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STUDY ON THE EFFECT OF BIOAUGMENTATION ON THE REDUCTION OF AMMONIA IN THE SEDIMENT OF SEMI INTENSIVE TAMBAK

Sarjito, Adi Santoso and Ali Djunaedi

Faculty of Fisheries And Marine Science, Diponegoro University

ABSTRACT

The aboratory scale experiment with split plot randomized design was perfomed to find out the effect bioaugmention on ammonia reduction in the sediment of semi intensive tambak. The main treatment was bioaugmentaion with probiotic epicin concentration of 0; 0.5 ; 1.0 and 1.5 ppm; as sub-treatment was the salinity (20; 25 and 30 ppt), and as a group was day (0; 2; 4 and 6). The result indicated that bioaugmentation was able to reduce ammonia concentration in the sediment of semi intensive tambak. The treatments, especially dose and days had a significant affect on the reduction ammonia in the sediment ($p<0.01$) with exception to salinity ($p > 0.05$). The capability of epicin as a bioaugmentation started on the day of 2. The most effective epicin dose to reduce ammonia in the sediment of semi intensive tambak for culture of Tiger shrimp (Penaeus. monodon F.) was 1.5 ppm.

Keywords: Bioaugmentation, ammonia, sediment, semi intensive tambak

I. INTRODUCTION

The pollution problem in culture medium has been frequently occurred at the penaeid shrimp (*Penaeus monodon* F.) culture (Spotte, 1979; Chamberlein, 1990; Maguire and Allan, 1990; Muslim *et al*, 1996). It may affects on the deleterious of water quality (Maguire and Allan, 1990). One of the potential toxic substance/ pollution is ammonia in both sediment and water which leads to a limitation of the life process. In certain condition, it may influenced on the shrimp growth and mortality (Apud, 1989; Maguire and Allan, 1990) and cause the failure of the culture (Maguire and Allan, 1990). This suggests that ammonia is one of limiting factors in the aquaculture system (Forteath, 1988).

In semi intensive shrimp culture, it needs relatively less intensive feeding. However, inappropriate feeding strategy may cause increasing of the organic waste such as: uneaten feed in the sediment (Maguire and Allan, 1990). Besides, organic matter from water source also influences the ammonia concentration in the water and sediment of tambak (Muslim *et al*, 1996). Decomposition of the organic matter including uneaten feed. in the sediment, produces ammonia (Spotte, 1979; Boyd, 1989; Colt and Amstrong, 1991; Maguire and Allan, 1990). Therefore, to solve ammonia problem in the culture medium of tiger shrimp, Kinne (1976); Liong and Subraniam (1996); suggested to use biological methods, one of them known as a bioaugmentation. Bioaugmentation can be conducted by using probiotic "epicin" which contains bacterial decomposer (Briggs and Turnbull, 1995; Liong and Subraniam, 1996) and a natural microbial growth stimulant (Liong and Subraniam, 1996). The beneficial of bioaugmentation (biological method) is more effective compared to both mechanical and chemical

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methods (Spotte, 1979) and relatively safe to the environment (Liong and Subraniam, 1996).

According to Liong and Subraniam (1996), bioaugmentation has been applied in shrimp culture, although the study about the methods has been very limited. Bioaugmentation is biotechnology applied in aquaculture by adding both nitrification and decomposer bacteria in the culture medium (Liong and Subraniam, 1996), in order to enhance the product (Briggs and Turnbull, 1993). Moreover, the effectiveness of nitrification is also influenced by several factors such as : ammonia as a toxic substances; temperature; pH; Dissolved oxygen and salinity (Spotte, 1979; Forteath, 1988).

Bioaugmentation using epicin was able to reduce ammonia in the water at the salinity range of 20 – 30 ppt (Sarjito, *et al.*, 1999). Therefore, a further study about the application of bioaugmentation is needed to find out the appropriate dose and salinity to reduce ammonia in the semi intensive tambak sediment.

II. MATERIALS AND METHODS

Bioaugmentation with probiotic "epicin" was prepared following Briggs and Turnbull's method (1993) Sediment of semi intensive tambak was taken from Brackish water Aquaculture Development Project (BADP), Jepara and then, placed on the aquarium of 12 L for shrimp culture. To investigate the effect of bioaugmentation on the reduction of ammonia in the semi intensive tambak sediment, seven - day - experiment was conducted under laboratory conditions. Juvenile shrimp was placed in each aquarium.

An Experimental laboratory and split plot randomized design was applied. The treatments were bioaugmentaion with concentration/dose of 0; 0.5; 1.0 and 1.5 ppm and salinity (20; 25 and 30 ppt) and as a group was day (0; 2; 4 and 6). Three repiclates were used. In the present experiment, bioaugmentation using epicin was only applied once at the beginning of the experiment (The ideal ammonia concentration in the water was 0.4 ppm). The experiment was conducted from November – December 1999 at hatchery of Fisheries and Marine Science Faculty, Diponegoro University.

During the experiment, each water quality parameters i.e. temperature; Dissolved oxygen; pH was at the range of 270C - 280C; 5,8 - 6,1 ppm; 7,8 - 8,1 respectively , which are suitable for Tiger shrimp (Apud, 1989; Chamberlein, 1990). Whereas, ammonia in the sediment was analyzed every two days using Parsons *et al.*'s method (1989). Anova was used to analyze the data.

III. RESULTS

Ammonia concentration in the sediment of semi intensive tambak at different concentrations of epicin, salinity and day, were shown in Table 1. Ammonia in the sediment of semi intensive tambak decreased with increasing of epicin dose and day indicating that bioaugmentation had greatly positive effect on the reduction of ammonia (Table 1).

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Table 1. The Effect of Bioaugmentation on the Ammonia in the Sediment of Semi Intensive Tambak on the Different Dose and Salinity

Salinity (ppm)	Epicin Dose (ppm)	Mean Ammonia Concentration In Sediment At The Day of (ppm)			
		0	2	4	6
20	0	1,080	1,203	1,389	1,483
	0,5	1,102	0,635	0,726	0,822
	1,0	1,126	0,609	0,704	0.802
	1,5	1,114	0,592	0,669	0,785
25	0	1,057	1,348	1,459	1,459
	0,5	1,113	0,622	0,787	0,787
	1,0	1,108	0,586	0,791	0,791
	1,5	1,112	0,550	0,776	0,776
30	0	1,142	1,194	1,206	1,329
	0,5	1,182	0,593	0,693	0,791
	1,0	1,131	0,571	0,661	0,784
	1,5	1,148	0,539	0,640	0.753

The capability of epicin as a bioaugmentation on the reduction of ammonia in the sediment of semi intensive tambak started on the day of 2 (Figure 1. and Table 1). Then, ammonia concentration in the sediment seemed to increase slightly on the day of 4 and 6 with an exception at salinity of 25 ppm (Figure 1.). It was also proved by Anova that dose and day had high significant effect on the ammonia reduction in the sediment as a culture medium of Tiger shrimp ($p<0.01$). However, it was found that salinity did not affect on the reduction of ammonia in the sediment ($p>0.05$) (Figure 2.). The result was also proved that without the treatment applied, ammonia in the sediment increased on the days of 2, 4, and 6. (Table 1; Figure 1.). None of the shrimp died revealing 100 % survival rate of Tiger shrimp (*P. monodon*) in the present experiment.

IV. DISCUSSION

Bioaugmentation is able to reduce ammonia concentration in the sediment of semi intensive tambak. It may be attributable to role of the decomposer bacteria of epicin to acclimatize with their new environment and supported by natural bacteria in order to reduce ammonia in both water and sediment. Ammonia is needed by nitrification bacteria to get energy for growth; survival and multiply (Spotte, 1979; Gaudy and Gaudy, 1986; Forteath, 1988). Besides, a natural microbial growth stimulant in the epicin may stimulate the natural microbial growth rate (Liong and Subraniam, 1995), thereby increasing the utilization of ammonia waste in sediment occurred (Briggs and Turnbull, 1995). The natural decomposer bacteria in the sediment i.e.: *Nitrosomonas* sp. and *Nitrobacter* sp. (Gaudy and Gaudy, 1981; Forteath, 1988; and Spotte, 1979) and the bacteria content of epicin i.e. : *Basillus,; Nitrosomonas;* and *nitrobacter* (Liong and Subraniam, 1996); *Bacillus subtilis; B. lycheniformis, B. megatorium, Lactobacillus* sp. *Nitrosomonas* sp., *Nitrobacter* sp. and *Saccharomyces cereviceae* (Noor, 1996) may have a role on the ammonia reduction in the sediment of semi intensive tambak. The sediment it self can be used as a suitable substrate of bacteria for growing

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and multiplying (Wickins, 1976l; Gaudy and Gaudy, 1981; Briggs and Turnbull, 1995; Sarjito *et al.*, 2000). It also proved by Anonymous (1996) that the amount of nitrification bacteria in the sediment was 1000 times more compared to that of nitrification bacteria suspended in the waters.

The reduction of ammonia by dose treatment of epicin as a bioaugmentation was also supported by the Anova result, where the dose had highly significant affect on the reduction of ammonia in the sediment ($p<0.01$). The reduction of ammonia in the semi intensive tambak sediment may relate to the total of decomposer/nitrification bacteria in the sediment or water column. Therefore, the high concentration of epicin was assumed that more total bacteria inoculated and then involved on the ammonia reduction. The similar result was also reported by Sarjito (1999; 2000) who found that bioaugmentaion was affected by dose.

In the present experiment, ammonia in the sediment of semi intensive tambak was able to be reduced by epicin with dose of 0.5 – 1.5 ppm in the various salinity of 20; 25; and 30 ppt; with the most effective dose was 1.5 ppm. The similar results were also reported by Sarjito *et al* (1999; 2000) who found that 1.5 ppm was the most effective dose of epicin to reduce ammonia in the culture medium of Tiger shrimp. However, the dose was higher compared to previous study conducted by Anonymous (1996) who suggested to use epicin concentration of 1.0 ppm.

The capability of decomposer bacteria (content of epicin) as bioaugmentation on the reduction of ammonia in the sediment of semi intensive tambak started on the days of 2., although increasing ammonia concentration in the sediment still occurred slightly on the day of 4 and 6, with an exception at salinity of 25 ppt (Figure 1.). The concentration of ammonia in the sediment of semi intensive tambak, however, was still lower compared to the concentration of ammonia in the sediment beginning of the experiment (day 0). The result also proved that bioaugmentation using epicin was able to reduce ammonia in the sediment of semi intensive tambak. Whereas, increasing of ammonia slightly in the sediment on the days of 4 and 6 may be attributable to the bacteria selection naturally. Dramatic ammonia reduction in the sediment occurred on the day of 2, may result on the limitation of availability of ammonia in the sediment, as source of bacterial energy, therefore only certain bacteria selected were able to survive. As the result, the total bacteria population may decrease on the days of 4 or 6, therefore increasing ammonia in the sediment occurred again. In addition to those factors, high survival rate of the shrimp may also contribute to the ammonia excretion (Claybrook, 1993; Wickins, 1976)

Sarjito *et al.* (1999) reported that salinity affected on the bioaugmentation process in order to reduce ammonia concentration in the water as culture medium. In contrast, the present experiment found that salinity did not have significant affect on the ammonia reduction in the sediment ($p>0.05$) (Figure 2.). The similar result also reported by Sarjito *et al.*(2000) who found that salinity did not affect on the ammonia reduction in the sediment of intensive culture of tiger shrimp. Anonymous (1996) stated that epicin as a bioaugmentation material works effectively in the range salinity of 0 – 40 ppt. In the present experiment, however, the result also indicated that increasing of ammonia concentration did not occurred on the day of 6 at salinity of 25 ppt. Therefore, it seemed to be that salinity of 25 ppt was a proper salinity for ammonia reduction in the sediment of semi intensive tambak using bioaugmentation with probiotic epicin.

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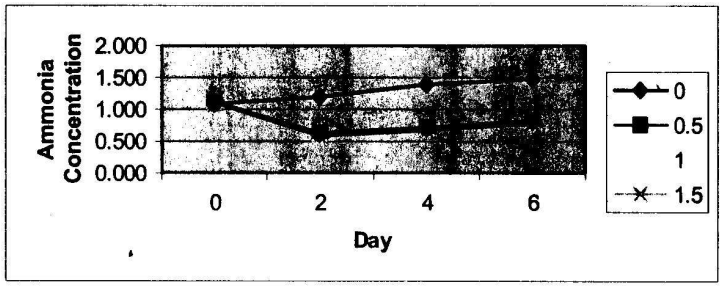
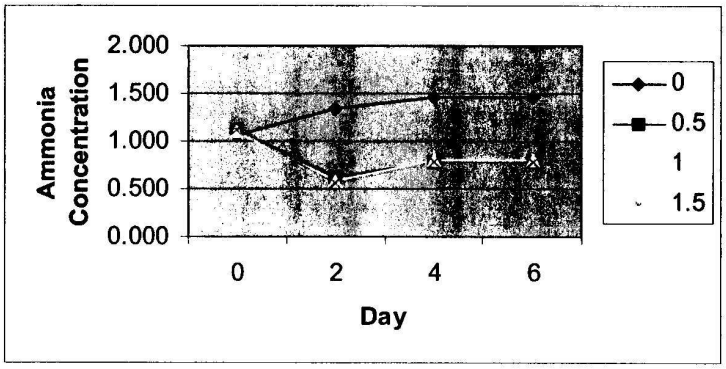
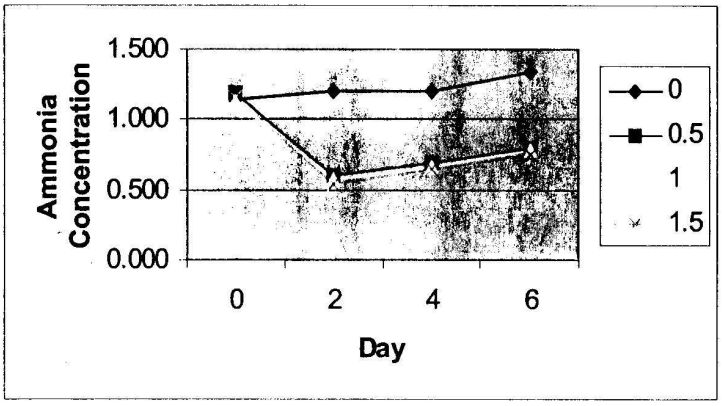


a. Salinity of 20 ppt



b. Salinity of 25 ppt



c. Salinity of 30 ppt.

Figure 1. The Effect of Bioaugmention Dose With Epicin on the Reduction of Ammonia Sediment of Semi Intensive Tambak In Various Salinity

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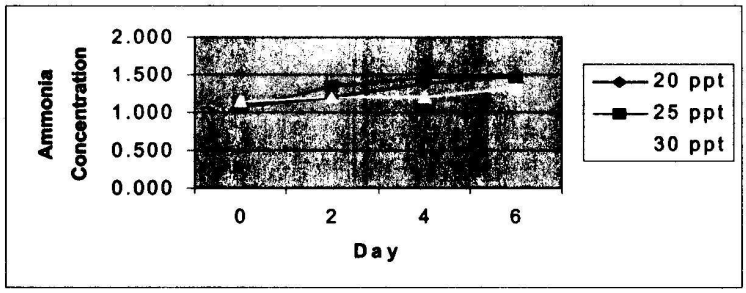
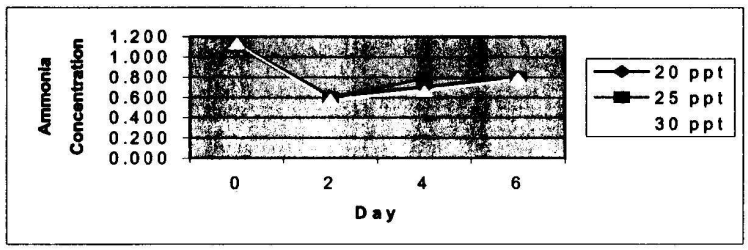
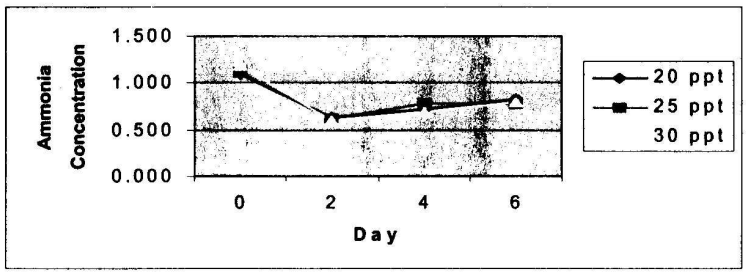


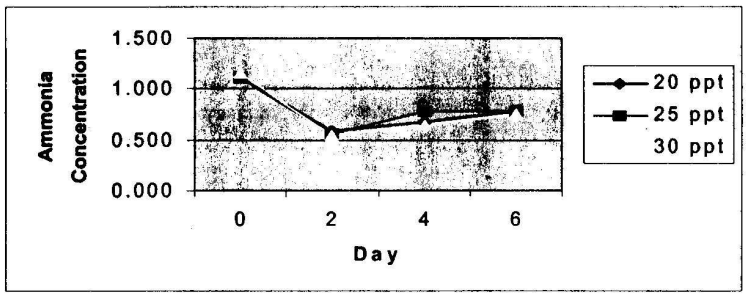
a. Epicin Dose of 0 ppm



b. Epicin Dose of 0.5 ppm



c. Epicin Dose of 1.0 ppm



d. Epicin Dose of 1.5 ppm

Figure 2. The Influence of Salinity on the Effective of Bioaugmentation for Ammonia Reduction in the Sediment of Semi intensive Tambak

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None of the shrimp was died during the experiment. High survival rate of tiger shrimp (*P. monodon*) (100%) may be attributable on the high water quality of culture medium that was suitable for the shrimps (Spotte, 1979; Apud, 1989; Chamberlain, 1990; Maguire and Allan, 1990). In the present experiment, the highest ammonia concentration in the sediment (1.485 ppm) was able to be tolerated by Tiger shrimp as detected in the sediment of the semi intensive without the bioaugmentation treatments. In addition, toxicity of ammonia also depends on the unionized ammonia concentration (Emerson *et al,* 1975; Forteath, 19881 Colt and Amstrong, 1991); pH; temperature and salinity (Boyd, 1989; Colt and Amstrong, 1991; Emerson *et al,* 1975; Forteath, 1988 ; Spotte, 1979). Therefore, the result also indicated that although bioaugmentaion was able to reduce ammonia concentration in the sediment of semi intensive tambak, actually it was also found that without treatment applied the shrimps was still able to tolerate the ammonia concentration.

V. CONCLUSION

1. Bioaugmetation using probiotic epicin was able to reduce ammonia in the sediment of semi intensive tambak.
2. The treatment, especially dose and day had significant effect on the reduction of ammonia in the sediment of semi intensive tambak, with exception on salinity.
3. The most effective dose of bioaugmention on the reduction of ammonia in the sediment of semi intensive Tambak using probiotic epicin was 1.5 ppm

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