

Utilization of Kepok Banana Peel Flour (*Musa paradisiaca formatypica*) as a Feed Additive for Sangkuriang Catfish (*Clarias gariepinus*) Cultivation

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Article Info

Article history:

Received: 01 December 2024

Revised: 08 February 2025

Accepted: 19 June 2025

Published: 22 June 2025

Keywords:

Banana Peel,
Feed Additives,
Sangkuriang Catfish.

Abstract

Background: Kepok banana peel (*Musa paradisiaca formatypica*) is one of the organic wastes that can be used as a feed additive and prebiotic for fish. Kepok banana peel has been less than optimally utilized even though the potential of banana in Lampung Province is very high

Aims & Methods: The purpose of this study was to analyze the growth of sangkuriang catfish (*Clarias gariepinus*) with the addition of kepok banana flour at specific concentrations and to analyze the quality of catfish cultivation water with the addition of banana peel flour. The research method was to make banana peel flour and then add it as a feed additive with a percentage of 2%, 4%, and 6%. The observations made were the growth of sangkuriang catfish and the quality of cultivation water by observing temperature, pH, and DO.

Result: The results of this study indicate that the analysis of the growth of sangkuriang catfish with the addition of kepok banana flour showed that at a concentration of 6% addition to fish feed, it could increase the highest fish growth, which was 4.67g/weeks for 28 days. The results of the analysis of the quality of catfish cultivation water showed that the pH, DO, and water temperature in each treatment followed SNI 6484-6:2024.

To cite this article: Qulubi, M. H., Rahmawati, S. H., Mandala, W. (2025). Utilization of kepok banana peel flour (*Musa paradisiaca formatypica*) as a feed additive for sangkuriang catfish (*Clarias gariepinus*) cultivation. *Open Science and Technology*, 5(1), 36-43.

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1. Introduction

Current catfish production is still very limited and unable to meet community needs. Efforts to meet the community's increasing needs are carried out by intensifying cultivation efforts supported by the availability of adequate seeds and feed (Shafrudin *et al.*, 2006). Cultivation of Sangkuriang catfish (*Clarias gariepinus*) is easy because this fish is easy to adapt to living in areas with tropical and subtropical climates (Al-Khalaifah *et al.*, 2020). The advantages of cultivating this fish include fast harvests, higher production results, more resistance to disease, very easy to cultivate, and simple maintenance techniques (Suraya *et al.*, 2016; Sopha *et al.*, 2015).

Sangkuriang catfish has a distinctive meat taste, so it is widely liked by the community (Sarmada *et al.*, 2016). In addition, the protein content in sangkuriang catfish is higher by 16.53%, compared to local catfish by 12.50% (Betlehemia, 2016). According to Rukmana (2017), sangkuriang catfish is a fairly good protein provider, it also contains phosphorus, potassium, fat, omega-3, omega-6, and vitamin B. This is the reason why sangkuriang catfish has great potential to be cultivated and developed. However, the problem in cultivation is the selection of feed and the provision of feed so that the productivity of sangkuriang catfish is high.

Feeding with high protein content and quality affects the growth and survival of sangkuriang catfish (Sopha *et al.*, 2015). The amount of feed needed by fish daily depends on the fish's size and age (Sarmada *et al.*, 2016). In cultivation efforts, feed is the main factor supporting their success. Adding prebiotics to feed can help fish digest and absorb food. This is because bacteria in prebiotic enzymes can break down complex compounds into simple compounds so that they can be used by fish (Ahmadi *et al.*, 2012). The bacteria contained in prebiotics produce enzymes for digestion, including lipase, amylase, protease, and cellulase (Kumar *et al.*, 2008; Afriansyah, 2014). Prebiotics added to feed will develop in the digestive tract and increase the number of beneficial bacteria in it so that they can increase fish growth (Sudiarto *et al.*, 2014). These bacteria are able to produce exogenous enzymes that help predigestion of fish feed and then increase the nutritional value of the feed. The concept of prebiotics in fish farming has long been of interest due to its ability to stimulate beneficial bacteria in the digestive tract of fish.

Kepok banana peel (*Musa paradisiaca formatypica*) is one of the organic wastes that can be used as feed additives and prebiotics for fish. Kepok banana peel has been less than optimally utilized even though the potential of kepok banana in Lampung Province is very high. This is in accordance with the Lampung Province BPS (2017), which stated that Lampung Province is the second producer of banana commodities in Indonesia due to geographical factors supporting banana cultivation. Pesawaran Regency is the center of the highest banana production in Lampung Province, namely 626,264 tons with a harvest area of 4,742,746 ha and a productivity of 0.13 tons/ha (Lampung Province Food Crops and Horticulture Service, 2017).

Kepok banana peel contains fiber and carbohydrates that can be used as food reserves. Fish can use the protein in it to support the growth and development of fish, and the distinctive aroma of kepok banana peel can be used as a natural aroma enhancer in the feed given (Anwar *et al.*, 2015). Kepok banana peel contains 1.27% carbohydrates, 1.71% protein, 0.30% vitamin C, and 3.28% fat. Kepok banana peel has a high nutritional content of carbohydrates and fat and contains vitamins B and C, protein, calcium, fat, carbohydrates, and water (Susanto, 2016). Kepok banana peel extract contains various phytochemical contents in it. There is 24 mg/g DW of tannin content contained in the 80% methanol extract of kepok banana peel and a flavonoid content methanol extract of kepok banana peel as much as 21.04 mg/g DW (Garcia *et al.*, 2016). Kepok banana peel contains tryptophan compounds (Fateme *et al.*, 2016) and carbohydrates, which are useful for the life phase of fish, as well as protein, which functions for fish growth (Anwar *et al.*, 2015).

This study used banana peel flour added to fish feed to support fish growth and development, as mentioned in the study of Firdaus *et al.* (2015) that fiber or carbohydrates in banana peels, when added to fish feed, can provide aroma to fish feed, facilitate the excretion of fish waste (feces), food reserves, and protein used by fish to support growth and development. Anwar *et al.* (2015) stated that differences very significantly influenced absolute growth, relative growth, and feed efficiency values of test fish in the composition of banana peel flour in feed treatments. Another study conducted by Aisyah *et al.* (2021) on the substitution of commercial feed with banana peel flour and fish meal on feed consumption values, specific growth rates, feed efficiency, energy retention and fat retention in catfish (*Pangasius hypophthalmus*) showed insignificant results. The purpose of this study was to analyze the growth of sangkuriang catfish with the addition of kepok banana flour at specific concentrations and to analyze the quality of catfish cultivation water with the addition of kepok banana peel flour.

2. Materials and Methods

2.1 Time and Place

The research was conducted from July to August 2021 at the Fisheries Cultivation Laboratory of Nahdlatul Ulama University, Lampung, Fish Seed Center (BBI) Purbolinggo, East Lampung, and the Agricultural Product Technology Laboratory of Lampung State Polytechnic (POLINELA).

2.2 Experimental Procedures

2.2.1 Making banana peel flour

Weighing 50 kg of banana peels, sorting the kapok banana peels, washing, and drying the peels are carried out with the help of sunlight after 16 hours (for 2 days with a drying time of 8 hours/day). Flouring is done with a flouring machine.

2.2.2 Fish feed manufacturing process

The test feed was made by mixing commercial feed with kapok banana flour as a prebiotic and adding tapioca flour according to the specified dose. After that, the repelling process and the last one were dried in an oven and sunlight until dry.

2.2.3 Preparation for fish cultivation

Catfish were reared at a density of 40 fish/pond measuring 1.5 x 1 m², as many as 20 fish. The experimental ponds were arranged randomly, and each pond was given an aerator. Sangkuriang catfish seeds used in the study were taken from the Purbolinggo Fish Seed Center (BBI). The duration of the study was 30 days. Before treatment, the test fish were adapted for 7 days by being given regular feed (non-prebiotic). Water quality was maintained and controlled during the adaptation process.

2.3 Experimental Design

Each treatment used 40 sangkuriang catfish measuring 5-7 cm or weighing 1.5 - 2 g/fish, so the number of experimental units was 20 treatments. The addition of banana peel flour as a prebiotic in feed with a treatment dose of P1: feed without adding prebiotics (control). P2: Feed with the addition of 2% banana peel flour/100 g of feed. P3: Feed with the addition of 4% banana peel flour/100 g of feed. P4: Feed with the addition of 6% banana peel flour/100 g of feed.

2.4 Data Analysis

Analysis of research data on the analysis of fish growth performance and water quality using qualitative descriptive.

3. Results dan Discussion

3.1 Fish Growth

Figure 1 shows that the growth of sangkuriang catfish after being given additional feed, namely kepok banana peel flour, experienced a better increase compared to the growth of sangkuriang catfish in the control treatment (P1). Details information can be found at Figure 1.

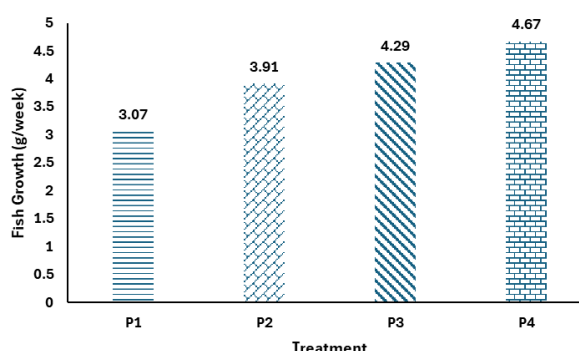


Figure 1. Growth of sangkuriang catfish.

Note * P1 = Control, P2 = Addition of 2% kepok banana peel flour, P3 = Addition of 4% kepok banana peel flour, P4 = Addition of 6% kepok banana peel flour.

The addition of kepok banana peel flour increases carbohydrate intake, where kepok banana peel flour is a source of carbohydrates that can meet 40-75% of energy sources in daily food intake, contributing 4 kilocalories/g of energy (Jeharu *et al.*, 2015), providing aroma to feed, helping with feces and food reserves (Argo *et al.*, 2014). The average growth value of sangkuriang catfish in the control treatment was 3.07g/weeks, P2 treatment was 3.91g/week, P3 treatment was 4.29g/week, and P4 was 4.67g/week. The highest average value was obtained in the P4 treatment, namely with the addition of a concentration of kepok banana peel flour of 6%; the higher the concentration of kepok banana flour, the faster the increase in fish weight for 28 days.

In this study, banana peel flour was added to the feed formula to add aroma to the feed and function as a prebiotic. According to Schrezenmeir *et al.* (2001), prebiotic administration can benefit the host by stimulating the growth of normal microflora in the host's digestive tract, although prebiotics are food ingredients that cannot be digested (non-digestible) by the host. By identifying the growth of sangkuriang catfish for 28 days by administering banana peel flour, this study could improve or stimulate the growth of more optimal intestinal microflora in the digestive tract so that it affected the growth of sangkuriang catfish weight.

Kepok banana peel contains high antioxidant compounds such as phenol, catecholamine, carotene and flavonoids, polyphenols, vitamin C, and tannin (Azza *et al.*, 2017 and Egbonu *et al.*, 2017), so it can be used as an antioxidant in fish and helps increase the growth of Sangkuriang catfish. Kepok banana peel contains 10.49% dietary fiber (Martharini *et al.*, 2017). Dietary fiber is a compound that cannot be metabolized but can be utilized by probiotics to support their growth. Melatiningsih's (2022) research on synbiotic drinks of Etawa goat milk with the addition of kepok banana peel and small white ginger and probiotic culture *Lactobacillus casei* showed that kepok banana peel can be used as a prebiotic.

One of the prebiotic ingredients comes from carbohydrates; food ingredients that are prebiotics can come from vegetables, tubers, or fruits. Kepok banana peel has a high sugar content, namely containing Inulin compounds (categorized as polysaccharides) and Fructooligosaccharides (FOS), which act as natural prebiotics (Hamad, 2014). Inulin is classified as a prebiotic because it can pass through the upper digestive tract and reach the large intestine, so it is also considered a "colonic foods" for intestinal microflora, and one type of prebiotic that is good to use and classified as a food ingredient that is accepted and used without limits and is considered a prebiotic model (Horie *et al.*, 2020).

3.2 Water Quality in Sangkuriang Catfish Cultivation

The quality of water cultivation is crucial to pay attention to because water plays a role in supporting fish life. The high dissolved oxygen content can be used to determine the life of Sangkuriang catfish because reduced oxygen levels will interfere with the fish's respiratory system (Sumardiono *et al.*, 2020), while poor acidity (pH) will affect the health, growth, and productivity of fish (Hutama *et al.*, 2023). The following is a graph of the acidity (pH) analysis results presented in Figure 2.

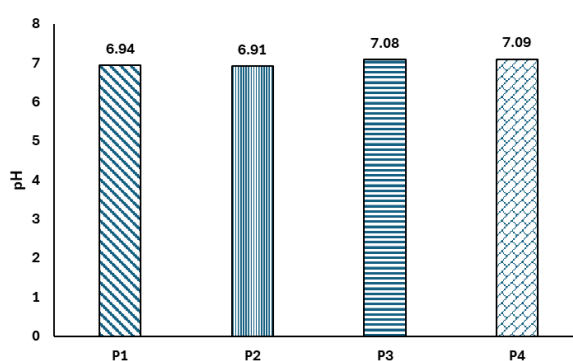


Figure 2. Acidity level in the Sangkuriang catfish pond.

Figure 2 shows the results of water quality analysis in each treatment. The results of water quality analysis are the degree of acidity (Potential of Hydrogen/ pH). In the control treatment, the results were = 6.94, treatment P2 was = 6.91, treatment P3 was = 7.08, and treatment P4 was = 7.09. The results of the analysis show that the water in the pond has good quality because it can be seen from the control treatment (P1) to P4 showing the pH level is within good limits according to the research of [Li et al. \(2023\)](#) stating that catfish grow optimally in the pH range of 6.5–8.5 in good physiological conditions and the immune system is functioning well.

The acidity level (pH) in water that has a level = >9 causes the appetite of catfish to decrease if the water pH level = <5 can cause mucus to clot on the catfish gills ([Widodo et al., 2023](#)). Water at a pH above 7 is called alkaline, while a pH below 6 is called acidic. Acidic conditions will cause the growth of fungi and pathogenic bacteria ([Hermansyah, 2017](#)). The pH level of the analysis results shows that the value is in the range of values between 6.94-7.09. This value shows that the pH is by the water quality standard set by SNI No. 3 of 2014 concerning catfish production, namely 6.5-8.5.

Dissolved oxygen (DO) is a determining factor in water quality when cultivating sangkuriang catfish because a lack of oxygen in the water will disrupt fish life. The area of the pond is 1x1 m². The results of observations in this study are presented in figure 3. The dissolved oxygen content in this study was above 3 mg/L, and this states that the DO content in the quality of catfish cultivation water was very good in each treatment in this study. [Patriono et al. \(2021\)](#) stated that a good oxygen concentration in aquaculture is between 5-7 mg/L; if it is below 4 mg/L, the fish's appetite will decrease, and if it is too long with such conditions, the fish will die. The Dissolved Oxygen (DO) content shows that the value is in the range of values between 6 -7.09 with a standard deviation range of 0.02-0.05. This value indicates that DO is by the water quality standard set by SNI No. 3 of 2014 concerning catfish production, namely 5-7 mg/L.

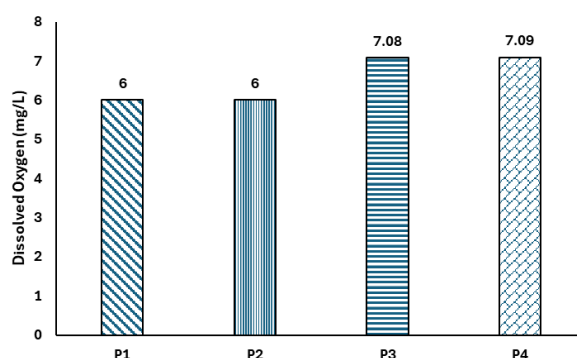


Figure 3. Dissolved oxygen in the Sangkuriang catfish pond.

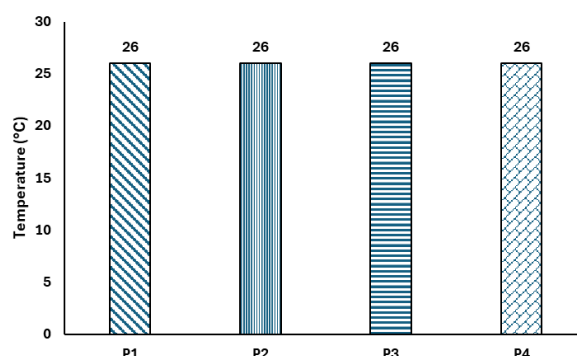


Figure 4. Water temperature in the Sangkuriang catfish pond.

Note * P1 = Control, P2 = Addition of 2% kepok banana peel flour, P3 = Addition of 4% kepok banana peel flour, P4 = Addition of 6% kepok banana peel flour.

The determinant of water quality in this study was water temperature. The observation results showed (figure 4) that the analysis water temperature was 26°C in each treatment, as presented in Figure 4. These results indicate that the observed water temperature follows SNI 01-3553-2006 concerning water quality in fish farming.

4. Conclusions

The study results indicate that adding kepok banana flour (*Musa paradisiaca formatypica*) to the feed of sangkuriang catfish (*Clarias gariepinus*) has a positive effect on growth performance. The optimal concentration was found at 6%, which resulted in the highest weight gain of 4.67 grams/weeks over a 28-day rearing period. Furthermore, water quality parameters—including pH, dissolved oxygen (DO), and temperature—across all treatments were within the acceptable range as specified by the Indonesian National Standard (SNI) 6484-6:2024.

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