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POTENTIAL UTILIZATION OF MANGROVE PROPAGULES AS FISH FEED (A REVIEW)

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ABSTRACT

Mangrove fruit is widely available along Indonesia's coast. Known as propagules, mangrove fruit that has undergone germination. Mangrove fruit known as "propagules"—a combination of the fruit and sprouts of the *Rhizophora* mangrove species—have germinated as a method of regeneration (hypocotyl). The active components in propagul, a feed additive, have a high level of antibacterial, antifungal, antiviral, insecticide, and antileukemic activity. 2.93 percent protein, 0.21 percent crude fat, 2.09 percent ash, 15.25 percent water content, and 25.98 percent crude fiber make up the mangrove propagules of *R. mucronata*. According to the proximate analysis's findings, the major barrier to the use of propanes is their high crude fiber content, which is bad for digestion and can stunt growth, especially in fish seeds. Several studies are reported to have conducted trials of giving fermented propagule as feed for several types of fish, such as tilapia (*Oreochromis niloticus*) and catfish (*Clarias gariepinus*). Propagules are able to support the survival of fish because of the large number of extracellular enzymes produced during fermentation, thereby improving the content of propagule flour for the better and affecting the survival of fish. The crude fiber content in propagule flour is quite high at 24.03%, it is suspected that it can also affect the growth of fish fry. The addition of a large percentage of fermented propagule flour will reduce the growth rate. This paper aims to describe the potential use of mangrove propagules in artificial fish feed, which is presented in the form of a literature study.

INTRODUCTION

Indonesia is a country that has a large coastal area and high biodiversity. The area of mangrove forests in Indonesia in 2009 was recorded at 3,244,018, 460 hectares and in West Java 7,932,953 hectares. Nearly 202 types of mangrove species have been identified and are growing well, one of which is *Rhizophora mucronata*. The process of pollination of mangrove *R. mucronata* occurs from April to October. Pollination produces green fruit that is 36-70 cm long and 2 cm in diameter [1]. Mangrove fruit can be found easily along the coast. Mangrove fruit that has experienced germination is called propagules. Propagules are mangrove fruit that have germinated as a means of regeneration of the Rhizophora mangrove species which is a combination of Rhizophora fruit and its sprouts (hypocotyl). The hypocotyl, which functions as a food reserve for this mangrove fruit, has come out of the fruit. Propagul as a feed ingredient has a high value of active ingredients including antimicrobial, antifungal, antiviral, insecticide and antileukemic activity [2].

R. mucronata mangrove propagules contain 2.93% protein, 0.21% crude fat, 2.09% ash, 15.25% water content and 25.98% crude fiber. Based on the results of the proximate analysis, the main obstacle to the use of propagules is the high content of crude fiber which is not appropriate for digestion and can inhibit growth, especially in fish seeds. For this reason, it is necessary to do engineering to overcome these obstacles by using fermentation technology. Fermentation is the process of breaking down organic compounds into simpler compounds by involving microorganisms. Fermented products are generally easily biodegradable and have a higher nutritional value than the original material [3], converting undesirable tastes and aromas into favored ones and synthesizing proteins. Another benefit of fermentation is that feed ingredients become more resistant to storage and can reduce the toxic compounds they contain, so that the economic value of the basic ingredients is much better [4].

The type of mold used for propagule fermentation is *Aspergillus niger*. Fermentation is carried out so that the fermented propagules can be used as feed ingredients with high active ingredient values for fish feed. Utilization of fermented mangrove propagules from *A. niger* is expected to increase the potential of mangrove propagules as alternative feed ingredients that can have an effect on growth for fish. The use of propagules as feed ingredients for fish has been carried out by several researchers, hence it is necessary that this paper aims to describe the potential use of mangrove propagules in artificial fish feed, which is presented in the form of a literature study.

BIOLOGY AND NUTRITIONAL CONTENT OF PROPAGULES

The type of mangrove Rhizopora mucronata is known by several regional names, namely mangroves, bare mangroves, early mangroves and bangko. This plant is mostly found in sandy areas and tidal areas, usually found in muddy places such as estuaries and the edges of mangrove vegetation. Mangrove plants can grow to a height of 35-40 m [5]. The classification of mangrove plants (*R. mucronata*) according to [6] is as follows:

Kingdom : Plantae
Class : Magnoliopsida
Order : Mytales
Family : Rhizophoraceae
Genus : Rhizophora
Species : *Rhizopora mucronata*

Mangrove plants have cylindrical stems, the outer skin is grayish brown to black, on the outside the skin looks cracked. The shape of the roots of this plant resembles a taproot (stick root). Taproot is used as a respiratory organ because it has lenticels on its surface. The roots of these plants grow hanging from low stems or branches and are coated with a kind of wax cell that can pass oxygen but does not penetrate water [5].

The regeneration tool for the *Rhizophora* mangrove species here is known as the propagule which is a combination of the *Rhizophora* fruit and its sprouts (hypocotyl). The hypocotyl, which functions as a food reserve for this mangrove fruit, has come out of the fruit. This species can live at various heights of the soil surface with a height of up to 25 m. Mangroves have fruit that has germinated called propagules. There are two types of mangrove germination, namely vivipari and cryptovivipari. Vivipari is a seed that has germinated while still attached to the parent tree and the sprout has come out of the fruit as in the family *Rhizophoraceae (Rhizophora, Bruguiera, Ceriops,* and *Kandelia*). While cryptoviviparian are seeds that have germinated while still attached to the parent tree, but are still covered by the seed coat. Propagules of *R. mucronata* are viviparous with an average size of 2.0–2.3 cm in diameter and 50–70 cm in length [7].

Propagules are usually found hanging on mangroves that can be found along the coast, unfortunately propagules have not been used optimally. Mangrove propagules consist of stalks, fruit petals, ovules (plumule), fruit, fruit chips, hypocotyl and radicle. Propagules are elongated and there are still fruit forms attached to the sprouts or commonly known as hypocotyls. This hypocotyl serves as a food reserve for propagules to grow [8].

Figure 1. Propagule Mangrove *Rhizophora mucronate*[1]

Almost all parts of the plant *Rhizophora* sp. including propagules also contain active ingredients. According to [9], *R. mucronata* mangrove propagules contain flavonoids, tannins, phenol hydroquinone, and saponins which have antimicrobial, anti-inflammatory, antioxidant properties as well as detoxification of toxins and are able to increase the body's immune system against disease. Proximate analysis was carried out to determine the nutritional value contained in mangrove propagules. The results of the analysis are in Table 1 below.

Table 1. Nutritional Content of Propagules Mangrove *R. mucronate*

%Dry Matter				
Protein	**Crude Fiber**	**Crude Fat**	**Ash**	**Moisture Content**
2.93	25.98	0.21	2.09	15.25

Source: Lab Analysis Results. Animal Nutrition and Animal Feed Chemistry, Unpad 2016

Mangrove propagules as feed ingredients have disadvantages such as containing high crude fiber and low protein content. Various processing of high-fiber feed ingredients has been carried out to increase the efficiency of feed use, such as physical, chemical, and biological processing or a combination (fermentation) [4].

UTILIZATION OF MANGROVES IN FISH FEED

Several studies are reported to have conducted trials of giving fermented propagule as feed for several types of fish, such as tilapia (*Oreochromis niloticus*) and catfish (*Clarias gariepinus*). The results of testing mangrove progagul as fish feed are as follows:

Survival Rate

Survival rate is a comparison value between the number of organisms that live at the end of maintenance and the number of organisms at the beginning of stocking which is expressed as a percentage where the greater the percentage value, the more organisms that live during a certain maintenance period in a culture container [10].

Table 2. Average Survival Rate of African Catfish

Feed Treatment	Average Survival (%)	
	Catfish	**Tilapia**
A (0%)	90.0 ± 0.18a	96.67 ± 10.64a
B (2.5%)	93.3 ± 0.24a	98.33 ± 7.46a
C (5.0%)	90.0 ± 0.30a	93.33 ± 10.64a
D (7.5%)	86.7 ± 0.09a	98.33 ± 7.46a
E (10.0%)	80.0 ± 0.05a	98.33 ± 7.46a

Description: Values followed by the same lowercase letters are not significantly different at the 95% confidence level

The results of statistical analysis showed that the addition of mangrove propagule flour in artificial feed showed no significant effect on the survival of African catfish and tilapia seeds. Propagules are able to support the survival of fish because of the large number of extracellular enzymes produced during fermentation, thereby improving the content of propagule flour for the better and affecting the survival of fish. [11] states that extracellular enzymes produced in microbial cells and released from cells into the fermentation medium to hydrolyze and degrade the complex components of the substrate into simpler compounds that are easily soluble and more easily absorbed by microbes, which will then be able to help the growth and reproduction of microbes themselves, thus the microbial growth becomes better and can contribute to increasing the protein content of the substrate as a cell protein.

When viewed from the survival value in the above study, in general the survival value of fish fry is very good (above 80%). Compared to the use of *Jaloh* leaves in tilapia feed [12], fermented sweet potato leaves [13], and *Lamtoro* leaves (Restiningtyas et al., 2015), the survival value with propagule consumption was higher. The differentiating factor in the response of each plant used was thought to be due to the type of fish used and the nutritional requirements of the test fish.

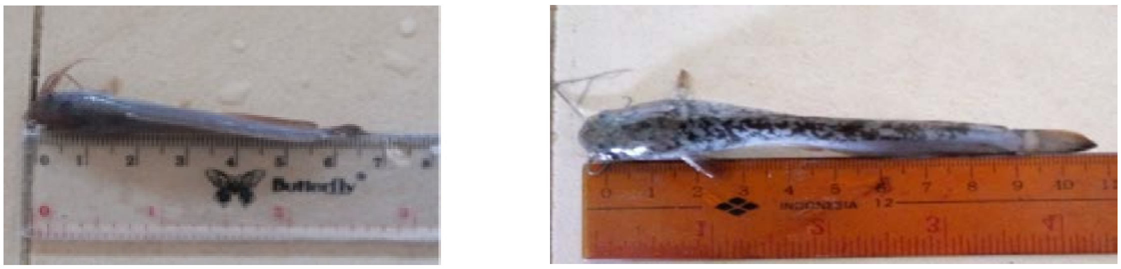
Mangrove propagules contain antioxidant compounds. This is said by [14] that some plants are known to contain antioxidant and phenolic compounds that have the ability as antioxidants. One hope of alternative sources of natural antioxidants is mangrove propagules (*Rhizophora mucronata* Lamk.). Antioxidants function as protectors from various diseases that will attack fish and cause the aroma of the feed to be maintained due to the presence of compounds which are the end products of autoxidation reactions (Priyanto 2012). According to research from Atta-au-rahman et al. (2001) the compounds that have the potential to have antioxidants are generally flavonoids, alkaloids and phenolics which are polar compounds. The results of [15] study showed that mangrove propagules contain alkaloids, steroids, flavonoids, phenol hydroquinone and tannins which function as natural antioxidants. According to [16], compounds such as flavonoids, alkaloids, polyphenols and phenolics can function to increase fish immunity, improve water quality, treat fish diseases and control pests in fish.

Daily Growth Rate

Based on the results of research on tilapia and catfish, it was found that the addition of fermented propagule flour with different percentages in the feed was able to increase the weight of fish with different values. The addition of fermented propagule flour to the feed of African catfish and tilapia gave a good response to growth, this can be seen from the increase in the average weight of individual fish seeds in each treatment with increasing rearing time (Figure 2).

Table 3. Average Daily Growth Rate of Fish

Feed Treatment	Daily Growth Rate (%)	
	Catfish	Tilapia
A (0 %)	1.26 ± 0.12a	1.25 ± 0.25a
B (2.5%)	1.33 ± 0.10a	1.34 ± 0.02a
C (5.0%)	1.21 ± 0.06a	1.18 ± 0.20a
D (7.5%)	1.26 ± 0.17a	1.17 ± 0.33a
E (10.0%)	1.29 ± 0.14a	1.12 ± 0.15a



a. b.

Figure 2. African Catfish Fry at the Beginning (a) and Late (b) Observations

Based on the results of research on tilapia and African catfish, it appears that the addition of fermented propagule flours up to 10% does not have a negative impact on the growth rate. The results of this analysis of variance indicated that the addition of fermented propagule flour up to 10% could be used as an alternative feed ingredient because it provided a daily growth rate that was not significantly different from the control treatment. The daily growth rate in each treatment had a value that was not much different due to the relatively the same fish acceptance of the feed given during the study. The value of the daily growth rate can be said to be quite good. According to [17], the decent value of the daily growth rate of fish is >1%.

The high value of the daily growth rate of African catfish fry is suspected because according to [11], in the fermentation process, *A. niger* mold produces enzyme products that can degrade crude fiber. Changes in crude fiber content after fermentation indicated enzyme production and mold growth, hence that they operated to minimize crude fiber and carbohydrate content in the feed. The result is to provide a fairly high daily growth rate value.

The crude fiber content in propagule flour is quite high at 24.03% and it is suspected that it can also affect the growth of fish fry. This is in line with one of the research projects that allowed crude fiber content in feed is 8-12%, while 3-5% and above 12% is estimated to reduce fish growth because it can reduce the absorption process of nutrients contained in fish feed.

The addition of a large percentage of fermented propagule flour will reduce the growth rate. This is presumably due to the carbohydrate content in the feed exceeds that required by the fish. The high carbohydrate content wiould affects the growth of the fish. According to [18], fish need 10-20% carbohydrates in their feed. Therefore, the high crude fiber content is underutilized by catfish which are omnivores but tend to be more carnivorous so that they are less effective at digesting polysaccharides than herbivorous fish species [19]. This is reinforced by the results of research by [13], who reported that a high percentage of crude fiber makes it difficult for fish to digest food. Furthermore, fish are generally less able to utilize carbohydrates. Thus, the more the addition of mangrove propagule flour, the lower the value of the growth rate due to the increasing carbohydrate content in the feed.

Conclusion

The application of fermented propagule flour in fish feed as much as 10% did not adversely affect the survival and growth rate of fish. However, it is suggested to explore for other treatment alternatives that can reduce crude fiber in propagule, hence that it becomes easier for fish to digest.

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