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EFFECT OF ARTIFICIAL FEED ENRICHED WITH FERMENTED MACROPHYTE ON GROWTH AND SURVIVAL RATES OF CLIMBING PERCH (*ANABAS TESTUDINEUS* BLOCH)

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Abstract – The present study was aimed to analyse the effect of different macrophytes species, namely *Eichornia crassipes* Mart (Solm), *Salvinia molesta* D.S. Mitchell, *Pistia stratiotes* L. fermented with *Aspergillus sp.* added to the artificial food, on the growth and survival rates of climbing perch (*Anabas testudineus* Bloch). Completely randomized design was applied in this experiment. Independent variables were comprised of different commercial and artificial fish feeds i.e.: commercial feed (control - A), and treated artificial feed made from *Eichornia crassipes* (B), *Salvinia molesta* (C) and *Pistia stratiotes* (D). Samples B, C and D were in form of powder which was fermented with 5 mL of *Aspergillus sp.* Number of climbingperch fish subjected to the experiment was180 individuals. Statistical method ANOVA with Duncan multiple test was used. Result showed that the addition of treated artificial foodsdid not significantly affect the growth rate (GR) and feed conversion ratio (FCR) of climbing perch compared to commercial food. However, the survival rate (SR) of climbing perch fed with treated feed was significantly higher than commercial food. Therefore, the quality of treated feed can be considered similar to the quality of commercial food.

INTRODUCTION

Climbing perch (*Anabas testudineus* Bloch) is recognized as one of the popular fishes in South Central Kalimantan province. However, a recent study by Bandung *et al.,* (2015) mentioned that the population of this species was extremely decline. The main reason of decreasing stock of this species was the high demand at local market which increases the intensity of fishing of climbing perch in Borneo Island. If fishing intensity continously increases time to time, this species may become extinct. In order to meet the market demand, fish farmers have started to culture climbing perch.

Culture of climbing perch has been profitable and successfully done by many farmers. However, there is problem regarding long duration of fish culture (8 months) which requires high amount of fish feed. Most of commercial fish feeds are quite expensive due to imported fish meal used as main material. Therefore, theuse of alternative protein source for feed was recommended (Gatlin *et al.* 2007; Tacon and Metian, 2008). Floating macrophytes, which contain high protein and fibre, grow abundantly in many freshwater bodies in South Kalimantan province. There were three floating macrophytes, namely water hyacinth (*Eichornia crassipes* Mart (Solm)), giantsalvinia (*Salvinia molesta* D.S. Mitchell), dan water cabbage (*Pistia stratiotes* L) that can be used as source of fibre for artificial fish food (Bandung *et al.,* 2016).

Pellet (artificial food) with high level of soft fibreis important for fish growth. Since floating macrophytes contain hard fibre, fermentation using microbial can be implemented to make them soft. Fermentation can change complex macromolecule into simple molecule which can be easily digested and absorbed by fish stomach (Yamamoto *et al.*, 2010). In addition, fermentation of macrophyte flour produces ethanol that can be used as energy storage

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for fish (Das *et al.,* 2016) and does notproduce toxic chemical substanceswhich may be harmful for the fish (Bangun, 1988).

MATERIALS AND METHODS

Microorganism and fermentation

Aspergillus sp. was obtained from local market nearby University of Lambung Mangkurat, Banjarbaru, South Kalimantan. This microbial was bought in solid form and used without prior sterilization. Floating macrophytes, *Eichornia crassipes*, *Salvinia molesta*, *Pistia stratiotes* leaves, used as substratee,were crushed until fine. 250 g substrate was put into a 1 L Erlenmeyer before inoculated with 10 g of *Aspergillus* sp. 100 mL of water was then added and mixed thoroughly. The fermentation process was conducted for 5 days using solid state fermentation method at temperature of 30 ± 2 °C (Rajesh *et al.,* 2010).

Artificial fish food production

Raw materials used for artificial feed included fermented floating macrophytes (*Eichornia crassipes*, *Salvinia molesta*, *Pistia stratiotes*) leaves flour, fish flour, mixture of rice and bran flours, corn flour, tapioca flour, fish oil, and mineral mix. Quadrated method was used for feed formulation. Formulation of artificial fish food isshown in Table 1.

Table 1. Artificial fish food formulation

No	Ingredient	Composition (%)		
		B	C	D
1	water hyacinth flour	15.2	-	-
2	giant salvinia flour	-	15.9	-
3	water cabbageflour	-	-	16.1
4	Fish flour	38.9	36.1	35.3
5	Corn flour	15.2	15.9	16.1
6	Bran flour	15.2	15.9	16.1
7	Tapioca flour	15.2	15.9	16.1
8	Fish oil	0.1	0.1	0.1
9	Vitamin mix	0.1	0.1	0.1
10	Mineral mix	0.1	0.1	0.1
	Total	100	100	100

Artificial Feed Treatment

Formulated artificial feed was given to climbing perch (*Anabas testudineus*), reared in floating net (dimension: 1x1x1 m^3), for 70 days. Climbing perch fingerlingssize used for this experiment was ranged from 5 to 8 cm in length with the density of 30 individuals in each floating net. The experiment took place at Centre of Freshwater Aquaculture *Mandiangin BincauInstalation, KarangIntan, Banjar Regency, South Kalimantan*. During experiment, fish were reared in floating nets and fed with artificial food (pellet) at 5% of biomass weight per day. Feeding time was set astwice a day, i.e.: in the morning (08:00 – 09:00 am) and in the afternoon (04.00 – 06.00 pm). The observation of fish response toward feed treatment was conducted during sampling every two weeks by weighing the biomass of 10 fish.

Growth rate, Feed Conversion rate and Survival rate

Completely randomized designwas used during experiment with 4 levels of treatment and 3 replications. Artificial feed treatments were comprised of 4 artificial fish food compositions, i.e. commercial food (A), artificial food made fromwater hyacinth flour (B), artificial foodmade from water cabbage flour (C) and artificial food made from giant salvinia flour (D). The specific growth rates (SGR), survival rate (SR) and food conversion ratio (FCR) of climbing perch were observed. Additionally, artificial food floating ability (FFA) and water quality parameters (water temperature (WT), pH, dissolved oxygen (DO) and ammonia (NH_3)) were also measured.SGR, SR, FCR were calculated using the following equations (Akpoilih *et al*., 2015):

Specific Growth Rate, SGR (%) = $\text{Ln}\ (W_2\text{-}W_1) \times (t_2\text{-}t_1)^{-1}$,

Feed Conversion Ratio (FCR) = FIxFWG^{-1}

Survival rate (%) = $[\text{INF} - \text{FM}] \times \text{INF}^{-1} \times 100$

Where; W_2 = final weight, W_1 = initial weight, t_2 = time at the end of experiment, t_1 = time at initial ofexperiment, FI = Feed Intake (g), FWG = Fish Weight Gain, INF = Initial number of fish; FM = Fish mortality number

RESULTS AND DISCUSSION

Artificial Food Floating Ability

Feedplays important roles on fish growth. Fish growth can be optimum if the amount of feed, its quality and nutrition content are sufficient. The floating ability of fish feed used during experiment is shown in Table 2.

The sinking time of feed affects strongly on opportunity of fish to consume such food, so that it

Table 2. Floating ability of treated artificial food

Treatment	Duration of Floating (minutes)
A	02:34:38:68 – 02:54:07:30
B	00:01:52:68 – 00:02:38:67
C	00:02:03:43 – 00:02:15:54
D	00:01:03:63 – 00:01:58:12

can minimize amount of uneaten food. Of four treated feeds, the artificial feed made from water cabbage flour (C) had the shortest floating time, i.e. less than 2 minutes. Three other feeds (A, B, and D) have floating time ranged from 2 to 3 minutes.

Specific Growth Rate of Climbing Perch

The mean of individual specific growth rate of climbing perch reared for 70 weeks ranged from 4.02% - 4.67% day^{-1}. It was found that the highest SGR of climbing perch was the ones fed with artificial food made from water cabbage flour (C) fermented with 0.02 mg/l of *Aspergillus*sp. Profile of SGR of climbing perch is shown in Fig. 1.

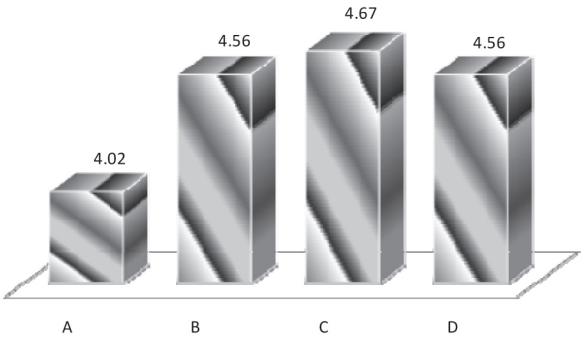

Fig. 1. Specific growth rate of climbing perch (% day^{-1})

As shown in Fig. 1, the highest specific growth rate of climbing perch was shown by fish treated with C (4,67% day^{-1}), followed by Band then D, (4,56% day^{-1}). The lowest SGR was observed on fish treated with A, i.e. commercial artificial food. According to FAO (2006) specific growth rate of climbing perchfed or treated with fermented artificial food was slightly higher than the ones reared in natural condition (usually grow 2 – 4% body weight per day). The addition of5 ml *Aspergillus* sp. during fermentation offloating watermoss or *Kiambang* (*Salvinianatans*) flour has resulted in higherspecific growth rate of climbing perch compared to water hyacinth and giant salvinia fermented flour.It may be related to the fact that floatingwatermoss fermented flour contained higher protein than water hyacinth or giant salvinia flour (Bandung *et al.*, 2016). Further, the addition of bacterial to fish food raw material can increase the absorption of protein by fish (Yamamoto *et al.*, 2010).

Liliefors normality test on specific growth rate of climbing perch showed that data was distributed normally with L_{maks} (0.194) <L_{table} 5% (0.242) dan L_{tablel} 1% (0,275). Bartlett homogenity test results also showed that data were homogenous (X^2_{count}(0,044) <X^2_{tabel} 5% (7,815) and X^2_{tabel} 1% (11,345)). Analysis of variance (ANOVA) on specific growth rate of climbing perch was found significantly different among level of factor as F (115,51^s) >dariF_{table} 1% (7,59) danF_{table} 5% (4,07). It was suggested that of the addition offermented macrophytes (water hyacinth, giant salvinia and water cabbage) flour affected specific growth rate of climbing perch significantly.

The fluctuation of fish growth rate was generally affected by the amount of provided artificial food, it's the fish ability in responding and utilize food (Bunasir *et al.* 2002), and the availability of space and water temperature (Asmawi, 1986)). Only 10% of provided artificial food wasutilized for growth or weight gain over time. The remaining was used as energy or lost in aquatic environment (Pillay and Kutty, 2005).

Survival Rate

During 70 days of treatment, the survival rate of climbing fish was vary ranging from 91.33 - 100%, as shown in Fig. 2.

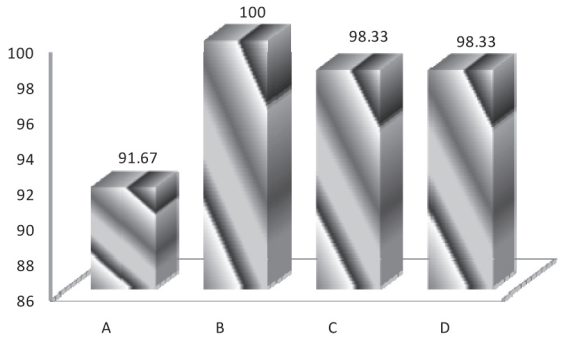

Fig. 2. Climbing fish survival rate (%)

The highest climbing fish survival rate was observed on fish treated with artificial fish food B (100%), followed by C (98,33%), D (98,33%) and A (91,67%), respectively.Liliefors normality test showed that the survival rate data was normally distributed (L_{maks} (0,170656) <L_{table} 1% (0,275)). Similarly, Bartlett homogenity test showed that data were homogenous, as X^2_{count}(0,014) < X^2_{table} 1% (11,345)and X^2_{table} 5% (7,815). Thesurvival rate of

climbing perch was found significantly different among level of factor with F (6,56) >F_{table} 5% (4,07).

Tukey's HSD test on survival rate of climbing perch showed that commercial fish food A was significantly different to B, C and D. On the other hand, there was no significant difference among the treated artificial fish food of B, C and D. . It was suggested that treatment B, C and D were better than A.Djarijah (2002) suggested that the survival rate of fish was affected strongly by age, water quality, food, parasite or pathogen and disease.

Fish fed with artificial fish food made frommacrophytes flour (B, C and D) showed high survival rate, i.e. ranging from 98,67 - 100%. It showed that the use of *Aspergillus*sp.to ferment thewater hyacinth, water cabbage and giant salvinia flour gave positive respond SR of climbing perch.Lower survival rate (50 – 60%)of climbing perch was observed byArdian (2012) where*Bacillus megaterium* was used during the fermentation of water hyacinth flour.

Food Conversion Ratio

The food conversion ratio (FCR) of climbing perch during 70 days of treatment was considerably varied. FCR value is commonly used to know whether the treated food is beneficial for fish growth. The total of food provided and FCR of climbing perch is shown in Fig. 3.

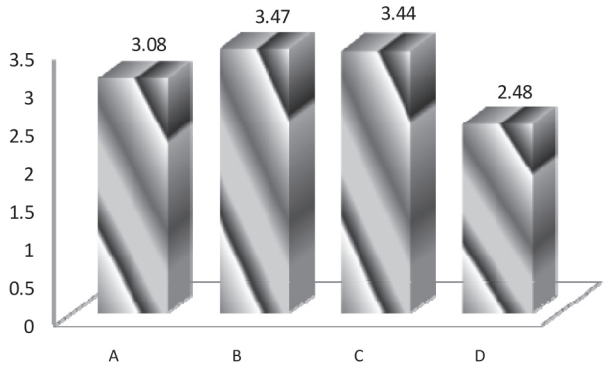

Fig. 3. Climbing perch food conversion ratio (FCR)

Fig. 3 reveals the lowest FCR value was treatment D, followed by treatment A, C and B, respectively. The lower the FCR, higher efficiency of artificial food given was expected. Liliefors normality test on FCR of climbing perch data of showed that data was normally distributed with L_{maks} (0,235) <L_{table} 5% (0,242) also L_{table} 1% (0,275). Similarly, Bartletthomogenity test showed that the variances were homogenous with X^2 (0,259) < X^2_{table} 1% (11,345) and X^2_{table} 5% (7,815). However, ANOVA test showed that FCR of climbing perchwas notsignificantly different among level of factors with F(0,63) <F_{table} 1% (7,59) and F_{table} 5% (4,07).It was suggested that FCR of climbing perch fed with artificial food made from fermentedmacrophytes (water hyacinth, giant salvinia and water cabbage) flour, did not significantly different to FCR of fish fed with commercial artificial food.

CONCLUSION

Feeding climbing perch with artificial feed made fromfermentedmacrophytes (water hyacinth, giant salvinia and water cabbage) flour resulted insimilar growth rate and food conversion ratio to that the ones treated with commercial artificial food. In contrary, the survival rate of climbing perch fed with artificial food was better than the ones fed with commercial artificial food.

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