MUSSEL WATCH:
METAL CONTAMINATION ASSESSMENT IN VEMBANAD LAKE

*Prema, D., V. Kripa, Jenny Sharma, G. Shylaja, Preetha G. Nair, K. S. Aswathi
K. S. Abhilash, Rakesh Sharma, R. Jeyabaskaran and P. Kaladharan.

*Fishery Environment Management Division, Central Marine Fisheries Research Institute
P. B. No.1603, Kochi 682 018, Kerala, India. Email : premadicar@gmail.com

INTRODUCTION

Bivalves are filter feeders and are known as bio-indicators of the environment in which they live. Mussels are widely used for assessing the status of coastal environmental health, especially to monitor trace metal accumulation in the ecosystem (Lakshmanan and Nambisan 1983; Krishnakumar et al. 1998; Yap et al., 2004; Sasikumar et al., 2011; Spada et al., 2013). Trace metals in the ecosystem can exceed the permissible level by way of increased industrial pressure and other anthropogenic activities; particularly in the coastal areas (Shahidul-Islam and Tanaka, 2004; Kaladharan et al., 2011).

Based on its potential for aquaculture, the present study was initiated in order to evaluate the trace metal accumulation in Vembanad Lake (VL), opening to the Arabian Sea.

MATERIALS AND METHODS

Seeds of green mussel *(Perna viridis)* of weight ranging from 2.66 to 8.34 g collected from Neendakara Bay in December 2012, were stocked in VL at Moothakunnam, Munambam, Cherai and Njarakkal. The content of metals viz. Copper (Cu), Lead (Pb), Cadmium (Cd) and Zinc (Zn) in water collected from the stocked locations of VL were analysed during March to June 2013, using Voltammetry as per Anoop et al. (2007). Tissue samples of mussel were subjected to microwave digestion as per USEPA method 3052 SW-846 - Update III and assessed for initial and final content of Cu, Pb, Cd and Zn, by means of Atomic Absorption Spectrophotometer A Analyst 700 (Perkin Elmer) using standard procedures. Blanks and known standards were run for quality control. Standard reference material was used for quality assurance and the recovery of each metal was found to be above 90%.

RESULTS

WATER

- The Cu and Zn content in water were below permissible level of 1000 ppb as per the stipulated limit of USEPA (1986) in the VL stations at Moothakunnam, Munambam, Cherai and Njarakkal (Fig. 1and 2).
- The Pb content in water was NOT DETECTED during March – May but detected in June 2013 in Moothakunnam, Munambam and Njarakkal. The values were below permissible level of 50 ppb as per the stipulated limit of USEPA, 1986 (Fig 3).
- Content of Cd in water was found NOT DETECTED during March – May but detected in June 2013 in Munambam only (Fig 4). The values were much below the permissible level of 10 ppb as per the stipulated limit of USEPA (1986).

Fig 1. Copper concentration in water at selected locations of Vembanad Lake

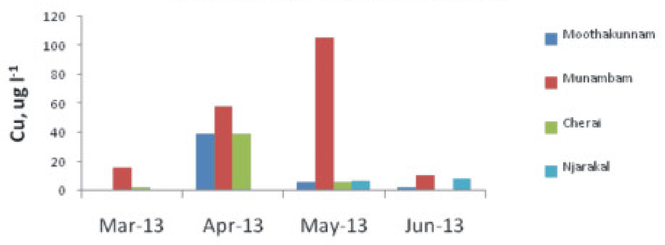


Fig 2. Zinc concentration in water at selected locations of Vembanad Lake

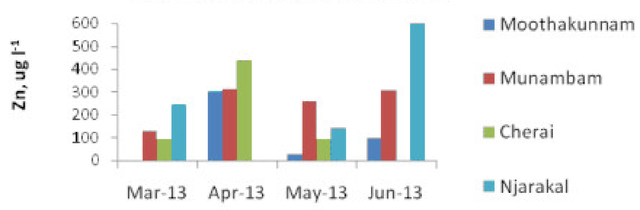


Fig 3 . Lead concentration in water at selected locations of Vembanad Lake

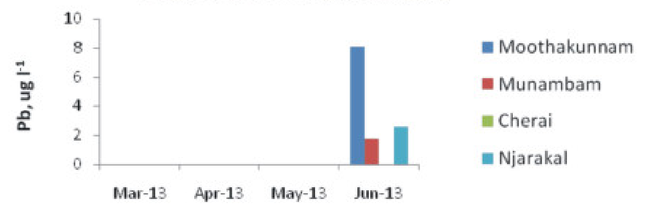
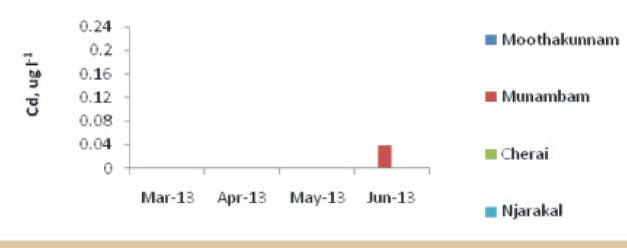


Fig 4. Cadmium concentration in water at selected locations of Vembanad Lake



RESULTS

MEAT

- The mean content and range of Cu, Zn, Pb and Cd in the initial sample from Needakara Bay and in the final harvested samples from the four VL stations where they were stocked are given in Table 1.

Metal	Location									
	Neendakara Bay (Initial)		Vembanadu Lake (Final)							
			Moothakunnam		Munambam		Cherai		Njarakkal	
	Mean	Range (N=6)	Mean	Range (N=5)	Mean	Range (N=5)	Mean	Range (N=5)	Mean	Range (N=5)
Cu, $\mu g\ g^{-1}$	Not Detected	Not Detected	Not Detected	Not Detected	Not Detected	Not Detected	Not Detected	Not Detected	Not Detected	Not Detected
Zn, $\mu g\ g^{-1}$	64.19	61.44 - 66.93	74.8	68.38 – 87.36	19.63	ND – 78.52	73.99	59.81 – 88.17	59.79	48.39 – 72.34
Pb, $\mu g\ g^{-1}$	3.33	2.92 – 3.74	4.00	2.47 – 6.60	2.26	ND – 5.65	7.19	5.63 – 8.74	0.37	4.15 – 5.96
Cd, $\mu g\ g^{-1}$	0.44	0.30 – 0.59	0.37	0.14 – 0.79	0.15	ND – 0.59	0.45	ND – 0.90	0.37	0.19 – 0.69

- The Cu content in tissue was NOT DETECTED in the initial meat sample from Neendakara Bay, as well as in the final samples from the stations viz. Moothakunnam, Munambam, Cherai and Njarakkal at VL.
- The mean content of Zn in meat sample from Neendakara Bay (64.19 ppm) and in the final samples from the same stations (Moothakunnam, Munambam, Cherai and Njarakkal) at VL (74.80, 19.63, 73.99, 59.79ppm respectively) also were much below the permissible level (217 ppm) as stipulated by WHO (1987), on meat dry weight basis.
- In Neendakara Bay (3.33 ppm) and in VL, in the stations viz. Moothakunnam, Munambam, Cherai and Njarakkal , the meat samples contained a mean Pb content (4.00, 2.06, 7.19, 4.86 ppm respectively), below the permissible level (9 ppm) as stipulated by WHO (1987), on meat dry weight basis.
- The mean Cd content in meat sample at Neendakara Bay (0.44 ppm) and in the above mentioned VL stations (0.37, 0.15, 0.45, 0.37 ppm) were below the permissible level for Cd (9 ppm) as stipulated by WHO (1987), on meat dry weight basis.
- Trace metals in mussels has been extensively studied from both ecotoxicological and seafood safety points (Krishnakumar et al. 1997; Glynn et al. 2003; Szefer et al., 2004; Prema et al., 2009; Sasikumar et al.,2011). But the results of the present investigation are unique as this is the first attempt of its kind in VL.

CONCLUSION

The above results indicate the suitability of the selected sites, viz. Moothakunnam, Munambam, Cherai and Njarakkal at VL for clean mussel / bivalve farming. No threats of the selected metal contamination or bioaccumulation above the permissible level in meat were observed during the grow-out period of six months. The meat was found to be safe for consumption with regard to the selected metal accumulation in the selected sites.

REFERENCES

Sasikumar, G, M. Krishnamoorthy, P. K. Krishnakumar and G. S. Bhat. 2011. Accumulation of trace metals in green mussel Perna viridis in the shellfish harvesting environment along southern Karnataka coast. Indian J. Fish., 58(1) : 53-58.

United States Environmental Protection agency (USEPA). 1986. Quality Criteria for Water. EPA 440/5-86-001. May 1986. Office of water regulations and standards. Washington DC., USA.

World Health Organization (WHO).1987. Evaluation of certain food additives and contaminants. Thirty-third report of the joint FAO/WHO expert committee on food additives. WHO Technical Report Series 776, Geneva.