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Leucaena leucocephala FOR FISH AND POULTRY FEED

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ABSTRAK

Vegetable raw materials have high potential as an alternative source of feed protein that is able to support optimal fish growth. Vegetable raw materials have advantages, including abundant and inexpensive availability, and sometimes in the form of waste or weeds, for example *Leucaena leucocephala*. Its use in fish feed formulations is limited by the presence of some antinutrient substances such as phytic acid, mymosins and tannins, as well as a fairly high content of crude fiber. The utilization 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%. Studies evaluating the nutritional quality of Leucaena as a fish feed ingredient gave varying results. There are significant differences with using *Leucaena leucocephala* as a substitute food for fish feed. It shows an increase in performance from the point of view of a certain growth rate, weight gain and feed conversion ratio. However, not all dietary experiments are affected for fish growth due to the processing techniques applied that involve soaking and drying the leaves thus reducing the antinutrients in Leucaena leaf meal which are mostly mimosin. The levels of incorporation of Leucaena leaf meal did not affect the palatability of the diets *Clarias gariepienus*, and can replace soybean meal in tilapia feed formulations up to 75%. The level of 20% Leucaena meal diets) increased mean feed intake during the finisher broiler phase

Introduction

Limited supply of quality feed raw materials is the main obstacle to the creation of sustainable aquaculture business activities in the midst of competition with other food production business activities (FAO 2006). High-quality sources of feed protein such as fish meal and soybean meal meal are increasingly limited, because the stock of trash fish in the sea as raw materials for fishmeal production is running low, so the price is increasing, and the price of soybeans is increasingly unaffordable. Consequently, efforts to find alternative sources of raw materials that have high nutritional value and abundant availability are the main focus of attention for fish nutrition farmers and researchers today. The high price of feed is due to the increase in the price of feed raw materials. According to Soebjakto (2015), fish feed raw materials such as fish meal, soybean meal, corn meal and Meet Bone Meal flour are still dependent on imports. As a result, the selling price of feed at the level of fish farmers is quite expensive.

Vegetable raw materials have high potential as an alternative source of feed protein that is able to support optimal fish growth (Nwanna *et al.* , 2008) Vegetable raw materials have advantages, including abundant and cheap availability, and sometimes they are waste or weeds, for example *Leucaena leucocephala* leaves, cassava leaves or aquatic plants. However, in compiling fish feed formulations based on vegetable ingredients, attention must be emphasized at the optimal level in feed and appropriate processing techniques so that their use is effective (Francis et al. 2001). Information about the optimal level of vegetable ingredients in feed is important related to the presence of several limiting factors such as high crude fiber levels and the presence of antinutrient factors (Kurniasih, 2012).

The nutritional attributes of *Leucaena leucocephala* and the factors limiting its use in poultry diets have been the subject of considerable research over the past 10 years. Recent data confirm the previous findings concerning the favorable proximate composition of *Leucaena* leaf meal (LLM), although the carotenoid content of this legume is now emerging as its major asset for the pigmentation of egg yolks and broiler carcasses.

One of the efforts that can overcome dependence on imported feed raw materials is the use of local raw materials for the manufacture of fish feed. One of the local raw materials that has the potential to be used as raw material for fish feed is lamtoro leaves (*Leucaena leucocephala*). The lamtoro plant is a local biological resource that has the potential to be used as a source of vegetable protein (Kasiga & Lochmann, 2014). The use of lamtoro leaves has been widely applied as feed raw materials in aquaculture activities, such as tilapia, rohu fish, and *Indian snakehead fish, Channa puncate.*

Leucaena leucocephala is one of the potential sources of vegetable protein for fish and livestock feed (D'Mello & Acamovic 1989). Lamtoro leaf flour (TDL) and lamtoro seeds have a fairly high protein content of around 25%. However, it is also known that Leucaena contains mimosine which is able to inhibit protein biosynthesis in animals so that it has an impact on decreasing the growth rate when consumed intensively (D'Mello & Acamovic 1989; Ter Muelen et al. 1981). *Leucaena leucocephala* has been identified to be one of such plants capable of reducing feed cost as the nutritive values are right and it's abundant in most part of the country (Jones 1979). *Leucaena leucocephala* is a leguminous, multipurpose tree that provides fuel wood, green manure, improves degraded lands and can be used as a cover crop. The leaves contain about 22.7% crude protein (Atawodi, et al., 2008) and survive well on degraded soils which are low in nutrients. It has bi-pinnate leaves, lanceolate leaflets and has flat pods containing small seeds. Although the leaves and seeds contain antinutritional factor known as mimosine (Francis et al., 2001) which has been reported to inhibit growth in animals (especially nonruminants), however with processing this antinutrients are easily destroyed hence improving their usability as animal feed.

The Potential of Ipil-Ipil (*Leucaena leucocephala*) for Fish Feed Nutritional

Lamtoro (*Leucaena leucocephala*) has been known in Indonesia for a long time with the name of Chinese petai, or Ipil-ipil . The plant belongs to legumes originally from Central America. This plant was brought to Indonesia in the 20th century as a shade plant in plantations. Now this plant is spread throughout the countryside because it is easy to grow in almost all places that get sufficient rainfall (Budiman *et al.,* 1994).

According to Bray et al. (1997), lamtoro plants can be planted using various planting systems, for example as erosion prevention fences, windbreaks or yard boundaries. NAS (1994) mentioned that in general lamtoro plants can produce dry matter from edible elements (leaves and small branches) of 6-8 tons per hectare per year or about 20–80-tons of fresh material per hectare per year. Lamtoro leaf flour (TDL) is a local biological resource that has the potential to be used as a source of vegetable protein in fish feed. This is due to the high protein content of about 34.38%, an amino acid composition that is almost balanced with soybean meal and is a source of vitamin A with a relatively high content of B-carotene.

The lamtoro plant is a local biological resource that has the potential to be used as a source of vegetable protein because it contains protein around 25.2 – 32.5% (Kasiga & Lochmann, 2014). According to (Hertrampf & Piedad-Pascual, 2000), the essential amino acids contained in lamtoro leaves consist of arginine by 2.20%, histidine by 0.74%, isoleucine by 2.44%, leucine by 3.02%, lysine by 2.37%, methionine by 0.58%, phenyalanine by 1.89%, threonine by 1.94%, tryptophan by 0.31%, and valine by 2.31%

Leucaena leucocephala Processing Method for Fish Feed

1) Solar drying To reduce the mymocin content in lamtoro leaves can be done by drying in the sun until completely dry. With drying, the mimosin content contained in lamtoro leaves will be reduced, so that it can be given as animal feed (Suprayitno, 1981).

2) Dry heating. Fresh lamtoro leaves are flattened over the container, then heated in the oven at 70 °C for 12 hours (Murthy *et al*., 1994).
3) Moist heating (steamed cooking) Fresh lamtoro leaves are put in a plastic bag and then heated in a water bath at a temperature of 70 °C for 15 minutes. After that the reaction is stopped by aerating (Lawrie *et al.,* 1983).
4) Soaking in water for 12 hours Fresh lamtoro leaves are soaked in water, left at room temperature for 12 hours, after which they are filtered with a cloth, further aerated (Murthy *et al*., 1994).

Researches

Research evaluating the nutritional quality of Leucaena as a source of protein for fish feed gave varied results:

Table 1. Researches of the experiment of *Leucaena leucocephala*

Type of Lamtoro (*Leucaena leucocephala*) Experiment	**Results**	**Experimental object**	**Workers**
Feeding treatment using bran raw materials and artificial feed using lamtoro leaf flour for growth with 28-30% protein content and 5% feeding dose of total biomass weight	There is a difference in the average length and weight between lamtoro leaf meal and bran feed.	*Pangasius hypophthalmus*	Manullang *et al*. (2021)
The leaves (not with the branches) get soaked first so that the mymosins disappear, treatmented with rumen fluid and fermented for 24 hours	Shows significant quality improvement, and can replace soybean meal in tilapia feed formulations up to 75%	*Nile tilapia*	Kurniasih et al., (2012)
Fingerlings were fed diet containing 0%, 5%, 10%, 15% and 20% inclusion levels of Leucaena leaf meal	The levels of incorporation of Leucaena leaf meal did not affect the palatability of the diets, instead there was observed significant increase growth as the inclusions levels increases.	*Clarias Gariepinus*	Tiamiyu *et al*., (2015)
Breeders given diets meal at 0%, 2.5%, 5.0%, 7.5%, and 10.0% of inclusion of *Leucaena leucocephala*	There was no significant difference in weight gain, feed conversion ratio and protein efficiency ratio.	*Tilapia zilli* Aquaria	Babalola *et al.,* (2020)
Breeders given isonitrogenous and isocaloric diets formulated with raw and treated *Leucaena leucocephala* leaf meal at 20%, 30% and 40% levels.	Both the inclusion level and type of *Leucaena* leaf meal in diets significantly affected the growth performance of rohu. Fish fed diets containing inoculated *Leucaena* leaf meal performed better in comparison with a fish meal based reference diet (RD)	*Labeo rohita*	Bairagi *et al.,* (2004)
Treatment of drying results at a temperature of 80 C, or soaked in a solution of ferrisulphates, for a week; can remove mimosine antinutrients, better than no treatment	Growth, FCR, SR not significant different on Nile Fish (Tilapia mossambica)	Fish nile	Camacho & Duureza (1977) in Cho, et.al. (19830
Tilapia fed with finely ground IILM at 3, 6, 9% of fish biomass. IILM fed at 25 and 5)% of daily ration to tilapia	Increasing amount of feed proportionately increased Growth Rate and Protein content of Tilapia	Fish nile	Pantastico & Baldia (1979) in Cho, et.al. (19830
Sexually mature Nile tilapia given test diets with and without ILLM	Mature breeders lost weight, show significantly low GSI and low fry production	Fish nile	Cruz (1982) in Cho, et.al. (19830
Breeders given isonitrogenous diets containing 0, 20, 40, 60% IILM	Male/Female lost weight at dietary LLM increased it 40%. At 80%, IILM fry production was significantly low	Fish nile	Pantastico & Baldia (1980) in Cho, et.al. (19830
A six-week experiment was conducted to assess the response of Cobb broiler chicks to diets containing varying levels (0%, 5%, 10% and 15%) of Leucaena leaf meal (LLM)	the inclusion of LLM in diets as low as 5% had adverse effects on the growth performance and economy of gain of broiler chickens. the experimental diets did not precipitate detrimental effect on the	Broiler chickens	Zanu, et. Al, 2011

	health status of broiler chickens.		
Leucaena leguminous plant as feed supplement in laying hens was evaluated at 50, 100 and 200 g/kg (5, 10 and 20%	L. leucocephala leaves may only be useful as feed supplement in egg laying hens at low levels of supplementation	Laying hen	Atawodi, et al. 2008
Leucaena leguminous plant as feed alternative	Feeding experiments using Leucaena showed that 5% Leucaena leaf meal could be used in the feed ration for chickens	chickens	Guodao, and Dongjing 2001
The groups were corresponded to four dietary treatments (LL0, LL7, LL14 and LL21) containing respectively 0, 7, 14 and 21% of Leuceana leaves meal	L. leucocephala leaves meal in the diet at 21% level, has no significant adverse effect on feed intake, average daily weight gain, feed conversion ratio and nutrients utilization (except ether extract) of adult indigenous Senegal chickens.	Sinegal chickens	Ayssiwede, et.al. 2010
Leucaena leucocephala seed meal (LSM) replaced groundnut cake at levels of 0, 5, 10 and 20% for an eight week period	Control and 20% LSM diets significantly (P<0.05) increased mean feed intake during the finisher phase	twenty 5-week old Shaver Cross broiler chicken	Okonkwo, IT Wamagi, BI Okon BI Umoh. 1995

Discussion

Cost on fish food is always the main budget item on fish farming venture. Therefore, dependable indices are necessary to determine the growth performance of the fish fed with formulated feed. The parameter such as feed conversion ratio, weight gain, feed consumed and protein efficiency ratio are relevant examples of such indicators that reflects how effective a feed fed to the fish can be in order to evaluate the profitability of a fish farm. Based on the diets research, the experimental diets indicating that the levels of incorporation of *Leucaena leaf* meal did not affect the palatability of the diets, instead there was observed significant increase in growth as the inclusions levels increases. This could be due to the processing technique applied which involved soaking and drying the leave hence reducing the antinutrient in Leucaena leaf meal which is mainly mimosine. The survival rate recorded in the experiment could be credited to good management practices in the feeding and water quality management by monitoring the water quality characteristics during the experimental periods.

The use of lamtoro raw materials for fish is limited by the high content of neutral detergent fiber (NDF) by 39.5% and acid detergent fiber (ADF) by 35.10% (Gracia et al. 1996). Crude fiber (fiber) is a carbohydrate component rich in lignin and cellulose that is difficult to digest. Cellulose is a skeleton of plant cells consisting of a p-D-glucose chain with a degree of polymerization of approximately 14,000. The use of TDL in feed is also limited by the presence of mymocin which is a heterocyclic amino acid. In addition to mymocin another nutrient ingredient contained in TDL is myoinositol hexakiphosphate (C6 H18O24P6) which is commonly called phytic acid and tannins.

Mimosine is a non-protein amino acid that has almost the same structure as tyrosine. The mimosien content of lamtoro leaves ranges from 2%-6% and varies depending on the degree of maturity. Mimosine containing high polyphenol compounds including tannins will bind to proteins, so proteins become unavailable to livestock and cause negative effects on palatability, digestibility, and growth (Wang *et al.*, 2000). Mimosine is an anti-nutritional substance in feed ingredients, which if consumed by livestock can cause a decrease in the performance of these livestock (Widodo, 2005).

According to Bairagi *et al.* (2004), lamtoro leaves contain crude fiber by 6.15%, cellulose by 12.56%, hemicellulose by 8.34%, tannins by 4.5% and mimosine by 2.2%. Tannins and mimosine are anti-nutritional substances that can interfere with the absorption of nutrients in the digestive tract and affect fish growth (Hertrampf & Piedad-Pascual, 2000). According to Jannathulla (2018a), tannins are protease enzyme inhibitors so that they inhibit protein digestibility in the fish digestive tract, lowering the value of feed palatability so that the amount of feed consumption and fish growth decreases. Therefore, efforts are needed to reduce the high value of crude fiber and the content of anti-nutritional substances in lamtoro leaves, one of which is by carrying out the fermentation process.

The use of *Leucaena leucocephala* leaves has been widely applied as feed raw materials in aquaculture activities, such as tilapia, rohu fish, and *Indian snakehead fish, Channa puncate. Leucaena leucocephala* leaf meal were being used by many researches, the feed ingredients used in the feed formulation include Fish meal, Soybean meal, Maize meal, Vitamin and Mineral premixes. It is also known that *Leucaena* contains mimosine which is able to inhibit protein biosynthesis in animals so that it has an impact on decreasing the growth rate when consumed intensively. There are significant differences with using *Leucaena leucocephala* as a substitute food for fish feed. It shows an increase in performance from the point of view of a certain growth rate, weight gain and feed conversion ratio. However, not all dietary experiments are affected for fish growth due to the processing techniques applied that involve soaking and drying the leaves thus reducing the antinutrients in Leucaena leaf meal which are mostly mimosine. The utilization of *Leucaena leucocephala* 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%.

Conclusion

One of the local raw materials that has the potential to be used as raw material for fish feed is lamtoro leaves (*Leucaena leucocephala*). Leaf meals such as *Leucaena leucocephala* are the cheapest source of plant protein that can be used to alleviate the cost of feed problem in aquaculture industry if well incorporated in fish and poultry diets.

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