UV-B PROTECTANT ACTIVITY AND THE EFFECT OF PLANT EXTRACTS ON THE REGULATION OF HAEM OXYGENASE-1 GENE VIA Nrf2 AND ANTIOXIDANT RESPONSE ELEMENT

A THESIS
SUBMITTED TO
SVKM’s NMIMS (DEEMED-TO-BE) UNIVERSITY
FOR THE DEGREE OF
DOCTOR OF PHILOSOPHY
IN
BIOLOGICAL SCIENCES
BY

JUILEE SANJAY PATWARDHAN

UNDER THE SUPERVISION OF
DR. PURVI BHATT

SVKM’s Narsee Monjee Institute of Management Studies
(Deemed-to-be University)
V.L. Mehta Road, Vile Parle (W), Mumbai- 400056
SEPTEMBER, 2016
UV-B PROTECTANT ACTIVITY AND THE EFFECT OF PLANT EXTRACTS ON THE REGULATION OF HAEM OXYGENASE-1 GENE VIA Nrf2 AND ANTIOXIDANT RESPONSE ELEMENT

A THESIS
SUBMITTED TO
SVKM’s NMIMS (DEEMED-TO-BE) UNIVERSITY
FOR THE DEGREE OF
DOCTOR OF PHILOSOPHY
IN
BIOLOGICAL SCIENCES
BY
JUILEE SANJAY PATWARDHAN

Dr. Purvi Bhatt
(Project Mentor)
Sunandan Divatia School of Science

Dr. Aparna Khanna
(Dean)
Sunandan Divatia School of Science

SVKM’s Narsee Monjee Institute of Management Studies
(Deemed-to-be University)
V.L. Mehta Road, Vile Parle (W), Mumbai- 400056
SEPTEMBER, 2016
DECLARATION BY THE STUDENT

This is to certify that the work embodied in the thesis ‘UV-B protectant activity and the effect of plant extracts on the regulation of haem oxygenase-1 gene via Nrf2 and antioxidant response element’ for the award of the Degree of Doctor of Philosophy in Biological Sciences is my own contribution to the research work carried out under the supervision of Dr. Purvi Bhatt. The work has not been submitted for the award of any other degree/ to any other University. Wherever a reference has been made to earlier reported findings, it has been cited in the thesis. The thesis fulfils the requirements of the ordinance relating to the award of the Ph.D. degree of the University.

Place: Mumbai

Juilee Sanjay Patwardhan

Date:

Forwarded by:

Dr. Purvi Bhatt

Project Mentor and Assistant Professor,
Sunandan Divatia School of Science,
SVKM’s NMIMS (Deemed-to-be) University,
Vile Parle (W), Mumbai – 400056.
CERTIFICATE

This is to certify that the work described in this thesis entitled ‘UV-B protectant activity and the effect of plant extracts on the regulation of haem oxygenase-1 gene via Nrf2 and antioxidant response element’ has been carried out by Ms. Juilee Sanjay Patwardhan under my supervision. I certify that this is her bonafide work. The work described is original and has not been submitted for any degree to this or any other University.

Place: Mumbai

Date:

Dr. Aparna Khanna
Dean
Sunandan Divatia School of Science
Date:

Dr. Purvi Bhatt
Project Mentor
Sunandan Divatia School of Science
Date:

SUNANDAN DIVATIA SCHOOL OF SCIENCE
SVKM’s Narsee Monjee Institute of Management Studies
(Deemed-to-be University)
V.L. Mehta Road, Vile Parle (W), Mumbai- 400056
This Thesis is Dedicated to

My Family
ACKNOWLEDGEMENTS

With immense pleasure, I avail this opportunity to express my gratitude to my guide Dr. Purvi Bhatt (Assistant Professor, Sunandan Divatia School of Science, NMIMS) who has supported and encouraged me throughout my research work. She has been inspiring and supportive, and has always been there to listen and give advice since the days of my post-graduation.

I would like to express a sincere gratitude to my mother Mrs. Madhuri Patwardhan, my father Mr. Sanjay Patwardhan, my husband Mr. Gaurav Dange, my mother-in-law Mrs. Vasanti Dange and my father-in-law Mr. Rajiv Dange for their undying love and mental and emotional support throughout the mentally tiresome years of my research work. This would not have been possible without their constant encouragement. A simple thank you will not be enough for their efforts in making me who I am today.

I would like to sincerely acknowledge Dr. Aparna Khanna (Dean, Sunandan Divatia School of Science, NMIMS) for providing all the necessary facilities required for the research and also for her help and support throughout.

I was fortunate to get critical inputs, timely suggestions, untiring help and thought-provoking comments from my doctoral committee member Dr. Dhananjaya Saranth (Professor, Sunandan Divatia School of Science, NMIMS) which helped improve the quality of my research.

I will like to thank my doctoral committee members Dr. Nancy Pandita (Professor, Sunandan Divatia School of Science, NMIMS), Dr. Krutika Desai (Associate Professor, Mithibai College, Mumbai) and Dr. Ramchandra Joshi (Former Sr. Manager, R&D, Lupin) for their constant and timely suggestions, support and encouragement.
I will like to thank Dr. Kshitij Satardekar (Scientist and Head, Animal Biotechnology and Biochemistry Division, Scientific Research Centre, V.G. Vaze College, Mumbai) for providing the Human Dermal Fibroblast cells for the research work, without which the work would not be possible.

I will like to acknowledge Mrs. Leena Kulkarni (Assistant Professor, Sunandan Divatia School of Science, NMIMS) and Dr. Brijesh Sukumaran (Assistant Professor, Sunandan Divatia School of Science, NMIMS) for their significant help in the statistical analysis of my results.

I will like to thank Dr. Ganesh Vishwanathan (SAIF, IIT Bombay) and Mrs. Madhura Joshi (SAIF, IIT Bombay) for allowing me to use the Flow Cytometer facility and also for making me understand the troubleshooting and important steps in sample processing for Flow Cytometer analysis.

A heartfelt gratitude to Dr. Kirti S. Laddha (Dean, Department of Pharmaceutical Science and Technology, Institute of Chemical Technology) for a gift sample of marker compound Rutin. I will like to thank Dr. Bindu Gopalkrishnan (Department of Botany, Mithibai College) for her help in microscopic analysis of the plant materials. I will also like to acknowledge Mrs. Geeta Pai (Lab Assistant, SPPSPTM, NMIMS) for her immense help during the HPTLC analysis.

I will like to thank all the non-teaching staff of Sunandan Divatia School of Science, NMIMS and C.B. Patel Research Centre for their support and help throughout the work.

Last but not the least, my friends at Sunandan Divatia School of Science, NMIMS for always being there when they were needed the most. I will like to thank Ms. Sonam
Malhotra and Ms. Samira Kargutkar for their help during standardization of the endogenous antioxidant enzyme assays. Without you both around, this would not be possible. I will also like to thank Ms. Shruti Taparia and Ms. Shreelekha Dutta for enjoying the days of performing antioxidant assays together, will cherish those days forever. I will also like to acknowledge Ms. Roshani Vyavharkar, Ms. Divya Pillai, Ms. Shweta Salunke, Ms. Saniya Laheri and Ms. Maneka Hoonjan for their constant encouragement and selfless help whenever required. I will like to thank Mr. Vaibhav Jadhav, Mr. Sagar Chhabria, Ms. Akshata Raut and Ms. Mugdha Kunte for their help and troubleshooting advices during western blot and PCR experiments. Without their constant madness and a sense of humour, it would have been difficult to cope with the mentally stressful years of my life.

My heartfelt apologies for missing out anyone to be acknowledged. Your help, support and encouragement means a lot.

Date:               Ms. Juilee Patwardhan