A laboratory experiment of 7-10 days' duration was conducted during May 1995 to evaluate the effect of turmeric in combination with lime on various physico-chemical parameters of water in fish ponds. Three dose-combinations of turmeric and lime, viz., A - 0.5 and 5.0 mg/l, B - 1.0 and 10.0 mg/l and C - 1.5 and 15.0 mg/l, respectively, per hectare-metre water were applied in filtered pond water kept in 10-l glass jars. Three replicates were maintained for each treatment and control groups, and water parameters in them were recorded every alternate day. The results of the experiment are described in the present communication.

INTRODUCTION

Epizootic ulcerative syndrome (EUS), a mysterious disease complex in fish, has been causing serious economic losses, particularly in freshwater aquaculture practices since 1988. A number of investigations pertaining to its control measures have been made (Jhingran and Das, 1990; Tripathi et al., 1990; Das et al., 1990; Dey, 1991; Kumar and Dey, 1992). Unslaked lime (CaO), when applied at 600 kg/ha-m water in three equal instalments at weekly intervals, has been found to give consistently good results in controlling this disease in cultivated ponds/tanks (Kumar and Dey, 1992). Extensive use of lime for EUS control triggered a quick rise in its cost and this became a serious constraint for rural fish farmers for procuring lime for EUS control in their ponds. Under these circumstances, it became necessary to undertake studies for finding out cheaper methods of EUS control. Turmeric, having skin protecting and antimicrobial properties, has been used for treating a variety of disease in man and domestic animals (Bhattacharya, 1988). Dey and Chandra (1994) successfully controlled EUS in fish by using turmeric in combination with lime for the first time in India.

The present communication describes results of a laboratory experiment aimed at evaluating the synergic effects of turmeric and lime on the various physico-chemical parameters of water in fish ponds.
MATERIAL AND METHODS

Water, collected from a pond of the Central Institute of Freshwater Aquaculture, Kausalyaganga, was filtered through a fine-meshed plankton-net cloth (50 μm pore size) and filled in 10-l glass jars in the laboratory as the test medium for the experiment conducted during May 1995 for a period of 7-10 days. The initial physico-chemical parameters of the water such as dissolved oxygen (DO), pH, total alkalinity, CO₂, BOD₅, NH₄-N, NO₂-N, NO₃-N and P₂O₅-P were recorded before initiation of the experiment. Freshly prepared turmeric powder and unslaked lime were used as the treatment material. Three dose-combinations of turmeric and lime, viz., A - 0.5 and 5.0 mg/l, B - 1.0 and 10.0 mg/l and C - 1.5 and 15.0 mg/l, respectively, per hectare-metre of water were applied in the test medium. The required quantity of turmeric and lime for each dose combination was measured and mixed thoroughly with a little water, and then the mixture was put in the jars and stirred well. Three replicates were maintained for each treatment and the control, and the parameters of water were recorded every alternate day during the experimental period. Total bacterial load in the treated and control groups was recorded.

RESULTS

The initial physico-chemical parameters of the test medium were recorded as follows: pH 7.6, DO - 5.8 mg/l, CO₂ - 5.2 mg/l, total alkalinity - 74 mg/l, BOD₅ - 2.9 mg/l, NH₄-N - 0.03 mg/l, NO₃-N - 0.01 mg/l, NO₂-N - 0.01 mg/l and P₂O₅-P - 0.01 mg/l. Total bacterial load count was 2580/ml. The average physico-chemical parameters and the total bacterial load of the water of treated and control groups after seven days of the experiment are presented in Table 1. The ambient temperature of the test media varied from 34.0 to 35.1°C during the experimental period. The results of the experiment indicated that the levels of pH, total alkalinity and DO increased more or less proportionately in all the three dose-combinations of turmeric and lime compared to the controls. The values of CO₂ and BOD₅ were found decreased in the treated groups immediately after application of turmeric and lime compared to the control, but the values started showing gradual increase after 72 hours. The increase in BOD₅ values was maximum in Treatment-C (almost similar to the control) followed by treatments-B and A. The levels of NH₄-N and NO₃-N also increased at the beginning in all the treated units compared to the controls, but thereafter showed a decreasing trend. In contrast, NO₂-N completely disappeared from all the treatments within 72 hours of application, but the levels started reappearing thereafter more prominently in Treatment-C followed by treatments-B and A. It was observed that the initial total bacterial load in the control did not differ from that of the final value after seven days of the experiment. On the other hand, the total bacterial load in the treated units after seven days showed that it was maximum in Treatment-C followed by treatments-B and A.
Table 1. Average (and range) water quality recorded after 7 days of experiment

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Control</th>
<th>Treatments (Turmeric: Lime, mg/l)</th>
<th>A (0.5: 5.0)</th>
<th>B (1.0: 10.0)</th>
<th>C (1.5: 15.0)</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>7.56 (7.53 - 7.40)</td>
<td>7.87 (7.60 - 8.13)</td>
<td>8.10 (7.60 - 8.63)</td>
<td>8.21 (7.60 - 8.80)</td>
<td></td>
</tr>
<tr>
<td>TA (mg/l)(^1)</td>
<td>72.80 (72.0 - 74.0)</td>
<td>76.20 (74.0 - 79.0)</td>
<td>81.40 (74.0 - 88.0)</td>
<td>84.20 (74.0 - 93.0)</td>
<td></td>
</tr>
<tr>
<td>Free CO(_2) (mg/l)</td>
<td>5.20 (5.10 - 5.30)</td>
<td>3.32 (1.50 - 5.20)</td>
<td>2.42 (Tr. - 5.20)</td>
<td>1.96 (Tr. 5.20)</td>
<td></td>
</tr>
<tr>
<td>DO (mg/l)(^2)</td>
<td>7.30 (5.80 - 8.30)</td>
<td>8.16 (5.80 - 10.10)</td>
<td>8.72 (5.80 - 2.90)</td>
<td>9.08 (5.80 - 12.00)</td>
<td></td>
</tr>
<tr>
<td>BOD(_5) (mg/l)</td>
<td>3.00 (2.90 - 3.10)</td>
<td>2.74 (2.50 - 2.90)</td>
<td>2.56 (2.40 - 2.90)</td>
<td>2.48 (2.00 - 3.00)</td>
<td></td>
</tr>
<tr>
<td>NH(_4)-N (mg/l)</td>
<td>0.002 (0.017 - 0.03)</td>
<td>0.029 (0.013 - 0.033)</td>
<td>0.029 (0.017 - 0.036)</td>
<td>0.029 (0.010 - 0.040)</td>
<td></td>
</tr>
<tr>
<td>NO(_2)-N (mg/l)</td>
<td>0.008 (0.007 - 0.010)</td>
<td>0.005 (Tr(^3) - 0.010)</td>
<td>0.003 (Tr. - 0.010)</td>
<td>0.003 (Tr. - 0.010)</td>
<td></td>
</tr>
<tr>
<td>NO(_3)-N (mg/l)</td>
<td>0.011 (0.007 - 0.016)</td>
<td>0.009 (0.007 - 0.010)</td>
<td>0.010 (0.007 - 0.013)</td>
<td>0.008 (0.003 - 0.016)</td>
<td></td>
</tr>
<tr>
<td>P(_2)O(_5)-P (mg/l)</td>
<td>0.010 (0.007 - 0.013)</td>
<td>0.004 (Tr. 0.010)</td>
<td>0.002 (Tr. - 0.010)</td>
<td>0.002 (Tr. - 0.010)</td>
<td></td>
</tr>
<tr>
<td>Total bacterial count (no./ml)</td>
<td>2580</td>
<td>1330</td>
<td>2460</td>
<td>2600</td>
<td></td>
</tr>
</tbody>
</table>

Figures in parenthesis indicate range values
\(^1\)TA - Total alkalinity; \(^2\)DO - Dissolved oxygen; \(^3\)Tr. - Trace
DISCUSSION

Extensive literature is available on the various physico-chemical parameters of fish ponds. Boyd (1979, 1982) carried out pioneering work on water quality parameters and the effect of liming in warmwater fish ponds. He observed that liming neutralises acidity in ponds and then it increases pH, total alkalinity and total hardness. Liming also reduces CO2 levels in ponds and its complete reduction occurs at pH 8.3 and above. In the present observations, increased levels of pH and total alkalinity, and decreased levels of CO2 in the treated units compared to the control might have been brought about by the action of lime of the combined treatment and these observations are in agreement with the findings of Boyd (1982). In the present study, the reduced values of BOD5, NO2-N and total bacterial load in the treated units compared to the controls suggested that the reduction in the levels of these parameters in the treated water might have been caused due to the reduced microbial activity possibly brought about by the turmeric component of the combined treatment, since turmeric has antimicrobial properties (Bhattacharya, 1988 in the form of lime in treatments). However, the observed increase in the bacterial load in treatments-C and B compared to Treatment-A appears to have been due to the fact that the availability of more active calcium added in the form of lime in treatments-C and B compared to Treatment-A might have influenced the bacterial counts considerably. The increased values of DO in both the treated and control units as recorded after seven days of the experiment might have been due to the enhanced rate of photosynthetic activities of the green algae escaped during filtration of the pond water.

The results of the present study indicating on one hand, the overall improvement of the importrant environmental parameters such as pH and total alkalinity, and on the other, the reduced microbial activities in the test medium of Treatment-A, due to turmeric (0.5 mg/l) and lime (5.0 mg/l) in the combined treatment conclusively explain the reasons of successful control of EUS of fish in India by Dey and Chandra (1994) through application of turmeric and lime at 1.0 and 10.0 mg/l, respectively, per hectare-metre of water in two equal instalments at 5-7 days' interval. It is an established fact that successful control of any disease outbreak in fish ponds should involve both the improvement of the environmental parameters, and checking of the pathogens and their proliferation. Since EUS outbreaks in ponds/tanks in India have been reported by many workers to be caused possibly by the simultaneous deterioration of some water quality parameters, particularly pH and total alkalinity, and bacterial involvement predominantly (Sarma et al., 1990; Das et al., 1990; Jhingran and Das, 1990; Tripathi et al., 1990; Chakraborty and Dastidar, 1991; Dey, 1991; Kumar and Dey, 1992), the successful method of controlling EUS of fish in ponds/tanks through application of turmeric in combination with lime appears to have been established by the results of the present study. It may be mentioned here that on the basis of the initial success, turmeric and lime have been used by many private fish farmers and state fisheries departments of India, and successful control of the disease by adopting this method has been reported.
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REFERENCES


