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Application of Barokah herb and salinity on the growth of Sangkuriang catfish *Clarias gariepinus* Burchell, 1822

Aplikasi Ramuan Barokah dan salinitas terhadap pertumbuhan lele Sangkuriang *Clarias gariepinus* Burchell, 1822

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ABSTRACT

The demand and need for catfish is increasing along with the growth of the Indonesian population, thus requiring greater catfish production. In addition, most of the brackish water areas in Indonesia have not been optimized for freshwater fish farming. Water salinity of 4 ppt plays a role in increasing fish growth, so when combined with the use of probiotics it has the potential to optimize catfish growth. This prompted a study on the Barokah herb, a herbal probiotic developed by the Mina Rukun fish group in Gunungkidul, which was combined with a water salinity of 4 ppt for more optimal rearing of Sangkuriang catfish. This study used a Completely Randomized Design with four treatment groups: control (K), salinity 4 ppt (S), herbal probiotics Barokah Herb with a dose of 30 mL/kg feed (P), and a combination of Barokah herb and salinity (PS). Each pond contained 375 catfish as replications with a stocking density of 250 fish/m^3. Data analysis was carried out using the ANOVA Test and the Tukey HSD Test as a post hoc test. The results showed that the combination of Barokah herb with a dose of 30 mL/kg feed and salinity of 4 ppt gave the best effect on the growth of Sangkuriang catfish, feed conversion ratio (FCR) of 1.001 and specific growth ratio (SGR) of 1.021. Histo-morphologically, the combination of Barokah Herb and 4 ppt salinity showed an increase in the dimensions of the villi, crypts, and tunica mucosa in the intestine and increased the dimensions skeletal muscle fascicles of the Sangkuriang catfish. This is related to the environment that is isoosmotic to the catfish's body and also the improvement of the catfish's digestive system.

Keywords: catfish growth, histo-morphology, barokah herb, salinity

ABSTRAK

Permintaan dan kebutuhan lele semakin meningkat seiring dengan pertumbuhan penduduk Indonesia, sehingga membutuhkan produksi lele yang lebih besar. Selain itu, sebagian besar wilayah perairan payau di Indonesia belum dioptimalkan untuk budidaya ikan air tawar. Salinitas air 4 ppt berperan dalam meningkatkan pertumbuhan ikan, sehingga ketika dikombinasikan dengan probiotik, berpotensi menjadikan pertumbuhan lele lebih optimal. Hal ini mendorong dilakukannya penelitian tentang probiotik herbal Ramuan Barokah yang dikembangkan oleh kelompok ikan Mina Rukun Gunungkidul yang dikombinasikan dengan salinitas air 4 ppt agar pemeliharaan ikan lele Sangkuriang lebih optimal. Penelitian ini menggunakan Rancangan Acak Lengkap dengan empat kelompok perlakuan yaitu kontrol (K), salinitas 4 ppt (S), probiotik herbal Ramuan Barokah dengan dosis 30 mL/kg pakan (P), dan kombinasi probiotik hebal dan salinitas (PS). Setiap kolam diisi 375 ekor ikan lele sebagai ulangan dengan padat tebar 250 ekor/m^3. Analisis data dilakukan dengan menggunakan Uji ANOVA dan Uji Tukey HSD sebagai uji post hoc. Hasil penelitian menunjukkan bahwa kombinasi Ramuan Barokah dengan dosis 30 mL/kg pakan dan salinitas 4 ppt memberikan pengaruh terbaik terhadap pertumbuhan ikan lele Sangkuriang, rasio konversi pakan (FCR) sebesar 1,001 dan rasio pertumbuhan spesifik (SGR) sebesar 1,021. Secara histomorfologi, kombinasi Ramuan Barokah dan salinitas 4 ppt menunjukkan adanya peningkatan dimensi vili, kripta, dan tunika mukosa pada usus serta peningkatan dimensi fasikulus otot rangka ikan lele Sangkuriang. Hal ini berkaitan dengan lingkungan yang isoosmotik terhadap tubuh ikan lele dan juga perbaikan sistem pencernaan lele.

Kata kunci: histo-morfologi, pertumbuhan lele, ramuan barokah, salinitas

INTRODUCTION

Catfish rearing production is the largest aquaculture production, which is 35.58% of the total aquaculture production (Sylvia & Ismoyowati, 2020). Many Indonesians do catfish rearing as a business opportunity, in a relatively easy way, and with high stocking density (Gustiano *et al.,* 2021). Indonesia's fish consumption figures from 2015-2021 continued to increase, from 41.11 kg/capita/year to 55.37 kg/capita/year (KKP, 2022). However, catfish rearing or production is not without obstacles. A number of obstacles that are often encountered in catfish rearing include the presence of pathogens in catfish, low nutritional content in feed, water salinity, and poor water quality (Thurlow *et al.,* 2019).

In addition, brackish waters also have the potential to be developed in catfish rearing so that they can support catfish production. Moreover, catfish have good adaptability in various environments (Suraya *et al.,* 2021). High water salinity can affect catfish growth, which is related to osmoregulation in the fish's body (Prananingtyas *et al.,* 2019). At a salinity of 4 parts per thousand (ppt), isoosmotic occurs between the fish's body and the water in the environment, making osmoregulation lower and energy can be diverted for growth (Laudin *et al.,* 2023; Sitio *et al.,* 2017).

Catfish growth is also greatly influenced by the presence of pathogens in the aquatic environment. Several types of pathogenic bacteria that infect the aquatic environment include *Aeromonas, Pseudomonas*, and *Edwardsiella*. However, there are several natural methods that can be used for immunotherapy in aquatic animals, such as probiotics, herbal plants, and yeast for live supplements for fish (Tiamiyu *et al.,* 2021; Balami *et al.,* 2022). The use of probiotics with the aim of increasing fish growth is currently popular among cultivators.

Commercial feed plays an important role in increasing fish growth. The use of suboptimal commercial feed can increase fisheries operational costs, thereby reducing profitability (Limbu, 2019). Several bacteria have been used as probiotics for catfish, both to increase growth, increase body immunity, and maintain water quality, namely *Lactobacillus casei, Lactobacillus plantarum* (Sartika *et al.,* 2022), and *Pediococcus acidilactici* (Hendam *et al.,* 2023). Bacteria in the digestive system will greatly affect the immunity of the fish by creating good digestive tract microflora (Mohammed *et al.,* 2023). Research by Hossain *et al*. (2024) shows that feed that has been given probiotics can significantly increase growth parameters, hypertrophic muscle growth, and intestinal morphology. Based on histo-morphological observations of muscle fibers, the use of multispecies probiotics affects the increase in the number of cell nuclei, muscle fiber diameter, and hyperplastic fish muscle fibers, as well as reducing the distance between fish skeletal muscle fibers.

Research by Gaffar *et al*. (2023) showed that the use of probiotics positively increased various histo-morphometric dimensions of the fish intestine, such as villi length, crypt width and depth, and intestinal muscle thickness. The use of probiotics makes the intestinal surface larger, namely the dimensions of the villi and crypt depth in the intestine are larger. This will improve intestinal performance. Increasing the number of goblet cells in various fish organs will increase the secretion of immunological substances that play a role in the fish's immune system (Haque *et al.,* 2021). The Mina Rukun Fish Group in Bejiharjo, Karangmojo, Gunungkidul developed an herbal probiotic called Barokah Herb which is used for Sangkuriang catfish rearing. However, the effect of the Barokah Herb on catfish growth has never been studied.

This study aims to determine the effect of the use of the Barokah Herb which is also combined with 4 ppt salinity on the growth of Sangkuriang catfish as seen from the increase in weight and length, as well as the histology of the intestine and skeletal muscles of the catfish. It is hoped that the combination of effective probiotic utilization can be identified to produce more optimal catfish production.

MATERIALS AND METHODS

Materials

Barokah herb is a herbal probiotic product produced by the Mina Rukun fish group in Gunungkidul, Yogyakarta. Other ingredients used include Hi-Pro-Vite pellets and Pandan Laut coarse salt.

The catfish preparation

The fish species is Sangkuriang catfish (*Clarias gariepinus* Burchell, 1822) from catfish hatchery in Jurangjero, Ngawen, Gunungkidul

Regency, Yogyakarta, Indonesia. The fish larvae used are 9 ± 1.19 cm in size or around three to four weeks after hatching.

Research location

This study was conducted in the rearing area of the Mina Rukun fish group in Karangmojo, Gunungkidul, Yogyakarta.

Catfish feeding and stocking density

Feeding was carried out with a frequency of two times a day, namely at 6 am and 6 pm, as much as 3% of the total weight of the catfish (Alalibo *et al.,* 2019; Zaidy, 2009). The stocking density applied in this study was 250 fish/m^3 (Difinubun *et al.,* 2023).

Experimental design

The design of this experimental study was a Completely Randomized Design with four treatment groups:

K = Treatment without Barokah herbs and salinity
S = 4 ppt salinity treatment
P = Barokah herb with a dose of 30 mL/kg
PS = Combination of 4 ppt salinity treatment and Barokah herb of 30 mL/kg

The Barokah herb application

The application of the probiotic dose of Barokah herb 30 mL/kg of feed (Putri *et al.,* 2022) was carried out by spraying the probiotics onto the pellets which were continuously stirred so that they were evenly distributed, each time in feeding process.

Data analysis

The data collected from the research were catfish growth (weight and length of fish), FCR and SGR, also histo-morphology of the intestine and skeletal muscles. The statistical method used was the ANOVA test with Tukey HSD as a post hoc test.

RESULTS AND DISCUSSION

Result

The catfish growth, FCR, and SGR

The following are data from measurements of the length and weight of catfish at the end of rearing process (harvest) (Table 1). Data related to growth as well as FCR and SGR of each treatment are shown in Table 1. Based on growth data with parameters of length and weight of catfish, it can be seen that the most optimal treatment for the growth of Sangkuriang catfish is the PS treatment, followed by treatments P, S, and K.

From Table 1, it can be seen that the lowest FCR was in the PS treatment, followed by the P, S, and K treatments. In addition, the highest SGR value was shown by the PS treatment, followed by the P, S, and K treatments. These data show that the PS treatment is the most efficient in feed use (lowest FCR) and provides the highest growth (highest SGR). Data related to the histo-morphology of the catfish intestine is also supported by Figure 1, to see the dimensions of various intestinal morphology parameters.

Histo-morphology of intestine

The following are the results of the cross-section of the catfish intestine from each treatment (Figure 1). Research on the effect of salinity and probiotics of Barokah Herb on intestinal histology showed significant results in several parameters, namely villi length, villi width, crypt depth, and tunica mucosa thickness. From these data, PS treatment or a combination of the probiotic Ramuan Barokah with salinity provided the best effect on increasing intestinal dimensions.

Histo-morphology of skeletal muscle fascicles

The following are the results of cross-sectional skeletal muscle fascicles from each treatment (Figure 2). A cross section of catfish skeletal muscle observed under a microscope to determine the histology of catfish fascicles from

Table 1. The growth of catfish and FCR-SGR in various treatments at the end of rearing process (10 weeks).

Treatment	Weight (gram)	Length (mm)	FCR	SGR
K	58.33 ± 20^a	174.73 ± 16^a	1.272	0.807
S	80.58 ± 19^b	191.83 ± 17^b	1.154	0.913
P	84.68 ± 22^b	197.20 ± 21^b	1.134	0.914
PS	88.58 ± 16^b	198.43 ± 17^b	1.001	1.021

Note: The values are mean and standard deviation (Tukey HSD, P<0.05). Differences in letter notation in one column indicate significant differences. Control group (K), salinity 4 ppt treatment (S), Ramuan Barokah probiotic treatment dose 30mL/kg feed (P), and combination treatment of salinity and herbal probiotic (PS).

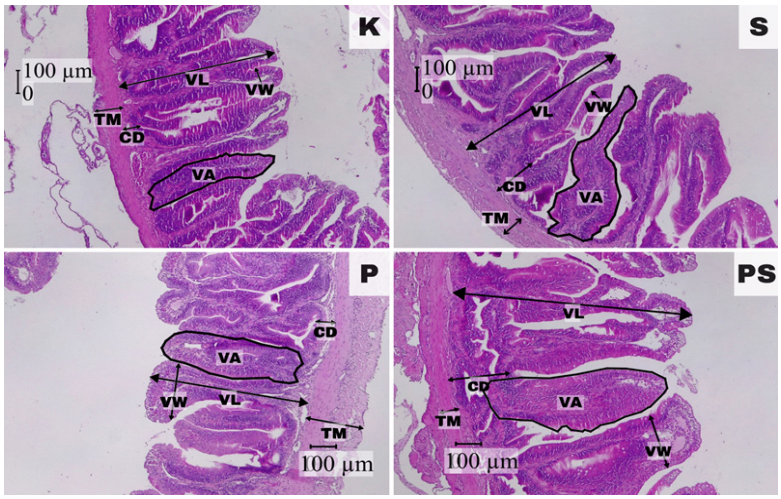

Figure 1. Area of fascicles of skeletal muscle of Sangkuriang catfish in various treatments.
Note: Control group (K), 4 ppt salinity treatment (S), Barokah Herb treatment with a dose of 30 mL/kg feed (P), a combination of salinity and probiotic treatment (PS). Crypta depth (CD), villus length (VL), villus width (VW), villus area (VA), thickness of t (TM).

Table 2. Histo-morphology of cafish intestine from the various treatments.

Treatment	Vili Length (µm)	Vili Width (µm)	Crypt Depth (µm)	T. Mucosa Thickness (µm)
K	438.66 ± 126^{a}	88.09 ± 11^{a}	65.92 ± 20^{a}	55.37 ± 16^{a}
S	528.77 ± 65^{a}	155.77 ± 32^{b}	81.66 ± 18^{a}	103.15 ± 23^{ab}
P	627.05 ± 45^{ab}	160.45 ± 10^{b}	109.57 ± 17^{ab}	189.94 ± 41^{bc}
PS	781.71 ± 30^{b}	229.95 ± 8.8^{c}	190.37 ± 65^{b}	167.77 ± 15^{c}

Note: Presented values are mean and standard deviation (Tukey HSD, P<0.05). Differences in letter notation in one column indicate significant differences. Control group (K), salinity 4 ppt treatment (S), Ramuan Barokah probiotic treatment dose 30mL/kg feed (P), and combination treatment of salinity and herbal probiotic (PS).

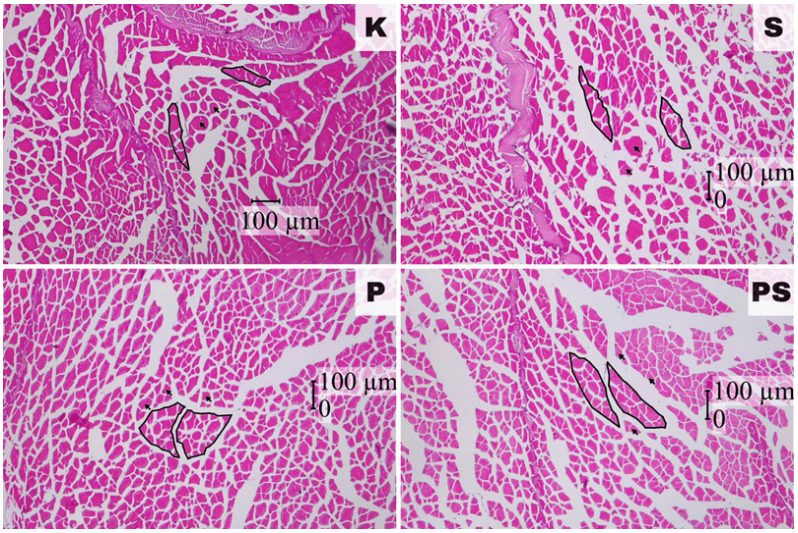

Figure 2. Histo-morphology of Sangkuriang catfish intestine in various treatments.
Note: Control group (K), 4 ppt salinity treatment (S), Barokah Herb treatment with a dose of 30 mL/kg feed (P), a combination of salinity and probiotic treatment (PS). Fascicle area (F), skeletal muscle cells (arrows), distance between cells (triangles).

various treatments is in Figure 2. Through this image, the area of the fascicles and the number of cells in each fascicle can be measured, with the measurement results shown in Table 3. From Table 3, it is known that the PS treatment showed the highest fascicle area and number of muscle cells compared to other treatments.

Discussion

Based on growth data with parameters of catfish length and weight, it can be seen that the most optimal treatment for the growth of Sangkuriang catfish is the PS treatment, followed by P, S, and K treatments. The PS treatment is able to provide the most optimal growth due to the use of probiotics Ramuan Barokah which can be a supplement that increases feed nutrition and also improves the condition of microflora in the digestive tract of Sangkuriang catfish (Yonata & Farid, 2016; Putri *et al.,* 2022). In addition, growth is also supported by the presence of 4 ppt water salinity which is an isoosmotic environmental condition with the catfish body, so that heavy osmoregulation that requires a lot of energy is not required (Sitio *et al.,* 2017; Laudin *et al.,* 2023). Figure 1 shows weekly growth, with the PS treatment being the treatment with the highest growth. FCR and SGR in Table 1 also support how PS treatment is very efficient in feed conversion and produces optimal growth.

The use of probiotics in catfish feed can increase nutrient absorption by catfish, namely by synthesizing essential nutrients by probiotic microorganisms and facilitating the digestion of complex compounds. Thus, digestion, nutrient absorption, and energy extraction from feed can be more efficient (Fitriana *et al.,* 2024). Moreover, the active compounds contained in the herbal probiotic Barokah herb, especially curcumin and essential oil can also increase enzymatic regulation in the digestive system (Kurniawan *et al.,* 2020; Santika *et al.,* 2021). Thus, the combination of Barokah herb with a dose of 30 mL/kg feed and a salinity of 4 ppt can produce more optimal growth of Sangkuriang catfish (*Clarias gariepinus* Burchell, 1822).

Furthermore, related to the histo-morphology of the catfish intestine from various treatments (Table 2), seen from the parameters of villi length, villi width, crypt depth and tunica

Table 3. Histo-morphology of skeletal muscle fascicles of catfish from various treatments.

Treatment	Fascicles Area (µm²)	Number of Muscle Cells
K	9.667 ± 1.456[a]	11.6 ± 2.4[a]
S	12.454 ± 3.486[a]	14.6 ± 2.6[a]
P	19.272 ± 6.093[ab]	18.4 ± 2.9[a]
PS	24.171 ± 8.917[b]	32.0 ± 11.9[b]

Note: Presented values are mean and standard deviation (Tukey HSD, P<0.05). Differences in letter notation in one column indicate significant differences. Control group (K), salinity 4 ppt treatment (S), Ramuan Barokah probiotic treatment dose 30mL/kg feed (P), and combination treatment of salinity and herbal probiotic (PS).

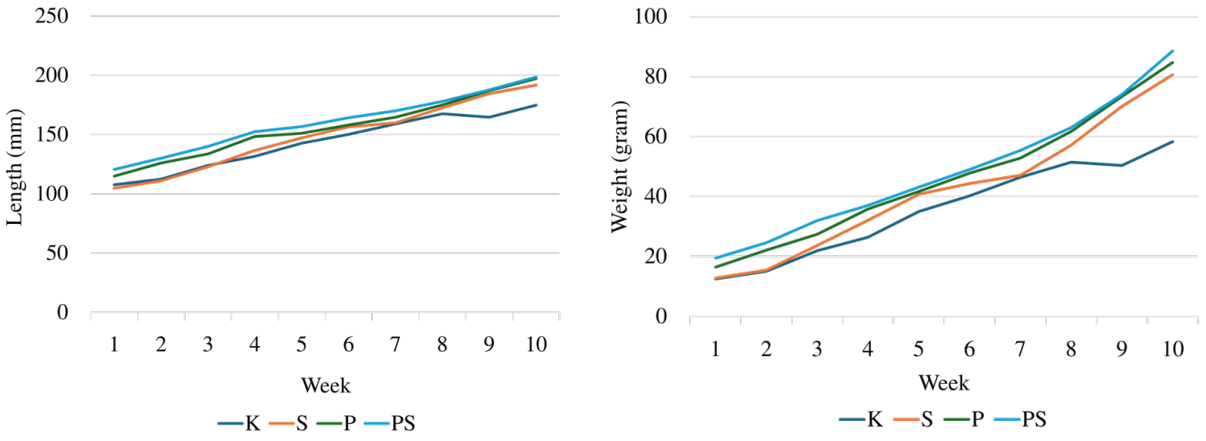

Figure 3. Weekly growth data of Sangkuriang catfish, (a) length of catfish, (b) weight of catfish. Control group (K), salinity 4 ppt treatment (S), Ramuan Barokah probiotic treatment dose 30 mL/kg feed (P), and combination treatment of salinity and herbal probiotic (PS).

mucosa thickness, the PS treatment showed the most significant results. This shows that the combination treatment of salinity and Barokah herb has a very good effect on the condition of the catfish intestines. The use of probiotics can significantly increase the histo-morphometric dimensions of the intestine including the length and width of the villi, the depth of the crypts, and the thickness of the intestinal muscles (Gaffar *et al.,* 2023; Sohel *et al.,* 2023). With a wider intestinal morphology, nutrient absorption will be more efficient and growth will be more optimal (Lisnahan *et al.,* 2019). This is compounded by the presence of a water environment with a salinity of 4 ppt which is iso-osmotic with the catfish's body, so that not much energy is expended by the catfish for osmoregulation (Sitio *et al.,* 2017).

Related to the influence of Barokah herb and salinity on catfish growth can also be seen from the skeletal muscles of catfish. Skeletal muscles such as cell size, number of cells, and fascicle area can be parameters of catfish growth (Hossain *et al.,* 2022). Skeletal muscle conditions are influenced by protein and fat levels, so they are also related to the effectiveness of nutrient absorption by the digestive system (Nwanna *et al.,* 2017). In addition, according to Fitriana *et al*. (2024), multispecies probiotics also play a role in providing essential nutrients and facilitating the digestion of complex compounds. Through Figure 2 and Table 3, it can be seen that the PS treatment group has a wider fascicle dimension.

In addition, the number of cells that make up the fascicle is also greater, so that the muscle mass is greater, and the growth data also shows the highest numbers. The Barokah herb produced by the Mina Rukun Fish Group in Gelaran, Bejiharjo, Karangmojo, Gunungkidul uses ingredients that can increase the nutritional content of feed which can directly affect the fulfillment of nutrition and growth of Sangkuriang catfish. These ingredients include palm sugar, molasses, and pure milk. The sugar contained in palm sugar and molasses can help increase bacterial growth and can also have a real effect on catfish growth (Dewi *et al.,* 2023). The sugar content can act as a source of energy for catfish. Meanwhile, milk is a natural ingredient that is rich in calcium and protein that can encourage catfish growth. Thus, the combination of Barokah herb with a dose of 30 mL/kg feed and a salinity of 4 ppt can produce more optimal growth of Sangkuriang catfish (*Clarias gariepinus* Burchell, 1822).

CONCLUSION

The use of herbal probiotics Barokah herb with a dose of 30 mL/kg feed combined with 4 ppt salinity gave a significant effect on the growth of Sangkuriang catfish (*Clarias gariepinus* Burchell, 1822) as indicated by the increase in body weight and length. This combination of treatments was also able to provide low FCR results of 1.001, with the highest SGR of 1.021. The real effect of the combination of Barokah herb and salinity treatments was also shown by the histo-morphological dimensions of the intestine which included the dimensions of the villi, the depth of the crypts, and the thickness of the tunica mucosa, as well as the dimensions of the skeletal muscle fascicles and the number of cells that make up the fascicles. The use of Barokah herb is possible to play a role in improving the condition of the digestive tract microflora, providing micronutrients, and increasing nutrient absorption. While the salinity of 4 ppt becomes an isoosmotic environment, so that the level of osmoregulation that requires energy can be suppressed.

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