BIOACCUMULATION OF HEAVY METALS AND PESTICIDES IN *VILLORITA CYPRINOIDES* (HANLEY) (PELECYPODA: CORBICULIDAE) FROM COCHIN BACKWATERS, KERALA

Dissertation submitted to the Mangalore University
in partial fulfillment of the requirements
for the Degree of
Doctor of Philosophy in Biosciences

by

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Dedicated to my

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Declaration

I hereby declare that this thesis entitled ***Bioaccumulation of heavy metals and pesticides in Villorita cyprinoides (Hanley) (Pelecypoda: Corbiculidae) from Cochin backwaters, Kerala*** *is the bona fide record of the original research work carried out by me under the supervision and guidance of* ***Dr. P. Kaladharan, Senior Scientist, Central Marine Fisheries Research Institute****, and no part of the thesis has been presented earlier for any other degree, diploma or similar titles of any University or Institution in India or abroad.*

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Certificate

This is to certify that the Doctoral Dissertation entitled ***Bioaccumulation of heavy metals and pesticides in Villorita cyprinoides (Hanley) (Pelecypoda: Corbiculidae) from Cochin backwaters, Kerala*** *is the authentic record of the original research work carried out by* ***Mr. Sivaprasad P. S., M. Sc.****, under my guidance and supervision and that no part of this dissertation has been submitted earlier for any other degree, diploma or similar titles of any other University or Institution in India or abroad.*

Ernakulam,
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Sivaprasad P. S.

Contents

Abstract

Bivalves are notorious for their ability to bioconcentrate contaminants and hence they can be used as effective indicators for monitoring trace toxic contaminants in coastal waters due to their wide distribution, sessile life style, euryhaline nature, resistance to stress and high accumulation of wide range of chemicals and ease of sampling. Bivalve resources of Kerala State mainly include different species of clams, oysters and mussels. During 2005- 2006 period, the total bivalve landing was about 61280 tones, of which 75% was contributed by a single species, *Villorita cyprinoides* (black clam). More than 90% of the total black clam production of the state is supported by Vembanad Lake system. Cochin backwaters, a part of Vembanad Lake system, one of the largest tropical estuaries along the west coast of India, is considered to be highly polluted due to effluent discharge from various sources.

The samples (water, sediment and black clam) for the present study were collected from one of the major canals of Cochin backwaters (Lat. 9^{0} 40' & 10^{0} 12' N and Long. 76^{0} 10' & 76^{0} 30' E) namely the Vemblai Canal. Samples for heavy metal analysis (water, sediment and black clam) were collected for a period of two years (January 2004 to December 2005). In the case of Organochlorine pesticides (OCPs), samples of water and clam meat were collected from the same site for a period of one year (January 2004 to December 2004).

The study revealed that the concentration of six heavy metals (As, Cd, Cr, Hg, Pb, Zn) and thirteen organochlorine pesticides (α BHC, γ BHC, β BHC, heptachlor, heptachlor epoxide, aldrin, dieldrin, endrin, ppDDE, opDDD, ppDDD, opDDT, ppDDT) found in *V. cyprinoides*, water and sediment are comparable to the earlier reports. Seasonal differences in the occurrence of heavy metal and pesticides are evident in the study. However, consistent statistically significant variations are rare. Environmental parameters like temperature, salinity and pH showed statistically significant correlation with few heavy metals such as Cd and Cr and OCPs like γ BHC, β BHC, aldrin, heptachlor epoxide, dieldrin and ppDDT. Higher values of

Bioconcentration factor (BCF) were obtained for almost all the heavy metals and organochlorine pesticide in the study. Values of Biotic sediment accumulator factor (BSAF) calculated for various heavy metals were moderately high for few metals. Seasonal difference is also evident in BCF and BSAF. Residual concentration of all the heavy metals and OCPs studied are within the safe limits prescribed by WHO and USFDA.

The results of this study enabled to conclude that *V. cyprinoides* possess the capabilities for accumulating heavy metals and OCPs from the surrounding medium. However, the bioaccumulation potential of the animal was found to vary with contaminants, seasons, levels in the surrounding medium and other unknown intrinsic and extrinsic factors. Therefore, the black clam can be used as sentinel organism in monitoring heavy metal and pesticide pollution in inland waters of Vembanad Lake systems. The residual limits of all the toxic contaminants are within the safe limits, and therefore the bivalve clam from Cochin backwater is safe and suitable for human consumption and for aquaculture as nutrient rich wet feed.

Acronyms

AAS	Atomic Absorption Spectrophotometer
Anon.	Anonymous
ANOVA	Analysis of variance
As	Arsenic
BCF	Bioconcentration factor
BDL	Below detection limits
BHC	Benzene hexachloride
BSAF	Biotic sediment accumulator factor
CBZ	Cominco Binani Zinc
Cd	Cadmium
CF	Concentration factor
Con.	Concentrated
Cr	Chromium
DDD	Dichloro diphenyl dichloroethane
DDE	Dichloro diphenyl dichloroethylene
DDT	Dichloro diphenyl trichloroethane
DO	Dissolved oxygen
ECD	Electron capture detector
EPA	Environmental Protection Agency
FACT	Fertilizer and Chemicals Travancore
FAO	Food and Agriculture Organization
FDA	Food and Drug Administration
GC	Gas Chromatorgraphy
H_2SO_4	Sulphuric acid
HCH	Hexa chlorohexane
HCl	Hydrochloric acid
Hg	Mecury
HIL	Hindustan Insecticides Limited
HNO_3	Nitric acid
IRE	Indian Rare Earths

MPEDA	Marine Products Export Development Authority
MRL	Maximum residual limit
ND	Not detected
OCPs	Organochlorine pesticides
op	ortho para
PAH	Polyaromatic hydrocarbons
Pb	Lead
PCB	Polychlorinated biphenyls
pp	para para
ppb	parts per billion
ppm	parts per million
ppt	parts per thousand
SD	Standard deviation
SPSS	Statistical Package for the Social Sciences
TCC	Travancore Cochin Chemicals
TCMC	Travancore Cochin Manufacturing Company
UCI	United Catalyst India
WHO	World Health Organization
Zn	Zinc
α	Alpha
β	Beta
γ	Gama

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