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THE CULTURE OF CATFISH (*Clarias* sp.) FRY IN THE PEAT POND BASED ON PINEAPPLE (*Ananas comosus* L) TUBER AND BANANA (*Musa* sp.) STEM CRUDE EXTRACT WITH COMMERCIAL PROBIOTIC MIX

Pemeliharaan Benih Ikan Lele (*Clarias* sp.) di Kolam Tanah Gambut Berbasis Ekstrak Kasar Bonggol Nanas (*Ananas comosus* L) dan Batang Pisang (*Musa* sp.) Serta Probiotik Mix Komersial

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ABSTRACT

One of the obstacles in cultivating catfish (*Clarias* sp.) is low feed efficiency. Therefore, a breakthrough is needed in catfish cultivation to increase the efficiency of feed utilization which will lead to increased production and profits in catfish cultivation businesses. This study aims to evaluate the effect of supplementation with crude extracts of pineapple tubers and banana stems as well as commercial probiotic mixes on the growth performance of catfish in flooded peat soil ponds. This study consisted of four treatments, namely control (A), 6% crude extract of pineapple weevil, 2% crude extract of banana stem, and 0.2% commercial probiotic mix (B), 6% crude extract of pineapple weevil, extract 2% banana stem crude, and 0.4% commercial probiotic mix (C), and 6% dose of pineapple tuber crude extract, 2% banana stem crude extract, and 0.6% commercial probiotic mix (D) are mixed into the feed with repeated three times. Fish with an average initial weight of 1.5 g were randomly stocked in 12 hapa measuring 1 x 1 x 1 m^3 installed in earthen ponds at a density of 40 fish/hapa. Fish were given the test feed ad satiation twice a day for 28 days. Supplementation with a 6% dose of pineapple tuber crude extract, 2% banana stem crude extract, and 0.4% commercial probiotic mix (treatment C) showed the best results on catfish growth performance parameters, namely the least amount of feed consumption, but still had biomass performance. harvest and daily weight growth were the same as controls.

Keywords: Banana, *Clarias* sp., Growth, Pineapple, Probiotic

ABSTRAK

Salah satu kendala dalam budidaya ikan lele (*Clarias* sp.) adalah efisiensi pakan yang rendah. Oleh karena itu, diperlukan suatu terobosan dalam budidaya ikan lele guna meningkatkan efisiensi pemanfaatan pakan yang berujung pada peningkatan produksi dan profit usaha budidaya ikan lele. Penelitian ini bertujuan untuk mengevaluasi pengaruh dari suplementasi ekstrak kasar bonggol nanas dan batang pisang serta probiotik mix komersial terhadap kinerja pertumbuhan ikan lele di kolam tanah gambut tergenang. Pada penelitian ini terdiri dari empat perlakuan, yaitu kontrol (A), ekstrak kasar bonggol nanas dosis 6%, ekstrak kasar batang pisang 2%, dan probiotik mix komersial 0,2% (B), ekstrak kasar bonggol nanas dosis 6%, ekstrak kasar batang pisang 2%, dan probiotik mix komersial 0,4% (C), dan ekstrak kasar bonggol nanas dosis 6%, ekstrak kasar batang pisang 2%, dan probiotik mix komersial 0,6% (D) dicampurkan ke dalam pakan dengan ulangan tiga kali. Ikan dengan bobot awal rata-rata 1,5 g ditebar secara acak pada 12 hapa berukuran 1 x 1 x 1 m^3 yang dipasang pada kolam tanah dengan kepadatan 40 ekor/hapa. Ikan diberi pakan uji secara *ad satiation* dengan frekuensi dua kali sehari selama 28 hari. Suplementasi ekstrak kasar bonggol nanas dosis 6%, ekstrak kasar batang pisang 2%, dan probiotik mix komersial 0,4% (perlakuan C) menunjukkan hasil terbaik pada parameter kinerja pertumbuhan ikan lele, yaitu jumlah konsumsi pakan paling sedikit, tetapi tetap memiliki performa biomassa panen dan pertumbuhan bobot harian yang sama dengan kontrol.

Kata Kunci: *Clarias* sp., Nanas, Pertumbuhan, Pisang, Probiotik

INTRODUCTION

Aquaculture productivity in Central Kalimantan Province has continued to experience a real increase since 2019 by 102,000 tonnes until 2023 reaching 136,000 tonnes or growth of around 7.5% (DJPB, 2023). Catfish ranks fourth out of five commodities with production 8.5% below catfish, tilapia, milkfish and above goldfish. Some of the superior characteristics of this fish include high physiological adaptability, disease resistance and fast growth, and the cultivation period is only around 2 months. One of the problems in cultivating catfish is the high amount of feed consumed. Gifari (2019) stated that catfish kept in a biofloc system with 11% feed per day produced a feed conversion ratio value of 2.1. Therefore, breakthroughs are still needed in catfish cultivation for reasons of saving feed efficiency and business profits.

A number of surveys and identifications have been carried out on the microbiota that inhabit the digestive tract/intestines of fish. The native microbiota inhabiting the fish intestine in freshwater fish species tends to be dominated by the genera Aeromonas, Acinetobacter, Bacillus, Flavobacterium, Pseudomonas representing the Enterobacteriaceae family, and obligate anaerobic bacteria from the genera Bacteroides, Clostridium, and Fusobacterium (Kim *et al*., 2007). Furthermore, there are a number of species of lactic acid bacteria (LAB = lactic acid bacteria) (Lactobacillus, Lactococcus, Streptococcus, Leuconostoc, and Carnobacterium spp.) (Vijayabaskar & Somasundaram, 2008). Types of yeast (Saccharomyces cerevisiae) are commonly used and are often well isolated from the microenvironment of fish intestinal organs. Yeast also constitute a significant part of the fish gut-dwelling microbiota and are capable of stimulating immune responses, increasing fish metabolism and growth (Gatesoupe, 2007).

The pineapple tuber (*Ananas comosus* L.) is a part of the fruit that has the benefit of helping food digestion, one of which is because it contains the enzyme bromelain. Pineapple tubers contain vitamins A, B3, B6, B12, antioxidants, phenols and flavonoids, soluble sugars, fiber and aroma attractants (Sun *et al*., 2016) which play a role in improving digestive metabolism and absorption of feed nutrients. Several research results in the field of aquaculture that utilize crude pineapple extract as a source of bromelain enzymes include: Wiszniewski *et al*. (2019) using pineapple extract at doses of 10 and 20 g/kg feed can increase

growth, feed efficiency and nonspecific immune response of *Acipenser ruthenus*. Supplementation of pineapple extract at a dose of 0.2 ml/kg feed produces the best feed efficiency values, protein efficiency ratio, and specific growth rate of vaname shrimp (*Litopenaeus vannamei*) (Rachmawati & Samidjan, 2018). Utilization of Ambon banana stems (*Musa paradisiaca*) at a dose of 5 g/L increases the immune response of *Oreochromis niloticus* against *Streptococcus agalactiae* infection as indicated by an increase in the relative percent survival (RPS), phagocytic activity, respiratory burst and lysozyme activity (Nurjanah *et al*., 2018). The research results of Ramadhan *et al*. (2017) the addition of banana stem extract at a dose of 0.5 g/kg feed was able to increase the growth of the nonspecific immune response of vaname shrimp against white spot disease. Supplementation with Ambon banana *Musa paradisiaca* stem flour was not able to support increased production performance in the first two weeks of grouper rearing in floating nets, but it could improve the health status of the fish (Wahjuningrum *et al*., 2022). Information regarding the application of commercial probiotic mix supplementation combined with crude extracts of pineapple tubers and banana stems in aquaculture apparently provides varying results on the growth performance of various fish species according to plant variety, extraction method, cultivar and cultivation environment. Therefore, this research was conducted to evaluate and further confirm the attractive positive effects of commercial probiotic mix supplementation combined with crude extracts of pineapple tubers and banana stems on the growth performance of catfish in flooded peat ponds.

METHODS

Time and Place

The research was carried out for 28 days in March-April 2024. The research was carried out in the experimental pool at Peat Techno Park (PTP), Palangka Raya University.

Tools and Materials

The tools used in this research include digital scales with a capacity of 30 kg x 1 g (Kenko model KK-SW1W), hapa measuring 1 x 1 x 1 m^3, blender, spoon, tray, thermometer, DO meter Lutron DO-5510, and digital pH meter ATC. The materials used in this research were catfish seeds weighing 1.5 g, pineapple tubers, banana stems, commercial probiotic mix, 0.9% NaCl, mask cloth, commercial feed with a protein content of 40%, and eggs.

Research Design

The research was conducted using a completely randomized design (CRD) with four treatments and three replications. The treatments given in this study were supplementation without crude extract of pineapple tubers and banana stems as well as commercial probiotic mix (treatment A), supplementation with crude extract of pineapple tubers at a dose of 6%, crude extract of banana stems at a dose of 2% and commercial probiotic mix at a dose of 0.2%. (treatment B), supplementation with crude extract of pineapple tuber at a dose of 6%, crude extract of banana stem at a dose of 2% and commercial probiotic mix at a dose of 0.4% (treatment C), supplementation for crude extract of pineapple tuber at a dose of 6%, crude extract of banana stem at a dose of 2 % and a commercial probiotic mix dose of 0.6% (treatment D) (v/v/w/w) (Djauhari *et al*., 2024) in catfish fry kept in peat ponds.

Research Procedure

The fish used were catfish with an initial weight of 1.5 g which were randomly stocked in 12 hapa measuring 1 x 1 x 1 m^3 installed in a peat pond. Catfish seeds are stocked at a density of 40 fish/hapa.

Pineapple tubers and banana stems were blended by adding 0.9% NaCl solvent in a ratio of 1:1 (w/v). Next, the mixture is filtered with a cloth mask and squeezed until a crude extract of pineapple tubers and banana stems is obtained. The feed used in this research was commercial feed with a protein content of 40%. Preparation of test feed was carried out by adding crude extracts of pineapple tubers and banana stems to commercial feed according to the treatment dose. Mixing commercial feed with pineapple tuber and banana stem extract is carried out using the coating method, then 2% egg white is added as an adhesive (Djauhari *et al*., 2023). The probiotics used are in powder form, which has advantages, including product safety reasons, easy to use and longer life span of microorganisms (Decamp and Moriarty 2007), produced by CV. Pradipta Paramita which contains a consortium of probiotic bacteria with a density of ≥ 107 CFU/g in accordance with PERMEN KP No. 1 of 2019 concerning Fish Medicine. The dose of probiotics used refers to the procedures for using probiotics written on the packaging with modifications. The control feed was not given the addition of crude extract of pineapple tubers, banana stems and commercial probiotic mix, but was given 2% egg white. Next, the feed is air-dried for approximately 10 minutes and ready to be given to the fish. Feeding is done ad satiation with a frequency of feeding twice a day (08.00 and 16.00 WIB). Fish rearing is carried out for 14 days. The water quality of the rearing media is monitored during maintenance with parameters and ranges: temperature 31-35ºC, DO 3.8-5.2 mg/L, and pH 5.1-5.5.

Research Parameters

The research parameters evaluated were growth performance parameters. The growth performance parameters measured consisted of initial biomass, final biomass, growth rate, specific growth rate, daily weight growth, amount of feed consumption, feed conversion ratio, and survival rate.

Data Analysis

The data obtained in this study was tabulated using Microsoft Excel 2019. Statistical analysis was carried out with SPSS version 25.0 software and data were presented as averages.

RESULT

Supplementation with a 6% dose of pineapple tuber crude extract, 2% banana stem crude extract, and 0.4% commercial probiotic mix showed a positive improvement effect on the growth performance parameters of catfish seeds reared in peat ponds for 28 days, namely having harvest biomass performance. and daily weight growth was the same as the control, but the amount of feed consumed was significantly less or more economical (225 g) than the control (248.33) (Table 1).

Table 1. Average Values of Initial Biomass (Bo), Final Biomass (Bt), Amount of Feed Consumption (JKP), Feed Conversion Ratio (FCR), Daily Growth Rate (LPH), Daily Weight Gain (DGR), and Survival Rate (TKH) Catfish Seeds Given Crude Extract of Pineapple Tubers, Banana Stems and Commercial Probiotic Mix For 28 Days of Cultivation

Parameter/ Treatment	Bo (g)	Bt (g)	JKP (g)	FCR	EP (%)	LPH (%/day)	DGR (g/day)	TKH (%)
A	60^{a}	328.33^{a}	248.33^{a}	0.93^{a}	108.05^{a}	6.08^{a}	9.58^{a}	95.83^{a}
B	60^{a}	293.33^{ab}	228.33^{b}	0.99^{a}	102.06^{a}	5.68^{a}	8.33^{ab}	90.83^{a}
C	60^{a}	291.67^{ab}	225^{bc}	0.97^{a}	102.96^{a}	5.65^{a}	8.28^{ab}	91.67^{a}
D	60^{a}	281.67^{b}	215^{c}	0.97^{a}	103.17^{a}	5.53^{a}	7.92^{b}	95.83^{a}

Note: Upper printed letters differ in the average value in the same row indicating a significant difference effect ($p<0.05$). A = feed without supplementation with crude extract of pineapple tubers, crude extract of banana

stems and commercial probiotic mix dose 0%, B = supplementation with crude extract of pineapple tubers dose 6%, crude extract of banana stems dose 2% and commercial probiotic mix dose 0.2%, C = supplementation with crude extract of pineapple tuber, dose of 6%, crude extract of banana stem, dose of 2% and commercial probiotic mix, dose of 0.4%, and D = supplementation of crude extract of pineapple tuber, dose of 6%, crude extract of banana stem, dose of 2% and probiotic mix commercial dosage of 0.6%. Bo = initial biomass of fish, Bt = final biomass of fish, JKP = amount of feed consumption, RKP = feed conversion ratio, DGR = daily weight growth rate, LPS = specific growth rate, and TKH = survival rate. Data are displayed as averages.

DISCUSSION

Giving a combination of crude extracts of pineapple tubers and banana stems as well as commercial probiotic mix doses at doses of 6%, 2% and 0.4% respectively to catfish fry reared in peat soil ponds showed significant positive improvements in growth performance parameters. namely saving the amount of feed consumed, but still contributing to harvest biomass and daily weight growth which is as good as the control. The amount of feed consumed is related to the efficiency of nutrient digestibility (Xie *et al*., 2021), which is influenced by the crude fiber content (Bhuyain *et al*., 2019) and anti-nutritional substances which also act as anti-bacterial compounds in banana stems, including tannins, saponins, flavonoids. and phytic acid (Felix e Silva *et al*., 2020; Nikmaram *et al*., 2017). The results of this study are in line with Nwanna *et al*. (2014) giving banana stem flour did not have a significant effect on the growth rate and feed conversion ratio of catfish. One of the indicators of a superior phenotype in a cultivar is that it is efficient in utilizing feed, but still shows good growth performance and health status. The enzyme bromelain is found in many parts of pineapple leaves, tubers and fruit. Supplementation of this exogenous enzyme is thought to increase protein digestibility which leads to increased protein retention, so that there is guaranteed bioavailability of energy for growth. Shi *et al*. (2016) stated that around 20-25% of feed protein cannot be digested by endogenous fish enzymes, therefore the addition of exogenous enzymes is very important to support optimum digestion of feed protein. Bromelin can break down proteins into simpler ones, namely peptides and amino acids and is thought to increase the utilization of fat in feed to be more efficient, meaning that digestion and absorption of protein and feed fat becomes more efficient. This is in accordance with the statement by Sawant & Nagendran (2014) that bromelain has the ability to increase the digestibility and nutrient absorption of feed protein. Wiszniewski *et al*. (2019) confirmed that bromelain supplementation of 20 g/kg feed showed an improvement in the structure of microvilli in enterocytes which caused the enterocyte surface to become wider, so that the function of absorbing feed nutrients became more efficient which was very evident in the number of supra nuclear vacuoles (enterocyte vacuoles that had absorbed nutrients feed) is increasing. This is also seen in the microvilli of goblet cells (mucocytes) as cells that produce mucus and digestive enzymes. Bromelain belongs to the cysteine amino acid group which plays an important role in achieving good body metabolism, because it contains antioxidants to correct nutrient malabsorption disorders. Supplementation of adequate doses of bromelain in fish feed (6%) is thought to increase the attractiveness, palatability and digestibility of feed nutrients (Hassaan *et al*., 2019). This will lead to an increase in appetite and fish growth performance, because the energy reserves stored for growth are greater. In addition, the bromelain enzyme plays an important role in maintaining the stability of the nutritional value contained in fish feed, both during storage and when feeding. Abdollahi *et al*. (2013) said that bromelain can protect feed nutrient components from leaching while fish feed is in water.

In general, the bacteria that live in the intestines of fish have a very important role and have the potential to produce various enzymes. These microbiota are capable of producing proteolytic, amylolytic, cellulolytic, lipolytic and chitinolytic enzymes, which play a very important role in digesting protein, carbohydrates, cellulose, fat and chitin (Bairagi *et al*., 2002;

Gutowska *et al*., 2004). The enzymes produced by these microbiota are very beneficial because they are used as probiotic supplements when formulating fish feed, especially in the larval stage of fish. It seems that this is a new opportunity and breakthrough in the field of fish nutrition, where fish nutrition experts can research further and utilize enzymes that are potentially produced by probiotic isolates in formulating fish feed by prioritizing feed efficiency and cost efficiency without sacrificing quality. fish meat. However, it is necessary to carry out more in-depth research to determine and evaluate and review if probiotic supplementation is carried out in fish basal feed, in fact, whether it is able to provide as many benefits as possible according to the fish's needs before probiotic supplementation in feed is recommended (Bairagi *et al*., 2002). In addition, the fish survival rate value ranged from 90.83-95.83%, this is thought to indicate an increase in the health status of the fish. The normal permanent resident microbiota of the fish gut confers many advantages/benefits on the metabolic physiology of the host gut. Some of these benefits include nutrient metabolism, contribution to resistance to colonization by beneficial bacteria, contribution to fighting colonization by harmful bacteria/pathogens that enter with the food consumed by fish (antagonistic activity against pathogens), immunomodulation (Denev *et al*., 2000). The gut microbiota has a powerful impact on the anatomical, physiological and immunological development of the host (Rawls *et al*., 2004). So, the formation of healthy and beneficial microbiota in the fish intestine has an important role in generating immunophysiological regulation through providing crucial signals for the development and maintenance of the fish immune system (Salminen *et al*., 2005). Probiotic dosage is a limiting factor for achieving optimum beneficial effects (Minelli & Benini, 2008). The dose of aquaculture probiotics generally ranges from 10^6-10^{10} CFU/g feed with the optimum dose varying depending on the type of fish and the type of immune parameters observed. Optimum concentrations are not only indicated by colonization and proliferation of bacteria in the intestine, but also by growth, immune response and protection of the host. The decrease in growth performance in the 0.6% probiotic dose treatment in this study could possibly be caused by digestive metabolic disorders due to excessive production of secondary metabolites, thus potentially disrupting the digestion and absorption of feed macronutrients, especially protein. The research results of Astria *et al*. (2017) stated that giving banana stem juice at a dose of 13 mL/L resulted in the highest survival rate for catfish *Clarias gariepinus* 53.33% ± 6.67% after being challenged with the pathogenic bacteria *Aeromonas hydrophila*, which was also supported by other fish health indicator parameters, such as total erythrocytes, hemoglobin, total leukocytes, phagocytic activity, and lysozyme activity. This is made possible by the saponin content of banana stems which is a secondary metabolite product that acts as an immunostimulant and antimicroorganism. Reducing pathogenic microorganisms in the digestive tract and intestines of fish, especially in mucocytic cells and enterocytes, can make the process of digestion and absorption of feed nutrients more efficient due to reduced competitors. Budi *et al*. (2015) said that Ambon banana stems *(Musa paradisiaca* var. sapientum) contain flavonoids, polyphenols, tannins and saponins which have great potential as antioxidants for reducing free radicals by transferring hydrogen atoms. The fruit and almost all parts of this plant can be utilized by both humans and livestock, because they contain important nutrient components as an energy source, such as crude fiber, sugar, protein, fat (PUFA), sterols, and minerals (potassium, magnesium, phosphorus, sodium and zinc), vitamins (pro-vitamin A, B1, B2, C), as well as several bioactive compounds, including glycosides, malic acid, and oxalic acid (Mathew & Negi 2017; Rao *et al*., 2016) which are very useful for improve health status (Brown *et al*., 2017). Banana stems are a potential source of prebiotics, because they contain resistant starch, cellulose, hemicellulose and lignin in varying amounts ranging from 60-80% which cannot be digested by the digestive metabolism of vertebrates including fish, but can only be utilized by probiotics that live in fish intestinal tissue. as an energy source (Mostafa, 2021). Diaz *et al*. (2023) stated that banana stems contain cello-

oligosaccharides which can be used as a potential source of prebiotics for future aquaculture. Furthermore, optimum growth and development of probiotics will help fish in digestive metabolism and nutrient absorption more efficiently by producing exoenzymes, namely digestive enzymes which will enrich the endoenzymes that fish naturally produce. In addition, probiotics have the ability to produce natural pathogenic antimicrobial compounds which are able to suppress and prevent the growth and development of pathogens so that the health status of fish improves (Farees *et al*., 2017; Powthong *et al*., 2020).

CONCLUSION

Supplementation of a combination of crude extracts of pineapple tubers, banana stems and commercial probiotic mix at doses of 6%, 2% and 0.4% respectively to catfish fry reared in peat ponds for 28 days was able to significantly reduce the amount of feed consumption which positively contributed. on feed cost savings.

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