Dedicated

To

Maa, Deuta,

Ankita,

&

Aaita

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Napaam, Tezpur-784028, Sonitpur, Assam, India

DECLARATION

I, do hereby declare that the thesis entitled " **Polysaccharide-based hydrogels and their potential applications**", submitted to the Department of Chemical Sciences, Tezpur University, under the School of Sciences is a record of original research work carried out by me. All sources of assistance have been assigned with due acknowledgment. I, also declare that neither this work as a whole nor any part of it has been submitted to any other University or Institute for any kind of degree, diploma or award.

Dimpee Sarmah

Place: Tezpur University, Tezpur **(Dimpee Sarmah)**

Date: 11-05-2023

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CERTIFICATE OF SUPERVISOR

This is to certify that the thesis entitled "**Polysaccharide-based hydrogels and their potential applications**" submitted to Tezpur University, in the Department of Chemical Sciences, under the School of Sciences, in partial fulfillment for the award of the degree of Doctor of Philosophy in Science is a record of research work carried out by **Ms. Dimpee Sarmah** under my supervision and guidance.

All help received by her from various sources have been duly acknowledged. No part of this thesis has been reproduced elsewhere for award of any other degree.

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The committee recommends for the award of the degree of Doctor of Philosophy.

Principal Supervisor **External Examiner**

Date: **Date:**

PREFACE

The alarming utility and the ever-increasing demands of polymeric materials in today's world led to the development of high-performing hydrogel for myriad applications. Amidst them, fabrications of polysaccharide-based materials have received remarkable attention due to their easy availability, biocompatibility, biodegradability, and affordable cost. The concept of "going green" and "sustainability" arises due to reducing the global impact associated with the synthetic monomer-based polymer industries. Therefore, a huge attention is devoted to the development of eco-friendly polymeric materials using renewable resource-derived materials for multifaceted applications. Polysaccharides are one of the most potent renewable sources for hydrogel fabrication due to their hydrophilicity, easy availability, and low cost. The backbone of these natural polymers can be grafted with different synthetic monomers to obtain bio-based polymeric materials with high performance. Thus, using one specific polysaccharide, different hydrogels can be obtained with attractive properties. Moreover, the properties can be tailored to achieve a specific material for the targeted applications. Thus, investigating the potential applicability of these materials, the present work focuses on the fabrication of polysaccharide-based hydrogels for advanced applications including agricultural, wastewater treatment, and biomedical field. Different starch modified hydrogels with diverse properties including high swelling ability, high adsorption capacity, mechanical toughness, self-healing ability, controlled release attribute, and swelling-induced mechanical strength have been developed to perform the aforementioned applications. Therefore, the work divulges a new avenue to synthesize high-performing starch-based smart hydrogels with remarkable properties and reflects the potential for utilization in modern applications in various fields.

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Place: Tezpur University, Tezpur **(Dimpee Sarmah)**

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LIST OF ABBREVIATION AND SYMBOLS

%	Percentage
°	Degree
3D	Three-dimensional
°C	Degree centigrade
AA	Acrylic acid
AAS	Atomic adsorption spectrophotometer
AIBN	2,2'-azobisisobutylonitrile
AM	Acrylamide
APS	Ammonium persulfate
a.u.	Arbitrary unit
ASTM	American society for testing and materials
BS	*Bacillus subtilis*
$CaCl_2$	Calcium chloride
$CaCO_3$	Calcium carbonate
$CaSO_4 \cdot 2H_2O$	Calcium sulfate dihydrate
CH_3OH	Methanol
cm	Centimeter
CMC	Carboxymethylcellulose
CR	Congo red
DMAB	4-Dimethylaminobenzaldehyde
DN	Double network
DSC	Differential scanning calorimetry
DTG	First derivative
ECH	Epichlorohydrin
eV	Electron volt
FESEM	Field emission scanning electron microscopy
FTIR	Fourier transform infrared
g	Gram
g/mol	Gram per mole
h	Hour
HA	Hydrophobically associated

HCl	Hydrochloric acid
IM	Inverted microscopy
IPN	Interpenetrating polymer network
k	Rate constant
kg	Kilogram
kJ	Kilojoule
kN	Kilonewton
kPa	Kilopascal
kV	Kilovolt
LB	Luria-Bertani
m	Meter
MBA	*N, N*-methylene bisacrylamide
MB	Methylene blue
min	Minute
mL	Milli litre
mm	Milli meter
MPa	Megapascel
MTT	3-(4,5-dimethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide
mol	Mole
mV	Millivolt
NaCl	Sodium chloride
$NaIO_4$	Sodium meta periodate
NaOH	Sodium hydroxide
OS	Oxidized starch
PAA	poly(acrylic acid)
PAM	Poly(acrylamide)
PDMS	poly(dimethylsiloxane)
PEG	poly(ethylene glycol)
PNIPAAm	poly(*N*-isopropylacrylamide)
PVA	Poly(vinyl alcohol)
s	Second
SA	*Staphylococcus aureus*
SAH	Superabsorbent hydrogel

SDBS	Sodium dodecylbenzene sulfonate
SDS	Sodium dodecyl sulfate
SEM	Scanning electron microscopy
SMA	Stearyl methacrylate
TEA	Triethylamine
T_g	Glass transition temperature
TGA	Thermogravimetric analysis
UTM	Universal testing machine
UV-vis	Ultraviolet-visible
XPS	X-ray photo electron spectroscopy
YE	*Yersinia enterocolitica*
λ	Wavelength
μL	micro litre(s)
μm	micro meter(s)

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