## Acknowledgements

I would like to extend my sincere gratitude and respect to my supervisor, Prof. Susanta Kumar Chakraborty, Department of Zoology for his constant encouragement, support, and under whose aegis this thesis has been completed. After being motivated by him, I have obtained the energy, interest and dynamism not only to select a challenging field of research, blending both laboratory and field activities but also to overcome the complicated and subdued hurdles for the completion of this Ph.D. dissertation on spending nearly five odd years of research.

I would also like to express my gratitude to Prof. Ranjan Chakraborty, Hon'ble Vice chancellor of Vidyasagar University; respected Dr. Jayanta Kishore Nandi, Registrar of Vidyasagar University; Prof. Subrata Kumar De, Dean, Faculty of science; Prof. Jayanta Kumar Kundu, Head, Department of Zoology; and other faculty members of Zoology, Department of Vidyasagar University viz. Prof. Bidhan Chandra Patra, Dr. Biplab Kumar Mandal, Dr. Sagar Acharya, Dr. Priyanka Halder Mallick for providing necessary facilities and extending their help during the Ph. D. research process.

I am really grateful to all the respective members of the Ph.D. committee of Biotechnology under the academic leadership of Prof. Mrs. Chandradipa Ghosh, Prof. Keshab Chandra Mondal and Prof. Goutam Paul, Pro-vice chancellor of Kalyani University for their criticism from time to time to make my research venture successfully.

I shall fail in my duty to don't acknowledge the all-round help from two of my teachers Dr. Debdulal Banerjee, Department of Botany, Vidyasagar University and Dr. Santi Mohan Mandal erstwhile Assistant Professor of Microbiology Department, Vidyasagar University presently senior technical superintendent, Central Research Facility, IIT Kharagpur.

Special thanks to Dr. Mrs. Tanusri Mandal, Dr. Smarajit Maiti, Dr. Bidyut Bandyopadhyay, Oriental institute of science and technology for their constant support and encouragement during my Ph.D. at Vidyasagar University.

Acknowledgements

I am grateful to Prof. Subrata Mandal (retired principal of Panskura Banamali College), Prof.

Pavuluri Srinivasa Rao, Associate professor and Prof Satis Bal (retired professor) of

Agricultural and food Engineering Department, IIT Kharagpur for encouragement. I also like

to thanks my elder brother Prof. Sukhes Ranjan Bhoumik (Southern Illinois University,

School of Medicine) for their help and concern throughout my life.

I am really obliged to the help and best wishes from my co-researchers viz. Dr. Hirulal Pakhira,

Dr. Mrs. Sangita Maity Duta, Dr. Manjistha Bhattacharya, Dr. Kartic Bera, Dr. Subrata Jana,

Hirulal Pakhira, Ram Kumar Ganguly, Dr. Sujoy Middya, Md. Abdullah Al-Helal, Joydeb

Shamayl, Santanu Ghara, Santu Paria, Dr.Samaresh Samanta and laboratory staff viz. Tusar

Goswami, Dr. Dilip Chakraborty, Krishnendu Ghose, Bapi Doloi, all security guards, and many

respected persons. I am thankful to Prof. Ajay Kumar Mishra, Director USIC, Vidyasagar

University and Mr. Dipankar Mandal, Technical Officer of USIC, Vidyasagar University. I

like to express my deep passion to my respected parents for prayers they uttered and hopes

treasured. With emotions, I fail to gather words enough to acknowledge the affection and moral

support I received from my daughter Shubhangi. I extend my deep sense of love and gratitude

to my sister Shilpita, my wife Smritikana, my anti Falguni Paria and all my students, relative,

and friends who helped me in one way or another for this successful completion. I am also

thankful to the authority of West Bengal Pollution Control Board, Public Health Engineering

Department, and West Bengal for partial financial support.

Above all, I thank God for sailing me smoothly through the rough sea.

Place: Midnapore

**Date:** 20.11.2020

Kishalay Paria

Kishalay Paria.

viii