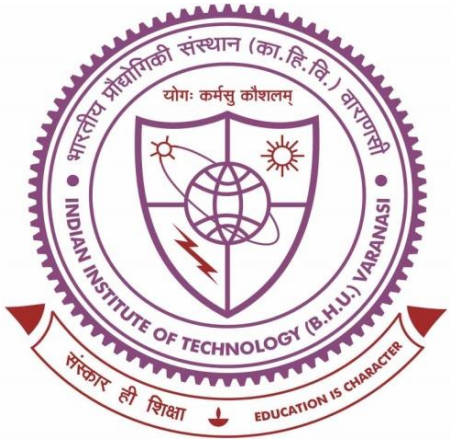
# Development of Luffa Cylindrica-based Scaffolds for Biomedical and Environmental Applications




**Thesis submitted in partial fulfillment for the Award of Degree**

## Doctor of Philosophy

**by**

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It is certified that the work contained in the thesis titled **"Development of Luffa Cylindrica-based Scaffolds for Biomedical and Environmental Applications"** by **"Ms. Shravanya Gundu"** has been carried out under my supervision and this work has not been submitted elsewhere for a degree.

It is further certified that the student has fulfilled all the requirements of Comprehensive Examination, Candidacy and SOTA for the award of Ph.D. Degree.

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I, **Shravanya Gundu,** certify that the work embodied in this thesis is my own bona fide work and carried out by me under the supervision of **Dr. Sanjeev Kumar Mahto** from **Decemeber 2017 to October 2023** at the School of Biomedical Engineering, Indian Institute of Technology (BHU), Varanasi. The matter embodied in this thesis has not been submitted for the award of any other degree/diploma.

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**Place: Varanasi**

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It is certified that the above statement made by the student is correct to the best of our knowledge.

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**Date:** 01/11/23 **(Shravanya Gundu)**

**Place: Varanasi**

# *Dedicated To….*
# *My Beloved*
## *Parents and In-laws,*
## *My Husband and Son,*
## *My Loving Sister and Brother*

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| | |
|---|---|
| % | Percentage |
| ° | Angle |
| °C | Degree Celsius |
| µg | Microgram |
| µL | Microlitre |
| µM | Micro molar |
| µm | Micrometre |
| 2D | Two-dimensional |
| 3D | Three-dimensional |
| AFM | Atomic force microscopy |
| ALP | Alkaline phosphatase |
| ALT | Alanine aminotransferase |
| ANOVA | Analysis of variance |
| As | Sampling area |
| AST | Aspartate aminotransferase |
| ASTM | American Society for Testing and Material |
| ATR | Attenuated total reflection |
| au | Arbitrary units |
| BOD | Biological oxygen demand |
| BSA | Bovine serum albumin |
| $CaCO_3$ | Calcium carbonate |
| CAD | Computer-aided design |
| CK-MB | Creatine kinase-MB |
| $CO_2$ | Carbon dioxide |
| COD | Chemical oxygen demand |
| DAPI | (4,6-diamidino-2-phenylindole) |
| DIV | Days in vitro |
| DMEM | Dulbecco's modified Eagle's medium |

| | |
|---|---|
| DMSO | Dimethyl Sulfoxide |
| DNA | Deoxyribonucleic acid |
| DSC | Differential scanning calorimetry |
| ECM | Extracellular matrix |
| EDC | 1-Ethyl-3-(3-dimethylaminopropyl)-1-carbodiimide hydrochloride |
| FBS | Fetal Bovine Serum |
| FTIR | Fourier transform infrared |
| G | Gelatin |
| GA | Gelatin-alginate |
| GAA | Glacial Acetic Acid |
| GelMA | Gelatin Methacryloyl |
| GO | Graphene oxide |
| GTA | Glutaraldehyde |
| H&E | Hematoxylin and eosin |
| $H_2O_2$ | Hydrogen peroxide |
| HA | Hydroxyapatite |
| Hz | Hertz |
| IFCC | International Federation of Clinical Chemistry |
| IU/L or U/L | International Units per litre |
| KPa | Kilo Pascal |
| LC | Luffa cylindrica |
| L-flakes | Luffa flakes |
| LiBr | Lithium bromide |
| L-mat | Luffa mat |
| L-powder | Luffa powder |
| mg/dL | Milligrams per decilitre |
| MG-63 | Osteoblast cell-lines |
| mL/h | Millilitre per hour |
| MPa | Mega Pascal |

| | |
|---|---|
| MSC | Mesenchymal cells |
| MTT | (3-(4,5-Dimethylthiazol-2-yl)-2,5-Diphenyltetrazolium Bromide) |
| MWCO | Molecular weight cut-off |
| NaOH | Sodium hydroxide |
| NCCS | National Centre for Cell Science |
| NHS | N-Hydroxysuccinimide |
| nm | Nanometre |
| OD | Optical density |
| PBS | Phosphate buffer saline |
| PCL | polycaprolactone |
| PDMS | Polydimethylsiloxane |
| $P_E$ | Effective porosity |
| PEG | Polyethylene glycol |
| PGA | Poly(glycolic acid) |
| PH | Psyllium husk |
| P-L flakes | PDMS-Luffa flakes |
| P-L mat | PDMS-Luffa mat |
| P-L powder | PDMS-Luffa powder |
| PLA | Polylactic acid |
| PLGA | Poly (lactic acid-co-glycolic acid) |
| PVA | polyvinyl alcohol |
| PVDF | polyvinylidene fluoride |
| Ra | Arithmetical mean deviation |
| RGD | Arginine-Glycine-Aspartate |
| Rp | Highest peak |
| rpm | Rotations per minute |
| Rq | Root means square roughness |
| RT | Room temperature |
| Rt | Total height of the profile |

| | |
|---|---|
| Rv | Lowest valley |
| SA | Surface area |
| Sa | Average roughness |
| SD | Standard deviation |
| SEM | Scanning electron microscopy |
| SFF | Solid Freeform Fabrication |
| Sp | Highest peak height |
| Sq | Root mean square roughness |
| SRL | Sisco Research Laboratories |
| St | Area peak to valley height |
| Sv | Maximum area valley depth |
| t | Time |
| TCP | Tissue culture polystyrene |
| TEBM | Tissue Engineering and Biomicrofluidics |
| TEOS | tetraethyl orthosilicate |
| Tg | Glass transition temperature |
| TGA | Thermogravimetric analysis |
| Tm | Melting temperature |
| TSS | Total suspended solids |
| UTM | Universal testing machine |
| V | Apparent volume |
| $W_d$ | Dry weight |
| $W_f$ | Final weights |
| $W_i$ | Initial weight |
| $W_w$ | Wet weight |