



Effect of Fermented Lamtoro Leaf (*Leucaena leucocephala*) Meal on Growth Rate of Giant Gourami Fingerlings (*Osphronemus gouramy*)

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Authors' contributions

This work was carried out in collaboration among all authors. Author CNR designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors YA and IBBS managed the analyses of the study. Author KH managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

This research aims to determine the percentage of the addition of fermented lamtoro leaf on fish growth rate of gourami fingerlings. The test fish used was gourami that amounted to 320 tails with a length of 4-6 cm from Farming Development Gurame and Nilem – Singaparna, Tasikmalaya. The container used in this research was an aquarium with a total of 16 pieces with a size of 40 × 30 × 30 cm³. The density of gourami fingerlings during the research was 20 fish-tails/aquarium with long maintenance of 40 days. The feed given is 5% of the fish body biomass. The research was conducted on 8 November 2019 until 14 February 2020 at the Fisheries Laboratory, Faculty of Fisheries and Marine Sciences, Universitas Padjadjaran, Indonesia. This research used experimental method with Completely Random Design (CRD), which consists of four treatments and four times the repeated feeding of commercial feed (control), the leaf meal of lamtoro

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fermentation result 10%, 15%, and 20%. Based on the results of the research, fermentation of lamtoro leaves can improve nutrient content after fermentation, seen from the presence of increased protein content from 21.88% to 26.11% and decrease in crude fiber content from 46.33% to 20.85%. The addition of lamtoro leaf meal fermentation results up to 15% in commercial feed resulting in a daily growth rate of 1.90%, feed conversion ratio of 2.05 and the survival rate of 70%.

Keywords: *Giant gourami fingerlings; fermented lamtoro leaf meal; daily growth rate; feed conversion ratio; survival rate.*

1. INTRODUCTION

Fish farming in Indonesia is plays an important role in the fishery sector. This relates to its role in supporting national food availability, creating income and employment. One of the many cultivated aquaculture fisheries is gourami cultivation.

Gourami is one type of freshwater fish that has been long known and cultivated by the people of Indonesia. Gourami includes commodities that were widely developed by farmers. Based on data obtained from the Ministry of Maritime Fisheries (2018) the average growth of the production of the Quarter I – III Year 2015 – 2018, its highest commodity was gourami fish 68.15% with the production increased from 169 thousand tons to 356.53 thousand tons (110.88%) [1]. The problem that is often encountered in the intensive fish cultivation production process is the provision of artificial feed because the price of feed is quite high. Based on this, many efforts to feed alternatives were more economical and easy to obtain. Some research has stated that gourami has a high growth potential when performed nutrient content improvement at each stage of maintenance, namely maintenance of larvae and fingerlings classified as carnivores, and stages of enlargement to the size of consumption [2].

One of the alternative feedstuffs that can be utilized is leaf lamtoro. Lamtoro leaf meal (LLM) is a biological resource and contains protein ranging from 25-30% and potentially used as a source of vegetable protein in fish feed [3]. It is maybe to use for the cultivation of gourami because the gourami 5-7 cm has given a protein level of 38% [4]. But it is also known that lamtoro contains mimosine can inhibit the biosynthesis of proteins in animals so that it has a decrease in the rate of growth when consumed intensively.

Efforts that can be done to overcome the high content of crude fiber is by fermentation

technology. The working principle in the fermentation process is to break down undigestible materials such as cellulose, hemicellulose into simple sugar that is easily digestible with the help of microorganisms. Crude fiber on the leaves of the lamtoro can be reduced due to the fermentation process with probiotics, thereby the digestion increases. Probiotics were additives that contain several bacteria (microbes) that provide beneficial effects of fish health because it can improve the balance of intestinal microflora, to provide benefits of protection, disease protection and repair of feed digestibility. Additionally, probiotics can also accelerate growth and increase immunity from certain pathogenic diseases [5].

Based on the explanation, this research was chosen for addition of leaf meal fermented by microbes mixed into commercial feed. The addition of fermented lamtoro leaf meal is expected to increase the growth rate of Gourami fingerlings.

2. MATERIALS AND METHODS

The research was conducted in the Fisheries Laboratory, Faculty of Fisheries and Marine Sciences, Universitas Padjadjaran, Indonesia, from November 2019 to February 2020. The materials used were 320 seed fish gourami with \pm 4-6 cm with weights \pm 10-15 gram, leaf lamtoro, binder, commercial fish feed, probiotics, and molasse. The research used an experimental method with a Completely Random Design (CRD), consisting of 4 treatments and 4 replications, namely:

Treatment A: Commercial feed (Control).

Treatment B: The addition of LLM fermentation with a 10% dose.

Treatment C: The addition of LLM fermentation with a 15% dose.

Treatment D: The addition of LLM fermentation with a 20% dose.

2.1 Experimental Feed

The test feed used was the synthetic feed in the form of dried pellets that were crumble. The feed was composed of commercial feed and fermented lamtoro leaf meal. The commercial feed used was a feed (a type of feed SNA-2) with brand Sinta Prima Feed containing 30% protein content, 5% fat content, crude fiber content of 6%, an ash content of 12% and moisture content 12%. Test feed formulations can be seen in Table 1.

Maintenance of fish carried out for 40 days with the feeding of LLM the result of fermentation with different amounts in each treatment three times a day at 08.00, 12.00 and 17.00 WIB with the amount of feeding 5% of the biomass fish.

2.2 Parameters

2.2.1 Changes in the nutritional value of Lamtoro leaf meal fermentation result

The observation was done by conducting a proximate test on lamtoro leaf meal, before and after fermentation to see changes in the nutritional value of Lamtoro leaves which include coarse protein levels, moisture content and coarse fiber.

2.2.2 Daily growth rate

The daily growth rate would be calculated using the formula [6]:

$$DGR = \frac{\ln W_t - \ln W_o}{t} \times 100\%$$

Description:

DGR = daily growth rate (%)
 lnWt = average weight of test fish at end of research (gram)
 lnWo = average weight of test fish in early research (gram)
 t = Duration of research (days)

2.2.3 Feed Conversion Ratio (FCR)

Feed conversion ratio was tested at the end of observation based on the formula of feed conversion ratio [7], namely:

$$FCR = \frac{F}{(W_t + D) - W_o}$$

Description:

FCR = Feed conversion ratio
 F = amount of feed given during research (gram)
 Wt = biomass at the end of research (gram)
 Wo = biomass at the beginning of research (gram)
 D = the weight of dead fish during research (gram)

2.2.4 Survival Rate (SR)

The fish survival calculation uses the formula [8] namely:

$$SR = \frac{N_t}{N_o} \times 100\%$$

Description:

SR = survival rate (%)
 Nt = number of live fish at end of observation (tail)
 No = number of live fish at the beginning of observation (tail)

2.2.5 Water quality parameters

The water quality parameter of the maintenance media was determined by measuring the physical and chemical parameters of water during experiments, namely temperature, pH, and dissolved oxygen. This Data was used to determine the feasibility of water quality media maintenance during research. Temperature, pH and dissolved oxygen measurements were carried out once every 10 days.

Table 1. Experimental feed formulation

Treatment (%)	Material			
	Commercial feed (%)	Fermented lamtoro leaf meal (%)	CMC* (%)	Total
A	100	0	0	100
B	88	10	2	100
C	83	15	2	100
D	78	20	2	100

* Carboxymethyl cellulose

3. RESULTS AND DISCUSSION

3.1 Changes in the Nutritional Value of Lamtoro Leaf Meal Fermentation

Based on the results of the proximate test of lamtoro leaves that have been done, produce changes in protein, crude fiber, and moisture content (Table 2).

Based on the data in Table 2, it can be noted that most of the content in the leaves of lamtoro before the fermentation changes for the better such as increased protein content from 21.88% to 26.11% and decreased crude fiber content from 46.33% to 20.85% after fermentation. However, the moisture content was increased from 63.00% to 81.19%. The increase caused by microorganisms began to utilize carbohydrates that were easily fermented in substrates as a source of energy to grow and thrive. The utilization of this carbohydrate produces the residual reshuffle in the form of water so that the water content in fermented substances increased. Besides, the longer the fermentation time, increasing in the number of growth of microorganisms contributing to most water content in fermented lamtoro leaves.

Meanwhile, the lamtoro leaf fermentation process has decreased the protein levels with a percentage of 26.11% to 25.58% and water content with a percentage of 81.19% to 9.15%. This was probably because feedstuffs have been converted into a meal. The meal process was one of the steps that need to be done so that the feed material was easy to be mixed with other feedstuffs. Materials that will be carried out process should be done drying first so that the water content in the leaf meal of the fermented leaves decreases considerably before the process of the decay.

The drying process will lead to the evaporation of water supported by [12] that the purpose of drying was to reduce moisture content in the ingredients. In the drying process, protein also

decreased, because the longer the heating, the leaves of the Lamtoro will lose more and more of protein content. This was in line with the statement [13], that with prolonged heating, the protein will be denaturated and would suffer damage.

The crude fiber content of the Lamtoro leaves decreased by a percentage of 46.31% to 20.85%, due to the presence of cellulase enzymes. According to [14], cellulases were a group of fibrolytic enzymes that can hydrolyze the fibers on the plant's cell walls to glucose. Bacteria in probiotics such as Bacillus species play a role in the breakdown of proteins into amino acids [15]. Amino acids used bacteria to multiply to increase feed proteins and lower the crude fibers [16].

3.2 Daily Growth Rate

The growth rate was the result of metabolic processes in the body that can lead to weight and volume increase within a certain period of time. Based on the observation of gourami that was given treatment for 40 days with four different treatments, it can be seen in Fig. 1.

The highest daily growth rate was in treatment A with an average of 2.06%, then followed by treatment C with an average daily growth rate of 1.90%; at the B treatment of 1.87 g/day and a D treatment of 1.72%. The average value of the daily growth rate indicates that the feed given can be digested by fish and shows good response to the feed given by the addition of fish weight. It was following the statement [17] that growth occurs because of the energy left behind after the need for basal metabolism and fish needs were fulfilled. The growth of fish will occur if the feed consumed has protein levels and protein balance-the right energy so that the protein was used as the constituent body for growth, while the non-protein energy from fats and carbohydrates was used as a source of energy [18].

Table 2. Proximate analysis of lamtoro leaf fermentation

Material	Parameters		
	Protein (%)	Crude fiber (%)	Water content (%)
Lamtoro Leaf	21,88*	46.31**	63,00***
Fermented Lamtoro Leaf	26,11	20,85	81,19
Fermented Lamtoro Leaf Meal	25,58	29,28	9,15

Source: Proximate Test Result of Nutrition Laboratory, Faculty of Animal Husbandry, Universitas Padjadjaran (2019); Explanation: * [9]; * [10]; * [11]

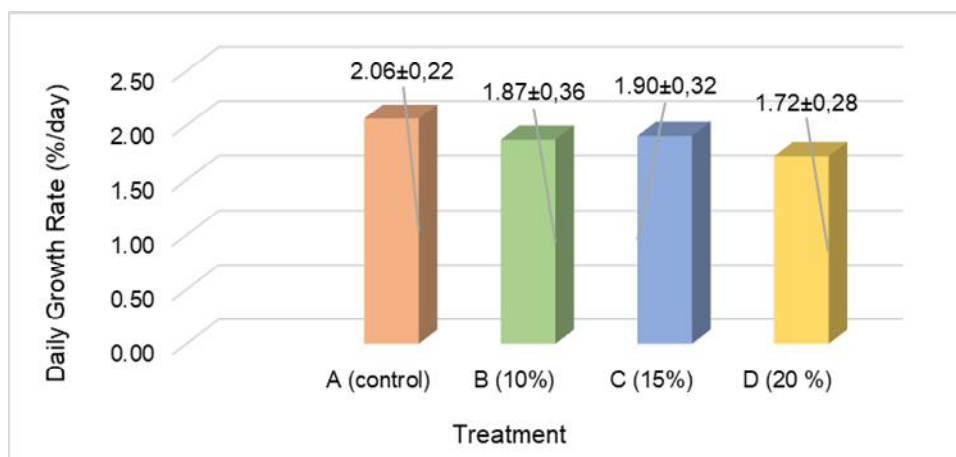


Fig. 1. Daily growth rate graphic

3.3 Food Conversion Ratio

Commercial feed that has been added to the leaf meal fermentation results with different presentation rates over the 40 days has resulted in a diverse FCR value (Fig. 2).

The value of FCR on gourami fingerlings given the commercial feed treatment that has been added lamtoro leaf meal fermented results ranging from 2.05-3.02 it means to get 1 kilogram of gourami fingerlings needed 2.05 -3.02 kilogram feed. The results of the print analysis showed that the addition of the leaf meal fermented in the commercial feed up to 20% give a different effect

to the conversion ratio of gourami fingerlings feed.

Based on Fig. 2, although the feed of the treatment has a relatively different composition, it gives the average value of a different FCR real. The lowest average value was in the C treatment with the use of 15% of the dried leaf meal fermented by 2.05% and the highest value was in the treatment B with the use of 10% of the leaf meal fermented by 3.02%. Feed with a high crude fiber content will decrease the digestibility of protein. According to [19] which states that the smaller the conversion value of the given feed means that the given feed was almost depleted and was used for growth.

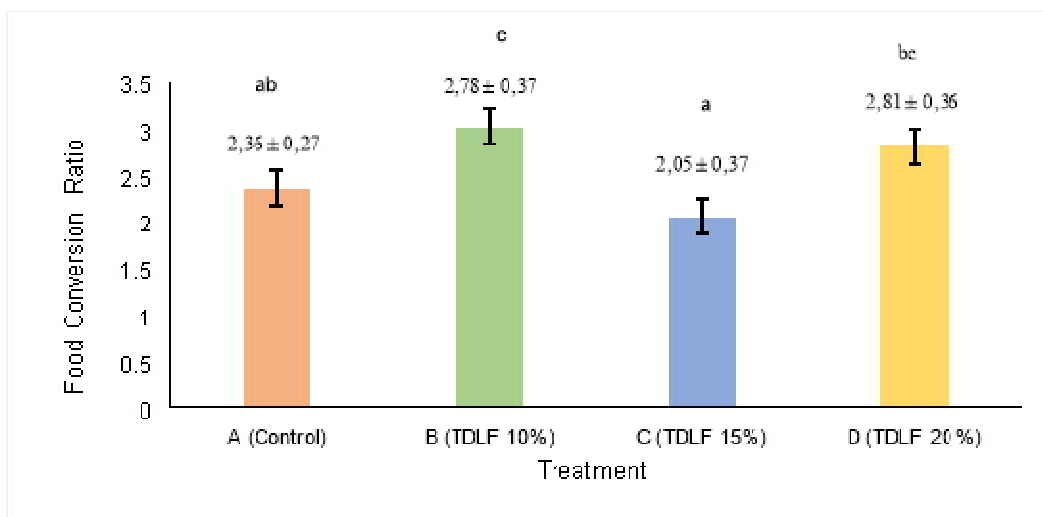


Fig. 2. Food conversion ratio graphic

3.4 Survival Rate

Survival was expressed as a percentage of the number of fishes that live during the maintenance period divided by the number of fish that was stocked [20]. The survival rate of each treatment with a maintenance period of 40 days can be seen in Fig. 3.

The average survival rate of gourami was between 70.00-81.67%. The survival rate at the highest maintenance period was at the B-treatment of 81.67% while the lowest was at C-treatment of 70.00%. According to [21] the survival rate (SR) is > 50% good, the survival of 30 – 50% moderate and less than 30% is not good.

The results of the analysis of the prints on the level of 95% confidence showed that the leaf meal of fermented lamtoro mixed with commercial feed given to gourami during the research with different concentrations did not give a real different influence to the survival rate

of gourami (Fig. 3). It was suspected that the feed with the addition of fermented lamtoro leaf meal does not give a harmful effect to the seed gourami. The death of fish was suspected because the adaptation of fish kept in an open pond was inserted into the aquarium.

3.5 Water Quality Parameters

The results on water quality obtained during the experiment showed that the quality of water was still in a good range to support the maintenance of gourami seeds. Water quality Data was obtained during the following research (Table 3).

Based on the results of water quality measurements during the research the average temperature value was at 28°C. In accordance with the earlier report [22] the temperature change reaches 4°C does not affect a lot in gourami because the gourami will be stressed when the temperature change reaches 5°C upwards.

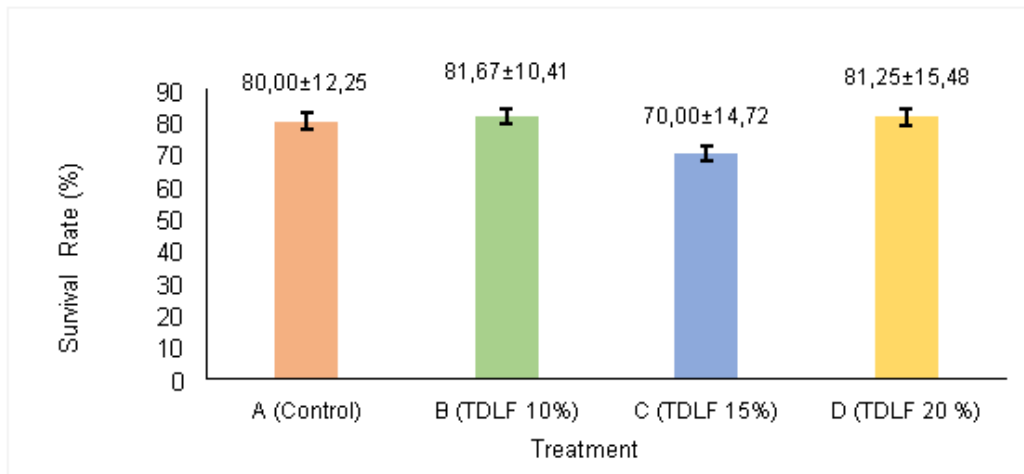


Fig. 3. Survival rate graphic

Table 3. Water quality measurement result

Treatment	Parameters		
	Temperature (°C)	DO (mg/l)	pH
A Control	28	5,0-5,7	7,1-7,7
B 10%	28	5,0-5,7	7,0-7,8
C 15%	28	5,0-5,8	7,1-7,7
D 20%	28	5,0-5,7	7,1-7,8
Standards	25-30*	4,0-7,1**	6,5-8,5*

Degree of acidity (pH) during the research was still within the normal range of 7.0 – 7.8. pH levels during experiments were still at an optimal level to support the sustainability (Fig. 3). The survival rate of each treatment with a maintenance period of 40 days growth.

Dissolved oxygen assists in the process of oxidation of waste and food combustion to produce energy for the life and growth of gourami. The decreased influence of dissolved oxygen levels in water can lead to stress, anorexia, tissue hypoxia, fainting and even mass deaths. Oxygen soluble level of the enlarged larvae of gourami was 4.0-7.1 mg/l [23]. The dissolved oxygen levels during the research were ranged from 5.0 to 5.8 mg/L. It is still at optimal level to support the sustainability and growth rate.

4. CONCLUSION

Based on the results of studies that have been done it can be concluded that:

1. Fermentation on the leaves of Lamtoro can improve the nutrient content, seen from the presence of increased protein content with a percentage of 21.88% to 26.11% and a decrease in crude fiber content with a percentage of 46.33% to 20.85% after fermentation.
2. The mixing of the leaves of the lamtoro meal fermented in commercial feed gives results that do not differ on each treatment, and the administration of 15% of the fermented leaves of the fermentation gives the highest daily growth rate of 1.90%, feed conversion rate of 2.05 and the survival rate of 70%.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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