



EVALUATION OF HEAVY METALS IN THE WATER OF FISH PONDS AT BHADRA FISH FARM, KARNATAKA

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Abstract:

The occurrence of heavy metals viz., copper, zinc, iron and manganese in surface water samples were measured in 6 fish ponds at Bhadra fish farm of Karnataka. The heavy metals were measured using Atomic Absorption Spectrophotometer (AAS). Average value of iron (Fe) in water samples is exceeding as per KSPCB standards in all the ponds except pond 1. In the present investigation Mn levels in the water samples varied from 5.0 to 99 µg/l respectively. Its concentration was higher than the world average values in Pond 3. Heavy metals in the order of their relative dominial were in the sequence Fe > Mn > Zn > Cu respectively.

Key Words: Heavy Metals, Bhadra Fish Farm & AAS

Introduction:

Biomagnification of these heavy metals along the food chains occurs leading to various health hazards to both humans and other living organisms. Heavy metals affect the structural, biological functioning of biomolecules (McCormick et al., 2005). They are also known to interfere with synthesis and metabolism of the hormones (Manjappa and Puttaiah, 2005; Riddell et al., 2005; Gupta et al., 2009; Neethu Patil and Puttaiah, 2014). This article documents and discusses the results of an investigation of heavy metal levels in the fish ponds of Bhadra fish farm, Karnataka.

Materials and Methods:

Study Area:

Bhadra fish farm, Karnataka which is located at 13° 41' N latitude and 75° 38' E longitude. The pond covers an area of 600 – 1500 m² and has a mean depth of 2 mt. Cowdung and poultry manures are added to the ponds as manures for zooplankton production.

Sampling Strategy:

Sampling work had been carried out for six months from March to August 2007. Grab samples of pond water were collected in 2 litre capacity polyethylene cans at monthly intervals. Sediment samples were taken in separate polyethylene bags on quarterly basis. All the samples were transported and stored at 4° C for a day.

Preparation of Samples:

Water Samples (500 ml.) were filtered through What man number 41 (0.45 µm size) filter paper for the estimation of heavy metals. Collected water samples were preserved with 2 ml concentrated HNO₃ to prevent precipitation of metals. Both the Samples were concentrated to ten folds on water bath and subjected to HNO₃ digestion using microwave assisted technique, setting pressure at 30 bar and power 700 watts, as per the methods for the examination of water and wastewater (Lenore Clesceri 1998; Anton Paar, 198).

Analysis:

Heavy metals analyses were performed on an Atomic Absorption Spectrophotometer (GBC Avanta Version 1.31) using acetylene gas as fuel (at 8 psi) and

air as an oxidizer. Operational conditions were adjusted to yield optimal determinations.

Results and Discussion:

The average values of heavy metals present in water are given in Table 1 and discussed metal wise.

Water Quality:

The surface water of the fish ponds are characterized by alkaline pH with a range of 7.2 to 7.4. The patterns electrical conductivity are also consistent in fish ponds For example, pond 2 and 4 have the lowest conductivities (164 and 172 $\mu\text{mhos/cm}$) While, pond 6 showed highest values of EC (302 $\mu\text{mhos/cm}$) due to input of cowdung and poultry manures besides fish feed (Table 1).

Zinc:

The permissible levels of Zn in drinking water according to IS is 5.0 mg/l (Awashthi, 2000). The average values of Zn in the present water bodies is ranged from 2 mg/L (pond 5 & 6) to 76 mg/L at pond 3. Zn concentration in Pond 2, 5 and 6 are below the permissible limits. The level of bio available Zn with respect to total content is found in average of 50% in water samples.

Copper (Cu):

The permissible concentrations of Cu in water and food according to IS are 0.05 mg/l, and 30 mg/kg respectively (Awashthi, 2000). It was found that all the pond samples collected were free from Cu contamination. The average values of Cu are much below the permissible levels.

It is found in less quantity as an essential element for organisms. Excess of copper in human body is toxic and causes hypertension and produces pathological changes in brain tissues. At lower concentrations, Cu ions cause headache, nausea, vomiting and diarrhoea and at high concentrations, it causes anaemia, gastrointestinal disorder and also leads to liver and kidney malfunctioning in extreme cases. (USEPA, 1999; Neethu Patil and Puttaiah, 2014).

Iron (Fe):

The desirable level of dissolved Fe for class surface waters – III is 500 $\mu\text{g/l}$ or less according to primary water quality criteria (KSPCB, 2002). The permissible concentration of iron in drinking water is 300 mg/l as per the Indian standards (Awashthi 2000). Average value of Fe in water samples is exceeding in all the ponds except pond 1.

Manganese (Mn):

The world average concentration of Mn in the water bodies is 8 $\mu\text{g/l}$ (Drever, 1982). In the present investigation Mn levels in the Water samples varied from 5.0-99 $\mu\text{g/l}$ respectively (Figure 1). Its concentration was higher than the world average values in Pond 3.

Conclusion:

The average heavy metals concentrations in water samples are found varying greatly. The bioavailability of heavy metals in water is in the following order of $\text{Fe} > \text{Mn} > \text{Zn} > \text{Cu}$. Fish ponds of Bhadra fish farm are used to produce fish seeds from brood fishes of Chinese exotic carps and Indian major carps. Hence, it becomes necessary that the ponds should be properly maintained for the future generation.

References:

1. Anton Paar (1998): Microwave sample preparation System – Instruction handbook, Anton Paar GmbH, Graz, Austria, P. 128.

2. Awashthi, S.K. (2000): Prevention of food adulteration Act No. 37, of 1954, Central and state rules as amended for 1999, Editions, Ashoka Law House, New Delhi.
3. Drever, J.I. (1982): The Geochemistry of Natural Waters Prentice – Hall, Inc., Engle wood cliffs, N.j. 07632: 298.
4. Gupta, A., Rai, D.K., Pandey, R.S., & Sharma, B. (2009). Analysis of some heavy metals in the riverine water, sediments and fish from river ganges at Allahbad. Environmental Monitoring and Assessment, 157, 449-458. <http://dx.doi.org/10.1007/s10661-008-0547-64>.
5. Karnataka State Pollution Control Board, (2002): Water quality monitoring of lakes in and around Bangalore city, Vol. 2, KSPCB, Bangalore, P.58.
6. Lenore S. Clesceri (1998): Collection and Preservation of samples an metals., In: Arnold B. Greenberg and Andrew D. Eaton (Eds.) standard methods for the examination of water and waste water, Edition 20, APHA, AWWA, WEF, Washington DC : 1.27 – 1.35, 3.1-3.21.
7. Manjappa, S., and Puttaiah, E. T. (2005). Evaluation of trace metals in the sediments of river Bhadra near Bhadravathi town, Karnataka, India. Journal of Industrial Pollution Control, 21(2), 271–276.
8. McCormick, Sd., O’Dea, M. F., Moeckel, A. M., Lerner, D. T. and Bjornsson, B. T. (2005). Endocrine disruption of parr-smolt transformation and seawater tolerance of Atlantic Salmon by 4-nolyphenol and 17 β estradiol. General and Comparative Endocrinology, 142, 280– 288. <http://dx.doi.org/10.1016/j.ygcen.2005.01.015>.
9. Neethu Patil & Puttaiah. E. T 2014. Assessment of Heavy Metal Concentration in Downstream of Bhadra River, Karnataka. International Journal of Environmental Sciences Vol. 3 No.1: 22-26.
10. Riddell, D. J., Culp, J. M., & Baird, D. J. (2005). Behavioural response to sublethal cadmium within an experiment aquatic food web. Environmental Toxicology and Chemistry, 24, 431–441. <http://dx.doi.org/10.1897/04-026R.1>.
11. USEPA (1999). National primary drinking water regulation. United States Environmental Protection Agency.

Table 1: Levels of heavy metals ($\mu\text{g/L}$) in fish pond water samples

Pond No	Area (m^2)	Zn	Cu	Fe	Mn	pH	EC ($\mu\text{mhos/cm}$)
1	600	9	0.02	130	20	7.4	212
2	600	3	0.005	305	20	7.3	164
3	1000	76	0.02	642	99	7.3	232
4	1000	8	0.012	559	5	7.4	172
5	1500	2	0.002	365	20	7.2	212
6	1500	2	0.002	385	30	7.2	302

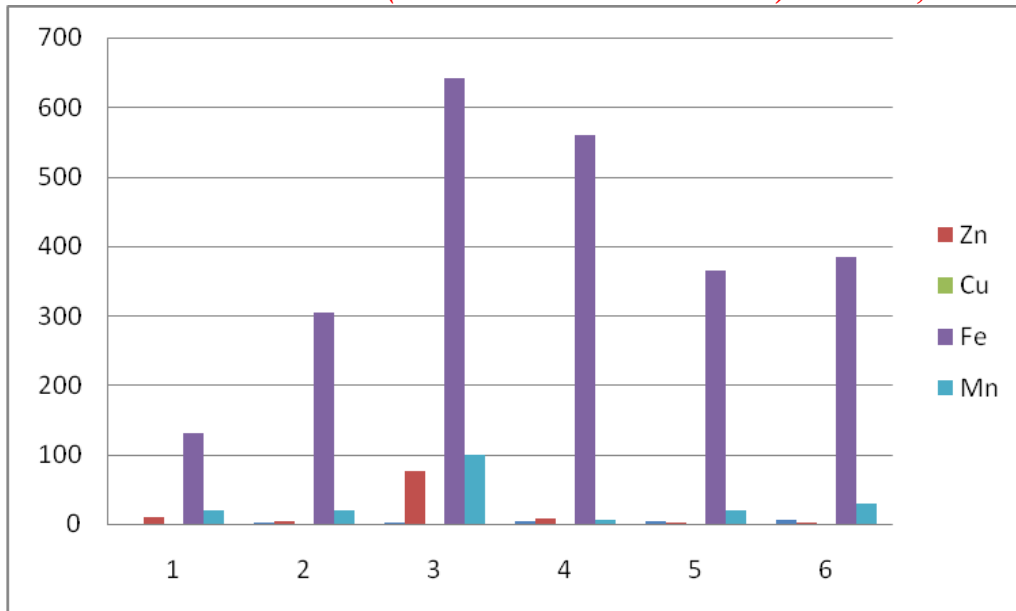


Figure 1: Concentration of heavy metals in the water of fish ponds