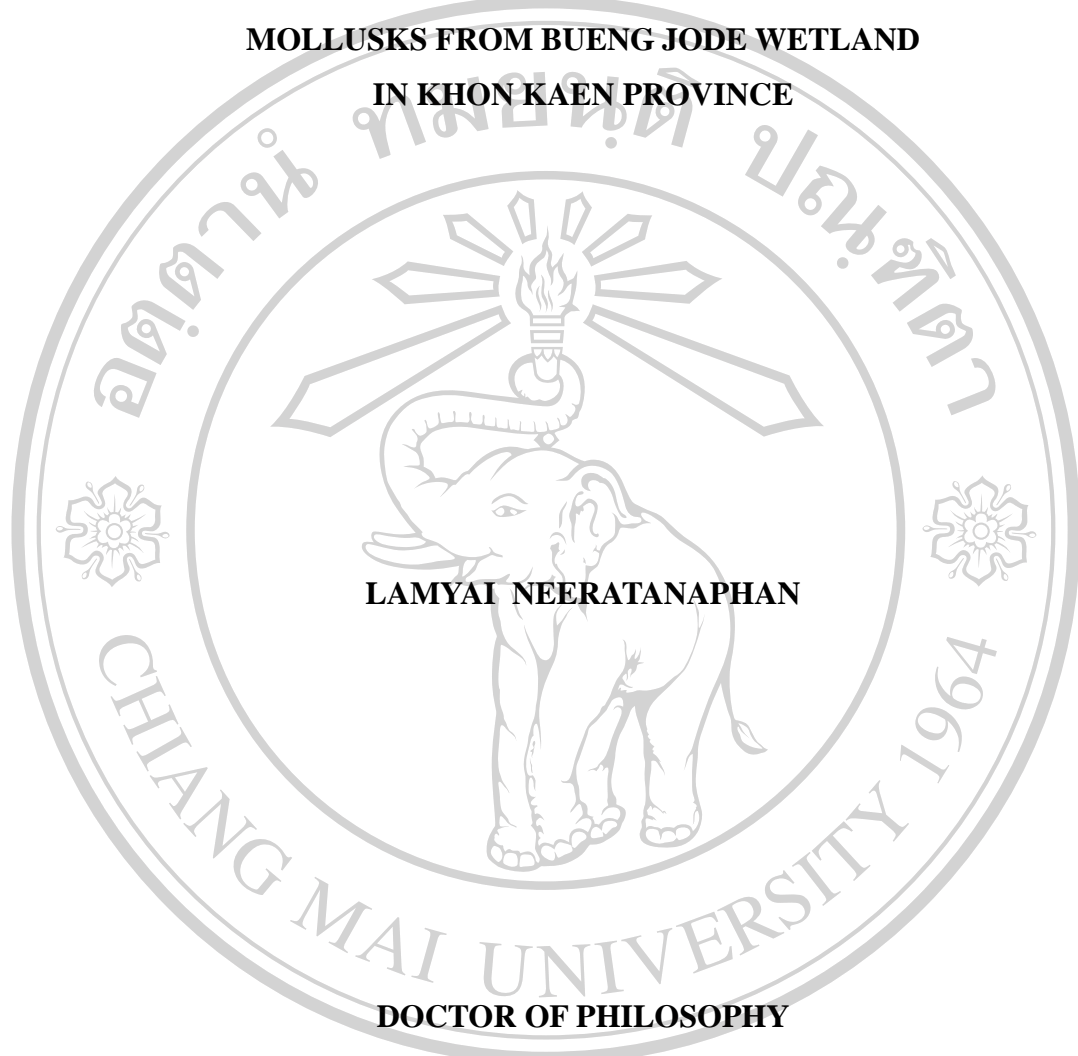


**ACCUMULATION AND TOXICITY OF HEAVY METALS ON EDIBLE
MOLLUSKS FROM BUENG JODE WETLAND
IN KHON KAEN PROVINCE**



LAMYAI NEERATANAPHAN

DOCTOR OF PHILOSOPHY

IN ENVIRONMENTAL SCIENCE

ลิขสิทธิ์มหาวิทยาลัยเชียงใหม่

Copyright© by Chiang Mai University

All rights reserved

THE GRADUATE SCHOOL

CHIANG MAI UNIVERSITY

MARCH 2009

**ACCUMULATION AND TOXICITY OF HEAVY METALS ON EDIBLE
MOLLUSKS FROM BUENG JODE WETLAND
IN KHON KAEN PROVINCE**



LAMYAI NEERATAPHAN

**A THESIS SUBMITTED TO THE GRADUATE SCHOOL IN
PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF**

**DOCTOR OF PHILOSOPHY
IN ENVIRONMENTAL SCIENCE**

ลิขสิทธิ์มหาวิทยาลัยเชียงใหม่
Copyright© by Chiang Mai University
All rights reserved

**THE GRADUATE SCHOOL
CHIANG MAI UNIVERSITY**

MARCH 2009

ACCUMULATION AND TOXICITY OF HEAVY METALS ON EDIBLE
MOLLUSKS FROM BUENG JODE WETLAND
IN KHON KAEN PROVINCE

LAMYAI NEERATANAPHAN

THIS THESIS HAS BEEN APPROVED
TO BE A PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF DOCTOR OF PHILOSOPHY
IN ENVIRONMENTAL SCIENCE

EXAMINING COMMITTEE

Yuwadee PeerapornpisalCHAIRPERSON
Assoc. Prof. Dr. Yuwadee Peerapornpisal

Chitchol PhalarakshMEMBER
Asst. Prof. Dr. Chitchol Phalaraksh

Weerah WongkhamMEMBER
Asst. Prof. Dr. Weerah Wongkham

Somporn ChantaraMEMBER
Asst. Prof. Dr. Somporn Chantara

Nathawut ThaneeMEMBER
Asst. Prof. Dr. Nathawut Thanee

Niwooti WhangchaiMEMBER
Assoc. Prof. Dr. Niwooti Whangchai

17 March 2009

© Copyright by Chiang Mai University

ACKNOWLEDGEMENT

I would like to express my appreciation to my thesis advisor, Assistant Professor Dr. Chitchol Phalaraksh for his many suggestions, guidance, keen interest, kindness and encouragement of my thesis work.

I am grateful to Assistant Professor Dr. Weerah Wongkham for his helpful recommendations, consultation and valuable suggestions on enzyme analysis technique, Associate Professor Dr. Yuwadee Peerapornpisal and Associate Professor Dr. Niwooti Whangchai for their helpful recommendations on this thesis.

I am deeply appreciated the assistant provided by Associate Professor Dr. Channarong Arannarot and Miss Yada Polsan, Department of Anatomy, Faculty of Medicine, Khon Kaen University, for their help, advice and recommendation regarding the electron microscopy.

I also give my gratitude to Assistant Professor Dr. Somporn Chantara for her helpful recommendation, consultation and valuable suggestions about heavy metals analysis, Assistant Professor Dr. Nathawut Thanee for his kind supervision, provision of reading proposals and discussions for improvement throughout this thesis work, Assistant Professor Dr. Pairat Tarbsripair for his consultation on mollusks identification.

I am deeply grateful to Assistant Professor Dr. Orrarujee Muanwong for her helpful recommendation, her keen interest, final proof-reading, editing comments and encouragement of my thesis work, Miss Patchareeyaporn Panyaarj, Miss Jariya Alongkornsopit and Miss Nawarat Muanglen for their assistance on field trip and experiment work.

I am grateful to financial support by the Commission on Higher Education (CHE) from my Master to Ph.D. degree. I also wish to acknowledge the financial support from the Fundamental Research Grant by the Graduate School of Chiang Mai University. I also thank all personnel from the Phoenix Pulp and Paper Company for guiding the way and collecting sample. Heavy metals analysis were performed at the

Laboratory Center for Food and Agricultural Products Company Limited (LCFA) in Khon Kaen and Chiang Mai. I also wish to thank the Freshwater Biology Laboratory at the Department of Biology, Faculty of Science, Khon Kaen University for physical-chemical measurement and mollusks identification.

Finally, I am deeply indebted to my parents, my beloved husband, Assistant Professor Wichai Neeratanaphan and members of my family for their love and encouragement.

Lamyai Neeratanaphan



ลิขสิทธิ์มหาวิทยาลัยเชียงใหม่
Copyright© by Chiang Mai University
All rights reserved