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SUPPLEMENTATION OF BOILED COCONUT WATER (*Cocos nucifera L.*) IN THE NURSERY STAGE II OF CATFISH (*Clarias* sp.)

Suplementasi Air Kelapa Rebus (*Cocos nucifera L.*) Pada Tahap II Pembibitan Ikan Lele (*Clarias* sp.)

Ricky Djauhari*, Murrod Candra Wirabakti, Hesli Kaharap Dehen

Aquaculture Study Program, Palangka Raya University, Palangka Raya, 74874

*Corresponding author: djrickyaku@gmail.com

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ABSTRACT

This study aims to evaluate the potential use of boiled coconut water (*Cocos nucifera* L.) as an alternative prebiotic source in the second nursery stage of catfish (*Clarias* sp.) cultivation. The study used a completely randomized design (CRD) consisting of four treatments: no prebiotic or probiotic supplementation (A), supplementation with boiled coconut water prebiotics at a dose of 2% (B), Evapond Bacillus probiotics at a dose of 1% (C), and a synbiotic (a combination of boiled coconut water prebiotics at a dose of 2% and Evapond Bacillus probiotics at a dose of 1%) (D), each with three replications. The evaluation results of the trial of using boiled coconut water as an alternative prebiotic for the maintenance of catfish fry at the second nursery stage showed the best feed efficiency, daily growth rate, and absolute growth on the 20th day.

Keywords: catfish, feed, growth, prebiotics, boiled coconut water

ABSTRAK

Penelitian ini bertujuan untuk mengevaluasi potensi penggunaan rebusan air kelapa (*Cocos nucifera* L.) sebagai sumber prebiotik alternatif pada budidaya ikan lele (*Clarias* sp.) tahap pendederan II. Rancangan penelitian yang digunakan adalah rancangan acak lengkap (RAL) yang terdiri dari empat perlakuan tanpa suplementasi prebiotik dan probiotik (A), suplementasi prebiotik air kelapa rebus dosis 2% (B), probiotik Evapond Bacillus dosis 1% (C) dan sinbiotik (kombinasi prebiotik air kelapa rebus dosis 2% dan probiotik Evapond Bacillus dosis 1%) (D) masing-masing dengan tiga ulangan. Hasil evaluasi uji coba pemanfaatan air kelapa rebus sebagai prebiotik alternatif untuk pemeliharaan benih ikan lele pada tahap pendederan II menunjukkan hasil efisiensi pakan, laju pertumbuhan harian dan pertumbuhan mutlak terbaik pada hari ke-20.

Kata kunci: lele, pakan, pertumbuhan, prebiotik, rebusan air kelapa

INTRODUCTION

Although the production volume of catfish for aquaculture in 2025 will decrease by approximately 200,000 tons compared to 2024, catfish will remain a mainstay for freshwater fish farmers, particularly in Java and Kalimantan. The Central Kalimantan Provincial Government is currently proactively promoting the development of catfish farming villages, not only for the sake of meeting animal protein needs and food security, but also for the low cost, relatively unobstructed cultivation process, and the possibility of harvesting six to eight times per year. The main problems frequently encountered by catfish aquaculturists are low feed efficiency and feed wastage.

Various efforts have been made to address the issue of feed efficiency and savings in catfish cultivation at the nursery and grow-out stages, including biofloc systems, the use of prebiotics, probiotics, and synbiotics. Prebiotics are compounds, substrates, long-chain sugars, nutrients, or fibers that serve as primary food sources for beneficial microorganisms in the fish digestive system (Mountzouris 2022). Prebiotics have several important characteristics, namely: resistance to the acidic environment of the stomach, fermentation by probiotics in the intestine, and the ability to increase the survival, growth, and multiplication of probiotics. Furthermore, probiotics will improve fish growth performance and health status (Davani-Davari *et al*. 2019). Some examples of prebiotics frequently applied to aquaculture activities include β-glucan, inulin, arabinoxylanoligosaccharides (AXOS), mannanoligosaccharides (MOS), galactooligosaccharides (GOS), and fructooligosaccharides (FOS). All types and types of prebiotics can generally support growth performance (Li *et al*. 2019), increase feed utilization efficiency (Shoaei *et al*., 2015) and the body's defense system (Li *et al*. 2021) as well as the resistance of aquaculture biota to disease (Abdel-Latif *et al*. 2022; Li *et al*. 2018; Yilmaz *et al*. 2022).

The main objective of catfish nursery activities in general is to produce seeds that have a fast growth rate, high survival rate, feed efficiency and uniformity of harvest size. Until now, exploration of new alternative prebiotic resources that are adequate as essential nutrient sources to support the survival, growth and multiplication of probiotics continues to be carried out in various aquaculture sectors, especially economically important fish. As is known, prebiotics act as the main nutrient source for both autochthonous and allochthonous probiotics, furthermore probiotics play a role in producing exogenous digestive enzymes that enrich endogenous digestive enzymes and produce natural pathogen antibacterial products, so the combination of both is very important to improve growth performance and fish health status.

Coconut (*Cocos nucifera L.*) is one of the leading local plantation commodities in Central Kalimantan. Pure coconut water has been known to be very nutritious, other external products can be coconut oil and milk (coconut milk). The production of coconut plantations in Central Kalimantan in 2024 reached an estimated value of 16.7 thousand tons. The prebiotic content of fructooligosaccharides (FOS) of around 19-20% was successfully extracted from the total carbohydrate sugars of 25-26% sourced from lean coconut residues which is very potential and significantly increases the proliferation and activity of SCFA (short chain fatty acids) production which helps reduce the pH of the intestinal lumen thereby creating inhibitory microecophysiological conditions for external pathogens by the probiotic bacteria *Lactobacillus casei Shirota* and *Lactobacillus bulgaricus* in vitro (Nor et al. 2017). The use of coconut water as a new alternative prebiotic source for sustainable freshwater aquaculture activities shows quite excellent real growth performance, including low feed conversion ratio values, high feed efficiency and shows a trend of uniformity of response in aquaculture biota (Markhamah *et al*. 2025). Ahmadi *et al*. (2012) stated that Sangkuriang catfish seeds with an initial average weight of 5 g produced an average final weight of individuals during a 30-day maintenance period that were given probiotic supplementation with a dose of 2-6 ml/kg of feed ranging from 10.4-13.8 g with a feed protein content of 33% and a feeding amount of 10% and a frequency of 3 times a day. The results of Markhamah et al.'s research. (2025) using 50 mL coconut water supplementation showed that the feed conversion ratio, feed efficiency, and daily growth rate of tilapia fry were 1.26, 79.45%, and 2.81%, respectively, and the final biomass and average individual weight were 160.85 g and 5.67 g, respectively. The use of coconut pulp flour can increase the daily growth rate and absolute growth as well as feed efficiency of milkfish fry (Chanos chanos) with an initial length of 5-7 cm during 60 days of maintenance (Mutiasari *et al*. 2017). Extraction of coconut pulp and pulp produces prebiotic galactomannanoligosaccharides which are useful as potential prebiotics for aquaculture biota (Sundu *et al*. 2020; Sitanggang *et al*. 2022). Coconut water contains several biologically active compounds such as protein, amino acids, fatty acids, minerals, vitamins, and phenolic compounds. The results of research by Shayanthavi *et al*. (2024) revealed that the bioactive compound content of young coconut water is highly dependent on the variety. Among other things, the King variety has a significantly higher total sugar content (63.58 mg/mL) compared to the Ran thembili variety (43.80 mg/mL). Furthermore, both varieties have high total antioxidant activity and phenolic content.

Research into the use of boiled coconut water as a new alternative prebiotic source in freshwater fish farming has not yet been conducted. Therefore, this study was conducted to evaluate the potential of using boiled coconut water as a new alternative prebiotic source in catfish farming.

RESEARCH METHODS

his study used a completely randomized design (CRD) consisting of four treatments: prebiotic supplementation with boiled coconut water, probiotic Evapond Bacillus, and synbiotic (a combination of prebiotic boiled coconut water and probiotic Evapond Bacillus), each with three replications. The treatments were:

A. Treatment without prebiotic supplementation, probiotic, and synbiotic supplementation + 2% egg white.
B. Treatment with prebiotic supplementation with boiled coconut water at a dose of 2% + 2% egg white.
C. Treatment with probiotic supplementation with Evapond Bacillus at a dose of 1% + 2% egg white.
D. Treatment with combination of prebiotic supplementation with boiled coconut water at a dose of 2% + probiotic Evapond Bacillus at a dose of 1% + 2% egg white.

Place and Time

This research was conducted from December 2025 to January 2026 at the Aquaculture Management Systems and Technology Laboratory, Department of Fisheries, Faculty of Agriculture, Palangka Raya University, Palangka Raya City.

Tools and Materials

The tools used in this study include a digital scale with a capacity of 500 g x 0.01 g, 12 round plastic basins with a volume of 50 L, measuring cups, spoons, trays, thermometers, a Lutron 5510 DO meter, and an ATC digital pH meter. The materials used in this study were 180 catfish seeds, 1 L of Evapond Bacillus probiotics, 1 coconut with 250 mL of boiled coconut water, and commercial pellet feed with a protein content of 40%.

Procedure

Prebiotic, Probiotic, and Synbiotic Supplementation and Catfish Maintenance

The feed used during maintenance is PF1000 pellet feed containing 40% protein and 6% fat. Preparation of boiled coconut water as an alternative prebiotic source is done by boiling pure coconut water for 5-7 minutes, then allowed to cool, then ready to be used for supplementation purposes into the feed. Preparation of test feed is done by adding and mixing commercial feed with prebiotic boiled coconut water dose of 2%, probiotic Evapond Bacillus dose of 1%, and a combination of prebiotic boiled coconut water dose of 2% with probiotic Evapond Bacillus dose of 1%, each added egg white as a binder dose of 2% according to treatment. Probiotic Evapond Bacillus contains two species of probiotic bacteria, namely Bacillus pumilus and Bacillus subtilis, each with the same bacterial density, namely ≥ 1.0 x 106 CFU / mL. Next, the feed is air-dried for 15 minutes and after that it is ready to be given to the test fish. Maintenance of catfish seeds is carried out for 30 days. The fish were fed twice daily at a 5% feeding rate. Feeding times were 8:00 AM and 4:00 PM WIB.

The fish used in this study were catfish fry obtained from fish fry farmers on Jalan G. Obos, Palangka Raya City. The test fish had an average initial weight of 4.00-4.78 g. The fish fry were acclimatized for 7 days before being transferred into a 50 L round plastic basin as a research container without using aeration. The stocking density of fish in each container was 15 fish. The water quality of the rearing media was monitored during maintenance with the following parameters and ranges: temperature 28-30.5 ºC, DO 4.1-4.4 mg/L, and pH 6.82-7.15.

Data collection

The main parameters evaluated in this study include: average body weight of individual fish, fish biomass, absolute growth, feed conversion ratio, feed efficiency, daily growth rate, and fish survival rate. Evaluation of the main performance parameters was carried out every 10 days (Rejeki *et al*. 2013). The supporting parameters measured included water quality parameters, namely temperature, pH, and DO, which were carried out at the beginning, middle, and end of the study. All main parameter data were analyzed using the MINITAB 15 program to assess whether the treatment affected the response and to differentiate the significance between treatments, while the supporting parameters were analyzed descriptively.

RESULTS

The results of maintaining catfish seeds for 30 days in plastic basins show a general picture of the growth performance of catfish seeds given prebiotic supplementation of boiled coconut water, probiotic Evapond Bacillus and synbiotic (combination of prebiotic boiled coconut water and probiotic Evapond Bacillus) presented in Table 1 and Table 2 shows the average value.

Table 1. Initial body weight (Wo), final body weight (Wt), initial biomass (Bo), final biomass (Bt), difference between final and initial biomass (ΔB), amount of feed consumption (JKP), feed conversion ratio (FCR), feed efficiency (EP), daily growth rate (LPH), and survival rate (SVR) of catfish fry with Evapond Bacillus and boiled coconut water supplementation, namely treatment without Evapond Bacillus and boiled coconut water supplementation (A), boiled coconut water supplementation at a dose of 2% (B), Evapond Bacillus supplementation at a dose of 1% (C), combination of boiled coconut water supplementation at a dose of 2% and Evapond Bacillus at a dose of 1% (D) for 30 days of maintenance in a plastic basin

Parameters /	**Wo (g)**	**Wt (g)**	**Bo (g)**	**Bt (g)**	**ΔB (g)**	**JKP (g)**	**FCR**	**EP (%)**	**LPH (%/hari)**	**TKH (%)**

Treatment										
A1	4,11	14,5	61,69	217,50	155,81	144,13	0,93	108,1	4,2	100
A2	4,00	15,42	60,00	231,31	171,31	148,49	0,87	115,37	4,5	100
A3	4,48	15,94	67,24	239,11	171,87	158,81	0,92	108,22	4,23	100
B1	4,13	13,82	61,91	207,25	145,34	142,69	0,98	101,86	4	100
B2	4,00	14,34	60,00	215,15	155,15	141,17	0,91	109,9	4,27	100
B3	4,06	14,15	60,92	212,30	151,38	144,19	0,95	104,99	4,17	100
C1	4,31	13,64	64,65	150,02	85,37	120,63	1,41	70,77	2,8	73,33
C2	4,41	15,71	66,15	220	153,85	146,42	0,95	105,07	4	93,33
C3	4,01	13,28	60,16	199,14	138,98	138,76	1,0	100,16	3,97	100
D1	4,34	16,07	65,04	225,03	159,99	156,28	0,98	102,37	4,13	93,33
D2	4,78	17,05	71,64	255,68	184,04	170,63	0,93	107,86	4,23	100
D3	4,29	13,6	64,39	203,98	139,59	146,1	1,05	95,54	3,87	100

Table 2. Average values of initial body weight (Wo), final body weight (Wt), initial biomass (Bo), final biomass (Bt), difference between final and initial biomass (ΔB), amount of feed consumption (JKP), feed conversion ratio (FCR), feed efficiency (EP), daily growth rate (LPH), and survival rate (SVR) of catfish fry with supplementation of Evapond Bacillus and boiled coconut water, namely treatment without supplementation of Evapond Bacillus and boiled coconut water (A), supplementation of boiled coconut water dose of 2% (B), supplementation of Evapond Bacillus dose of 1% (C), combination of supplementation of boiled coconut water dose of 2% and Evapond Bacillus dose of 1% (D) for 30 days of maintenance in a plastic basin

Parameters / Treatment	Wo (g)	Wt (g)	Bo (g)	Bt (g)	ΔB (g)	JKP (g)	FCR	EP (%)	LPH (%/hari)	TKH (%)
A	4,20	15,29	62,98	229,31	166,33	150,48	0,91	110,56	4,31	100
B	4,06	14,10	60,94	211,57	150,62	142,68	0,95	105,58	4,15	100
C	4,24	14,21	63,65	189,72	126,07	135,27	1,12	92	3,59	88,89
D	4,47	15,57	67,02	228,23	161,21	157,67	0,99	101,92	4,08	97,78

After being raised for 20 days, catfish fry given boiled coconut water supplementation treatment showed an increased daily growth rate value exceeding other treatments, namely 4.7% (Figure 1) or an increase of 135.45% compared to other treatments, supported by good feed conversion ratio (0.84) and feed efficiency (119.44%) as well as the lowest feed consumption amount of 73.69 g (Figure 2), experiencing the highest increase in feed efficiency (35.96%) compared to other treatments, namely from 83.48% at the time of sampling on the 10th day to 119.44% on the 20th day (Figure 3). In the 10th day of sampling, it was found that the highest absolute growth increase of 202.79% was seen in the boiled coconut water supplementation treatment (Figure 4). The evaluation conducted on the sampling of the average body weight of individual fish from the 10th day to the 20th day (Figure 5) showed an increase in the average body weight value of individual fish in the boiled coconut water supplementation treatment (159.72%) which was higher than the Evapond Bacillus probiotic supplementation treatment (154.59%) and synbiotic (157.39%).

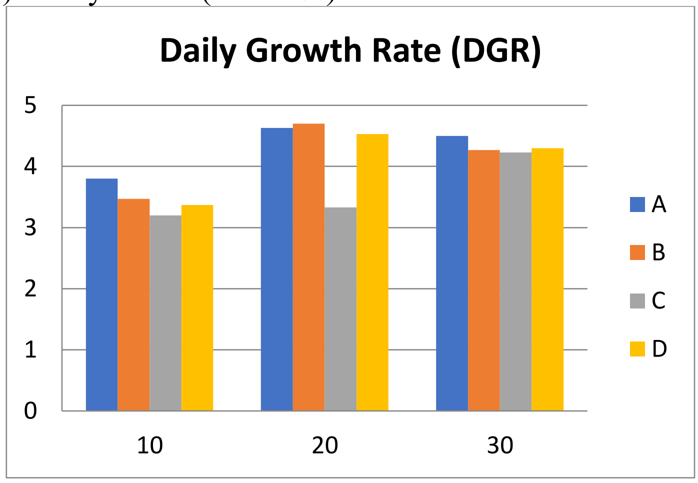

Figure 1. Histogram of daily growth rate of catfish fry reared in plastic basins with prebiotic, probiotic and synbiotic supplementation.

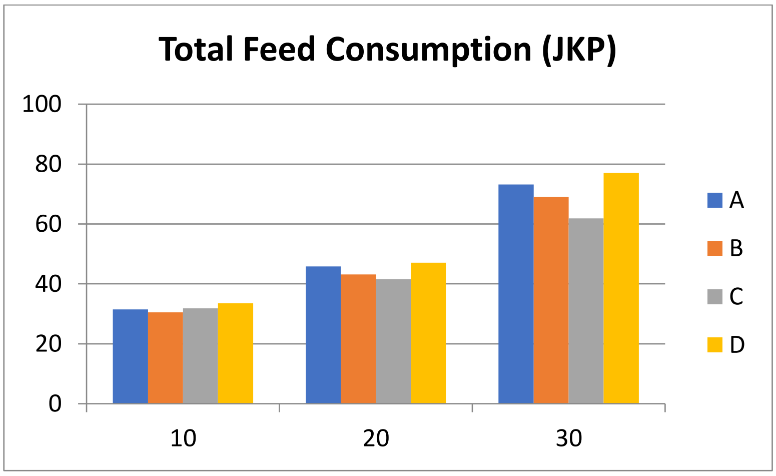

Figure 2. Histogram of the amount of feed consumption of catfish fry reared in plastic basins with prebiotic, probiotic and synbiotic supplementation.

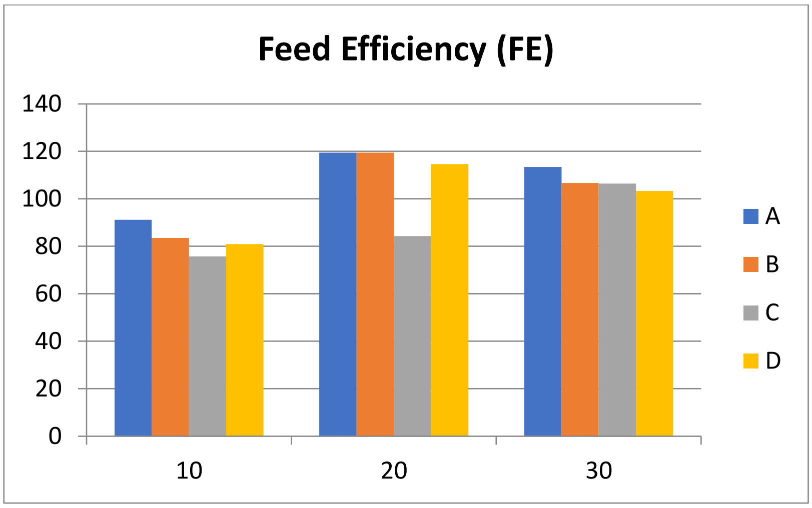

Figure 3. Histogram of feed efficiency of catfish fry reared in plastic basins with prebiotic, probiotic and synbiotic supplementation

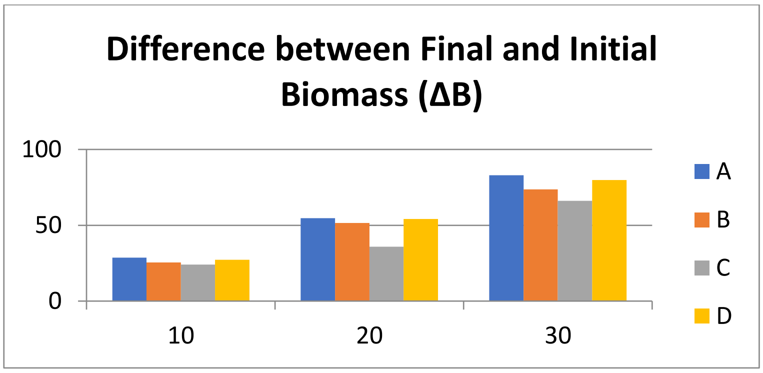

Figure 4. Histogram of absolute weight growth of catfish seeds raised in plastic basins with prebiotic, probiotic and synbiotic supplementation.

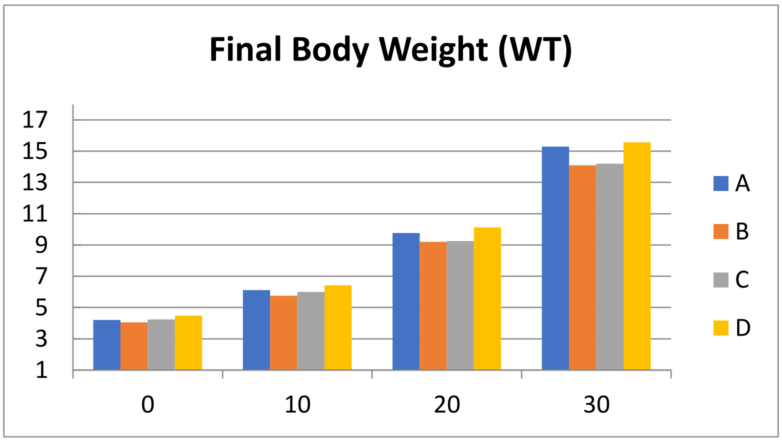

Figure 5. Histogram of body weight of catfish fry reared in plastic basins with prebiotic, probiotic and synbiotic supplementation.

The C1 fish group given Evapond Bacillus probiotic supplementation showed a drastic decrease in survival rate (73.33%) because on the 12th and 13th day of observation there were 1 and 3 fish deaths, respectively, so that the average survival rate finally became 88.89% (Figure 6). This condition was also confirmed by the feed conversion ratio value being very high and the highest (Figure 7), as well as the final biomass value being the lowest (189.72 g) (Figure 8) compared to other treatments during maintenance.

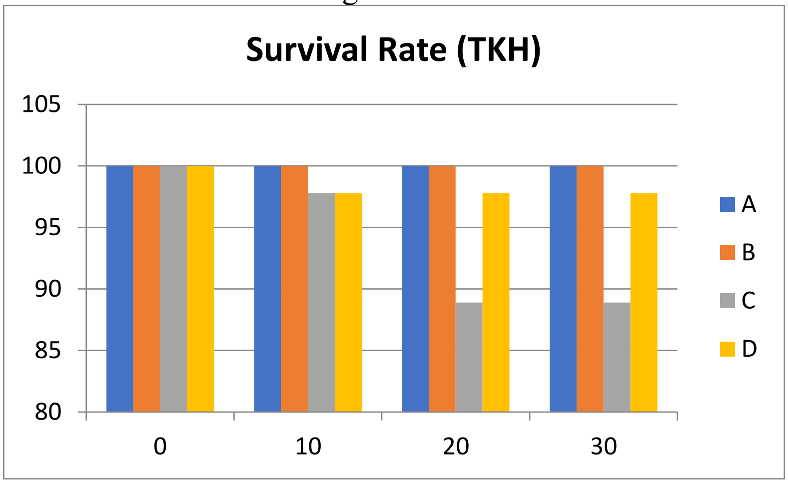

Figure 6. Histogram of the survival rate of catfish fry reared in plastic basins with prebiotic, probiotic, and synbiotic supplementation.

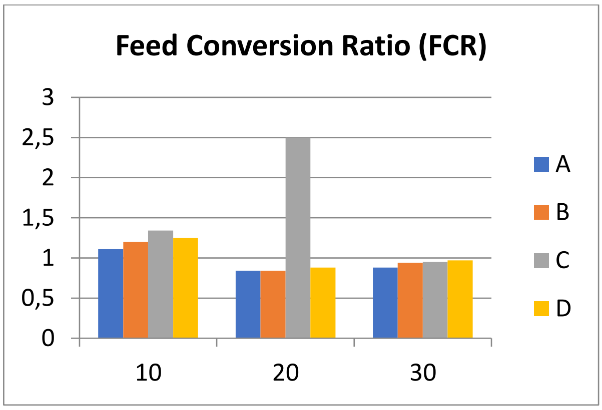

Figure 7. Histogram of feed conversion ratio of catfish fry reared in plastic basins with prebiotic, probiotic, and synbiotic supplementation.

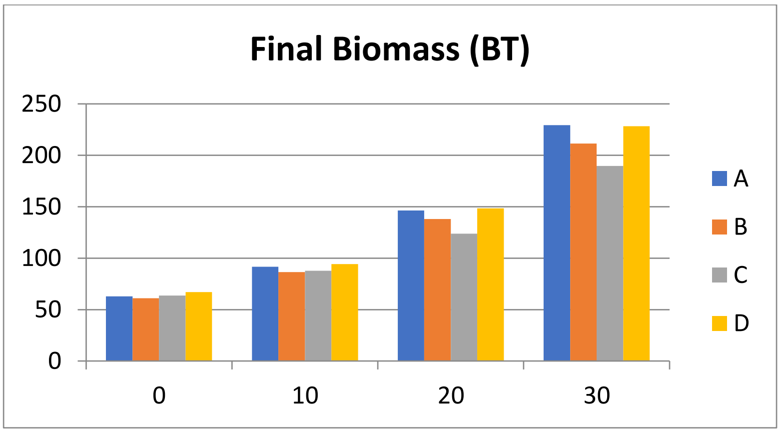

Figure 8. Histogram of final biomass of catfish fry reared in plastic basins with prebiotic, probiotic, and synbiotic supplementation.

DISCUSSION

Prebiotics are beneficial compounds or nutrients that provide an essential and primary energy source for the microbiota living in the gut of fish (Tran & Li 2022). Based on the results of a 20-day study of catfish fry maintenance, it was shown that the prebiotic supplementation with boiled coconut water demonstrated the best growth performance, with the highest daily growth rate and increased feed efficiency, as well as the lowest feed consumption. This demonstrates the potential role of a new alternative prebiotic, boiled coconut water, which can provide an essential nutrient source for both *autochthonic* and *allochthonic* probiotics. Adequate nutrient availability for all probiotic species can improve the survival, growth, and multiplication of probiotics in the host's intestinal tissue. Furthermore, it significantly supports the health of mucocyte and enterocyte cells, which play a crucial role in producing digestive enzymes, making the digestion and absorption of feed nutrients more efficient, thereby reducing feed consumption, which in turn can still have a beneficial effect on increasing the growth rate of catfish fry. The prebiotic or immunosaccharin content in boiled coconut water is thought to increase the surface area of enterocyte and mucocyte cells and the length of microvilli, thus increasing the efficiency of digestion and nutrient absorption. According to Al-Sheraji *et al*. (2013), prebiotics can prevent the adhesion of pathogenic microorganisms to intestinal epithelial cells, eliminating them through their mechanisms of action as receptors and modulators in the fish immune system, and controlling inflammation (Mohammadi *et al*. 2021).

Ahmadi *et al*. (2012) stated that Sangkuriang catfish seeds with an initial average weight of 5 g produced an average final weight of individuals during a 30-day maintenance period that were given probiotic supplementation at a dose of 2-6 ml/kg of feed ranging from 10.4-13.8 g with a feed protein content of 33% and a feeding amount of 10% and a frequency of 3 times a day. Furthermore, it was stated that the daily growth rate and feed efficiency values ranged from 2.04-3.12%/day and 31.65-43.93%, respectively. Azrita *et al*. (2023) in a research study found that enrichment of feed formulation of boiled coconut water and sugar from fermented palm oil sap with various types of fungal strains at a dose of 150 ml/kg feed, was significantly able to improve the composition of essential amino acids in feed and carcass, feed utilization efficiency, daily growth rate, protein efficiency ratio, condition factor, and micromorphological size of the intestines of juvenile gourami (*Osphronemus goramy*).

In general, the catfish nursery process is divided into four stages, namely the first stage, the average body weight of the fish ranges from 0-10 g, the second stage 5-15 g, the third stage 10-20 g, and the fourth stage 15-25 g. This research activity is included in the second nursery stage group, it can be explained that the peak phase of growth acceleration occurs in the range of body weight 5-15 g or the middle value is 10 g. The results of this study indicate that catfish seeds reach this body weight size in the 20-day maintenance period. The results of the 20th day sampling showed that the growth performance value of catfish seeds supplemented with boiled coconut water was able to reach the peak of growth acceleration, especially in the parameters of daily growth rate and feed efficiency. When evaluated from the amount of feed consumed by catfish seeds, in general, the results of this study were twice as successful in showing the efficiency of feed savings and the final average body weight of individual catfish seeds was higher, which ranged from 14.1-15.57 g. This condition also confirms that cheap commercial feed does not necessarily guarantee better digestive metabolism and nutrient absorption, even if supplemented with probiotics, prebiotics, and synbiotics. The results of research by Markhamah et al. (2025) using a 50 mL dose of coconut water supplementation showed that the feed conversion ratio, feed efficiency, and daily growth rate of tilapia fry were 1.26, 79.45%, and 2.81%, respectively, and the final biomass and average individual weight were 160.85 g and 5.67 g, respectively.

A very important and interesting observation for freshwater fish farmers in general and catfish in particular is that upon entering the third or final 10 days of the catfish fry rearing period during the second nursery stage, all treatments showed a decline in growth performance, except for the probiotic supplementation treatment, specifically in the parameters of feed conversion ratio, feed efficiency, and daily growth rate. The decline in growth performance of catfish fry in all treatments upon entering the third 10 days is suspected to be due to the feed being too small or no longer suitable for the size and opening of the fish's mouth. The implication of this is thought to cause the feed to be directly swallowed by the fish without undergoing initial digestion in the oral cavity. Therefore, the size of the feed particles provided should be larger, so that the digestive process that has already begun in the oral cavity can proceed optimally. This phenomenon is suspected to be due to the selection, transition, regeneration, adaptation, survival ability, and multiplication of external (*allochthonous*) probiotics intentionally introduced through feed requiring longer time to settle in the fish's intestinal tissue, which must have previously contained permanent resident (*autochthonous*) probiotic bacteria. Sugiani *et al*. (2022) revealed that the main requirements for ideal probiotics are the ability to survive, form colonies, multiply, and perform in dynamic balance, both in number, type, and species. Based on observations and real evaluations of the results of this study, it appears that there is a suspected unique and specific tendency in the interaction of probiotics with individual fish, meaning that each individual fish has permissive and adaptive properties towards external probiotics. This is indicated by the probiotic supplementation treatment (treatment C), especially during sampling on the 20th day, in general, all growth performance parameters in replicates C2 and C3 showed much better results than replicate C1. The transition process, regeneration, accommodation, and performance of these probiotic bacteria are suspected not only to disrupt the balance and composition of the number, type, and species of probiotic bacteria that will remain in the intestinal tissue, but also to disrupt digestive metabolism and absorption of feed nutrients. This condition is evidenced by a very real and lowest decrease in fish growth performance values among other treatments at the time of sampling on the 20th day, including the value of the feed conversion ratio reaching 2.5, feed efficiency only reaching 84.35%, absolute growth of 35.95 g, daily growth rate of 3.33% and final biomass of 123.67 g, as well as the mortality rate of fish given probiotic supplementation (replicate C1) is quite high seen in observations on the 12th and 13th days of the maintenance period, so that the value of the fish survival rate on the 20th day of sampling is only 73.33%. According to Sugiani *et al*. (2015) the introduction of allocthonous probiotic bacteria in an effort to improve feed efficiency and growth rate of aquaculture biota is usually less effective, allegedly due to the nature of nutrient and living space competitors with autochthonous probiotic bacteria, especially applications at high doses. Therefore, it can be said that the peak growth acceleration of catfish fry supplemented with probiotics likely occurs between 20 and 30 days into the second nursery stage. Another crucial factor thought to significantly contribute to the success of this second nursery stage is the selection of fry before they are released into the fish culture (maintenance) tank. Specifically, it is recommended to select (sort) catfish fry of uniform size as much as possible. Based on the results of the 10-day sampling, there were indications of very high genetic variability among individual catfish fry, both related to growth potential and the diversity of gut microbiota between individual fish. The number, type, and species of probiotics inhabiting the gut of the catfish fry certainly differ between individuals.

CONCLUSION

The results of the evaluation of the trial of using boiled coconut water as an alternative prebiotic for the maintenance of catfish seeds at the nursery stage II showed the results of feed efficiency, daily growth rate, absolute growth, and an increase in the average body weight of the best individual fish on the 20th day.

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