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to
My Beloved Parents

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ACKNOWLEDGEMENTS

It is indeed my proud privilege to express my deep sense of gratitude, respect, indebtedness and sincere regards to **my Supervisor, Dr. Manoj Kumar**, for his excellent supervision, skilled and valuable guidance, stimulating discussion, unfailing support, and immense help. I am grateful to him for his sincere concern throughout the research period that he has extended to me for the successful completion of my researchwork.

I wish to express my heartfelt thanks to **Prof. Nira Misra**, School of Biomedical Engineering, IIT (BHU) for her constant encouragement over entire period of my association with her. In fact, she has been a source of inspiration for me to have an optimistic approach in life and do my best. I am proud to have a teacher like her who is always motivative and supportive, even in most adverse situations.

I am thankful to **Prof. Rajeev Prakash, external RPEC member**, School of Materials Science and Technology, IIT (BHU) for giving me valuable suggestions throughout my research period. I wish to express my heartfelt thanks to **Prof. P. K Roy, Coordinator** of School of Biomedical Engineering, IIT (BHU) for his constant support.

I would like to express my sincere gratitude to **Dr. Sanjay Kumar Rai, DPGC Convener and internal RPEC member**, School of Biomedical Engineering, Indian Institute of Technology (BHU) for his valuable inputs, suggestions and affectionate attitude. It is a profound privilege to be a student of School of Biomedical Engineering, IIT (BHU). I would like to express my thanks to the faculty members of the school to **Prof. A K Ray, Prof. Ranjana Patnaik, Prof. Neeraj Sharma, Dr. Shiru Sharma, Dr. Sanjay Kumar Rai, Dr. Marshal, Dr. Pradip Paik, and Dr. Sanjeev Kumar Mahto** for their kind support at all moment during the progress of my research.

I would also like to express my sincere thanks to **Prof. Biswajit Ray**, Department of Chemistry, Institute of Science, Banaras Hindu University, Varanasi, for his valuable suggestions and support.

I would like to express my heartfelt gratitude to **Dr. Kunal Pal**, Department of Biotechnology and Medical Engineering, NIT Rourkela for providing me necessary characterization facility. I am highly thankful to **Dr. Santosh Kumar Singh**, Centre of Experimental Medicine and Surgery, IMS, BHU for allowing me to perform biocompatibility studies.

I am also grateful to the non-teaching staff members **Mr. Bharat Vishwakarma, Dr. Anuj Srivastava, Mr. Ajay Kumar, Mr. Bhuwaneshwari Sharan, Mr. Parmatma Nand Singh, Mr. Suresh Kumar** and **Mr. Kishori Lal** for their support and cooperation during my research work. I am also thankful to my friends **Mr. Shivesh Sabbarwal, Mr. Kedar Sahoo, Mr. Sambhav Vishwakarma, Smt. Rajshree Singh, Dr. Sarada Mallick, Mr. Sunil Kumar** and **Dr. Dheeraj Choudhary** for their unconditional support during this period.

Words plunge insufficient to express my regards and deep emotions to my **beloved grandparents** and my **parents** for being the source of unconditional love and inspiration to move on the way to my goal of achieving higher education. Their everlasting encouragement, patience, sacrifice and blessings have brought me up to this stage.

I would like to express my gratitude towards the **Central Instrumentation Facility Centre (CIFIC) IIT (BHU)**, Varanasi for providing me the necessary facilities for conducting my research work smoothly. I take this occasion to acknowledge the financial assistance provided by **Ministry of Human Resource and Development** in the form of Teaching Assistantship.

Finally, I bow my head humbly before the almighty **God** without whose consent and blessings, this work would have been impossible.

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Abstract

Chitosan based hydrogel has been reported for biomedical applications in the area of tissue engineering, wound healing and drug delivery. However, use of chitosan involves dissolution of chitosan in various types of acidic solvents (hydrochloric acid, acetic acid), which may impart toxicity to the hydrogel. Generally, these acids are very toxic in nature. If any residual amount of acid present in the final product, it may leach out to the nearby tissues and may cause damage to the tissue. Current thesis deals with the development of chitosan based hydrogels, which excludes the use of acidic solvents.

Initially, i have developed hydrogel based on chitosan lactate (water soluble) and Poly(vinyl alcohol), designated as PVA/CL composite hydrogel. These hydrogels composite were synthesized by chemical crosslinking using glutaraldehyde as crosslinker. Developed hydrogels were characterized by Fourier transform infrared spectroscopy (FTIR), X-ray diffraction (XRD), Attenuated total reflectance (ATR).

Whereas its crystallinity was investigated using Differential Scanning calorimetry (DSC). Furthermore, we have studied thermogravimetric analysis (TGA) of these hydrogels to know its stepwise rate of degradation. Water retention capacity of these hydrogels were evaluated by gravimetric method. While its mechanical properties were evaluated using Stress relaxation study. Using stress relaxation data, percentage stress relaxation was computed. Viscoelastic behaviour of hydrogels was confirmed by stress relaxation study. Moreover, its surface topology was studied using Scanning electron microscopy (SEM) and Atomic force microscopy (AFM). Prepared hydrogel toxicity was evaluated using L- 929 cell line (mouse fibroblast cell line) by performing MTT assay. Reduction in cell viability of the composite hydrogel was observed with increase in the compactness of hydrogel composite. Furthermore, cell viability was carefully evaluated using fluorescence microscopy studies. For its application in the area of topical bandage, its drug delivery capability was also examined by using ciprofloxacin as a model drug. This drug was loaded into the developed hydrogel and its release pattern was studied. Beside this drug release kinetics of all hydrogels were studied. The drug release profile was confirmed by formation of zone of inhibition against E.coli bacteria. Our studies demonstrate excellent antimicrobial properties in the drug loaded hydrogel. Our studies suggest

future application of the developed hydrogel in the area of drug delivery and as anti-infective coating and wound dressing.

Current studies has also undertaken studies on the development of PVA/ Chitosan oligosaccharide based composite hydrogel, designated as PCO composite hydrogel. Chitosan oligosaccharide exhibits excellent water solubility and good biocompatibility. These hydrogels were developed using glutaraldehyde as a chemical crosslinker and hydrochloric acid as a catalyst. Water retention capacity of these hydrogels was also studied. Furthermore, crystallinity, microstructure and surface topology of the hydrogels were studied using X ray diffraction, electron microscopy, and atomic force microscopy respectively. The porous nature of hydrogel has been confirmed by scanning electron microscope. Whereas, its molecular interaction between PVA and chitosan oligosaccharide due to crosslinking has been confirmed by Fourier transform infrared spectroscopy. Moreover, its wettability analysis was performed by measuring contact angle using plate method. Contact angle study was performed with respect to water as a test fluid. Furthermore, hydrogel thermal degradation kinetics was carried using thermogravimetric studies. This data was used to obtain various kinetics parameters such as activation energy (thermal stability), frequency factor and order of reaction of the hydrogel degradation through mathematical modeling. Further, hydrogel stress relaxation profile was obtained using Weichert model to understand its viscoelastic behavior. For biocompatibility evaluation, hydrogel was studied using L 929 cell line (mouse fibroblast cell line) by MTT assay and fluorescence microscopy. In order to know its biomedical application, Lomefloxacin was loaded as a model drug into the hydrogel and drug release kinetics was studied. Drug release kinetics was performed for all the developed hydrogels. Furthermore, using the hydrogel drug system, E. coli growth suppression was also studied. The sustained drug releasing property using hydrophilic drugs was observed in all the developed hydrogels. Our studies suggest great potential in these developed hydrogels for their future applications in the area of topical bandage, biomedical scaffold and drug delivery therapeutics, however further studies are required.