Dedicated to

My

Beloved Parents

DECLARATION

I hereby declare that the thesis entitled on **"Metal-free and Transition Metal Complex Mediated Synthetic Approaches towards the Development of Bioactive Compounds"** submitted for the award of Ph.D. Degree, is the result of investigations carried out by me at Department Chemistry, University of North Bengal under the supervision of Professor Bhaskar Biswas and further that no portion of this thesis has ever used as the foundation for the award of a any degree or fellowship.

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Dr. Bhaskar Biswas, Professor, Dept. of Chemistry

CERTIFICATE

I declare that **Mr. RAJANI KANTA MAHATO** has prepared the thesis entitled of**"Metal-free and Transition Metal Complex Mediated Synthetic Approaches towards the Development of Bioactive Compounds"** for the award of Ph.D. degree of University of North Bengal, under my supervision. He has completed his thesis work at the Department of Chemistry, University of North Bengal.

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Metal-free and Transition Metal Complex Mediated Synthetic Approaches towards the Development of Bioactive Compounds Thesis submitted to University of North Bengal in partial fulfillment of the requirements for the degree of Doctor of Philosophy in Chemisty By Mr. RAJANI KANTA MAHATO (M.Sc. in Chemistry) Supervised by Prof. BHASKAR BISWAS DEPARTMENT OF CHEMISTRY UNIVERSITY OF NORTH BENGAL DARJEELING -734013 WEST BENGAL, INDIA May 2023

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PREFACE

The journey of my research work related to my doctoral degree thesis entitled **"Metal-free and Transition Metal Complex Mediated Synthetic Approaches Towards the Development of Bioactive Compounds"** started in the year 2018 under the supervision of Dr. Bhaskar Biswas of the department of Chemistry at Surendranath College, Calcutta University, West Bengal, India. Later, I shifted to the University of North Bengal as a State fellow as Dr. Biswas joined to the Deartment of Chemistry, University of North Bengal. I admitted to the Ph.D. course work in January 2020 and successfully completed the same with CGPA 9.60 on 5th February 2021. I have been registered for the Ph.D. degree which effect from 2nd January 2020 with vides Ref. No. Ph.D/Chem. (1347) / 569 / R-2021.

Bioactive compounds are highly significant for their huge medicinal applications. Therefore, lots of research has been going on for the development of the bioactive compounds from a long time.

The current study deals with the production of the value-added bioactive compounds through the newly synthesized transition metal complex and metal-free synthetic routes. A variety of spectroscopic and analytical techniques, as well as single crystal X-ray diffraction examinations, have been used to characterise the synthesized compounds. Detail theoretical calculations using the Density Functional Theory (DFT) have been used to further correlate the structural characteristics with the theorical possibilities and for the proposed mechanisms of the reaction. Finally, the future direction of the exploration has been defined with respect to current scientific and industrial relevant.

Acknowledgement

First and foremost, I want to express my gratitude to God, the Almighty, for giving me the blessings for this long journey.

I would like to take this opportunity to express my sincere gratitude and debt of gratitude to my supervisor, Prof. Bhaskar Biswas, whose wise counsel, constant support, outstanding supervision, and care give me the freedom to conduct my research in a wonderful environment. I successfully overcame several challenges and learned a lot under his guidance. He has been the source of my unending inspiration as I have persevered down this wonderful doctoral study.

I want to extend my profound gratitude to Prof. Biswajit Sinha, Head of the Department of Chemistry at the University of North Bengal, for providing the administrative assistance and facilities I needed to complete my research. I greatly appreciate the assistance provided by all other faculty members and the department's non-teaching staff during the research phase.

For his prompt assistance and cooperation with Single Crystal X-ray diffraction experiments, I would like to express my gratitude to Dr. Angshuman Roy Choudhury of the Department of Chemical Sciences at the Indian Institute of Science Education and Research (IISER) Mohali. Additionally, I would like to express my gratitude to our esteemed national and international collaborators for providing me with invaluable experimental and theoretical support during my research study.

I am thankful to all my lab mates, especially Dr. Prafullya Kumar Mudi, Mr. Chanchal Kumar Pal, Mr. Suvojit Roy, Ms. Shreya Mahato, Mr. Subham Mukherjee, Mr. Sangharaj Diyali, Mr. Subhajit Saha, Mr. Subhankar Kundu, Ms. Ananya Debnath, Mr. Nilankar Diyali, Ms. Meena Chettri and all other research scholars of the department. I am also thankful to everyone who helped me, directly or indirectly to complete my research.

Finally, I express my heartfelt gratitude to my parents and my other family members for their unwavering love and support throughout this journey.

LIST OF TABLES

Table **Page No.**

LIST OF FIGURES

Figure **Page No.**

LIST OF APPENDIXES

Appendix **Page No.**