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THE EFFECT OF PAPAYA LEAF EXTRACT (*Carica papaya*) AND ZEOLITE ON WATER QUALITY IN THE CULTIVATION MEDIUM FOR STRIPED CATFISH (*Pangasianodon hypophthalmus*)

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ABSTRACT

Striped catfish maintenance media often experience water quality problems. Efforts to overcome water quality problems can be made using papaya leaves (*Carica papaya*). Papaya leaf has benefits in maintaining water quality. In addition to papaya leaf, zeolite can be added as a water filter in the maintenance media. One of the water quality parameters that must be maintained is the physical parameters, namely temperature, turbidity, DHL, TDS, and TSS. This research was conducted from April 2024 to February 2025. This study aimed to determine the effect and best dosage of papaya leaf and zeolite solutions on water quality in striped catfish seed cultivation media. The method used in this study was the experimental method and Completely Randomized Design (CRD), which used four treatment levels with three replications. The treatments given were without papaya leaf solution and zeolite (P0), papaya leaf solution 4 mL/L and zeolite 17.05 g/L (P1), 5 mL/L and zeolite 17.05 g/L (P2), 6 mL/L and zeolite 17.05 g/L (P3). The striped catfish used was 5.9-6.6 cm in size, with a stocking density of 60 fish/tank. Fish maintenance was carried out for 30 days, with feeding conducted at satiation levels, and the feeding frequency was 3 times a day, namely 08:00 WIB, 13:00 WIB, and 16:00 WIB. The administration of 6 ml/L papaya leaf solution resulted in temperature (25.63 ± 0.05^{b}), turbidity (1.83 ± 0.01^{a}), electrical conductivity (83.66 ± 0.57^{a}), TDS (63.66 ± 0.57a) and TSS (28.00 ± 1.00^{a}) and absolute weight of 2.92 ± 0.313^{c} g/fish, absolute length of 3.56 ± 0.472^{b} cm/fish and LPS value of 1.72±0.122c g/day. Papaya leaf solution and zeolite filter significantly affected water quality.

Keywords: Growth, Papaya Leaf, Striped Catfish, Water Quality, Zeolite

1. INTRODUCTION

Striped catfish (*Pangasianodon hypophthalmus*) is one of the freshwater fishery commodities with high economic value. High-density striped catfish farming often faces challenges, including maintaining water quality. As stocking density increases, the accumulation of organic matter, namely waste, also increases. The current issue in catfish farming is the decline in water quality, which plays a crucial role in farming. The decline in water quality in fish farming media is caused by leftover fish feed and fish waste (feces). Fish farming wastewater can lead to increased levels of N_2 and NH_3 due to protein and amino acid breakdown[1].

Water quality generally indicates the condition of water. One of the water quality parameters that must be maintained is the physical parameters of water, namely temperature, depth, clarity, TDS, and TSS[2]. Setioningrum et al.[3] state that physical parameters include temperature, odor, total dissolved solids (TDS), turbidity, taste, color, and DHL. Poor water quality and uneaten feed accumulating in aquaculture ponds can affect fish growth[4]. Efforts to

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improve and maintain water quality have been extensively undertaken, both physically and chemically; however, the costs associated with these methods remain significant and are sometimes environmentally unfriendly[5]. One approach to addressing declining water quality is the use of papaya leaves.

Papaya leaves (*Carica papaya*) have benefits in maintaining water quality, optimizing the breakdown of feed residues in the aquaculture medium, preventing the growth of fungi and pathogenic bacteria, enhancing fish immunity, increasing fish appetite, and containing vitamins beneficial for fish growth[6]. Phytochemical screening of papaya leaves revealed the presence of flavonoids, saponins, tannins, quinones, steroids, triterpenoids, and certain alkaloids, which function as antibacterial agents[7]. Papaya leaves also contain the enzyme papain. The optimal pH of papaya solution ranges from 5 to 7[8].

Filters are also commonly used to maintain water quality, such as zeolite as a substrate that can filter harmful substances in the rearing medium. Zeolite acts as a physical filter that separates suspended particles (larger than 5 micrometres) from water by passing water through a substrate capable of capturing solids in the water before it enters the cultivation container[9]. Zeolite has been used to reduce ammonia levels in recirculating systems for tilapia, with the optimal dose being 17.05 g/L[10]. According to Kim et al.[11], the combination of zeolite and papaya leaves has proven effective in promoting the growth rate of striped catfish and improving water quality in the cultivation medium. This study aims to test the effect of the combination of papaya leaf solution and zeolite on water quality improvement and to determine the optimal dosage in striped catfish fry cultivation media.

2. RESEARCH METHOD

Time and Place

Time and Location This research was conducted from April 2024 to February 2025 at the Hatchery of the Faculty of Fisheries and Marine Science, Universitas Riau.

Method

This study used an experimental method with a completely randomized design (CRD) consisting of four treatments and three replications. The treatments were given in the form of variations in the dose of papaya leaf solution, while zeolite was used in a fixed dose of 17.05 g/L in all treatments. The treatments given are:

P0 : Control (without papaya leaf solution and zeolite)
P1 : 4 mL/L papaya leaf solution + zeolite
P2 : 5 mL/L papaya leaf solution + zeolite
P3 : 6 mL/L papaya leaf solution + zeolite

Procedures

Preparation of Papaya Leaf Solution

The steps involved in preparing papaya leaf solution are based on Nilna et al[12]; Sumahiradewi et al.[13], namely using young papaya leaves, washing them with clean water, then slicing them, followed by drying the leaf in an oven at 60°C for 2 hours, After drying, the papaya leaf is ground using a blender, then sieved using a 0.32 mm mesh sieve. The papaya leaf powder is then steeped in mineral water and heated to 50°C for 15 minutes at a ratio of 1 gram of papaya leaf powder per 1 L of water (1g/L). The resulting papaya leaf solution is directly applied to the growth medium according to the predetermined treatment dosage.

Zeolite Filter Preparation

Zeolite is activated before use to increase its particle absorption efficiency. Zeolite is weighed at 100 g, placed in a beaker containing 1000 mL of NaOH solution, stirred for 2 minutes, and left to stand for 4 hours. After that, the zeolite is washed with distilled water until the smell of NaOH disappears. The zeolite is dried for 2–3 hours at 150°C[10]. The zeolite dosage used

in the maintenance container refers to the study by Hasibuan et al.[10], which is 17.05 g/L. The zeolite dosage in each container is the same. The zeolite is placed in a bottle used as a filter container above the fiber tank. The zeolite filter works by pumping water from the fiber tank and flowing it through the zeolite-filled filter, then returning the water to the fiber tank.

Data Analysis

Data on temperature, turbidity, electrical conductivity, TDS, TSS, fish length, and survival rate were presented in tabular form and analyzed using ANOVA. If the results showed P<0.05, a Newman-Keuls post hoc test was performed to determine the differences between treatments. Meanwhile, water quality data were analyzed descriptively.

3. RESULT AND DISCUSSION

Temperature

Temperature is an important parameter in water quality because it directly affects fish growth, metabolism, appetite, and survival[14]. During the study, the best treatment was observed in P3 (6 mL/L papaya leaf solution + 17.05 g/L zeolite), which maintained a stable temperature within the optimal range of 25.3–25.8°C, consistent with the ideal temperature range for striped catfish cultivation of 25–30°C[15]. The average temperature values during the study in the striped catfish cultivation medium can be seen in Figure 1.

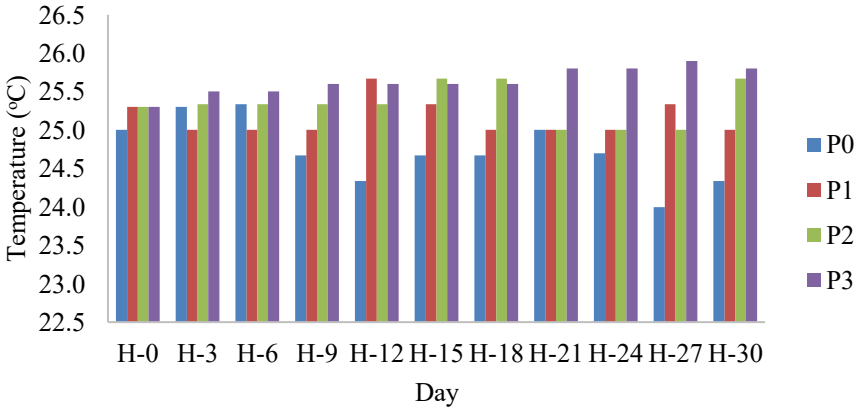

Figure 1. Average temperature

Figure 1 shows that adding 6 mL/L of papaya leaf solution and 17.05 g/L of zeolite in treatment P3 can help maintain water temperature stability through several mechanisms, with an average temperature range of 25.3–25.8°C. Papaya leaves contain bioactive compounds such as papain, flavonoids, and phenolics, which have antioxidant and antibacterial properties and can reduce ammonia and nitrite levels in water. This helps reduce stress and maintain metabolic stability and body temperature in fish[16].

Additionally, as a physical filter, zeolite effectively absorbs ammonia and other ions, thereby reducing exothermic chemical reactions that cause temperature fluctuations. Zeolite also slowly releases calcium and magnesium ions, which help stabilize ionic balance in water. The combination of papaya leaf and zeolite has been proven to have a synergistic effect in maintaining stable water temperature and improving the overall quality of the cultivation environment[17].

Turbidity

Turbidity is an important parameter in aquaculture water quality because it can interfere with light penetration and photosynthesis and trigger the growth of algae and pathogenic microorganisms[18]. During the study, the best turbidity values were obtained in treatment P3 (6 mL/L papaya leaf solution + 17.05 g/L zeolite) with a range of 0.45–3.28 NTU, still within

the optimal range according to Febriyanti[19], which is 2–30 NTU. The average turbidity values during the study in the striped catfish cultivation medium can be seen in Figure 2

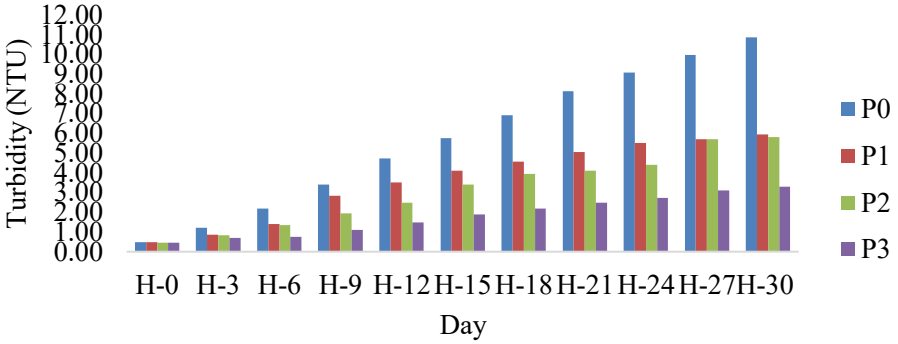

Figure 2. Graph of average turbidity

Figure 2 shows that adding 6 ml/L of papaya leaf solution and 17.05 g/L of zeolite to P3 resulted in an average range of 0.45-3.28 NTU. Papaya leaf solution contains active compounds such as papain and phenolic compounds with coagulant properties, aiding in the precipitation of suspended particles, and contains natural antibacterial agents that reduce the population of bacteria causing turbidity[16]. Meanwhile, zeolite acts as a physical and chemical filter with a porous structure capable of absorbing fine particles and harmful ions such as ammonia and nitrite, affecting turbidity[20].

The combination of papaya leaf and zeolite produces a synergistic effect in reducing water turbidity in aquaculture. Papaya leaf functions as a flocculant, while zeolite acts as a filter and absorber of dissolved substances, resulting in clearer water and supporting optimal fish growth[17].

Electrical Conductivity

Electrical conductivity (EC) is an important parameter in determining the quality of aquaculture water, as it indicates the amount of dissolved ions such as sodium, calcium, and sulfate that affect the water's ability to conduct electricity. In this study, treatment P3 (6 mL/L papaya leaf solution and 17.05 g/L zeolite) showed an electrical conductivity range of 53–110 µmhos/cm, still within the safe range for fish, which is 100–500 µmhos/cm[21]. The average electrical conductivity values during the study on striped catfish culture media can be seen in Figure 3.

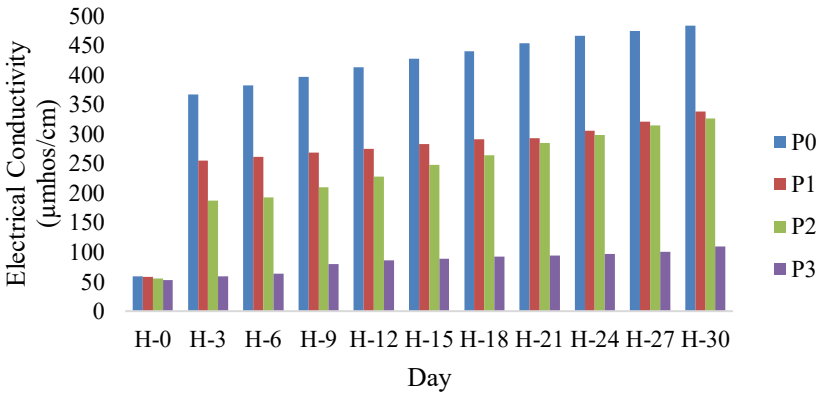

Figure 3. Graph of average electrical conductivity

Figure 3 shows that adding 6 ml/L of papaya leaf solution can affect the electrical conductivity of water by 53-110 µmhos/cm. The decrease in DHL is caused by bioactive compounds in papaya leaf, such as papain and phenolics, which can bind free ions,

thereby reducing the total concentration of dissolved ions[22]. On the other hand, zeolite absorbs ions such as ammonia, nitrate, and heavy metals thanks to its porous structure. It gradually releases calcium and magnesium ions to maintain ionic balance[20].

The combination of papaya leaf solution and zeolite synergizes to stabilize DHL. Papaya leaf reduces the number of free ions, while zeolite regulates ion release in a controlled manner, maintaining ionic balance without drastically increasing DHL[23]. Therefore, managing DHL using these natural materials is an effective strategy in aquaculture water quality management, as higher levels of ionized salts result in higher DHL values[24].

Total Dissolved Solids (TDS)

Total Dissolved Solids (TDS) measure the concentration of dissolved solids in water, including minerals, salts, and organic substances. The average TDS value during the study on striped catfish cultivation media can be seen in Figure 4

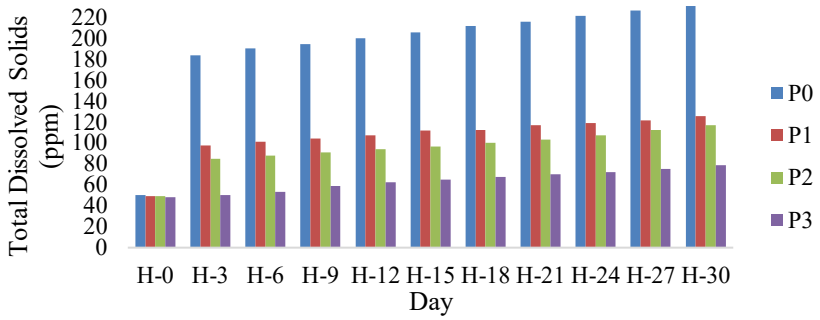

Figure 4. Graph of average total dissolved solids

The results shown in Figure 4 indicate that treatment P3, which involved adding 6 mL/L of papaya leaf solution, yielded the best results for TDS values, ranging from 48 to 79 ppm. These values are still well below the acceptable TDS threshold for striped catfish farming, which is <1000 ppm[25]. The low TDS values in this treatment are likely due to the interaction of active compounds in papaya leaf that can bind dissolved ions such as ammonia, nitrite, and nitrate[26].

Papaya leaves contain bioactive compounds such as papain, phenolics, and flavonoids that can neutralize dissolved ions in water, thereby significantly reducing TDS levels[22]. Additionally, papaya leaf solution has coagulant properties that can help precipitate suspended particles in water[16].

Zeolite, as an additive in the cultivation medium, also reduces TDS. Zeolite has a high adsorption capacity for harmful compounds such as ammonia, nitrate, and heavy metals and can slowly release beneficial ions such as calcium and magnesium[20]. The TDS value resulting from filtration can reduce dissolved substances in the cultivation medium, and the absence of flowing water circulation causes sedimentation, leading to deteriorated water quality[25]. The combination of papaya leaf and zeolite has proven effective in maintaining the stability of water quality in striped catfish aquaculture by reducing dissolved solids content[23].

Reasonable TDS control has a positive impact on the aquatic environment. Low TDS values can reduce the risk of pH fluctuations and maintain the stability of other water quality parameters. Clear and balanced water supports the photosynthesis process of aquatic plants and creates an ideal environment for fish growth, reducing stress and increasing feed efficiency[27].

Total Suspended Solids (TSS)

Total Suspended Solids (TSS) indicate the amount of solid particles suspended in water, organic, such as plankton and detritus, and inorganic, such

as mud and silt. In striped catfish farming, high TSS levels can reduce water clarity, disrupt fish respiration, and increase disease risk. The average TSS values during the study on striped catfish farming media can be seen in Figure 5.

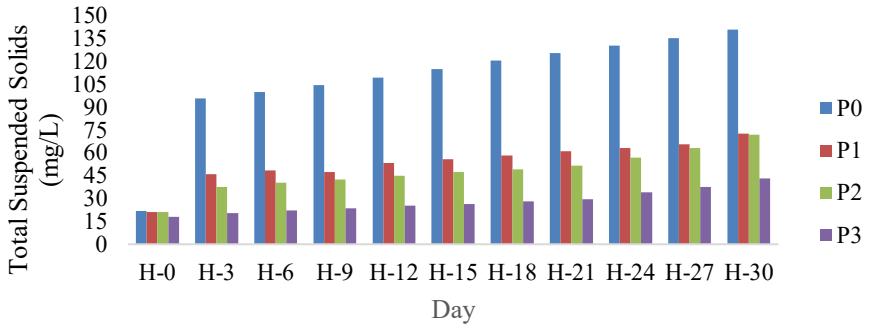

Figure 5. Graph of average total suspended solids

Figure 5 shows that adding 6 mL/L of papaya leaf solution can reduce TSS in aquaculture water. The TSS in this treatment was 18–43 mg/L, which is still within the safe limit according to Situmorang et al.[28], namely 25–80 mg/L for fisheries activities. The low TSS in this treatment is likely due to the coagulant effect of compounds in papaya leaf that can settle suspended particles to the bottom of the water. The decrease in TSS is also closely related to improved water clarity, as turbidity is directly influenced by the number of particles suspended in the water[29]. Thus, adding papaya leaf solution plays a role in maintaining aquaculture water's visual and ecological quality.

Additionally, the use of zeolite filters also supports the reduction of TSS. Zeolite's irregular crystal structure and large surface area make it effective in capturing colloidal and fine particles before the water returns to the aquaculture medium[25]. Zeolite functions as both a physical filter and an adsorption medium for small particles, as explained by Jubaedah et al.[30], who noted that the filter can effectively retain small particles.

TSS levels influence turbidity, salinity, and dissolved oxygen (DO) levels. Higher TSS levels result in cloudier water and reduced light penetration, which impacts water clarity and DO levels[31]. Therefore, managing TSS through the use of papaya leaf solution and zeolite is an important strategy in creating a healthy cultivation environment for striped catfish.

Growth Rate of Striped Catfish (*P.hypopthalmus*)

Fish growth is greatly influenced by feed quality and environmental conditions, including aquaculture water quality. A decline in water quality can cause stress, growth disorders, increased pathogenic microbes, and even fish mortality[32]. The data from observations of striped catfish during the study can be seen in Table 1.

Table 1. Average absolute weight, absolute length, and specific growth rate of striped catfish

Treatment	Absolute Weight (g/ fish)	Absolute Length (cm/ fish)	Specific Growth Rate (g/day)
P0	1,67 ± 0,100^{a}	2,00 ± 0,300^{a}	1,11 ± 0,061^{a}
P1	1,80 ± 0,043^{a}	2,30 ± 0,435^{a}	1,16 ± 0,087^{a}
P2	2,28 ± 0,069^{b}	2,53 ± 0,057^{a}	1,38 ± 0,105^{b}
P3	2,92 ± 0,313^{c}	3,56 ± 0,472^{b}	1,72 ± 0,122^{c}

The study's results indicate that adding papaya leaf solution and zeolite significantly impacts the growth of striped catfish. Based on Table 5, the best treatment

was obtained in P3, which involved the addition of 6 ml/L of papaya leaf solution and 17.05 g/L of zeolite. In this treatment, the weight reached 2.92 ± 0.313 g/fish, the length was 3.56 ± 0.472 cm/fish, and the specific growth rate (SGR) was 1.72 ± 0.122 g/day.

The growth improvement in P3 is likely due to the combination of papaya leaf solution and zeolite, which improves water quality by reducing TDS and TSS and suppressing pathogenic microorganisms. The bioactive compounds in papaya leaf, such as papain and flavonoids, enhance fish health and feed efficiency, while zeolite helps maintain the stability of water chemical parameters. This combination creates an optimal environment for fish growth. Thus, the simultaneous use of papaya leaf solution and zeolite has been proven to enhance the growth performance of striped catfish. This strategy can be applied in aquaculture practices to improve feed efficiency and fish productivity sustainably. The growth rate of striped catfish absolute weight during the study can be seen in Figure 6.

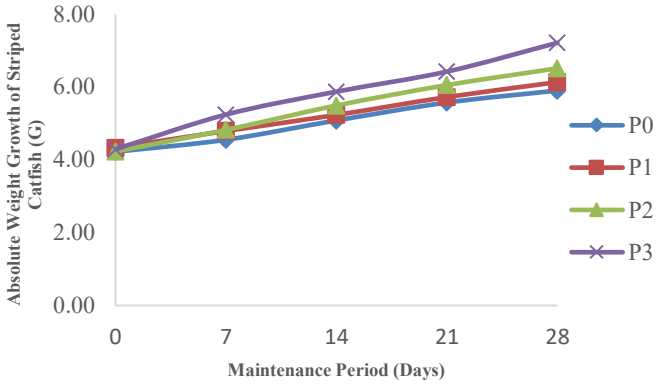

Figure 6. Absolute weight growth of striped catfish

Figure 6 shows that the absolute weight of striped catfish increases over time. Treatment P3 (addition of 6 ml/L papaya leaf solution and zeolite) produced the highest absolute weight, 2.92 g/fish, on day 28. Conversely, treatment P0 (without adding papaya leaf and zeolite) showed the lowest growth. This indicates that adding papaya leaf solution plays a role in maintaining water quality during cultivation.

Environmental factors such as temperature, pH, dissolved oxygen, and ammonia levels are the main determinants of fish growth success[33]. The addition of papaya leaf solution and the use of zeolite can improve these conditions. Zeolite absorbs harmful compounds, while papaya leaf solution helps settle suspended particles and supports water quality stability.

In addition to maintaining water quality, papaya leaf also contains the proteolytic enzyme papain. This enzyme helps improve protein digestion efficiency in feed, contributing to fish growth[34]. According to Hasibuan et al.[10], good water quality influences growth, which correlates with the biomass weight of striped catfish in the cultivation medium. The absolute growth rate of striped catfish during the study can be seen in Figure 7.

the striped catfish's highest absolute length growth was obtained in treatment P3 (6 mL/L papaya leaf solution and zeolite), which was 3.56 cm/fish on day 28. This increase is closely related to improved water quality due to the combination of papaya leaf solution and zeolite filter use. The decline in water quality during maintenance is generally caused by the accumulation of metabolic waste and feed that forms toxic compounds such as ammonia[35]. Zeolite plays an important role in absorbing ammonia and nitrate, thereby maintaining stable and safe water quality for fish[36]. Rahman et al.[37] reinforced this by stating that using zeolite in aquaculture

can reduce stress and accelerate fish growth.

Additionally, bioactive compounds in papaya leaf, such as papain, flavonoids, and phenolics, possess antimicrobial properties that help reduce the potential for disease infections in fish[38]. A healthy environment allows fish to use their energy for growth rather than fighting pathogens[39].

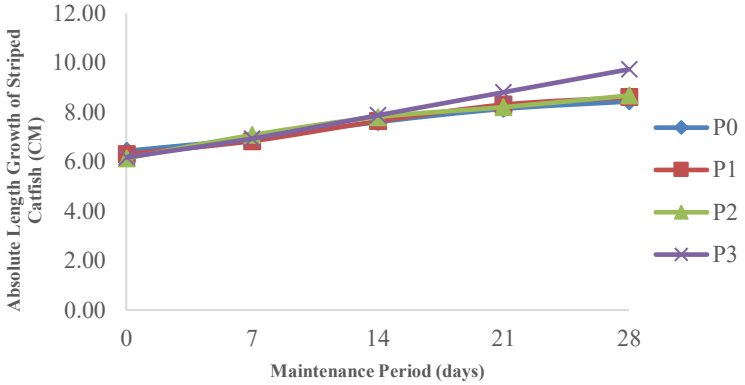

Figure 7. Absolute length growth of striped catfish

Studies by Kim et al.[11] show that combining papaya leaf solution and zeolite significantly increases fish growth, including absolute length, by up to 18% compared to the control. This combination reduces water toxicity, improves digestive efficiency, and strengthens the fish's immune system. Qiang et al.[40] also stated that zeolite plays a role in stabilizing water quality parameters and reducing stress caused by environmental fluctuations.

4. CONCLUSION

Based on the results of this study, papaya leaf solution administration affects water physical parameters in striped catfish farming. The best treatment in this study was the use of 6 mL/L papaya leaf solution, which resulted in water physical parameters of temperature (25.3-25.8°C), turbidity (0.45-3.28 NTU), electrical conductivity (53–110 µmhos/cm), TDS (48–79 ppm), and TSS (18–43 mg/L). The weight gain was 2.92 g/fish, the length was 3.56 cm/fish, and the specific growth rate was 1.72%.

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