INVESTIGATING ROLE OF INTRACELLULAR MESSENGERS AND ENERGY METABOLITES DURING STEM CELLS TRANSDIFFERENTIATION ON BIOENGINEERED PLATFORMS

Thesis submitted in partial fulfillment

for the Award of Degree

Doctor of Philosophy

by

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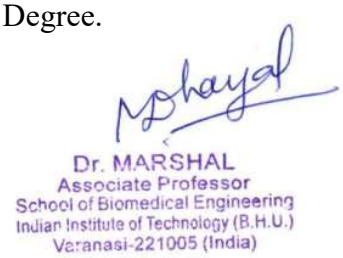

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Acknowledgment

I am thankful to my supervisor, Dr. Marshal, Associate professor, Nanocellular Medicine and Biophysics lab, School of Biomedical Engineering, India Institute of Technology (Banaras Hindu University) Varanasi 221005, UP, India. I owe him gratitude for granting me the opportunity of making the most from his wisdom and knowledge. He has been very supportive, patient and encouraging throughout the duration of my thesis. He has always been a source of inspiration and positivity.

I also extend my gratitude towards my Research Progress Evaluation Committee (RPEC) members, Dr. Sanjay Kumar Rai (Associate Professor, School of Biomedical Engineering) and Prof. Jahar Sarkar (Professor, Department of Mechanical Engineering), for their invaluable advice and assistance during my research, and evaluating my work and providing helpful feedback to improve it on time to time. Special thanks to Prof P. K. Roy for his reading of our manuscripts and for providing motivational support.

I am at a loss of words to express my feelings for the cherished moments and sweet memories I shared with my lab mates, Devdutt, Shubhangi, Shenlata, Shailendra, and Sanju. I am wholeheartedly thankful to them for being the stress-reliever with whom I shared many ups and downs. Thanks to Dr Aleem A. Khan and Dr. Sandeep Vishwakarma from Deccan Medical College, Hyderabad for supporting my research work and help me in obtaining results for animal experiments and stem cells. I thankful to Dr. A V S Sainath and Mr. Krushna K. Palodkar (IICT, Hyderabad) for synthesizing hydrophobic glycopolymers. Special thanks to Miss Sumedha and Mr. Taresh for being invaluable seniors and friends. I would also like to express my utmost appreciation and gratefulness to Suman Mam, Anjani, and Einstein.

Thanks to Mr. Ram Singh (ISLS, BHU) for helping in acquiring fluorescence images, Miss Priyanka (BHU) for extending her support during gene analysis and Mr. Bharat Vishwakarma (SBME) for his help in assisting in lab work and common facility. Lastly, I would like to thank all the faculty and staff of Biomedical Engineering for providing constant support, Central Instrumentation Facility (CIF), IIT (BHU) and Interdisciplinary School of Life Sciences (ISLS), BHU for providing all the facilities to support my research work.

Finally, yet most importantly, I would like to express my heartfelt thanks to my beloved parents for their blessings and I devote this work to the Almighty.

Juhi Jaiswal

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Preface

This thesis is submitted for the degree of doctor of philosophy at Indian Institute of Technology (Banaras Hindu University), Varanasi. The research described herein was conducted under the supervision of Dr. Marshal in the school of biomedical engineering, Indian Institute of Technology (Banaras Hindu University), Varanasi, between July 2017 to February 2022.

This work is the best of my knowledge, original except where acknowledgment and reference are made to previous work. Neither this nor a substantially similar thesis has been or is being submitted for any other degree, diploma, or other qualification at any other university.

Stem cell therapy is booming for providing valuable cells to repair or regenerate damaged cells and tissues that conventional medicines cannot cure. Understanding stem cell biology can lay the foundation for cell-based therapies of disease. The engineered material can act as a driver to guide stem cells to differentiate into a particular lineage. Thereby, exploiting the material properties can provide an effective strategy to generate the desired cells of our choice from the undifferentiated stem cells. Also, the differentiation process is an energy-driven mechanism, so analyzing the dynamics of the cell's powerhouse, mitochondria, can help understand the mechanism of differentiation and cell-material interaction. The comprehensive study of material properties and their correlation with energy metabolites and intracellular messengers can advance our knowledge in developing precise treatment modalities. The present thesis's objective was to investigate the role of intracellular messengers and energy metabolites during cell transdifferentiation on bioengineered platforms. This thesis will be beneficial for the researcher/ academics / industrial working in the area of stem cell therapy and regenerative medicine.

List of publications from part of this thesis work

1. **J Jaiswal**, M Dhayal, Electrochemically differentiated human MSCs biosensing platform for quantification of nestin and β-III tubulin as whole-cell system, Biosens. Bioelectron. 206, 114134 (2022).
2. D Sharma, R Devi, **J Jaiswal**, H S Dutta, R Khan, M Dhayal, A Highly Sensitive Immunosensor Based on In Situ Reduced Gold-Chitosan Nanocomposite for Detection of Monosodium L-glutamate. J. Biosyst. Eng. 46 (2022).
3. A K Singh*, **J Jaiswal***, M Dhayal, Platinum disc electrode for in-situ electrochemical inactivation of bacterial growth in culture media, J. Electroanal. Chem., 868, 114-119 (2020). (*Equal Contribution)
4. S K Vishwakarma, **J Jaiswal**, K H Park, C Lakkireddy, N Raju, A Bardia, Md. A Habeeb, S A B Paspala, A A Khan, M Dhayal, TiO2 Nanoflowers on Conducting Substrates Ameliorate Effective Transdifferentiation of Human Hepatic Progenitor Cells for Long-Term Hyperglycemia Reversal in Diabetic Mice, Adv. Therap., 1900205 (2020).
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6. **J Jaiswal**, M Dhayal, Electroanalytical Method for Quantification of Hepatocellular Carcinoma Cells as Charge Transport Barriers in Culture Media, Electroanalysis, 32, 890-897(2020).

List of publications patents from part of this thesis work

1. Marshal and **Juhi Jaiswal**, Indian Patent Application Number- TEMP/E-1/7430/2022-DEL; A Method for Electro/Electrochemical Differentiation of Stem Cells.
2. Marshal and **Juhi Jaiswal**, Indian Patent Application Number- TEMP/E-1/7199/2022-DEL; A System and Method for Electrochemical Detection and Quantification of Cell Characteristics and Functions.
3. Marshal and **Juhi Jaiswal**, Indian Patent Application Number - TEMP/E-1/18855/2020-DEL; An Anti-Microbial Multi-Layer Face Mask and a Method of Preparation Thereof.
4. Marshal, **Juhi Jaiswal** and Ashish Kumar Singh, Indian Patent Application Number -TEMP/E-1/16742/2020-DEL; Three Electrode System for Inactivation of Bacterial Cells.
5. Marshal and **Juhi Jaiswal**, Indian Patent Application Number - TEMP/E-1/41068/2019-DEL; A Novel Process for Synthesis of Metal Nanoparticles and a Product Thereof.
6. Marshal and **Juhi Jaiswal**, Indian Patent Application Number - TEMP/E-1/29577/2019-DEL; A Novel Space Filler Material for Postcancer Surgery and a Method of Preparation Thereof.