ABSTRACT

LIME SLUDGE WASTE OF PAPER MILL AS AN ALTERNATIVE SOURCE OF LIMING IN FISH FARMING

The thesis consists of five chapters under the broad headings of (i) Introduction (ii) Materials and Method (iii) Results (iv) Discussion and (v) References.

CHAPTER 1: INTRODUCTION

In this chapter a brief description of the pisciculture has been incorporated. The importance of fish has also been illustrated. A brief description of the freshwater aquaculture of our country has been illustrated with main role of fish farming. The status of the fishery in Assam has also been incorporated. The different physico-chemical properties required for fishery has also been illustrated. The importance and benefits of liming in fisheries and also the different liming materials in fishery were incorporated. Since the focal point of the present work is the alternative source of liming in fishery. The role of industrial solid waste specially the lime sludge waste of paper mill has been incorporated since it is used in the present investigation. The effects of this solid waste on soil quality and water were highlighted with some relevant literatures. The chapter is basically a review of some selected literatures on topics related to the present study. Though there is lack of literatures directly related to the present work yet, some important literatures were highlighted which were indirectly related to the present work. The importance of the present investigation has also incorporated. At the end of the chapter the objectives of the study were also discussed. The objectives are------
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- To analyze the various physico-chemical properties and toxic metals present in the lime sludge waste of Jagiroad Paper Mill of Assam.
- To study the impact of application of lime sludge waste on water quality parameters and also on fish growth in experimental aquaria cultured in the laboratory.
- To evaluate the impact of application of lime sludge waste on quality and quantity of plankton (both phytoplankton and zooplankton) in beakers.
- To study the toxicity of lime sludge waste on fish cultured in different concentrations in small sized aquaria under laboratory conditions.
- To study the impact of lime sludge waste on water and soil quality parameters and on the growth of fish in experimental ponds.

CHAPTER 2: MATERIALS AND METHOD

In this chapter, detailed description of the materials and method used in the present investigation has been incorporated. This chapter gives a brief description of (a) the procedure for the analysis of different physico-chemical properties viz. pH, conductivity, water holding capacity, organic carbon, percentage of calcium carbonate, available phosphorous, sodium, potassium and heavy metals (Pb, Mn, Cu, Zn and Hg) of lime sludge waste and marketed lime or pure lime (b) the procedure for the analysis of different physico-chemical properties viz. pH, conductivity, free carbon dioxide, dissolved oxygen, total alkalinity, total hardness and chloride of the sludge mixed water in aquarium, beakers and also pond (c) the procedure for growth studies of fishes in aquaria by using lime sludge waste and marketed lime, the procedure for growth of
plankton studies in beaker water by using different concentration of lime sludge waste, the procedure for growth studies of fishes in small sized aquaria by using different concentration of lime sludge waste. This chapter also gives a brief description of the procedure for the determination of protein and lipid content in the cultured fishes and the procedure for the determination of the length-weight relationship of the cultured fishes. This chapter gives a brief description of the procedure for the identification of the plankton studied in the present investigation. This chapter also describes the procedure for the analysis of the various physico-chemical properties of the soil of the lime sludge added pond and control pond (i.e. pond without adding lime sludge waste).

CHAPTER 3: RESULTS

This chapter gives the data obtained from the present investigation.

It starts with the characterization of lime sludge waste of paper mill and marketed lime or pure lime used by the fish farmers for liming their ponds with respect to pH, conductivity, water holding capacity, organic carbon, percentage of calcium carbonate, available phosphorous, sodium, potassium and heavy metals (Pb, Mn, Cu, Zn and Hg). The pH of the lime sludge waste is slightly lesser (10.98) than that of marketed lime (11.79) and the percentage of calcium carbonate of lime sludge waste is found to be 66.5% and that of marketed lime is 99%.

The required dose of lime sludge waste is 1.5 times more than that of pure lime or marketed lime to maintain pH within desirable range.

After addition of lime sludge waste and pure lime the various physico-chemical parameters of aquatic media of the experimental aquaria were investigated and the results were depicted in tabular forms. The average length and weight of the cultured fishes were determined after six months of stocking in the experimental aquaria and were found to be
increased. The values of “n” for *Catla catla* cultured in the three aquaria were recorded as 2.13569 (in lime sludge waste mixed water), 2.35461 (in pure lime mixed water) and 1.94278 (in control). The values of “n” for *Labeo rohita* cultured in the three aquaria were recorded as 2.10667 (in lime sludge waste mixed water, 2.52560 (in pure lime mixed water) and 2.41309 (in control). The values of “n” for *Cirrhinus mrigala* cultured in the three aquaria were recorded as 1.81791 (in lime sludge waste mixed water, 1.91050 (in pure lime mixed water) and 1.52670 (in control).

After analyzing the different physico-chemical parameters of the beaker water mixed with different concentration of lime sludge waste it was found that the value of pH was found to be maximum (8.83) in the beaker water in which the concentration of lime sludge waste was 10% (i.e. beaker-5) and the value of pH was found to be minimum (7.59) in the beaker water in which the concentration of lime sludge waste was 0% (i.e. beaker-1). Like pH other parameters were also found to be highest in 10 concentration of lime sludge waste. In the present investigation period six genera of phytoplankton belonged to four groups namely Myxophyceae, Chlorophyceae, Bacillariophyceae, Euglenophyceae were observed. Out of which, one genus belonged to Myxophyceae, two Chlorophyceae, two Bacillariophyceae and one Euglenophyceae. Five genera of zooplankton representing four groups namely Protozoa, Rotifera, Cladocera and Copepoda were observed. Out of which, two genera belonged to Protozoa, one Rotifera, one Cladocera and one Copepoda.

After analyzing the different physico-chemical parameters of the aquarium water mixed with different concentration of lime sludge waste it was found that the value of pH was found to be maximum (8.95) in 20% concentration of lime sludge waste whereas the value was minimum (7.60) in 0% concentration of lime sludge waste. Like pH the trend
of other parameters were also same.. It was also observed from the study that after 30 days of exposure of the fishes in the lime sludge waste mixed water there was no toxic effect on the fishes up to 15% concentration, however at 20% concentration all the fishes died. The protein content of the tissues (whole fish) of the fishes cultured in different concentrations (0%, 1%, 5%, 10% and 15%) were found to be 2.920mg/g, 2.653mg/g, 3.973mg/g, 7.386mg/g and 5.106mg/g. The lipid content of the fishes cultured in different concentrations (0%, 1%, 5%, 10% and 15%) were found to be 6.4%, 12.36%, 11.66%, 12% and 9.49%. The percentage of lipid found to be maximum in 1% of lime sludge waste, whereas the value was minimum in 0% concentration of lime sludge waste.

Assessment of the various physico-chemical parameters of the soil and water of the two ponds were also investigated monthly after addition of lime sludge waste and introducing the fingerlings of Indian Major Carps and were found that the pH of the soil of the two experimental ponds were found higher (6.60) in lime sludge waste added pond (i.e. pond-1) than the pH (5.40) of the control pond (without lime sludge waste, i.e. pond-2). Like pH other parameters were found to increase. Like soil parameters the water parameters were also found to increase. The values of ‘n’ for Cirrhinus mrigala cultured in the two ponds were recorded as 2.41309 (for fishes cultured in lime sludge mixed pond) and 2.52095 (for fishes cultured in control pond), which were almost same. The values of ‘n’ for Catla catla were recorded as 3.55011 (from control pond) and 2.91612 (from lime sludge mixed pond). The values of ‘n’ for Labeo rohita were recorded as 2.03511 (from control pond) and 1.99338 (from lime sludge mixed pond. The ‘n’ values of ‘n’ for Labeo bata fish were recorded as 1.73629 (from control pond) and 1.79769 (from lime sludge pond).

CHAPTER 4: DISCUSSION
This chapter gives the discussion of the results obtained for each of the parameters.

It starts with the characterization of lime sludge waste of paper mill and marketed lime or pure lime used by the fish farmers for liming their ponds. Lime sludge waste of paper mill has high pH. But, it is slightly lower than the pH of the marketed lime. Experimental findings also revealed that the concentration of heavy metals present in lime sludge waste is lower than that of marketed lime. However, the metals present in the sludge and marketed lime were not so high to cause harm to the aquatic life. Both lime sludge waste and marketed lime can increase the pH, alkalinity, hardness of the water after mixing with water. Like marketed lime sludge waste has no toxic impact on the growth of fish when fishes were cultured in aquarium with lime sludge mixed water.

It was revealed from the study that the pH, conductivity, total alkalinity and total hardness were found to increase gradually with increasing the concentration of lime sludge waste. When the growth of plankton in different concentration of lime sludge waste compared, it was revealed from the study that the increase in the concentration of the lime sludge waste favoured the growth of plankton. It was also revealed from the study that the growth was maximum up to a certain range of concentration (i.e. 2% to 5%) and after that the growth was found minimum in the highest concentration of lime sludge waste (i.e. 10%).

After mixing lime sludge waste in different concentrations (viz. 0%, 1%, 5%, 10%, 15% and 20%) in small sized aquaria the different physico-chemical properties pH, conductivity, total alkalinity and total hardness were increased gradually with increasing the concentration of lime sludge waste. The pH was found to be highest (8.95) in highest concentration (i.e. 20%) of lime sludge waste. The test fishes exposed to different
concentrations of lime sludge waste exhibited normal behaviour. After 30 days of exposure of the fishes in the lime sludge waste mixed water there was no toxic effect on the fishes. There is also no effect of concentration of lime sludge waste on the protein and lipid content of the fish.

There is good impact of the lime sludge waste on the soil as well as water. Fishes cultured in the lime sludge added pond showed normal growth. The chapter finally enumerates the following conclusions:

1. Both lime sludge waste of paper mill and marketed lime used by the fish farmers are highly alkaline.
2. Lime sludge waste can be used as an alternative source of liming material in fish farming since it can increase the pH, alkalinity and hardness of the water and also it has no toxic substances.
3. Lime sludge waste of paper mill has no adverse impact on the growth of fish as well as on the growth of plankton.
4. There is good impact of lime sludge waste on physico-chemical properties of water as well as soil.

CHAPTER 5: REFERENCES

The thesis ends with a complete list of references to the research publications, journals and books that have been consulted and cited during the course of the study.