Role of Zeolites in the nutrition of fish

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Introduction

Zeolite comes from a Greek word and was found by a Swedish geologist Baron Alex Frederick in 1756. Zeolite is also known as clinoptilolite which has three dimensions. Besides, it also has the criteria for absorbing and good ion exchanger. There are more than 50 types of natural zeolite in the world mostly derived from the volcanic rocks. The most commonly used in various fields zeolite is clinoptilolite namely for water cleaning and waste treatment (Konikoff, 1973). In animal production, zeolite is used to increase the performance of animal production. Researchs from Russia, Japan and United States have shown that clinoptilolite helped to increase the animals' body weights and increased in feed efficiency when incorporated at the rate of 1 – 5 % in their diets (Quinsenberry, 1968; Minato, 1968). Currently, zeolites has also been used in aquacultural practices. Zeolites have been used in ponds with the aim of removing ammonia through ion exchange, providing physical cover over sediments to prevent leaching of metabolites into the water column, removing suspended solids, and improving water color and diatom blooms. Zeolites have the capacity to remove ammonia and other nutrients/metabolites from fresh waters by ion exchange and absorption, thus helping to reduce ammonia accumulation which are very toxic to fish and prawn (Rodards, et al 1983). The aim of this study were to evaluate the effect of zeolite in fish diet, its effect on pisciponic culture and water quality.

Materials and Methods

Experiment 1. Effect of Zeolite in a Pisciculture system.

A complete randomized design with three treatments in triplicate was carried out. Treatment 1: use of commercial diet enriched with 3% zeolite plus 3 cotton bags each containing 140g zeolie hanging in each rearing tank. Treatment 2Same type of feeding without zeolite plus 14 small bags each containing 10g zeolite as bed for growth of lettuce seedling in the hydoponic compartment of the system plus adding zeolite at 3% of given feed daily in the rearing tank and treatment 3: Use of commercial feed without addition of zeolite in feed and rearing tank. All tanks has a hydroponic compartment with a capacity of 14 plants and 50 tilapia with averaging weight of 3.8g were stocked per tank. Salad (*Lactuva sativa* var *longifolia*) was used in this experiment. Statistical analysis was conducted by the Statistical Analysis System (SAS, 2000).

Experiment 2To evaluate the effect of five different levels of zeolite in culture water on growth and survival of silver barb *Barbodes gonionotus* larvae.

Larvae of silver barb *B. gonionotus* were stocked at $25L^{-1}$ in 10L tanks and were offered six various concentrations of zeolite including 0, 2, 4, 6, 8 and 10 g/liter in triplicate for 18 days, starting at completion of yolk absorption. All the larvae were fed with *Artemia* on *adlibitum* basis. Ammonia, pH, O_2, temperature, hardness and alkalinity were monitored every other day for each treatment. Mortality was record everyday for all treatment. Length and weigh were measured at the beginning and every four days. Statistical analysis was conducted by the Statistical Analysis System (SAS, 2000)

Results and DiscussionExperiment

1Fish in tanks given zeolite treatment had a higher significant growth and biomass as compared to fish treated with no zeolite. However fish treated with zeolite in their feed did not show any significant different (P>0.05) with the control fish group. The highest growth in biomass was found in fish given the feed without zeolite in the diet but with zeolite treatment in the water and hydroponic bedding with a value of 1406 mgC/m^2. There was no significant different in survival rate (P>0.05) of fish in all treatments with values ranging from 74-79%. There was a significant different (P<0.05) in protein retention in groups of fish treated with zeolite with values of 67.54 % (treatment 1), 65% (treatment 2) and fish without zeolite treatment with 63% (treatment 3). The highest yield of salad was obtained with treatment 2 with a value of 1507 g (highly significant at P<0.05) followed by salad in treatment 1 with a value of 768g and lastly by salad in the control group (without zeolite treatment) with a value of 275g. There was no different in protein content with values of 27, 26 and 26% for treatment1, treatment 2 and treatment 3 respectively. Similarly there waere no significant different for lipid and fibre content in all groups of salad with values ranging from 12% for treatment1 and tretment 2 and 10% for treatment 3 and 23% fibre content (treatment 1), 24% (treatment 2) and 21% (treatment 3). However there was a significant different (P<0.05) for ash content in salad at the end of the experiment. Salad in treatment 3 had the highest value of 28% followed by salad in treatment 1 with a value of 27% and lastly by salad in treatment 2 with a value of 25%. There were no different in the content of ammnonia in the water with values ranging from 3.9 to 4.6 ppm. Treatments with zeolite had a lower value of ammonia content.

Experiment 2: Larval growth and survival were generally higher for those treated by different zeolite concentrations. Treatment with the highest zeolite content (10g/l) had the highest weight gain with a value of 31.06% and the group of larvae treated with no zeolite had the least percentage of gain in growth with a value of 27.31%. Higher growth and survival at higher zeolite concentrations suggesting its suitability and its important role on improving growth and survival of fish. . Significant lower survival and growth were recorded on larvae without zeolite treatment. Negative correlation was found between Ammonia concentration and zeolite level. Lower ammonia in higher zeolite treated tanks (0.1±0.08 ppm), indicated the strong positive effect of zeolite on water quality. Results of this study demonstrated the high potential of zeolite in larviculture and hatchery production of freshwater fish industry in Malaysia. Results from the experimental values showed that use of zeolite will increase the growth of fish, increase the yield of salad (pisciponic system) could be due to availability and slow release of nitrogen-N from ammonia retained by zeolites used as bedding for salad. Water quality is much better when treated with zeolite (reduce the ammonia content in water). This is very important factor especially for hatcheries whereby the young fish cannot withstand high amount of ammonia content which is very toxic to them. Other parameters such as dissolved oxygen, pH, alkalinity and temperature were not influenced by the zeolite at all.

Conclusions

Use of zeolite is beneficial in aquaculture practice, especially with the limited amount of good water which can be used by a fish farmer currently. Most river water are being polluted and the available water are to be shared with other animals and for human used. Use of zeolite will enable the farmer to recirculate the water. For practicality, pisciculture will increase the yield in form of fish and vegetables. The use of filters is not needed here because plants (vegetables) can be used as filters and at the same time will benefit from the circulating ammonia as their fertilizer. Use of zeolite will enhance the efficiency of the systrem because due to the nature of zeolite itself which can absorb and exchange ions, will release the nitrogen slowly for the plants to utilize. Hatchery use of zeolite is beneficial as it will reduce the amount of ammonia significantly. Thus , higher survival of larvae.

Benefits from the study

Hatcheries management made easier. Higher survival of fish larvae. Fish grow better in an environment free from ammonia. Double in yield if pisciculture is practiced. Training of students pursuing postgraduate studies. Product developed and feeding strategies to be used by fish farmers. Reduced feed costs through improved feed efficiency

Patent(s), if applicable:

None

Stage of Commercialization, if applicable:

Not Yet

Project Publications in Refereed Journals:

Nil

Project Publications in Conference Proceedings

1. Rafiee, G. R., **C. R. Saad**, M. S. Kamarudin, K. Sijam, Md. R. Ismail and K. Yusop. 2002. A simple Technical Feasibility for Production of Fish and Vegetable in an Integrated Re-Circulating System. Proceedings of Second International Conference on Sustainable Agriculture for Food, Energy and Industry. Setember 8 – 13, 2002, Beijing, China. Edited by Li Dajue, Institute of Botany, Chinese Academy of Sciences. Pp 354 – 360.

2. **Che Roos Saad**, Gholam Reza Rafiee, Mohd. Salleh Kamarudin, Kamaruzaman Sijam and Mohd. Razi Ismail. 2002. Use of Lettuce (*Lactuca sativa* Var. Longifolia) for Purification of Aquaculture Wastewater. Proceedings of Second International Conference on Sustainable Agriculture for Food, Energy and Industry. Setember 8 – 13, 2002, Beijing, China. Edited by Li Dajue, Institute of Botany, Chinese Academy of Sciences. Pp 1511 – 1517

3. **Saad, C. R.**, A.R Alimon, and L. Asgari. 2002. Effect of different zeolite concentrations on survival and growth of silver barb, *Barbodes gonionotus* (Bleeker) larvae and its role on water quality. UPM, Malaysia. RMC/PRP 2002

Graduate Research

Name of Graduate	Research Topic	Field of Expertise	Degree Awarded	Graduation Year
Dyg. Norashikin Awg. Chee	Kesan zeolite keatas perkembangan ikan tilapia (*Oreochromis sp*) dalam system piskiponik	Agriculture	B.Sc	2003

Rostina Binti Rolon	Kesan penggunaan zeolite dalam system piskiponik terhadap pertumbuhan sayuran salad (Lactuva sativa var. Longifolia)	Agriculture	B.Sc	2003
Nik Azmi Nik Him	Penggunaan zeolite dalam makanan ikan tilapia	Agriculture	B.Sc	2002

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