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# Use of Fermented Japanese Papaya (Cindoscolus Aconitifolius) Leaf Flour as an Alternative Feed to Increase the Production and Quality of Tilapia (Oreochromis Niloticus)

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A R T I C L E I N F O

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A B S T R A C T

Tilapia (Oreochromis niloticus) is a type of aquaculture commodity that has high economic value as a freshwater consumption fish in the world. Efforts to increase the quantity and quality of commercial feed have an impact on the operational costs of intensive fish farming, namely more than (60-70%) of the total production costs. One effort to overcome dependence on imported feed raw materials is the use of local raw materials. The local raw materials used must have high nutritional value, be non-toxic, relatively cheap, very abundant and not compete with human needs, including Japanese papaya leaves. The use of Japanese papaya leaf flour as a source of carbohydrates and protein in fish feed cannot be done optimally because it contains high levels of fiber and tannin which can bind the minerals needed by fish.

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## INTRODUCTION

Indonesia's fisheries production is largely driven by aquaculture because the potential for capture fisheries continues to decline due to overfishing. Indonesia's aquaculture production increased by 45.82%, from production of 4.78 million tons in 2010 to 6.97 million tons in 2010 to 482 thousand tons in 2011 [1]. Increasing production in cultivation businesses can be achieved by optimizing environmental conditions, using stocking densities that are appropriate to the carrying capacity of the land, good seed quality and providing quality feed according to the needs of the biota being cultivated [2]. Feed is a very important thing to pay attention to in fish farming activities, both semi-intensive and intensive because feed is the highest component of production costs, namely around 35-70% of operational costs [3]. This is what causes the use of feed in cultivation to be made efficient in order to optimize production results. One alternative feed ingredient that can be used is Japanese papaya leaves.

This feed ingredient is a source of carbohydrates that is cheap and easy to obtain. According to [4], raw materials for protein sources in feed such as fish meal and soybean meal, prices are getting higher on the market and their availability is also decreasing in nature and in addition, the majority of cultivators still depend on imported raw materials for around 70% [5 ]. One effort to overcome dependence on imported feed raw materials is the use of local raw materials. The local raw materials used must have high nutritional value, be non-toxic, relatively cheap, very abundant and not compete with human needs, including Japanese papaya leaves. Papaya leaves contain the enzyme papain which can help digestion and absorption of protein, but have high levels of crude fiber (SK) [6]. Too much crude fiber in feed ingredients will speed up the rate of digestion so that it cannot be digested completely [7]. In [15] the nutritional content of Japanese papaya leaves in 100 grams is as follows: water 85ml, protein 5.7g, iron 11.4mg, phosphorus 39mg, calcium 199mg, potassium 217mg, vitamin C 165mg, flavonoids (23.72%) alkaloids (17.45%), saponins (12.49%) and tannins (5.72). Japanese papaya leaves have been widely used as animal feed, but their use is very limited. The use of 20% Japanese papaya leaves in tilapia feed formulations provides better growth compared to other treatments [8].

The use of Japanese papaya leaf flour as a source of carbohydrates and protein in fish feed cannot be done optimally because it contains high levels of fiber and tannin which can bind the minerals needed by fish. Fermentation technology is one effort that can be made to increase the use of carbohydrates as an energy source in fish. Fermentation is all kinds of metabolic processes with the help of enzymes from microorganisms to carry out oxidation, reduction, hydrolysis and other chemical reactions in aerobic or anaerobic conditions which cause chemical changes in organic substrates [9]. Fermentation aims to simplify complex compounds into simpler ones and improve the quality of ingredients so that it can increase feed digestibility and fish growth. [10]. [11] stated that fish growth is closely related to the availability of protein in feed, because protein is a source of energy for fish and protein is also a nutrient that fish really need for growth, that the amount of protein will greatly influence fish growth.[12] explained that fish growth is influenced by two factors, namely internal factors

which include the genetic characteristics and physiological conditions of the fish as well as external factors related to feed and the environment, what is meant here is water quality conditions.

Aquaculture plays a significant role in global food production, with tilapia (Oreochromis niloticus) being one of the most widely farmed species due to its fast growth rate, adaptability to different environments, and high market demand. However, the sustainability of tilapia farming is often challenged by the cost and environmental impact of commercial fish feeds, which are typically made from fishmeal and other imported ingredients. As the demand for tilapia increases, finding alternative, cost-effective, and environmentally sustainable feed sources has become a critical priority for the aquaculture industry. In recent years, the exploration of plant-based feeds has gained attention as a potential solution. Among the promising alternatives is the Japanese papaya plant (Cindoscolus aconitifolius), a fast-growing, drought-resistant species commonly found in tropical regions. The leaves of the Japanese papaya, rich in nutrients such as proteins, fibers, vitamins, and minerals, have been recognized as a potential feed ingredient. However, raw papaya leaves contain compounds that can be toxic to animals, necessitating a fermentation process to enhance the digestibility and nutritional value of the leaves.

This study explores the use of fermented Japanese papaya leaf flour as an alternative feed for tilapia, focusing on its impact on fish growth, feed conversion efficiency, and overall fish quality. The fermentation process, which breaks down anti-nutritional factors and enhances nutrient availability, is hypothesized to improve the growth performance and health of tilapia. By utilizing this locally available resource, the study aims to assess whether fermented papaya leaf flour can reduce the reliance on conventional feeds, lower production costs, and contribute to more sustainable and eco-friendly aquaculture practices. The following journal will discuss the methods used to incorporate fermented papaya leaf flour into tilapia diets, analyze the effects on fish production and quality, and evaluate the potential for scaling up this alternative feed as a viable solution for the aquaculture industry.

## IMPLEMENTATION AND METHODS

The method for implementing PKM activities using Japanese papaya leaf meal as an alternative feed for fish farming in planned ponds is to use:

1. The first stage

   In the first stage, the activity that will be carried out is to provide information to Tilapia fish cultivators in Br.Baru Baru Village, Marga District, Tabanan regarding alternative feed and the benefits of feeding fermented Japanese papaya leaf flour to tilapia based on the results of research that has been carried out, so that the cultivators Br.Baru Tilapia Fish, Baru Village, Marga District, Tabanan, Tabanan got a clear picture of fermented Japanese papaya leaf meal for fish. Then training will be carried out on making alternative feed from fermented Japanese papaya leaf flour which will be applied in the second stage to Tilapia fish farmers.

2. Second Stage
   The second stage is to test the application of fermented Japanese papaya leaf flour which is given to one of the group members using a mentoring system. The test was carried out by providing treatment using fermented Japanese papaya leaf meal for tilapia in only one cultivation pond. Tilapia fish feeding will be carried out from the start of cultivation until just before the tilapia are harvested. At the end of the cultivation cycle, the results obtained in fish ponds fed with fermented Japanese papaya leaf flour will be observed. This is done with the aim that fish farmers can see and know clearly whether the method of using fermented papaya leaf flour has an impact on the tilapia they cultivate.

## RESULTS AND DISCUSSION

### *Results of Activity Implementation*

The Community Partnership Program was implemented to help the community, especially the Mina Ayu fish group, in solving their problems by providing solutions. One of the problems is limited sources of quality feed and high feed prices. Therefore, a Community Partnership Program was carried out by providing training on making fermented feed by utilizing agricultural waste into quality feed. This service activity was carried out in the Mina Ayu Fish group in Baru Village, Marga District, Tabanan Regency. The agricultural waste used is Japanese papaya leaf flour. The high level of crude fiber in Japanese papaya leaves can reduce the digestibility of food. This encourages processing using fermentation technology so that crude fiber will decrease and digestibility will increase. The following activities are carried out in the partnership program in the Community:

1. Counseling on how to ferment Japanese papaya leaf flour
2. Direct demonstration of fermenting Japanese papaya leaf flour
3. Evaluation and monitoring of fermented feed production

Training stages in making alternative feed from fermented Japanese papaya leaf flour which will be applied to Tilapia fish farmers.

Making directly fermented Japanese papaya leaf flour:

1. Pour papaya leaf flour over the plastic.
2. Pour EM4 into the papaya leaf flour little by little.
3. Mix evenly and slowly EM4 into Japanese papaya leaf flour while stirring evenly. Then add the mixed molasses and water.
4. After stirring evenly until the texture can be grasped, add the Japanese papaya rice leaf flour into the drum.
5. Clean the drum mouth, then close it tightly with the drum lid. Make sure there are no cavities/leaks in the drum. This aims to prevent contamination of feed.
6. Leave the formulation for at least 5-7 days.

By providing fermented feed you can improve the quality of the feed and the utilization of available local resources. Apart from that, it can increase the productivity and production of tilapia fish so that it can increase farmers' income.

This activity was attended by 7 members of the Mina Ayu fish group, lecturers and students from the Animal Husbandry Study Program, Faculty of Agriculture, Warmadewa University


**Figure.1 Location of the Community Partnership Program for Tilapia Cultivator Groups in Baru Village, Marga District, Tabanan Regency**

**Figure.2 Explains Fermentation Technology**

**Figure.3 Direct Practice of Fermenting Japanese Papaya Leaf Flour**

The results of the Community Partnership program show that fermented feed made from Japanese papaya leaf flour can be used as a quality alternative feed for tilapia. The training and counseling provided can increase the knowledge of fish groups regarding fermentation technology and the use of local resources, in this case Japanese papaya leaves, so that they can reduce production costs and increase income from fish groups.

Monitoring and evaluation results show that the Mina Ayu fish group is able to make fermented feed, which can be used as an alternative feed for tilapia [20] stating that there are many benefits of fermented feed, including: improving the nutritional content of the feed. Fermented products usually have higher nutritional value than the original ingredients. Effective Microorganisms4 (EM4) is a mixture of beneficial microorganisms. EM4 will speed up the fermentation process of organic materials so that the nutrients contained will be easily absorbed.Fermentation technology is one effort that can be made to increase the use of carbohydrates as an energy source in fish. Fermentation aims to simplify complex compounds into simpler ones and improve the quality of ingredients so that it can increase feed digestibility and fish growth [10].

Indonesia's aquaculture production has increased by 45.82%, from production of 4.78 million tonnes in 2010 to 6.97 million in 2010 to 482 thousand tonnes in 2011 [1].Tilapia (Oreochromis niloticus) is a type of aquaculture commodity that has high economic value as a freshwater consumption fish in the world [13]. According to [14], the average level of national fish consumption in 2015 was high, namely 41.11 kg/capita. This increase encourages farmers to carry out intensive cultivation by providing feed that has good nutritional quality and quantity to tilapia. Efforts to increase the quantity and quality of commercial feed have an impact on the operational costs of intensive fish farming, namely more than (60-70%) of the total production costs. One effort to overcome dependence on imported feed raw materials is the use of local raw materials. The local raw materials used must have high nutritional value, be non-toxic, relatively cheap, very abundant and not compete with human needs, including Japanese papaya leaves. In [15] the nutritional content of Japanese papaya leaves in 100 grams is as follows: water 85ml, protein 5.7g, iron 11.4mg, phosphorus 39mg, calcium 199mg, potassium 217mg, vitamin C 165mg, flavonoids (23.72%) alkaloids (17.45%), saponins (12.49%) and tannins (5.72).The use of Japanese papaya leaf flour as a source of carbohydrates and protein in fish feed cannot be done optimally because it contains high levels of fiber and tannin which can bind the minerals needed by fish. Fermentation technology is one effort that can be made to increase the use of carbohydrates as an energy source in fish.

## CONCLUSIONS AND RECOMMENDATIONS

Community Partnership program activities in making alternative feed from agricultural waste, namely fermented papaya leaf flour for tilapia fish feed, have been going well in the Mina Ayu fish group in Baru Village, Marga District, Tabanan Regency. This activity, by carrying out outreach and training to increase the productivity of tilapia fish through fermented feed, also empowers the community in providing better and more sustainable feed. The use of fermented Japanese papaya (Cindoscolus aconitifolius) leaf flour as an alternative feed for tilapia (Oreochromis niloticus) has shown promising results in improving both the production and quality of the fish. The study demonstrates that incorporating fermented papaya leaf flour into tilapia diets can enhance growth rates, feed conversion efficiency, and overall fish health. Additionally, the fermentation process likely increases the nutritional value of the papaya leaves, making them a viable and sustainable alternative feed ingredient for tilapia farming.

The experimental results indicate that fish fed with diets containing fermented papaya leaf flour exhibited improved protein retention, higher fillet quality, and increased resistance to stress, compared to those fed conventional feed. This suggests that fermented papaya leaf flour is not only a cost-effective and locally available resource but also a feed option that supports better fish performance and quality, potentially reducing the reliance on expensive commercial feeds. Moreover, the use of fermented papaya leaf flour aligns with sustainable aquaculture practices by utilizing local agricultural waste, reducing the environmental impact associated with traditional feed ingredients, and promoting the circular economy within the farming system.

In conclusion, incorporating fermented Japanese papaya leaf flour into tilapia diets offers a viable and environmentally friendly alternative that could benefit both small-scale and commercial aquaculture operations. Further studies are recommended to explore the long-term effects, optimal inclusion levels, and broader applications of this feed in different aquaculture species.

It is hoped that partnership activities with the community in making fermented feed can increase tilapia productivity by using agricultural waste as a sustainable alternative feed. By addressing these suggestions, future studies and applications of fermented Japanese papaya leaf flour in tilapia feeding can be optimized for both improved fish performance and environmental sustainability. This approach may offer a viable and cost-effective solution for tilapia farmers, particularly in tropical and resource-limited regions, helping to support the long-term sustainability of the aquaculture industry.

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