the efficiency of feed utilization was 95.92±2.49%, the FCR was 1.67±0.03, and the survival rate of fish survival is not significant.

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