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Rearing Of River Catfish Seed (*Mystus nemurus* C.V) in Aquaponic Resirculation System with the Addition of EM_4

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ABSTRACT

This research was conducted from March to April 2013, for 45 days in Breeding Laboratory Unit of Fisheries Faculty and Marine Sciences, University of Riau. The aim of the Research was to investigate the effect of EM_4 inoculant and the use mustard plant as biofilter, on growth and survival rate of river catfish seed (*Mystus nemurus*). The Method used was experiment with 4 treatments and 3 replications. The treatments were A = Water without the inoculant EM_4 (as control), B = 250 ml inoculant EM_4, C = 300 ml inoculant EM_4, D = 350 ml inoculant EM_4. The best result was treatment C (300 mL inoculant EM_4) with absolute growth weights (11,83 g), absolute growth length (6.01 cm), daily growth rates (2.77) and survival rates 93,06 %. Water quality recorded during in the research period with ammonia (NH_3) 0,02-0,09 mg/L, nitrite (NO_2) 0,73-4,10 mg/L, nitrate (NO_3) 0,63-2,73 mg/L, temperature 30-31^0 C, pH 6-7, dissolved oxygen (DO) 3-4,5 mg/L.

Keywords: *river catfish seed* (*Mystus nemurus* C.V*), aquaponic, resirculation,* EM_4 *inoculant*

INTRODUCTION

Aquaculture as fish culture activities in controlling media has objectives to increase fish production, so that it can increase fishermen income. Aquaculture commodities have important role to design as well as to obtain fish production agree with the goal of aquaculture activities. Catfish (*Mystus nemurus* C.V) is one kind of familiar freshwater fish for fishermen communities and they have high economic values, and the fish can be selled in fresh and processing form.

Main problems facing by fishermen are to obtain seed of fish in good quality and sufficient quantity. High demand of channel catfish juveniles in market could give opportunities for the fishermen to increase productivity of fish larvae for rearing in ponds. Growing out of channel catfish still have various obstacles, so that information of aquaculture technology is needed.

Innovation technology could decrease waste disposal and increase productivity of ponds. One of innovation technology that could be implemented is integration of fish farming system with vegetables through aquaponic system. Aquaponic as bio-integration related with resirculating aquaculture technique and vegetables or hydroponic (Diver, 2006). Aquaponic technology could produce fish optimally at limited land and water in city areas. Principically, the technology not only used limited water and limited land but also it could more efficient through utilizing of nutrient from methabolic waste disposal and it is one of fish aquaculture technique as environmental friendly.

Resirculation system with various filter materials has been implemented by former researchers. Based on the above explanation, this paper would present the result of fish growing in the resirculation system by adding EM_4 with various dosages.

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Objectives of the research were to investigate the effect of EM_4 Inoculant as well as the utilization of vegetables as biofilter toward the growth and survival rates of river catfish seed (*Mystus nemurus* C.V) and production of fish.

MATERIALS AND METHODS

The research was conducted as long as three months from March 13 until April 27, 2013 in the Laboratory of Fish Breeding, Fisheries and Marine Sciences Faculty, Riau University. Materials used in this reasearch were as follows: river catfish seed *(Mystus nemurus)* with size of 7.5 - 9 cm in length as many as 288 fish seed and mustard greens vegetables. The inoculant used was EM_4 dormant in one box produced by PT. Songgolangit Jakarta. Material used for activating EM_4 was Indomilk fresh milk and well water, while tools used was fiber box dimension (50 x 50x 50) cm^3 which filled by 80 litres of water equipped by water pump 13 watt power to fill the box with water. Filter box used was a gutter with dimension (200 x 13.5 x 10) cm^3 and volume 40 litres. The fish meal which given during rearing catfish or research period was fish pellet produced by FF-999 factory (with composition of 38% proteins, 4% fat, 6% fiber, and 12% water content).

Research Design. Design of the research planning was experimental model using Complete Random Design with treatments as follows:

The treatments implemented in this research were EM_4 inoculant concentration as follows:

A = water without EM_4 inoculant (control)
B = 250 ml of EM_4 inoculant
C = 300 ml of EM_4 inoculant
D = 350 ml of EM_4 inoculant

Data Collection. Water quality parameters that were recorded as long as research period were: pH, DO, CO_2, NH_3, NO_2, NO_3. Measuring was conducted as many as four times a long research period.

Absolute Growth Weight of Fish. Absolute growth weight could be measured using formula of Effendie (1986) as follows :

Wm = Wt – Wo

where :

Wm = absolute growth rates (grams)
Wt = average of fish growth weight at the end of the research period (g)
Wo = average of fish weight at the beginning of the research (g)

Absolute Growth Length of Fish. Average growth length could be measured using formula of Effendie (1986) as follows :

Lm = Lt – Lo

where :

Lm = absolute growth length (grams)
Lt = average of fish growth length at the end of the research period (m)
Lo = average of fish length at the beginning of the research period (m)

Daily Growth Rates. According to Metaxa *et al* (2006) daily growth rates could be measured using formula as follows:

$$\alpha = \left(t\sqrt{\frac{Wt}{Wo}} - 1 \right) \text{ x } 100\%$$

where :

α = daily growth rates (%)

$\overline{Wt}$ = average of fish weight at the end of the research (g)

$\overline{Wo}$ = fish weight at early research (g)

t = length of research period (day)

Survival Rates (%). According to (Effendie, 1989), survival rates could be calculated using the formula as follows:

$$SR = \frac{Nt}{No} x\ 100\%$$

where :

SR = survival rates of fish (%)

Nt = total of life fish at the end of the research period (fish)

No = total of life fish at the beginning research period (fish)

Data Analysis. All data were analized using variance analysis such as absolute growth weight, absolute growth length, daily growth rates and survival rates,. If data analysis were different, the data would be analized again using Newman Keuls Test. Water quality parameters were analized descriptively in form of graphs and figures.

RESULT AND DISCUSSION

Water quality parameters recorded as long as research period such as ammonia, nitrites, nitrates, temperature, pH, dissolve oxygen and carbondioxydes. Those environmental parameter data are presented on the Table 1 as follows.

Table 1. The average of water quality parameters recorded as long as research period.

Parameters	EM_4 Inoculant				
	Unitan	A (0 mL)	B (250 mL)	C (300 mL)	D (350 mL)
NH_3	mg/L	0.02-0.11	0.02-0.11	0.02-0.09	0.02-0.10
NO_2	mg/L	0.73-3.17	0.73-0.48	0.73-4.10	0.73-0.96
NO_3	mg/L	0.63-5.63	0.63-4.82	0.63-2.73	0.63-4.12
Temperature	^0C	30-31	30-31	30-31	30-31
pH	-	5-6	6-7	6-7	7
DO	mg/L	3-3.5	3-3.5	3-4.5	3-4,5
CO_2	mg/L	6.39-10.20	6.39-10.20	6.39-10.68	6.39- 10.78

From the above Table, it can be concluded that all water quality parameters (temperature, pH, dissolved oxygen (DO), carbon dioxide (CO_2), ammonia (NH_3), nitrite (NO_2^-) and nitrate (NO_3)) as long as research period of each treatment is optimal for fish growth. pH values were achieved as long as research period of 5 – 7. It could be concluded that the water pH could support catfish growth and survival. According to Daelami (2001), low pH and high pH could affect negatively fish life. Generally, fish could grow well in the waters with neutral water pH. Ideally, the good pH range can support fish growth in aquaculture environment around 5-9 (Syafriadiman *et al.* 2005). EM_4 containing photosynthetic bacteria (*Rhodopseudomonas* sp.) with sun light as energy resources it create amino acid, nucleid acid and those have function to grow *V.A. mycorhiza* and it will bind nitrogen in water columb. According to Syafriadiman *et. al.*, (2005) nitrogen in water columb will react with water to produce ammonium and OH^-, where OH^- ion will increase pH values in waters.

As long as research period, water temperatures at all treatmements were recorded around 30-31 ^{0}C and it is appropriate to support fish growth. According to Boyd (1990) suitable difference water temperature for living organisms is not more than 10 ^{0}C and range temperature for tropic organisms is around 25-32 ^{0}C.

Dissolved oxygen (DO) were recorded at all treatments around 3 – 4.5 mg/L. All dissolved oxygen at all treatments were still appropriate to support the growth of catfish juveniles. Eventhough, According to Syafriadiman *et al* (2005) ideal dissolved oxygen concentration in water to support fish development should be more than 5 mg/L. In the research, dissolved oxygen was increasing slightly along research period because function of resirculation system. Lesmana (2001) stated that resirculation system has a function to maintain biological parameters, water temperature and oxygen distribution as well as toxic methabolic prevention. High oxygen concentration in water that is caused by *Lactobacillus* bacteria and *Bacydiomycetes* fungi may speed up the decomposition of feces and fish meal residue and create alcohol, ester and glucose. Furthermore the presence of sun light and CO_2 concentration in the water may be used for photosyntesis of the *Rhodopseudomonas* bacteria, and as a result the concentration in the media that contain the EM_4 inoculant increase (Hasibuan *et al*, 2004).

CO_2 content at all treatments was in appropriate concentration for fish development. Kasry (2002) stated that the CO_2 concentration in the water was produced by the decomposition process of organic materials, but it is used for photosyntesis process of the *Rhodopseudomonas* bacteria. So, the oxygen concentration in the media that contain EM_4 inoculant may increase and it may support the growth of fish.

Ammonia concentration at the end of the research period was achieved at treatment A (0.06 mg/L), B (0.04 mg/L), C (0.03 mg/L) dan pada D (0.05 mg/L). Ammonia in water columb produce from feses and decomposition of un-eaten food by microba. The highest ammonia concentration at all treatments was achieved at the day -15 of research period (Figure 1).

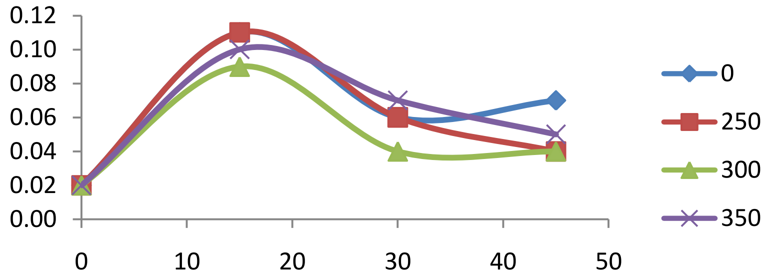

Figure 1. Ammonia (NH3) fluctuation as long as research period

Increasing the ammonia concentration during the 1st to the 15th day of the research was caused by a technicalproblem, as the filter was not functioning effectively. After that period, the ammonia concentration decrease, especially in the treatment C, as the mustard green roots is able to absorb the ammonia and it is better than other filter materials. According to Putra and Pamukas (2011) mustard greens is able to decrease NH_3 concentration, because the nitrogen concentration in water could be used for growth process, especially the nitrite and ammonium. Ammonia concentration in all treatments was in the safe range for the life of organism. Boyd (1990) said that ammonia concentration was safe for aquatic organism is less than 1 mg/L. Results of Variance Analysis (ANAVA) P (0.022) < 0.05, it indivates that the aquaponic recirculation system that is combined with the used of EM_4 inoculants was more effective in maintaining the ammonia concentration in the catfish culture media compared with other treatments.

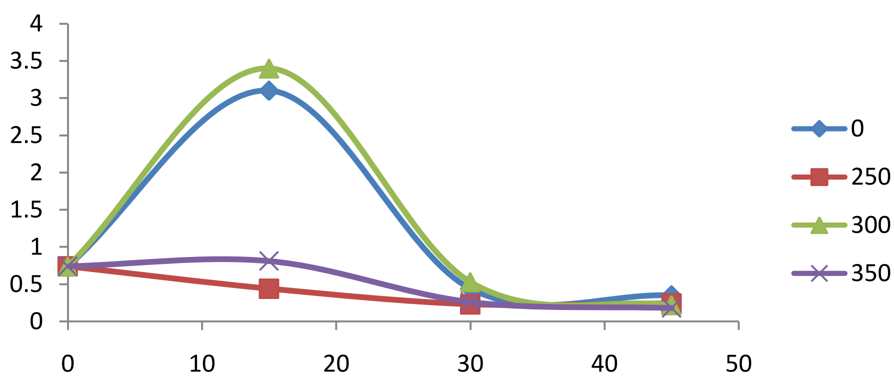

Figure 2. Nitrite (NO_2^-) fluctuation as long as research period

Nitrite concentrations (NO_2) were increasing at day 15, where the highest nitrite concentration was A (3.09 mg/L) and then C (3.40 mg/L). Furthermore, nitrite concentration decreasing at day 45, where nitrite concentrations at the end of research period were different. Results of Variance Analysis (ANAVA) P (0.000) < 0.05 showed that different doses of inoculants EM_4 were significantly affecting nitrite concentration in the catfish culture media.

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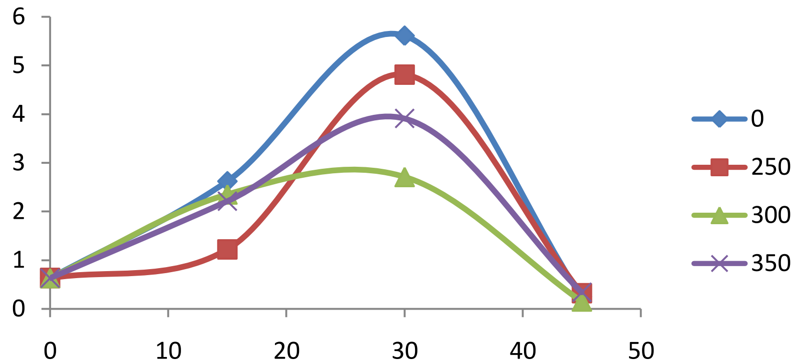

Figure 2. Nitrate (NO_3^-) fluctuation as long as research period

Nitrate (NO_3^-) concentration in all treatments was increasing up to the day 30 and decreasing up to the day 45. The highest nitrate concentration by the 30th day was the treatment A (5.63 mg/L), B (4.82 mg/L), C (2.73 mg/L) and D (3.80 mg/L) respectively. Nitrate as nitrogen form has function as main nutrient for algae growth. Nitrate is originally from ammonium (NH_4) that entering the culture media through domestic wastes. In the outlet its concentration is decreasing due to microorganism activities such as Nitrozomonas. The microbacteria oxidized ammonium and it is become nitrate. Oxidation processing is reduce the oxygen concentration, especially during the rainy season. Results of Variance Analysis (ANAVA) P (0.000) < 0.05 showed that different dosages of EM_4 inoculants were significantly affecting the nitrite concentration in the catfish culture media.

Absolute Growth Weight of Catfish Juveniles. Absolute growth weight of catfish during the research period could be seen in Table 2. In each treatment, the average of absolute growth weight of fish during the research period was increasing. The highest weight was achieved in the treatment C (11.83 grams) and followed by treatment D (8.72 grams), B (8.49 grams) and A (7.45 grams) respectively. It could be concluded that in the treatment C, the fish could use the fish meal better than the others as appetite of the fish in the treatment was higher than that of other treatments.

Table 2. Absolute growth weight of catfish *(Mystus Nemurus C.V)* as long as research period

Repetition	EM_4 Inoculant (ml/L)			
	A (0)	B (250)	C (300)	D (350)
1	7.76	6.60	11.90	7.98
2	7.82	10.12	12.96	11.22
3	6.76	8.64	11.62	6.96
Average (Std.dev)	7.45 ±0.59	8.49 ±1.81	11.83 ±0.18	8.72±2.22

Fish growth means fish body alteration in weight and length along with difference times. In order to reach better growth, the fish should obtain fish meal in good nutrious content as long as culture period. Fish growth affected by internal and external factors such as genetic, sex, age, water quality, food as well stocking density (Effendi, 2003).

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Results of Variance Analysis (ANAVA) P (0.117) > 0.05 showed that different doses of inoculants EM_4 were not affecting significantly absolute growth rates of catfish juveniles.

Absolute Growth Length of Catfish Juveniles. Absolute growth length of catfish as long as research period could be seen on Table 3.

Average absolute growth length of fish as long as research period was increasing of each treatment. The highest catfish growth length was achieved at treatment C (6.01 cm) and then follow by treatment D (4.66 cm), B (4.63 cm) and A (4.33 cm) respectively. It could be concluded that at treatment C, with aquaponic resirculation system the fish could utilize fish meal better than the other treatments. Besides the fish appetite in the treatment was higher than the other fish treatments.

But, the results of Variance Analysis (ANAVA) P (0.574) > 0.05 showed that different doses of inoculants EM_4 were not affecting significantly the absolute growth length of catfish juveniles.

Table 3. Absolute growth length (cm) of catfish *(Mystus Nemurus C.V)* as long as research period

Repetition	EM_4 Inoculant (mL/L)			
	A (0)	B (250)	C (300)	D (350)
1	4.00	3.96	5.88	4.60
2	5.10	5.36	6.74	5.00
3	3.90	4.56	5.40	4.38
Average (Std. dev)	4.33±0.66	4.63±0.6	6.01±0.67	4.66±0.31

Daily Growth Rates of Catfish Juveniles. Daily growth rates of catfish juveniles were different at each treatment as shown on Table 4. The average of daily growth rates of catfish (*Mystus nemurus C.V*) was achieved by each treatment as follows: C (2.77 %), B (2.38 %), D (2.36 %) and A (2.13 %) respectively. Fish growth is affected by internal and external factors. Internal factors involving heredity, age, sex and others, while external factors such as fish meal, and environmental parameters. Result of variance analysis (ANAVA) P (0.11) > 0.05 showed that aquaponic resirculation system combining with inoculants EM_4 were not significantly affecting daily growth rates of catfish fingerling compare with other treatments.

Table 4. Daily growth rates of catfish (*Mystus nemurus C.V*) as long research period.

Repetition	Treatment (%)			
	A (0)	B (250)	C (300)	D (350)
1	2.20	2.36	2.34	2.27
2	2.21	1.98	2.84	2.74
3	1.98	2.63	2.81	2.02
Average (Std.dev)	2.13 ±0.13	2.38 ±0.32	2.77 ±0.03	2.36 ±0.36

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Survival Rates of Catfish (*Mystus nemurus* C.V). The research was conducted as long as 45 days using resirculation water system added with EM_4 inoculant. The best survival rates was achieved by treatment C (93.06 %), D (90,28 %), B (87.50 %) respectively and the lowest was reached by treatment A (84.72 %). Catfish mortality as long as research period caused by canibalism characteristic of the fish. Survival rates are comparison between life fish at the research period with total fish number at the formerly research period. In aquaculture activities, fish mortality as an indicator of successful fish culture (Tang. 2000). Result of variance analysis (ANAVA) P (0.041) < 0.05 showed that aquaponic resirculation system combining with inoculants EM_4 were affecting effectively survival rates of catfish fingerling compare with other treatments.

CONCLUSION

The application of EM_4 inoculant has significant effect on ammonia, nitrite and nitrate concentration at fish culture media and alsopositively affects the absolute growth rates, daily growth rates, absolute growth length and survival rates of the fish. The best result was provided by the treatment C (300 mL of EM_4 inoculant) with absolute growth weight (11.83 g), absolute growth length (6.01 cm), daily growth rates (2.77%) as well as survival rates (93.06%) respectively.

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