Joy Prokash **Debnath**

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Education

Shahjalal University of Science and Technology (SUST) *Sylhet 3114, Bangladesh*

Bachelor of Science (B.Sc.) in Biochemistry and Molecular Biology *2020 – 2025*

- CGPA: 3.58 out of 4.00
- Graduation delayed due to the COVID-19 pandemic

Research Experience

1. Undergraduate Research Assistant

BMB, SUST

Supervisor: Dr. Tanvir Hossain *Oct 2022 – July 2024*

Responsibilities and Experience

- Implemented a full RNA-seq workflow in bash from FASTQ to raw counts, leveraging both splice-aware alignment and quasi-mapping for gene quantification.
- Utilized SRA and GEO to retrieve raw transcriptomic data (microarray and RNA-seq) and compared statistical models such as edgeR, limma, and DESeq2 based on Differentially Expressed Genes (DEGs).
- Constructed collective dynamics of gene networks to reveal functional modules and hub genes enriched in biological pathways.
- Benchmarked fifteen supervised learning models in PyCaret and utilized the best-fitted classifier to validate the biomarkers based on discriminatory power.

Publications

- **Identification of potential biomarkers for 2022 Mpox virus infection: a transcriptomic network analysis and machine learning approach**, Published in Scientific Reports.
- **Upregulation of RRAD in Monkeypox Infections**, Under Rivision.

2. Undergraduate Research Assistant

Laboratory of Genomics and Transcriptomics, BMB, SUST

Supervisor: Dr. Ajit Ghosh *Nov 2023 – Oct 2025*

Responsibilities and Experience

- Compared between random forest (gini) and XGboost (gain) feature importances to identify key dysregulated transcripts responsible for salinity stress across tomato variants.
- Extracted total RNA from plant samples on different time points of salt stress, followed by cDNA library preparation and nanodrop quantification.
- Ran PCR with housekeeping (EF1α) and target-gene primers to confirm cDNA synthesis and primer specificity simultaneously, visualizing bands on agarose gel electrophoresis.
- Validated candidate biomarkers by qRT-PCR, calculating relative log2 fold change from Ct values via the ΔΔCt method.
- Retrieved sequences using bash, profiled conserved domains and motifs of m6A regulators and built maximum-likelihood phylogenies with 1000-bootstrap in MEGA, visualized in iTOL.

Publications

- **Genome-wide identification and characterization of m6A regulatory genes in Soybean: Insights into evolution, miRNA interactions, and stress responses**, Published in PLoS One.
- **BioSalT (Biomarkers of Salinity Stress in Tomato): A Multigene Machine Learning Model for Early Salinity Stress Detection in Solanum lycopersicum**, Manuscript Under Preparation.

3. Remote Research Assistant

Child Health Research Foundation (CHRF), Dhaka

Supervisor: Preonath Chondrow Dev *Jun 2024 – Present*

Responsibilities and Experience

- Developed a backend with FastAPI, integrating R and Python workflows to automate cross-platform Differential Gene Expression (DGE) Analysis, visualization, building Biomarker-Algorithms (single- and multi-gene) and STRINGdb-based biomarker discovery.
- Implemented nested cross-validation for model building, using the inner layer for hyperparameter tuning.
- Utilized docker to achieve a reproducible version control system, Next.js and TypeScript to create an interactive Graphical User Interface (GUI), EC2 service of AWS for deployment.
- Constructing a multi-source gene expression database with DE matrices and using MLPRegressor for training DeepFold.

Publications

- **omicML: an integrative tool of bioinformatics and machine learning algorithms to identify transcriptomic biomarkers**, Submitted to Bioinformatics.

Ongoing Research (for Publication)

- **DeepFold: A Deep Learning Framework that Emulates Statistical Models for Differential Gene Expression Analysis.**

4. Remote Research Intern

Australian Institute for Bioengineering and Nanotechnology - AIBN, UQ, Australia

Investigator: Dr. Tanvir Hossain — *Feb 2025 – Aug 2025*

Responsibilities and Experience
- Conducted bulk ncRNA-seq analysis on cancer cell lines, including ADMSC, BMMSC, HeLa, MCF7, MDAMB231, TM6, A549, H1975.
- Analyzed the expression profiles of Y and U glycoRNAs to examine their significance in extracellular vesicles (EVs), epithelial–mesenchymal transition (EMT) and in lung cancer.
- Filtered ncRNAs utilizing ncRNAtools part of RNAcentral API and selected best features by RFE-RF for ML analysis.
- Discovered nc-markers of EMT, EV, and lung cancer and common among all and analyzed their qRT-PCR validation result.

PhD Thesis Research
- **Chip Development for efficient glycoRNA Isolation and Marker-based Cancer Detection**, Thesis Defended.

5. Research Assistant

Bangladesh Medical University (BMU), Dhaka

Supervisor: Dr. S M Rashed Ul Islam — *Nov 2024 – Present*

Responsibilities and Experience
- Detected malignant samples of HNSCC by hispopathology, followed by multiplex and nested PCR to screen HPV.
- Utilized sanger sequencing of L1 viral gene and immunohistochemistry of host proteins (upregulated by HPV infection) for further validation.
- Utilizing molecular techniques to validate cancer specific biomarkers, retrieved through computation methods.

Publications & Conferences
- **Molecular screening of Head and Neck Squamous Cell Carcinoma patients for Human Papillomavirus**, Accepted for presentation at the IPVS 2025 – International Papillomavirus Conference, Bangkok, Thailand and Also accepted at the 11th Wuhan International Symposium on Modern Virology & Viruses 2025, Wuhan, China.

Ongoing Research (for Publication)
- **Machine Learning-Driven Identification and Quantitative Validation of Cancer-Specific Biomarkers across Multiple Carcinomas of Different Anatomic Sites**, Collaborative Work Between: Department of Surgical Oncology, Department of Otolaryngology–Head & Neck Surgery, and Department of Pathology, BMU; Department of Surgical Oncology, National Institute of Cancer Research & Hospital (NICRH); and BMB, SUST.

6. Research Assistant

Department of Chemistry, BUET · BMU · SUST

Supervisor: Papia Rahman — *Mar 2025 – Present*

Responsibilities and Experience
- Utilized DeepProfile framework for Oropharyngeal Carcinoma, integrating 26 GEO datasets and reduced the dimension with PCA for Variational Autoencoder (VAE) model training.
- Streamlined Integrated Gradients (IG), ensemble latent feature learning and TCGA survival benchmarking.
- Synthesized Ag-deposited Ni/rGO nanospheres and evaluated their electrochemical glucose-sensing efficiency, antibacterial activity, and antioxidant properties.

Publications
- **Deep Neural Profiling Reveals RAP1GAP2 as a Latent Regulator of Tumor Invasion in Oropharyngeal Carcinoma**, Manuscript under Revision.

Ongoing Research (for Publication)
- **Synthesis and Application of Ag-deposited Ni/rGO nanospheres in Glucose Sensing, Antibacterial Properties, and Antioxidant Activity**, Funded by SUST Research Center.

Publications

3. omicML: an integrative tool of bioinformatics and machine learning algorithms to identify transcriptomic biomarkers, Submitted to Bioinformatics

Submitted @ Bioinformatics, Oxford University Press — *Oct 2025*

J. P. Debnath, K. Hossen, M.S. Khandaker, S. Majid, M. M. Islam, S. Arefin, S. Sarker*, T. Hossain*, and P. C. Dev*

2. Genome-wide identification and characterization of m6A regulatory genes in Soybean: Insights into evolution, miRNA interactions, and stress responses

Published @ PLOS ONE, Public Library of Science — *Jul 2025*

S. B. Sayed, M. A. Rabbi, **J. P. Debnath**, K. Hossen, and A. Ghosh*

1. Identification of potential biomarkers for 2022 Mpox virus infection: a transcriptomic network analysis and machine learning approach

Published @ Scientific Reports, Nature Publishing Group UK — *Jan 2025*

J. P. Debnath, K. Hossen, S. B. Sayed, M. S. Khandaker, P. C. Dev*, S. Sarker*, and T. Hossain*

Conference Publications

1. Molecular screening of Head and Neck Squamous Cell Carcinoma patients for Human Papillomavirus

Accepted @ IPVS 2025 – International Papillomavirus Conference, Bangkok, Thailand; Accepted @ 11th Wuhan International Symposium on Modern Virology & Viruses 2025, Wuhan, China; Published @ NCBI GenBank (Public Repository) *Sep 2025*

M. S. Khandaker, S. M. R. U. Islam*, **J. P. Debnath**, K. Hossen, S. F. A. Razib, B. P. Dey, and S. F. A. Razib

Manuscripts Under Revision & Preparation

2. BioSalT: A Multigene Machine Learning Model for Early Salinity Stress Detection in *Solanum lycopersicum*

In Preparation *Oct 2025*

K. Hossen, **J. P. Debnath**, U. Datta, and A. Ghosh* **[Joined Co-First Authors]**

1. Deep Neural Profiling Reveals RAP1GAP2 as a Latent Regulator of Tumor Invasion in Oropharyngeal Carcinoma

Under Revision *Oct 2025*

J. P. Debnath, T. Hossain*, and P. Rahman*

Fellowship

National Science and Technology (NST) Fellowship

BSc (Honours) Research Fellowship, Ministry of Science and Technology (MoST), Dhaka, Bangladesh *2025*

Received **approx. $450** from the MoST to support undergraduate research thesis work.

References

Dr. Tanvir Hossain

Assistant Professor, Department of Biochemistry and Molecular Biology (BMB), Shahjalal University of Science and Technology (SUST), Sylhet

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Dr. S. M. Rashed Ul Islam

Associate Professor, Department of Virology, Bangladesh Medical University, Shahbag, Dhaka-1000, Bangladesh

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Preonath Chondrow Dev

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