UTILIZATION OF LAMTORO LEAF (*Leucaena leucocephala*) IN FEED ON THE GROWTH OF SEVERAL TYPES OF FRESHWATER FISH: A REVIEW

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ABSTRACT

Lamtoro leaf (Leucaena leucocephala) has a lot of nutrients such as protein, lipid, fiber, amino acids, etc. Lamtoro leaf is easy to get and cheap. Some of these reasons make lamtoro can be used as an alternative material for fish feed. However, the fiber content in lamtoro is quite high so it needs to be fermented so that it can be used as feed ingredients. Several studies have been conducted to examine the effect of giving lamtoro which is neither fermented nor fermented on the growth of freshwater fish such as gouramy, carp, catfish, and Asian redtail catfish. The results showed that the administration of lamtoro had a positive effect on the growth of these freshwater fish. The purpose of this review article is to describe the effect of lamtoro on the growth of gouramy, carp, catfish, and Asian redtail catfish.

Keyword: *alternative fish feed, feed, growth, freshwater fish, lamtoro*

1. INTRODUCTION

The problem that is often faced in the production process of intensive fish farming is the provision of artificial feed because the price of feed is quite high. According to [1], the use of imported fish feed raw materials, such as fish meal, is a big problem that results in high fish feed prices. Based on this, many efforts have been made to make economical alternative feeds. Several studies have stated that gouramy has high growth potential if the nutritional content is improved at each stage of its maintenance, namely the maintenance of carnivorous larvae and fry, as well as the enlargement stage to the size of consumption [2]. Protein is the main energy source for fish. So, a good supplementary feed is usually a feed with a higher protein content than carbohydrates. In general, the stunted growth of gouramy is due to insufficient protein requirements in feed to stimulate growth. The preparation of fish feed formulations should use protein derived from vegetable and animal sources together to achieve nutritional balance at a relatively low price [3].

The feed given to fish should be by the needs of the fish, available, and guarantee health. Feed is an element that really supports aquaculture business activities, so the available feed must be adequate and meet the needs of the fish. Feed is the largest constituent in the production cost structure of fish farming which reaches more than 70% [4]. To reduce feed costs, some farmers use alternative feed ingredients as a substitute for feed ingredients [5] reported that some vegetable raw materials have high potential as an alternative source of protein feed that can support optimal fish growth. Vegetable raw materials have advantages such as abundant and cheap availability, and sometimes they are waste or weeds, for example, lamtoro leaves, cassava leaves, or aquatic plants. However, in developing fish feed formulations based on plant-based ingredients, attention must be paid to optimal levels of feed and proper processing techniques for effective utilization [6]. Information on optimal levels of plant-based

ingredients in feed is important due to the presence of several limiting factors such as high crude fiber content [7] and the presence of anti-nutritional factors [8]. [6] reported that excessive consumption of plant materials by fish can reduce the rate of growth and body resistance which in turn increases mortality if this situation continues. One of the alternative feed ingredients that can be used optimally is lamtoro leaf. Lamtoro leaves (*Leucaena leucocephala*) in the form of flour can be used as a mixture of fish feed in pellet form [9].

2. LAMTORO (*Leucaena leucocephala)*

2.1 Morphology of Lamtoro (*Leucaena leucocephala)*

Lamtoro or Chinese stinky bean (Figure 1) is a type of shrub from the family Fabaceae (Leguminosae, legumes). It is often used in the reforestation of land or preventing erosion. Lamtoro comes from Mexico and Central America, where this plant grows widely. The Spanish colonizers brought the seeds from Mexico to the Philippines at the end of the sixteenth century. From this place, lamtoro began to spread widely to various parts of the world. It was grown as a shade for coffee plants, a producer of firewood, and a source of animal feed. Lamtoro easily adapts in various tropical areas such as Asia and Africa including Indonesia [10]. Based on the literature, the following is a general classification of lamtoro plants:

Kingdom : Plantae
Division : Magnoliophyta
Class : Magnoliopsida
Order : Fabales
Family : Fabaceae
Genus : Leucaena
Species : *Leucaena leucocephala* (Lamk.) de Wit

Figure 1. Lamtoro Leaves

Lamtoro consists of 53 species which are classified into 10 well-known species. While all of these species may be very useful in the tropics, only the lamtoro has been used extensively [11]. Lamtoro plants grow well in areas with annual rainfall between 1000-3000 mm. While [12] suggested that the lamtoro plant be planted in areas where the rainfall is more than 750 mm per year and the altitude is more than 1500 m above sea level. Furthermore, it is also stated that the soil suitable for this crop is neutral soil or alkaline soil (animal grazing land), where lamtoro and fodder grass are grown together in the right ratio.

According to [13], lamtoro plants can be grown using various planting systems, for example, erosion prevention fences, windbreaks, or yard boundaries. NAS (1994) states that generally lamtoro plants can produce dry matter from edible elements (leaves and small twigs) of 6-8 tons per hectare per year or about 20-80 tons of fresh matter per hectare per year.

2.2 Nutritional Content of Lamtoro

Lamtoro leaf flour is a potential local biological source to be used as a source of vegetable protein in fish feed because it contains about 25-30% protein [11] or 24.2% [14] which is the highest value compared to other vegetable protein sources after soybeans. The proximate test on unfermented and fermented lamtoro leaf flour that has been carried out by [15] can be seen in Table 1.

Table 1. Proximate Test Results for TDL (Lamtoro Leaf Flour) and TDLF (Fermented Lamtoro Leaf Flour)

Sample	Ash	Lipid	Crude fiber	Protein	BETN
TDL	7,53	4,48	46.31	30,56	54,76
TDLF	8,19	5,25	34,14	31,82	57,13

Source: Restiningtyas *et al.* (2015)

Meanwhile, the essential amino acid components of lamtoro leaf meal, soybean meal, and fish meal can be seen in Table 2. The range of values shows that the availability of essential amino acids is similar to that of soybean meal, although it is still far from the amino acid content of fish meal [16]. Lamtoro leaf flour is also a source of vitamin A with relatively high-carotene content and xanthophyll content which is a source of pigmentation in the skin and egg yolk [16].

Table 2. Composition of essential amino acids of Fish Meal (TI), Soybean Meal (TBK) and Lamtoro Leaf Flour (TDL)

Amino acid	TI (g/16 g N)	TBK (g/16 g N)	TDL (g/16 g N)
Arginine	4,6	6,94	1,02-5,25
Histidine	2	2,64	0,40-1,44
Isoleusin	3	5,01	1,24-6,65
Leusin	5,5	7,54	1,60-6,65
Lysine	6,2	6,28	1,28-6,07
Methionine	1,6	1,38	0,23-1,19
Phenylalanine	3,2	5,03	1,07-3,92
threonine	3,1	4,92	0,87-5,07
Tryptophan	2,3	1,18	0,24-0,38
Valin	3,2	4,72	1,01-6,29

The use of lamtoro raw materials for fish is limited by the high content of Neutral Detergent Fiber (NDF) of 39.5% and Acid Detergent Fiber (ADF) of 35.10% [12]. Crude fiber is a carbohydrate component rich in lignin and cellulose which is difficult to digest. Cellulose is the skeleton of plant cells consisting of p-D-glucose chains with a degree of polymerization of approximately 14,000 [17]. The use of lamtoro leaf flour in feed is also limited by the presence of mimosin which is a heterocyclic amino acid, which is an amino acid that has circular carbon chains with different groups. Mimosin is often called leucine with the molecular formula $C_8H_{10}O_4N_2$. Judging from its structure, it is a derivative of protein, it is characterized by the presence of N in its structure [18]. In addition to mimosin, other nutrient ingredients contained in lamtoro leaf flour are myoinositol hexakisphosphate ($C_6H_{18}O_{24}P_6$) which are commonly called phytic acid and tannins.

3. UTILIZATION OF LAMTORO PLANTS FOR FEEDING VARIOUS TYPES OF FISH

3.1 Gouramy (*Osphronemous gouramy* Lac.)

A study about the utilization of lamtoro as feed of gouramy has been conducted. This study used an experimental method with a completely randomized design (CRD), which consisted of four treatments and four replications, namely the provision of commercial feed (control), fermented lamtoro leaf flour 10%, 15%, and 20%. The test fish used were 320 gourami fish with a length of 4-6 cm from the Center for Development of Carp and Nilem Fish Cultivation – Singaparna, Tasikmalaya. The containers used in this study were 16 aquariums with a size of 40 × 30 × 30 cm^3. The density of gouramy fry during the study was 20 fish per aquarium with 40 days of maintenance. The feed given is 5% of the fish body biomass. Parameters observed were changes in the nutritional value of lamtoro leaf meal, growth rate, feed conversion ratio, survival rate, and water quality which were observed every 10 days. Data on growth, feed conversion ratio, and survival was analyzed using analysis of variance, while changes in nutrition of lamtoro leaf meal were analyzed descriptively. Based on the results of the study, the addition of fermented lamtoro leaf flour to 15% in commercial feed resulted in a daily growth rate of 1.90%, a feed conversion ratio of 2.05, and a survival rate of 70%.

3.2 Catfish (*Clarias gariepinus*)

Catfish is one of the fish that has high economic value and is a public favorite because it has a low price and good taste. A study about the utilization of lamtoro as feed of catfish has been conducted. Four treatments and 3 replicates, namely: A (reference feed 70% + leucaena leaves meal 30%), B (reference feed 70%+fermented leucaena leaves meal with *Aspergillus. niger* 30%), C (reference feed 70%+fermented leucaena leaves meal with *Rhizopus oligosporus* 30%), and feed D (reference feed 70%+fermented leucaena leaves meal with *Saccharomyces cerevisiae* 30%) were used in this study. The juvenile catfish (initial weight was 5.45±0,16 g) are randomly distributed into eighteen tanks with 40 fish per aquarium. Each diet is randomly assigned to the triplicate aquarium and fed to fish three times a day up to satiation for 4 weeks. The results showed that fermented leucaena leaves treatments were significantly higher ($P<0.05$) than that control in final weight and feed conversion rasio. Nutrients digestibility and final weight were significantly highest ($P<0.05$) in fermented leucaena leaves with *A. niger* compared to the other treatment. The value of protein digestibility was significantly highest ($P<0.05$) in fermented leucaena leaves with *A. niger* (76.04%), followed by fermented Leucaena leaves *S. cerevisiae* with (69.71%), fermented leucaena leaves meal with *R. oligosporus* (68.24%), and control (65.18). Leucaena leaves had no effect on physiological processes in catfish, as shown by hematological parameter values that were within the normal range.

3.3 Carp (*Cyprinus carpio*)

A study about the utilization of lamtoro as feed of carp fish has been conducted. The test fish used was carp (*C. carpio*) with an average individual weight of 2.30 ± 0.02 g/head. Feed was given at 08.00 am and 16.00 pm at satiation. The container used is a tub with a capacity of 15 liters. The test fish were reared for 40 days with a stocking density of 1 fish/l. This research was conducted by experimental method using a completely randomized design (CRD) with 4 treatments and 3 replications. Treatments A, B, C, and D with concentrations of 0, 5, 10, and 15% respectively. The observed data included total feed consumption (TKP), feed utilization efficiency (EPP), protein efficiency ratio (PER), relative growth rate (RGR), survival rate (SR), and water quality. The results showed that fermented lamtoro leaves had a significant effect (P0.05) on SR. Treatment C gave the highest score at TKP at 69.03%, EPP at 41.89%, PER at 1.23%, and RGR at 3.14%/day. Water quality parameters during the study were in the range that was suitable for the life of carp (*C. carpio*). The conclusion obtained is that fermented lamtoro leaf feed can increase the growth process of carp (*C. carpio*).

3.4 Asian Redtail Catfish (*Hemibragus nemurus*)

A study about the utilization of lamtoro as feed of Asian redtail catfish has been conducted. The purpose of this study was to determine the amount of fermented flour from lamtoro leaves used as an alternative ingredient, the level of digestibility of lamtoro leaves, and growth of fish fry (*Hemibragus nemurus*) to feed with the addition of fermented flour from leaves of lamtoro (*Leucaena leucocephala*). The method used is the Completely Randomized Design (CRD) experimental method with 5 different treatments: P0 (0: 100%), P1 (10: 90%), P2 (20: 80%), P3 (30: 70%), P4 (40:60%), and 3 replicates for each treatment. The crude protein content of the test feed was 30%. The results of the study show that fermented lamtoro leaf flour in feed gives a real difference ($P<0.05$) on feed

digestibility, feed efficiency, protein retention, and growth specific. The highest feed digestibility in P3 feed (30:70) 62,96%, efficiency feed on P3 feed (30:70) 21.12%, protein retention on P3 feed (30:70) 13.45%, and the specific growth of feed P3 (30:70) was 1.93%. Water quality in maintenance container temperature between 26-31^{0}C, dissolved oxygen between 2.8-3.4 ppm, and pH between 5-7.

4. CONCLUSIONS

Based on the results of a literature search, it is known that the nutritional content of the Lamtoro plant has good quality. Lamtoro can meet the nutritional needs of several types of freshwater fish. This shows that lamtoro leaves have good potential to be used as an alternative feed for freshwater fish feed.

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