Minireview Article

Biological Processing of Leguminous Plants as Fish Feed Ingredients

ABSTRACT

Fish feed has a crucial role in the success of fish farming, namely influencing growth. Development and use of alternative feed in fish farming as a solution to reduce pressure on natural resources and increase the sustainability of the fisheries sector. The use of legume plants as an alternative fish feed ingredient can be used to support the sustainability of fish farming. This review article aims to collect and provide information about several research results regarding the use of legume plants as ingredients in fish feed. The method used in preparing this review article is a literature review. Many studies have been conducted to evaluate the nutritional potential, availability, and impact of the use of legume plants on fish growth. Leguminous plants have the potential to be used as fish feed ingredients because their protein content ranges from 27-35% and has been proven to have an effect on increasing body weight so they can be used as an alternative feed.

Keywords: Vegetable proteins, legumes, nutritional evaluation

Introduction

The level of productivity of fish farming is influenced by fish feed and growth factors (Handajani 2011). Quality feed really supports the growth process (Wijianto 2022). The main factor that influences growth in fish cultivation and health is feed (Khasani 2013). High quality and balanced nutrition contained in feed is needed by fish for adequate growth in quality and quantity in a short time (Adẹ́yẹ̀mi et al. 2020).

Feed is one of the largest expenses in cultivation (Listiowati and Pramono 2014). Feed occupies the largest cost, namely 60% of total production costs (Romansyah 2016). Commercial and artificial feed production is often faced with various problems related to the availability of ingredients that are difficult to obtain and their high prices (Yashni et al. 2020).

There is a need for alternative ingredients with affordable prices, good availability and of course quality nutritional content (Djonu et al. 2020). Forage in wet or flour form is a cheap source of protein that can be used as alternative feed (Listiowati and Pramono 2014).

Leguminosae is a plant that has a high protein content (Puspita et al. 2015). Legume plants are a potential source of vegetable protein because of their high nitrogen content and complete amino acids (Hutasoit et al. 2017).

Therefore, based on the description above, the author is very interested in writing a review article by collecting and providing information about several research results that use legume plants as fish feed ingredients.

Method

This preparation uses a literature review with a narrative literature review method. This method identifies, assesses, and interprets all findings on a research topic. Literature reviews contain descriptions of theories, findings and other research materials obtained from reference materials to serve as a basis for research activities. A literature review is a comprehensive review to find rationale for research that has been carried out or for ideas for further research. Narrative is a series of sentences that are narrative or explanatory in nature. In another sense, narrative is said to be prose whose subject is a series of events. So using the method above is the right way to look for comparisons in research.

Characteristics of Leguminous Plants as Fish Feed Ingredients

So far, fish feed generally still relies on fish meal, a by-product of livestock activities, meat and bone meal as the main source of protein (Waruwu 2022). The decline in fishmeal production and increasing demand for fishmeal has caused a significant increase in the price of fishmeal (Hernandez et al. 2008 in Suprayudi 2011). Therefore, it is necessary to look for alternative feed ingredients to replace or reduce the use of fish meal.

The criteria that must be met by alternative feed ingredients are that they have the nutrients needed by fish in sufficient quantities, are cheaper, the raw materials are available in large quantities, do not compete with

human needs and their continuity is guaranteed (Sari 2018). Raw materials for sources of vegetable protein as alternative feed that are easy to obtain at affordable prices include the use of plants in the form of Indigofera zollingeriana leaves (Mukti et al. 2019), moringa (Maslang et al. 2018), lamtoro (Restiningtyas 2015), gamal (Nazlia 2019)and turi (Meilisza et al. 2021).

In general, the source of vegetable protein in fish feed that is widely used is soy flour where soy flour is relatively expensive, so there is a need for alternative ingredients as a substitute for soy flour which can reduce production costs, especially feed which can ultimately increase fish income and production (Mulyono 2018) . Fish feed ingredients are usually divided into 2 types, namely basal ingredients and supplements. Basal feed ingredients, namely a type of fish food that has a protein content of less than 20%, while supplements have a protein content of more than 20%. (Yunaidi 2019). Several types of legume plants and their nutritional content that can be used as fish feed ingredients can be seen in Table 1.

Table 1. Nutrient Content of Leguminous Plants as Fish Feed Ingredients

Plant Types	Proteins	Fat	Ash Content	Crude Fiber	BETN	Reference
Indigofera zollingeriana	27.08	5.94	12.22	6.61	48.15	Aprilia et al. 2022
Moringa Leaves	27.67	5.61	9.21	16.45	41.05	Indriati and Yuniarsih 2021
Lamtoro leaves	21.63	5.8	6.9	15.4	-	Juwandi et al. 2018
Gamal leaves	16.88	-	10.37	16.97	-	Nazlia 2019
Turi Leaf	31.29	7.57	7.34	27.88	28.02	Aryani and Susilowati 2018

The choice of fish formulation must meet the minimum requirements needed by fish, because it can accelerate growth, shorten the maintenance period, and reduce the risk of death (Yunaidi and Wibowo 2019). Protein requirements in feed range from 27-35%, thus based on Table 1 these plants have the potential to be used as fish feed ingredients (Mose and Saselah 2021). The use of legume plants as fish feed ingredients is constrained by the high level of crude fiber which can reduce the level of feed digestibility, so this can be reduced by fermentation and hydrolysis processes (Suprayudi et al. 2012).

Technology to Improve the Nutritional Quality of Plant Feed Ingredients

The high crude fiber content and the presence of anti-nutritional substances and amino acid composition that is different from plant raw materials are the main obstacles in the use of vegetable materials as raw materials for fish feed (Pamungkas 2012). One effort to overcome these obstacles is fermentation technology (Pamungkas 2011).

Fermentation

Fermentation is a process to increase the digestibility of ingredients because fermented ingredients can change plant material substrates that are difficult to digest into single cell proteins from starter organisms such as Rhizopus sp, thereby increasing the digestibility of ingredients (Adelina et al. 2009). The use of Rhizopus sp provides added value by producing compounds that can function as antioxidants and antimicrobials (Kurniawan et al. 2019). Rhizopus sp also improves nutritional quality, increases digestibility and facilitates the absorption of minerals by converting them into organic matter (Endrawati and Kusumaningtyas 2017). The working principle of the fermentation process is to break down indigestible materials such as cellulose and hemicellulose into simple sugars that are easily digested with the help of microorganisms (Firdayanti 2019).

Results

Plants can be used in aquaculture, one of which is as alternative feed (Pamungkas 2012). Biological processing technology and utilization of leguminous plants in fish feed formulations can be seen in table 2:

Table 2. Application of the Use of Leguminous Plants in Fish Feed Formulation

Plant Types	Organism	Bacteria	Dose	Results	Reference
Indigofera zollingeriana	Catfish Pangasius sp.	-	20%	Absolute weight growth was 2.15 g, daily growth rate was 1.00% and feed efficiency was 44.60%	Mukti et al. 2019
Moringa Leaves	Parrot fish	-	7%	The specific growth rate is 0.12% with an average weight of 3.16 grams. At 100% survival rate.	Astiyani et al. 2020
LamtoroLeaves *(Laucaena gluca)*	Red Tilapia Fish Seeds	Mold Trichoderma sp.	10%	Provides a real influence (P<0.05) on the RGR, EPP and PER values, namely 2.09%/day respectively; 60.84% and 2.03%.	Restiningtyas 2015
Gamal Leaves	Gourami Fish (Osphronemus gouramy)	EM4 brand commercial probiotic	75%	Absolute weight growth on day 40 showed significantly different results. The treatment value of 75% is significantly different and higher than 25% and 50%.	
Gamal Leaves	Nener Milkfish (Chanos-chanos)	-	20%	Has a significant effect on growth, feed conversion ratio and survival rate of milkfish (P<0.05) and reduces the cost of animal raw materials by 30%.	Aaron et al. 2021
Turi Leaves	Srikandi Tilapia Fish Seeds	*Rhizopus oligosporus*	10%	The fish biomass growth rate in treatment C (10%) was 7.33 gr and the survival rate was 100%.	Ridho et al. 2017

Discussion

Growth can occur because the feed energy provided exceeds the fish's needs for maintenance (body maintenance) (Setiawati et al. 2008). The greater the available energy, the more sufficient it will be for maintenance needs and the rest will be used for growth. The results of this study indicate that the growth in absolute weight of catfish has a different effect. The highest absolute weight growth was found in the 20% treatment, namely 2.15%. The growth in weight shows that the catfish is able to utilize the nutrients contained in the feed and convert them into energy and body weight (meat) (Mukti et al. 2019).

The daily growth rate has increased, with the increasing addition of Moringa leaf flour to commercial feed. Fish that were given treatment C (Addition of 7% Moringa leaf flour) increased by 0.19 grams every day with an average weight of 3.16 grams. The high growth of tilapia fish is supported by the amino acid content contained in Moringa leaves. According to Paisey (2009), amino acids are part of protein which functions to repair body tissues and organs which are used as an energy source in metabolic processes. Apart from that, amino acids are one of the building blocks of protein, if imperfections occur then the growth system will be disrupted and not run optimally (Astiyani et al. 2020).

Feeding with 10% (C) fermented lamtoro leaves in artificial feed had an influence on the relative growth rate of red tilapia (O. niloticus) with the highest value of 2.09 ± 0.07 %/day. These results are different from the

research of Fitriliani (2010) which gave the highest results in relative growth in the 0% treatment with a yield of 2.77 ± 0.44 lamtoro leaf flour which had been hydrolyzed with rumen fluid enzyme extract in sheep. These results suggest that the weight used in this study was smaller than previous research (Fitriliani 2010), namely tilapia fish weighing 7 - 10 g with the total protein produced in the 0% treatment feed being 31.12% (Restiningtyas 2015).

The best treatment was found in treatment C with the use of 20% gamal leaf flour. The high growth in length, absolute weight growth, survival rate and low feed conversion ratio are thought to be caused by the high attractiveness of the feed in this treatment, so that the feed is more responded to and consumed by the milkfish fisherman. The content of gamal leaf flour and fish meal is not excessive compared to treatments A and B so it can increase the palatability of the feed (Harun et al. 2021).

The highest growth was obtained in treatment C with the percentage of added fermented turi leaf flour from the total feed weight of (10%) which was 7.33 gr. It is suspected that the level of use of fermented turi leaf flour in artificial feed is quite optimal, which is supported by the composition of other feed ingredients. According to Alava and Lim (1983) inRidho et al. (2017), that artificial feed whose components consist of two or more protein sources can trigger fish growth as long as the combination of these protein sources complement each other so that it will provide better results, than feed that only contains one protein source. To achieve nutritional balance in feed, it is best to use protein that comes from vegetable and animal protein sources together (Afrianto and Liviawati 2005 inRidho et al. 2017).

Conclusion

Based on the description above, it can be concluded that several legume plants have the potential to be used as alternative feed ingredients. This can be seen from the influence of adding these plants to the feed on increasing the weight and digestibility of fish. Alternative feed can be used as a solution to reduce the production cost problem of aquaculture.

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