Application of fermented aquatic weeds in formulated diet of climbing perch (*Anabas testudineus*)

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Abstract— *Feed is the element that really support the activities of aquaculture, there for the feed that is available must be adequate and meet the needs of the fish. The purpose of this research was to evaluate effect aquatic weed flour addition that have been fermented in artificial feed to growth performance and feed efficiency of climbing perch. The experimental method with Completely Randomized Design were used in this study. Nine treatments with three replication were tested, namely, Feed A (A. niger-Savinia molesta), Feed B (A. niger-Pistia stratiotes), Feed C (A. niger-Lemna minor), Feed D (R. oryzae-Salvinia molesta), Feed E (R.oryzae-Pistia stratiotes), Feed F (R.oryzae-Lemna minor), Feed G (S.cerrevisiae-Salvinia molesta), Feed H (S.cerrevisiae-Pistia stratiotes), and Feed I (S.cerrevisiae-Lemna minor). The experimental fish was reared in bucket plastic (vol 20 L) at stocking density of 10 fish in each bucket. The fish fed at ration of 5% body weight per day. The results showed that the highest absolute growth and specific growth rate were found at treatment Feed F (17.38 g and 221.97%, respectively). The higher feed convertion ratio (FCR) and feed efficiency were found at treatment Feed I. Based on the absolute growth, specific growth, feed convertion ratio, and feed efficiency, climbing perch fry required R. Oryzae-Lemna minor in feed formulation. It was concluded that R oryzae-Lemna minor as feed for climbing perch.*

Keywords— Fermented feed, climbing perch, Anabas testudineus, aquatic weed, A. niger, R. oryzae, and S. cerrevisiae

I. INTRODUCTION

Climbing perch, *Anabas testudineus* or locally known as is betok, is a freshwater fish species that possess a labyrinth organ, which allows th fish to breathe at mospheric oxygen (Hughes & Singh 1970a; 1970b). This species is commonly found in swamps, marsh lands, lakes, canals, ponds, rice field, pools, small pits, and estuaries (Rahman & Marimuthu 2010; Akbar *et al*, 2011). This fish is widely distributed include India, the Indochina Peninsula, Southern China, Taiwan, the Philippines and Indonesia (Morioka *et al*, 2009).

Climbing perch is one of freshwater fish that have the potential to be cultured (Muchlisin 2013) and it has a reasonable price in local and international markets. This species has been initially cultured by local people in South Kalimantan, Indonesia. The cultured fish fed commercial diet causes high production costs due to high feed price in the local market (Akbar *et al*, 2011), this is because most of the materials of the feed is fishmeal that costly. Therefore, many efforts are continuously being made to find other alternative protein sources which are cheap, available and good nutritional value as substitutes for fish meal. The alternative raw materials that can be evaluated were aquatic weeds.

In South Kalimantan Province, Indonesia, with tropical climate, aquatic weed are plentiful, diversified, and available. The are widely researched and used as food for livestock husbandry, but limited for aquaculture (Chowdhury *et al*, 2008; Tavares *et al*, 2010; Talukdar *et al*, 2012; Mishra 2013). Therefore, study on potential utilization of aquatic weed in fish culture is necessary, which will be very useful for extension work to help fish farmers make the most of availably cheap ingredients and increase their income through fish culture. Among variety of aquatic weeds, *Salvinia molesta*, *Pistia stratiotes*, and *Lemna minor*, which are abundant in ponds, gardens, etc, and have good nutritional value were chosen for this study. For example, *Salvinia molesta* has been 15,9% protein and 16,8% fiber (Warasto *et al*, 2013). *Lemna minor* contain up to 18-43% protein by dry weight and can be used without further processing as a complete feed for fish. Compared with most other plants, *Lemna minor* contain little fiber (Chowdhury *et al*, 2008; Tavares *et al*, 2010). *Lemna minor* as a natural biofilter in aquaculture system (Mutaz & Tharwat 2012). Aquatic weed potentially used as a fish feed, but the utilization of aquatic weed as a feed constrained in the high fiber. However, the nutrition compositions of the aquatic weed can be increased by fermentation process with using fungi *Rhyzopus oryzae* (Achi 2005), yeast *Saccharomyces cerevisiae* (Achi 2005; Salnur *et al*, 2009; Ozorio *et al*, 2012), and *Aspergillus niger* (Palinggi *et al*, 2008). Nurfadillah *et al* (2011) flour *Azzola pinata* fermented in two days of using *Trichoderma harzianum* lowering crude fiber 37.19% and increasing crude protein 38.65%. Sitohang *et al* (2012) fermentation ricemeal with *Saccharomyces cerevisiae* for two days can be lowered crude fiber 17,43%.

Therefore, it was crucial to explore the alternative materials for climbing perch diet to overcome this problem, and the alternative raw materials that can be evaluated were aquatic weeds (*Salvinia molesta, Pistia stratiotes*, and *Lemna minor*).

II. MATERIALS AND METHODS

The method experimental method with Completely Randomized Design was used this study. There was nine treatments and every treatment has three replications. The experimental feed was consisted of nine different composition of raw materials which labelled as A, B, C, D, E, F, G, H, and I. The Feed A was used *A. niger* to ferment *Salvinia molesta* (*A. niger- Salvinia molesta*); Feed B (*A. niger-Pistia stratiotes*); Feed C (*A. niger-Lemna minor*); Feed D (*R. oryzae-Salvinia molesta*), Feed E (*R. oryzae-Pistia stratiotes*); Feed F (*R. oryzae-Lemna minor*); Feed G (*S. cerevisiae-Salvinia molesta*); Feed H (*S. cerevisiae-Pistia stratiotes*); and Feed I (*S. cerevisiae-Lemna minor*). The fermentation was conducted for three days at room temperature using the inoculums 10% w/v at optimum age. The fermentation product was mixed with otheringredients (Table 1). The Ingredients were mixed in a mixer with the resulting dough being extruded through a pelleting machine to produce 1-1.5 mm diameter pellets (Muchlisin *et al*, 2006).

TABLE 1
THE COMPOSITION OF EXPERIMENTAL DIET OF CLIMBING PERCH, *A. TESTUDENEUS*

No	Ingredient	Composition (%)		
		A	B	C
1	*Lemna minor*	20		
2	*Salvinia molesta*		20	
3	*Pistia stratiotes*			20
4	Kacang negara meal	18	18	18
5	Fish meal	30	30	30
6	Palm cake	8.5	8.5	8.5
7	Vitamin mix	1.5	1,5	1.5
8	Mineral mix [1]	2	2	2
9	Wheat flour	19.5	19.5	19.5
10	CMC	0.5	0.5	0.5
	Total	100	100	100

Remarks:
Mineral mix non P of contain (g kg^{-1} dry feed): NaCl 0.5; $MgSO_4.7H_2O$ 7.5; KCl 17.53; Fecitrat 1.25; $CaCl_2.2H_2O$ 13.34; filler 30.5 and trace element mix (0.5g) provided: $ZnSO_4.7H_2O$ 17.365; $MnSO_4$ 8.1; $CuSO_4.5H_2O$ 1.55; KIO_3 0.15; and filler 30.5 g kg^{-1}.

The climbing perch fry (6-8 g) were reared in plastic bucket (vol. 20 L) at stocking density of 10 fishes in each bucket. The fish fed at ration of 5% body weight per twice daily (8:00-9:00 and 17:00-18:00) for 56 days. The sampling was done two weeks interval to record weight and lengt gain Data were subjected to one way analysis of variance (ANOVA), followed by Duncan's multiple range test.

III. RESULT AND DISCUSSIONS

3.1 Survival, growth, feed convertion ratio, and feed efficiency

TABLE 2
THE SURVIVAL RATE (SR), ABSOLUTE GROWTH (AG), SPECIFIC GROWTH RATE (SGR), FEED CONVERTION RATIO (FCR), AND FEED EFFICIENCY (FE) OF CLIMBING PERCH AFTER 56 DAYS OF CULTURE.

Treatment	SR (%)	AG (g)	SGR (%)	FCR	FE (%)
A	100	8.41 a	113.96 a	2.79 a	35.84 a
B	100	10.35 a	134.07 a	2.85 a	35.14 a
C	100	09.07 a	138.68 a	2.80 a	35.74 a
D	100	08.68 a	110.71 a	3.45 a	29.00 a
E	100	14.64 a	183.69 a	2.22 a	45.04 a
F	100	17.38 a	221.97 a	2.10 a	47.53 a
G	100	14.41 a	182.64 a	2.40 a	41.72 a
H	100	15.98 a	183.26 a	2.01 a	49.63 a
I	100	17.04 a	218.74 a	1.81 b	55.11 a

Different superscript in the same column indicate significant amongst treatments ($p<0.05$)

3.2 Water quality parameter

The water quality parameter such as water temperature, dissolved oxygen (DO), pH, and ammonia (NH_3) were monitored initial and final the experimental period. The ranges were: temperature 26-28.4^{0}C, DO 3.0-3.9 mg L^{-1}, CO_2 1.54-2.1 mg L^{-1}, pH 6.8-7.8, and NH_3 0.02-1.98 mg L^{-1}.

IV. DISCUSSION

The results showed that the absolute growth was ranged between 8.41 g to 17.38 g, specific growth rate was ranged between 110.71% to 221.97%, feed conversion ratio 1.81-3.45 and feed efficiency 29.74-55.11%. The Anova test revealed that differences in the composition of aquatic weed in the diet was not significantly affect growth performance, feed conversion, feed efficiency and survival rate (P>0.05). However the best growth performance was found at treatment F (*R. oryzae-Lemna minor*) with the absolute growth of 17.38 g, specific growth rate of 221.97%, these values were not different significantly with other treatments (Table 2). However, the best feed conversion and feed efficiency were found at treatment I (*S. cerevisiae-Lemna minor*) where the feed conversion at experiment I was different significantly with other treatments, but the feed efficiantly was not different among the treatment (Table 2). After 56 days of cultured period, the survival rate of climbing perch were 100%.

Feed consumption, growth, and feed efficiency of fish are normally governed by a few environmental factors. Environmental parameters exert an immense influence on the maintenance of a healthy aquatic environment and production of food organism. In the present study the water quality parameters were found to be within the acceptable level for fish culture. Recommendation for water quality usually specifies dissolved oxygen (DO) greater than 3 mg L^{-1} (Hossain *et al*, 2012). In the present study, the range of DO was 3.0-3.9 mg L^{-1}. Ammonia concentration is also an important growth affecting factor. Ammonia fluctuated within the range of 0,02-1.98 mg L^{-1}. The pH is more suitable for fish culture. According to Swingle (1967) and Boyd (2000) pH ranging from 6.5-9.0 is suitable for pond fish culture. The pH values obtained in the present study (6.8-7.8) fell within this suitable range. The range of temperature, DO, pH, and NH_3 in the experimental were within the acceptable range for survival and growth of climbing perch.

This results is similar to the report of several authors who have demonstrated the use of *Lemna minor* as a partial replacement for fishmeal in the diet and other animals. Fasakin *et al* (2001) reported the use of duckweed *Spirodella polyrrhiza* in the diet of the Nile Tilapia (*Oreochromis niloticus*). They stated that fish fed duckweed based diet had higher growth rates than fish fed diet containing water fernmeals.

The authors indicated the possibility of partial replacement of fishmeal with duckweed in the diet of Nile Tilapia. Shireman *et al* (1978) reported that *grass carp* performance on a duckweed diet was superior to fish maintained on *catfish chow*. Robinette *et al* (1980) fed *channel catfish* on prepared diet consisting of 20% dry duckweed; the weight gain, food conversion and energy use were equal to central diets (a standard catfish feed).

The production was significantly higher in ponds with supply of duckweed than that of the ponds without supply of duckweed in monoculture of tilapia (Chowdhury *et al*, 2008) and polyculture system (Kabir *et al*, 2009; Talukdar *et al*, 2012). Influence of duckweed on production of fish is positively significant indicated that duckweed might be used as preferable feed items for fishes in mono-polyculture.

Yilmaz *et al* (2004) reported no significant difference between the growth performance of fish that were fed diets containing up to 20% duckweed and fish that were fed the control diet, while carcass lipid and carcass protein also increased except for the diet with 15% duckweed meal in the common carp, *Cyprinus carpio*, fry. These authors concluded that a diet containing up to 20% duckweed could be used as a complete replacement of fishmeal for commercial feed in the formulation for common carp fry.

V. CONCLUSION

The research shows that the utilizing of the fermented feed on the climbing perch had the positive effect. Base on results of this experiment, it concluded that using fermented feed (*R. oryzae-Lemna minor*) and fermented feed (*S. cerevisiae-Lemna minor*), which can be recommended for the culture of climbing perch.

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