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Research Article

DETECTION OF BACKGROUND LEVELS OF HEAVY METALS IN THE BRACKISH WATER FISH FARM

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Abstract- Water is the most important resource of a country, and of the entire society as a whole, since no life is possible without water. Toxic heavy metal pollution of water is a major environmental problem, and most conventional remediation approaches do not provide acceptable solutions. This study demonstrates the background levels of Fe, Pb and Al in fish farm (Zadgaon, Shirgaon, Panvel and Pargaon creek). Heavy metals were analysed using atomic absorption spectrophotometer. Results indicated the highest concentration was found in sediment samples (0.98 mg/kg) for iron in Pargaon creek while minimum (0.001 1 mg/kg) for aluminum in Shirgaon fish farm.

Key word- Heavy metal, fish farm, pollution.

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Introduction

Environmental pollution is the result of rapid industrialization, technological advancement and unprecedented increase in population. Human evolution has led to immense scientific and technological progress. Urbanization and industrial revolution as such involved the intensive use of raw materials and water. The oceans occupying about the three-fourths of the earth form the ultimate dumping site for all kinds of wastes. Billions of liters of waste water are generated everyday from industries and domestic sources. Most of the industries discharge their waste directly (without any treatment) into the streams, lakes, oceans as well as in the open land that contaminate the ground water. These wastes range from simple, weak sewage containing organic and mineral matters to highly toxic kinds containing pesticides, detergents, heavy metals and other toxic substances. Environments have been contaminated by heavy metals ever since the original magma of the earth solidified. Heavy metals are on the forefront of academic and regulatory concerns. Heavy metal has been man's endeavor in his attempt to augment industrial development. Today, the heavy metals are termed as 'devils in disguise' and the economic reasons compel us to keep these using. Nearly every government around the world advocates for an environment free from harmful contamination for their citizens. Always there is demand for a development of country's economic, agricultural and industrial progress but with maintaining the safe, pure, and natural environment. But jokingly; it is the economic, agricultural and industrial developments that are the main sources for the pollution of Environment. Since the beginning of the industrial revolution, pollution by toxic metals is increased.

Millions of gallons of water containing toxic heavy metals are generated annually from several metal processing industries. The main sources of heavy metal pollution are mining, milling and surface finishing industries, which discharge a variety of toxic metals into the environment [7]. Industrial effluents may be discharged directly into the sea, or via waterways or sewer but whatever the disposal route, these constitute an important source of contamination of the environment [25] Many industries discharge their heavy metals into the water [11].

Heavy metals produce undesirable effects, even if they are present in extremely minute quantities, on human, animals and plant life. Metals discharged into water bodies are not biodegraded [30] but undergo chemical or microbial transformations, creating large impact on the environment and public health [28]. The release of various heavy metals into aquatic environment is a worldwide problem of increasing magnitude. The toxic effects on the biota have been known for a very long time. The heavy metals can affect their survival, reproduction, physiological change and also behavior [15]. Therefore, the need arises to constantly monitor these metals and find a way of removing them from the ecosystem before the threshold level is reached. According to aquaculture aspect point of view it will be helpful for the understanding the levels of heavy metals in aquafarm

Materials and Methods

The present investigation was conducted on the following aspects: Detection of background levels of the selected heavy metals *viz* iron, lead and aluminum in the brackish water fish farm of Zadgaon, Shirgaon, Panvel and Pargaon.

Sampling sites and locations

To assess the background levels of selected heavy metals *viz*; iron, lead and aluminum water samples and sediment samples were collected from brackish water fish farm of Zadgaon as well as Shirgaon of Ratnagiri district (latitude 16°55'11.81"N and longitude 73°20'05.42"E) and Panvel and Pargaon creek of Raigad district (latitude 18°31'22.02"N and longitude 73°10'49.1"E).

Collection

Surface water samples and sediment samples were collected at random from different areas of fish farm, of Zadgaon, Shirgaon, Panvel and Pargaon creek. Water samples were collected in plastic bottles that had been previously soaked in 10% nitric acid for 48 hours and thoroughly rinsed with deionized water. The sediment samples were collected from a desired depth by using a spade in a zigzag manner [10]. Composite sample was prepared, put in air-dry plastic bags and sealed. The samples were labeled carefully and brought to laboratory for further analysis.

Instrument used

Atomic Absorption Spectrophotometer: The AAS model used in the study for heavy metal level detection was Shimadzu AA 6800. For operating this instrument wizard software was used. The operating condition of the instrument is mentioned in [Table-1] [23].

Table-1 *Working condition for the analysis of metal by atomic absorption spectrophotometer [23].*

Metal	Wavelength (nm)	Slit width (nm)	Current (mA)	Gas	Support
Lead (Pb)	283.3	1.0	10	Air-Acetylene	Air
Iron (Fe)	248.3	0.2	12	Air-Acetylene	Air
Aluminum (Al)	309.33	0.3	5	Nitrous oxide-acetylene	Air

Statistical analysis

Data on heavy metal content between treatment and days was designed as ANOVA. Significant difference was indicated by $P < 0.05$, the Students Newman Kuel's multiple comparison test was used to determine the significant difference between the treatments and days [24].

Results

Background levels of iron lead and aluminum of fish farm Zadgaon, Shirgaon, Panvel and Pargaon creek.

Water samples

Iron content in water samples of fish farm of Zadgaon, Shirgaon, Panvel and Pargaon creek are given in [Table-2]. The iron levels in these water samples were 0.017, 0.012, 0.92 and 0.96 mg/l respectively. Zadgaon fish farm and Shirgaon pond had lower levels 0.008 mg/l, and 0.005 mg/l respectively, while Panvel had 0.14 mg/l and Paragon creek had 0.18 mg/l of soluble lead. The concentration of aluminum present in water samples of fish farm of Zadgaon, Shirgaon, Panvel and Pargaon creek were 0.0010, 0.0012, 0.0032 and 0.0035 mg/l respectively. Maximum concentration in water samples of fish farm was recorded in Pargaon creek whereas minimum concentration was recorded in Shirgaon fish farm for all the metals.

The trend of overall concentration in water samples irrespective of metals followed the order of: Pargaon > Panvel > Zadgaon > Shirgaon

Sediment samples

Iron content in sediment samples of fish farm of Zadgaon, Shirgaon, Panvel and Pargaon creek are given in [Table-3].The iron levels in sediment samples were 0.019, 0.015, 0.95 and 0.98 mg/kg respectively. Similarly lead content in sediment samples of fish farm of Zadgaon was 0.009 mg/kg while the Shirgaon farm had 0.007 mg/kg, Panvel pond and Pargaon creek had higher levels of 0.17 mg/kg and 0.19mg/kg of soluble lead respectively. The concentrations of aluminum in sediment samples of fish farm of Zadgaon, Shirgaon, Panvel and Pargaon creek were 0.0014, 0.0011, 0.0037 and 0.0039 mg/kg respectively.

Maximum concentration in sediment samples of fish farm was recorded in Pargaon creek whereas minimum concentration was in Shirgaon fish farm. The trend of overall concentration in sediment samples irrespective of metals followed the order of:

Pargaon > Panvel > Zadgaon > Shirgaon

Table-2 *Iron, lead and aluminum concentration in water samples of fish farm.*

Sr no.	Location	Concentration (mg/l)		
		Iron	Lead	Aluminum
1.	Zadgaon	0.017	0.008	0.0012
2.	Shirgaon	0.012	0.005	0.0010
3.	Panvel	0.92	0.14	0.0032
4.	Pargaon	0.96	0.18	0.0035

Table-3 *Iron, lead and aluminum concentration in sediment samples of fish farm.*

Sr no.	Location	Concentration (mg/kg)		
		Iron	Lead	Aluminum
1.	Zadgaon	0.019	0.009	0.0014
2.	Shirgaon	0.015	0.007	0.0011
3.	Panvel	0.95	0.17	0.0037
4.	Pargaon	0.98	0.19	0.0039

Discussion

Wetlands are believed to be natural sinks for metals, as large quantities of organic and inorganic materials are added to the aquatic ecosystem. Recently, biological systems for wastewater treatment based on aquatic plants have received a growing attention since they represent an alternative approach for removal of pollutants (Wolverton and McDonald, 1979; [31] O' Brien, 1981; [17] DeBusk and Reddy, 1987 [3]). Many widespread aquatic floating weeds, such as water hyacinth and duckweed, are commonly utilized for this purpose (Culley and Epps, 1973 [2]; Porath *et al*., [21] 1979 Oron *et al*., 1987 [19]). Metal accumulation in aquatic plant is function of vigour and growth, phenology, as well as metal speciation and aquatic chemistry [6]. Aquatic plants are known to accumulate heavy metals from contaminated water and sediment [8, 29]. Aquatic weeds like water hyacinth absorb metallic ions and deposit them in different parts of the body depending upon their affinity towards that particular metal. Thus, absorption and accumulation mechanism of macrophytes potentially render the services of cleaning of water body from the heavy metal contamination [20]. The mechanism in the absorption of heavy metals by water hyacinth is given as follows. The main process is translocation, which is accompanied by two other processes namely root pressure and leaf transpiration [12]. Denny (1980) [5] proved that heavy metals were taken up by plants by absorption and translocation, and released by excretion. He noted that the main route of heavy metal uptake in wetland plants was through the roots. Matagi *et al.* (1998) [16] have reviewed the heavy metal removal mechanisms in wetlands. This explains why wetland plants can have very high magnitude of heavy metal concentration in their tissues compared to their surrounding environment [18].

In the present study the highest concentration of iron, lead and aluminum content in water were 0.96, 0.18, and 0.0035mg/l and 0.98, 0.19 and 0.0039 mg/kg in sediment samples as observed in Pargaon creek while minimum were 0.012, 0.005 and 0.0010mg/l in water and 0.015, 0.007, and 0.0011mg/kg in sediment samples of Shirgaon fish farm respectively. Among the different heavy metals tested *viz* iron, lead and aluminum, concentration of iron in water and sediment samples was maximum in Pargaon creek whereas minimum in Shirgaon fish farm. It may be due to the laterite background of the sediments which is naturally rich in iron oxides. The surface charge, ion exchange capacity, and increasing levels of iron oxides, organic matter, and clay mineral interactions increases in precipitation rates leading most probably to the adsorption of metals from water into the sediments.

When metal concentrations in sediment and water samples are compared, among all the sites, sediment concentration were found higher than that of water samples. This is in agreement with many studies for example Goulet *et al.* (2005) [9] in Saguenay area, Canada for aluminum; Demirezen and Aksoy, (2006) [4] in Sultan marsh, Iraq for iron; Lokeshwari and Chandrappa (2006) [14] in Lalbagh tank, Banglore for iron and lead; and Tiwari *et al*. (2007) [27] in Shahpura lake, Bhopal for lead. This may be related to nature of the activities at the studied areas as heavy metals are present in raw household products such as pharmaceuticals, paints, battery, fuel combustion by transportation means etc. due to continuous adding, sediment load is raised consequent to interaction with the water.

Conclusion

The highest background concentration of iron, lead and aluminum content in water were 0.96, 0.18, and 0.0035 mg/l and 0.98, 0.19 and 0.0039 mg/kg in sediment samples as observed in Pargaon creek while minimum 0.012, 0.005 and 0.0010 mg/l in water and 0.015, 0.007, and 0.0011 mg/kg in sediment samples of Shirgaon fish farm respectively.

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Application of research: The background level detection of heavy metals is necessary for the water treatment before using it in sustainable aquaculture. It will be useful to control the heavy metal pollution.

Research Category: Aquaculture, pollution

Abbreviations:
Pb: Lead
Fe: Iron
Al: Aluminium

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