

**PHYSIOLOGICAL
RESPONSES OF FISHES
TO
PAPER MILL EFFLUENT**

Dr. Prasanta Nanda
(Associate Professor)
**Department of Zoology,
D.N.Government College,
Itanagar, Arunachal Pradesh, India.**

PHYSIOLOGICAL RESPONSES OF FISHES TO PAPER MILL EFFLUENT

Copyright © : Dr. Prasanta Nanda
Publishing Rights © : VSRD Academic Publishing
A Division of Visual Soft India Pvt. Ltd.

ISBN-13: 978-93-87610-04-0
FIRST EDITION, MAY 2018, INDIA

Printed & Published by:
VSRD Academic Publishing
(A Division of Visual Soft India Pvt. Ltd.)

Disclaimer: The author(s) are solely responsible for the contents compiled in this book. The publishers or its staff do not take any responsibility for the same in any manner. Errors, if any, are purely unintentional and readers are requested to communicate such errors to the Authors or Publishers to avoid discrepancies in future.

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system or transmitted, in any form or by any means, electronic, mechanical, photo-copying, recording or otherwise, without the prior permission of the Publishers & Author.

Printed & Bound in India

VSRD ACADEMIC PUBLISHING
A Division of Visual Soft India Pvt. Ltd.

REGISTERED OFFICE

154, Tezabmill Campus, Anwarganj, KANPUR – 208003 (UP) (IN)
Mb: 98999 36803, Web: www.vsrdpublishing.com, Email: vsrdpublishing@gmail.com

MARKETING OFFICE

340, FF, Adarsh Nagar, Oshiwara, Andheri(W), MUMBAI–400053 (MH)(IN)
Mb: 99561 27040, Web: www.vsrdpublishing.com, Email: vsrdpublishing@gmail.com

P R E F A C E

At the dawn of the civilization man was oblivious of the hazardous aftermath of his exploitation of nature which stems from the pollution of air, water and land. The environmental pollution has drastically upset the balance in the ecosystem resulting in the environmental crisis in modern days. In the early phase of the civilization the disproportion between man and space was not as glaring as it is today. The population explosion accounts for such an impasse. India is the most populous country in the world next to China. Her population constitute 16% of the world population. So, time present cries for the escalation of food production in order to feed the multitudes of men. The expansion of agriculture, industries and urbanization along with a considerable hike in food production has catered to the needs of modern man. There is not an iota of doubt that modern man is enjoying a comfortable life today but, as he has lacerated nature and defied the environment, our modern civilization reels under an insolent cause which would eventually pave way to man's total annihilation. The toxic refuses of the industrial establishments released into the rivers, streams, canals and lakes prove fatal to the fishes subjecting them into various types of physiological stresses.

Fresh water aquaculture is most significant and the urgent need of the hour as it provides the protein nutrients to the teeming millions of human population. Rivers, ponds and lakes are the main habitat of fresh water and brackish water fishes .Modern pisciculture looks forward to keeping up the good health of the fishes and their interminable growth in their ecological homes. It is observed that fresh water ecosystem is highly reactive to the organic as well as the inorganic pollutants

and their presence entails the high rate of mortality of the fishes. These fishes seem to be a sensitive bioindicator of aquatic pollution and are aptly used as test species in toxicological screening of pisciculture.

Due to rapid progress made in industrialisation without adequate environmental safety measures, pollution of water bodies in India has become a common feature. Pulp, paper and board mills are some of the major industries in our country. They are generally regarded as polluting industries because of the considerable material loss into the environment. Because of high oxygen demand of pulp and paper mill effluents, direct disposal to natural waterways is no longer allowed. Therefore, many paper mills have adopted some types of primary and in some cases secondary treatment to lower the BOD and COD to remove suspended particles. All treatments however produce effluents and sludge, which ultimately must be disposed of.

The orient paper mill (OPM) located at Brajarajnagar of Orissa was one of the biggest and oldest paper mills of India. The effluents of the mill are discharged to the river Ib after some preliminary treatments. However the downstream part of the river has considerable pollution exceeding the recommended Indian standard. Keeping this in view this piece of investigation has been carried out to study the effects of paper mills waste water on some biochemical and physiological changes of the fish, *Anabas testudineus* (BLOCH).

Any change in the morphology or behaviour of fish exposed to the effluents of paper mill may be considered as significant and sensitive symptoms useful in toxicological studies. Blood is used as a sensitive index to understand the physiology of a fish under normal and stressed conditions. Scanty information is available on

haemato-biochemical changes in fish under the stress of paper mill effluent. Hence an attempt has been made here to study the haemato-biochemical changes under the stress of paper mill effluent. The liver is also a vital organ as it regulates many metabolic activities in vertebrates including fish. This is immediately affected by any kind of stress. Any bio-chemical change in liver leads to many abnormalities in the metabolic activities of the fish. Muscle plays an important role in locomotion and any kind of movement in an animal. Muscle contraction is more or less a bio-chemical phenomenon. Hence any bio-chemical alteration in muscle leads to abnormal functioning of the muscle thereby endangering the survival of the fish. Toxic materials including paper mill effluent, adversely affect the respiratory physiology of an animal, which may lead to the death of the fish.

The thesis has been divided into 8 chapters. Chapter I deal with the introductory part of the thesis. Chapters II and III deal with the physico-chemical analysis of paper mill effluent and the determination of 96 hour L C₅₀ dose of this effluent to the fish, *Anabas testudineus* respectively whereas chapter IV incorporates the morphological and behavioural changes due to long term exposure to paper mill effluent. Chapter V deals with various aspects of the haematology of the fish under normal condition and under stress of paper mill effluent. The bio-chemical changes in blood, liver and muscle are presented in chapters VI. Chapter VII gives a picture of the changes in respiratory metabolism in the fish due to paper mill effluent toxicity. Whereas in chapter VIII bio-accumulation of some selected heavy metals in some tissues of the fish exposed to paper mill effluent has been presented.

 Dr. Prasanta Nanda

ACKNOWLEDGEMENT

A work of this would not have been possible without contribution of several. First I would like to thank my supervisor Prof.M K Behera for his guidance during the entire journey of my work.

I would like to thank Dr.K.C.Bhainsa, Scientist-F, Bhaba Atomic Research Centre for his constant help and encouragement during the work. I am also indebted to all my teachers who taught me the very basic of this subject.

Thanks are also due to several of my colleagues and friends including Dr.S.Panigrahi and Dr.H.Sharma.

Finally, I would like to thank my mother Mrs P.Nanda and wife Mrs.Suprava Babu for keeping me away from all family works and responsibility which enabled me to concentrate on this work.

 *Dr. Prasanta Nanda*

Dedicated
to
my daughters
Ayushi and Adyasha

CONTENTS

CHAPTER 1 : INTRODUCTION	1
1.1 THE ENVIRONMENT	3
1.2 AQUATIC ENVIRONMENT	4
1.3 AQUATIC POLLUTION	5
1.4 PAPER MILL POLLUTION	6
1.5 METHODS OF WASTE DISPOSAL	8
1.6 THE ORIENT PAPER MILL, BRAJRAJNAGAR	9
CHAPTER 2 : PHYSICO-CHEMICAL ANALYSIS OF PAPER MILL EFFLUENT	11
2.1 MATERIALS AND METHODS.....	15
2.2 RESULTS	15
2.3 DISCUSSION	16
CHAPTER 3 : DETERMINATION OF LC₅₀ DOSE OF PAPER MILL EFFLUENT	19
3.1 MATERIALS AND METHODS.....	23
3.1.1 EXPERIMENTAL DESIGN.....	23
3.1.2 TOXICITY TEST	24
3.2 RESULTS	25
3.3 DISCUSSION	25
CHAPTER 4 : BEHAVIOURAL AND MORPHOLOGICAL CHANGES IN FISH <i>A. testudineus</i> ON EXPOSURE TO PAPER MILL EFFLUENT.....	27
4.1 MATERIALS AND METHODS.....	30
4.2 RESULTS	31
4.3 DISCUSSION	32

CHAPTER 5 : HAEMATOLOGICAL RESPONSE OF <i>A. testudineus</i> ON EXPOSURE TO PAPER MILL EFFLUENT.....	35
5.1 MATERIALS AND METHODS	40
5.2 RESULTS.....	41
5.3 DISCUSSIONS	43
CHAPTER 6 : BIOCHEMICAL CHANGES IN SOME TISSUES OF <i>A. testudineus</i> EXPOSED TO PAPER MILL EFFLUENT	45
6.1 MATERIALS AND METHODS	51
6.2 RESULTS.....	51
6.3 DISCUSSIONS	53
CHAPTER 7 : RESPIRATORY METABOLISM OF <i>A. testudineus</i> ON EXPOSURE TO PAPER MILL EFFLUENT.....	57
7.1 MATERIALS AND METHODS	61
7.2 RESULTS.....	61
7.3 DISCUSSION	62
CHAPTER 8 : BIO-ACCUMULATION OF HEAVY METALS ON SOME TISSUES OF <i>A. testudineus</i> EXPOSED TO PAPER MILL EFFLUENT	65
8.1 MATERIALS AND METHODS	69
8.2 RESULTS.....	70
8.3 DISCUSSION	77
REFERENCES.....	83