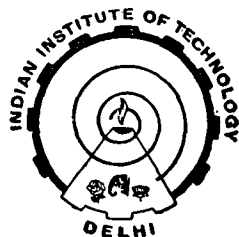


# **POLYMERS IN MEDICINE AND SURGERY : CELLULOSIC SYSTEMS**

By  
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CENTRE FOR BIOMEDICAL ENGINEERING

thesis submitted in fulfilment of the requirements of the degree of  
**DOCTOR OF PHILOSOPHY**  
to the Indian Institute of Technology, Delhi



**DEPARTMENT OF TEXTILE TECHNOLOGY  
INDIAN INSTITUTE OF TECHNOLOGY, DELHI**

**1983**

C E R T I F I C A T E

This is to certify that the thesis entitled,  
"POLYMERS IN MEDICINE AND SURGERY: CELLULOSIC SYSTEMS"  
being submitted by Mr. T. JAI MANGAL SINHA for the award  
of the 'degree of 'DOCTOR OF PHILOSOPHY' in TEXTILE  
TECHNOLOGY of the INDIAN INSTITUTE OF TECHNOLOGY, DELHI  
is a record of bonafide research work carried out by him  
under my guidance and supervision. To my knowledge, it  
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of the degree. The matter embodied in this thesis has  
not been submitted for the award of any degree or  
diploma of any other University or Institute.

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## A C K N O W L E D G E M E N T

Mere words are no substitute to express my deep sense of gratitude to my guide and mentor Prof. Dr. (Mrs) Padma Vasudevan under whose unparalleled guidance I could accomplish this task. Her keen interest, meticulous guidance, constant encouragement, healthy criticism and moral support have been indeed of great help to me.

I thank Prof. S.K. Guha and Prof. S.N. Tandon of Centre for Biomedical Engineering Research Centre, Indian Institute of Technology, and All India Institute of Medical Sciences, New Delhi for providing me all the necessary laboratory facilities.

Invaluable guidance of Dr. N.K. Mehra of Department of Anatomy, All India Institute of Medical Sciences in biocompatibility studies is gratefully acknowledge.

I am thankful to Dr. W.E. Dulin of Upjohn Co. Kalamanjoo, U.S.A. for gifting me streptozotocin.

I am grateful to Prof. K.S. Gopal Krishnan and Mr. P.K. Mehta of Centre for Biochemical Engineering, Indian Institute of Technology for their cooperation in in carrying out amino acid analysis studies.

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I am ever grateful to Dr. K. L. Jailakhani and Dr. V.S. Mehta, Department of Neuro Surgery, All India Institute of Medical Sciences, New Delhi and Dr. Durga Kumari of Oklahoma State University, U.S.A. for their help in various experiments.

Assistance from friends, technical staff in various forms are gratefully acknowledged.

I am grateful to Prof. M. S. Valiathan, Director Sree Chitra Tirunal Institute for Medical Science and Technology, Trivandrum for taking keen interest in my work and for providing me valuable guidance from time to time.

Financial assistance from Bhabha Atomic Research Centre, Bombay and Indian Council of Medical Research, Delhi are gratefully acknowledged.

Last but not the least I am ever grateful to my beloved brother Mr. T. G. K. Murty, my affectionate brother-in-law and sister Mr. and Mrs. P. R. Rao and my nephew master Raj Kumar for providing me all the drive and encouragement during last stages of my work and for providing all the necessary help during compilation of this thesis.

I owe my gratitude to my parents for what I am today.

  
( T. JAI MANGAL SINHA )

## ABSTRACT

Various chemical modifications of cellulose having applications in Medicine and surgery are reviewed. Cellulosic derivatives based on different methods of oxidation viz. sodium meta-periodate,  $\text{NaClO}_2$  as well as  $\text{NO}_2$  oxidation are described. Conditions of synthesis, chemical characterization, bio-degradation and bio-compatibility of these cellulose derivatives are discussed. Most of the possible applications of these oxidation products for sustained drug delivery were examined.

Available modes of insulin delivery were critically analyzed. Alzet mini osmotic pump was used as a model for achieving prolonged insulin delivery in streptozotocin diabetised monkeys. Parameters like blood sugar, intravenous glucose tolerance test were monitored. Osmotic pump is able to maintain sustained normoglycemia in diabetic monkeys for a period of 8 days. The total dosage being less than that required when insulin is given free. The drawback of the method is that it requires surgical implantation of the pump.

DAC was studied as a biodegradable carrier for sustained release of insulin in diabetic rabbits. Insulin DAC (Insulin depot) was characterized by spectroscopy, gel permeation chromatography, and photon correlation

techniques. Amino acids of insulin involved in binding to DAC were determined by amino acid analysis, to be Phe, Lys, Arg and Tyr. Sustained insulin delivery upto a maximum period of 14 days was observed in diabetic rabbit as model.

Prolonged topical drug delivery using DAC as a carrier was also studied from cellulosic wound dressings. Various antimicrobial agents chosen for sustained topical delivery were acriflavin, bacitracin, neomycin, and dihydrostreptomycin. Different modes of binding were attempted. Binding by lyophilization was found to show both instantaneous and prolonged antimicrobial activity indicating the presence of free as well as bound antimicrobial agent and was thus more suitable for wound dressing than completely immobilized samples. Mixture of DAC bound acriflavin, bacitracin, neomycin and dihydrostreptomycin was found to have wide spectrum antimicrobial activity. Also effect of the polymer on wound healing was studied. 6-Carboxy cellulose (CC) and 2,3,6-tricarboxy cellulose (TCC) were evaluated for hemostatic activity. Various parameters for blood coagulation were studied. The hemostatic activity was related to the generation of low pH environment. Lastly the spermicidal activity of CC and TCC were evaluated. TCC was found to have very good spermicidal activity which was again pH dependent.

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