

*This work is  
dedicated to  
my Family*

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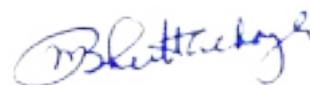
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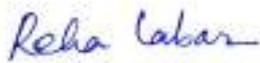
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# Declaration

I declare that the thesis entitled “Medicinal and molecular profiling of selected tea varieties of Darjeeling and Dooars” has been prepared by me under the supervision of Prof. Arnab Sen, Department of Botany, University of North Bengal and under the co-supervision of Dr. Malay Bhattacharya, Assistant Professor, Department of Tea Science, University of North Bengal. No part of the thesis has formed the basis for the award of any degree or fellowship previously.



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# Certificate

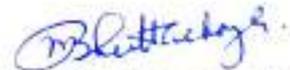
I certify that Miss. Reha Labar has prepared the thesis entitled "Medicinal and molecular profiling of selected tea varieties of Darjeeling and Dooars", for the award of Ph.D. degree of the University of North Bengal, under our guidance. She has carried out the work at the Department of Botany, and at the Department of Tea Science, University of North Bengal. The results incorporated in this thesis have not been submitted for any other degree elsewhere.



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# Preface

“A journey, after all, neither begins in the instant we set out nor ends when we have reached our doorstep once again. It starts much earlier and is never over because the film of memory continues running on inside of us long after we have come to a physical standstill. Indeed, there exists something like a contagion of travel, and the disease is essentially incurable” — *Ryszard Kapuscinski*.

The thought of pursuing research had already kindled within me when I was doing my master's in Visva Bharati. The thought of wanting to do something for my birthplace and my people made me keen on “Tea Research” since tea is what has given a worldwide identity to my Darjeeling and my people. Such a naive thought and it manifested into reality before I could even realize that it happened. It is said that Life is indeed a journey with different paths and every path I took, every door I knocked just kicked me somehow to the path where I started a new journey of Ph.D. in the Department of Botany, University of North Bengal. Everything seemed surreal when I joined as an RGNF

fellow under the project of Tea Research.

“At times, our light goes out and is rekindled by a spark from another person. Each of us has cause to think with deep gratitude of those who have lighted the flame within us.” – Albert Schweitzer

We should always develop an attitude of gratitude and be grateful for everything and every step we take with the help of others. Today, I take this opportunity to thank my supervisor Prof. Arnab Sen, Molecular Cytogenetics Laboratory, Department of Botany, University of North Bengal. Prof. Arnab Sen was the one who opened the door, welcomed me, and showed me the way when I had nothing in me that could contribute to his research endeavor. He neither tested me nor examined me and without hesitation or any reluctance asked me to join his lab from the very next day. The very first day he mesmerized me with his humility and the next moment I knew I belonged here. He had no idea about my capabilities but he allowed me to explore research, being in his team, and

always pushed me to find myself and do things on my own. He allowed me to fall and at the same time felt proud when I stood up on my own. Words are certainly not enough to express my gratitude to you. Not many people have the privilege to work under someone like you. I shall be forever grateful to you for giving me that privilege.

Albert Einstein once quoted, “In the middle of difficulty lies opportunity” and I am much privileged since my opportunity was knocked along with my co-supervisor, Dr. Malay Bhattacharya, Molecular and Tissue Culture Laboratory, Department of Tea Science, University of North Bengal. He made every path look easier when I was even reluctant to walk. He never allowed me to be still, instead encouraged me to keep moving. I shall always abide by your words, “First do it and we shall see what happens.” I do not have enough words to express my gratitude for the efforts you made for me and I shall always be indebted to you.

I am very much grateful to all the teachers of the Department of Botany as well as the Department of Tea Science. Their valuable suggestion and ideologies inspired me and helped me in shaping this thesis. I extend my gratitude to all the non-teaching staff of the Department of Botany who continuously worked round the clock

to make our work easier. Some knew more about our deadline of paperwork and like a savior, they walked from one lab to the other and reminded us beforehand while few of them constantly worked under the scorching heat taking care of the gardens and even the plants planted by the scholars. I am very much grateful for all the unconditional service you have provided to us. I would also like to thank the non-teaching staff of the Department of Tea Science who waited for us selflessly beyond their working hours.

“God sends help in disguise”, and I can't think of a better way to thank them than now. I owe my gratitude to Dr. Laxmikanta Padhi and his wife Dr. Tanmayee Mishra, Dr. Ritu Rai, and Dr. Pranay Bantawa, Mr. Jolen Tamang, and Mrs. Saroja Chettri, Dr. Tilak Saha, and his wife Mrs. Mosumi Sarkar Saha, and my little companion Manyata Saha aka Tinni. They were the ones that accepted me into their family, listened to me, cared for me, and even reprimanded me when I did something wrong. They made me feel at home when I was away from my home during my tenure.

Some left footprints to follow which made my journey easier and with due respect, I would like to thank all my senior Research colleagues, Dr. Ritu Rai, Dr. Ayan Roy, Dr. Sanghati

Bhattacharya, Dr. Indrani Sarkar, and Dr. Pallab Kar, and Mr. Arnab Chakraborty. I especially want to acknowledge the guidance, suggestion, and mentoring of my senior lab mates, Dr. Indrani Sarkar and Dr. Pallab Kar, and Mr. Arnab Chakraborty whose valuable guidance helped me in shaping my thesis.

There is a famous saying of Izaak Walton, “Good company in the journey makes the way seem shorter.” When you find a bunch of people walking down the same lane, the journey becomes way much adventurous, experiencing everything together, be it the low and high tides, the uphill and downhill roads, twists and turns, cool breeze, or the scorching heat. My journey of a Ph.D. would certainly be dreary without them. Today, I take this opportunity to thank each one of them. I appreciate the good company of my lab mates, Indrani Sarkar, Mousikha Lala, Soumita Bhattacharjee, Saroja Chettri, and Sandipan Ghosh. Things would have been much complicated, uninteresting, and tiring without my lab associates. Thank you very much for just being there for me and helping me in every possible way. I would also like to acknowledge my budding juniors Sutapa Dutta and Swarnendra Banerjee. I would feel regretful if I fail to mention the name of Mr. Basudev Singha whose presence in our lab

makes our work way much easier.

Ryunosuke Satoro quoted, “Individually, we are one drop. Together, we are an ocean.”

As we navigate through research, we should always be open to collaboration. Other people and their ideas can always be better than others. We should collaborate since as individuals we can do a lot, but as members of a team, we can achieve more. I am sincerely grateful since I got an opportunity to collaborate with such brilliant minds and I barely have any words to express my gratitude to them. I am very much indebted to the guidance and assistance of Prof. Tapas Kumar Kundu and his inquisitive and hard working scholar Miss Rini Labar, Nanotechnology Lab, Department of Physics, Visva Bharati. Working with them in collaboration not only helped me in shaping my thesis or my research work but also helped me to grow as an individual.

One should always be grateful even for the smallest help or a kind courtesy and generosity. Even a smile can make a difference to this world, forget about kind gestures. I would like to thank a bunch of people who were directly or indirectly helped me in every way possible during my research tenure. I am thankful to Smt. Dipali Sen, Mrs. Gargi Sen for their support, and homely feeling in Siliguri. I am

grateful to my landlord Shyam Ghosh and family whose presence made me feel like having a guardian away from home. I would also like to acknowledge the constant support provided by Mr. Angad Thapa and his family during a crucial time.

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“When I started counting my blessings, my whole life turned around.” – Willie Nelson. I have received the highest form of blessing in my family. I am blessed and feel lucky to be born as a daughter to Mr. Suresh Kumar Labar and Mrs. Nikita Labar. I would certainly not have arrived here today if they had not encouraged and supported me in every aspect of life. I have always idolized my father and mother and no one else. They taught me through their actions to never take things for granted but instead keep on moving ahead. They gave me my life, the ladder of dreams, steps of freedom, and zeal to pursue and move forward no matter what. They also gave me my dear siblings Miss. Rini Labar and Mr. Riaz Labar who has always been a constant support during my hard and smooth sailing of life. My sister Rini Labar is my friend and someone I have always looked up to. She has protected me in every aspect and she is the key to my inspiration and I have no regrets about following in her footsteps. My brother Riaz Labar is in awe of

inspiration and my only reason to keep me going since I have to show him the way my sister did. He has been the energy that keeps me going. I have no words for how grateful and blessed I feel being part of you and I can express my gratitude only through my unconditional love towards you all.

“Family isn't always by blood. It is the people in your life who want you in theirs; the ones who accept you as you are. The ones who would do anything to see your smile”- Nishan Panwar.

My in-laws Mr. Balaram Sundas and Mrs. Geeta Sundas became my parents as soon as I wedded their son. I feel blessed and I am grateful to them for all the things they have done for me and I respect their understanding towards my ambition and responsibility as a daughter. I feel extremely happy, lucky, and grateful to have them beside me as my support. I am also thankful to my dear sisters Prerna Subba, Asmita Sundas, and Aditi Sundas for their moral support and understanding.

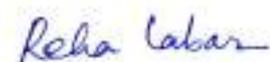
I have no words to express my gratitude towards my better half, Anupam Sundas. You certainly are my best friend, my guidance, and my inspiration. I am very lucky to have you as my life partner. I am indebted to you for all your support and understanding. You made my dream as

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I extend my gratitude to my family in Kalimpong, Teesta, and Tindharia. I will be always grateful for the admiration you showed towards me and my dreams.

I have saved the dear one and the merciful one for the last since without the glory and blessings of the Lord I would not have come across such a challenge to overcome my weakness. He gave me challenges, showed my weakness, and also sent help in all possible sources. His blessings touched me through various people I came across during this endeavor.

"I give thanks to you, O Lord my God, with my whole heart, and I will glorify your name forever." Psalm 86:12

  
09.03.2022

[REHA LABAR]

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