

The 'OMICS' Era: Sequencing and Beyond



With the advances in DNA sequencing technology resulting in the birth of genomics towards the end of the last century, there was the advent of “OMICS” revolution. It continued with the technological advancements in high-throughput analyses of RNA

(transcriptomics), proteins (proteomics), lipids (lipidomics), carbohydrates (glycomics) and other metabolites (metabolomics). Subsequently, the popular suffix “OMICS” has been adopted in other scientific areas to denote studies undertaken on a high-throughput or genome-wide scale, currently resulting in more than 1000 different “OMICS” approaches; from pharmacogenomics and microbiomics, to more amusingly named disciplines such as ‘breathomics’ and even ‘urinomics’, demonstrating the incredible range of areas to which these techniques have been applied (Stagljar, 2016).

Recent studies involving transcriptome analysis, microbiomics, proteomics and metabolomics have provided a new insight to infinite dimensions of host-pathogen interactions and their impact on human health. This has resulted in better understanding of the disease processes. Each type of omics data, on its own, typically provides a list of differences associated with the disease. These data can be useful to identify markers of the disease process and to have an insight in to the biological pathways or processes that are different between the diseased and control groups (Hasin *et al.*, 2017).

OMICS approach in biology has also brought in a paradigm shift in the ‘one gene-one protein’ concept which has been dominating for many decades in biomedical sciences. Better understanding of the intricate network of molecular interactions involving proteins, lipids, carbohydrates and several other metabolites has lead to a level of complexity and emergent properties of biomolecules that cannot be explained using the traditional “one-by-one” analysis of individual cellular components.

Despite the striking success of omics-based disciplines, however, some scientists still have concerns about such a holistic approach to science. One justifiable concern is the lack of concordance and high error rates of particular high-throughput datasets resulting from “OMICS” analyses.

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Sometimes a dataset generated by one lab differs from another generated by some other lab using the same method (Stagljär, 2016). Technical difficulties, expensive instruments, rare expertise, and other related issues make the use of omics limited. Moreover, the enormous data generated from each omics study often with small sample size complicates the data interpretation and restricts the clinical value of such studies (Eriksson *et al.*, 2004).

OMICS approaches generate data to provide biological insight based on statistical inferences made on datasets that are typically large. However, the ability of omics approaches to produce meaningful insight into the disease process is very much dependent on available sample sizes, and in many settings an underpowered study may not only be a shot in the dark, missing true signals, but it is also more likely to produce false positive results (Hasin *et al.*, 2017). As the cost of generation and analyses of omics data continues to decrease, it is hoped that availability of more types and amounts of high throughput data and their effective analyses will provide us more meaningful information in the near future to understand host-disease interactions leading to development of individualized treatment regimens and personalized medicine.

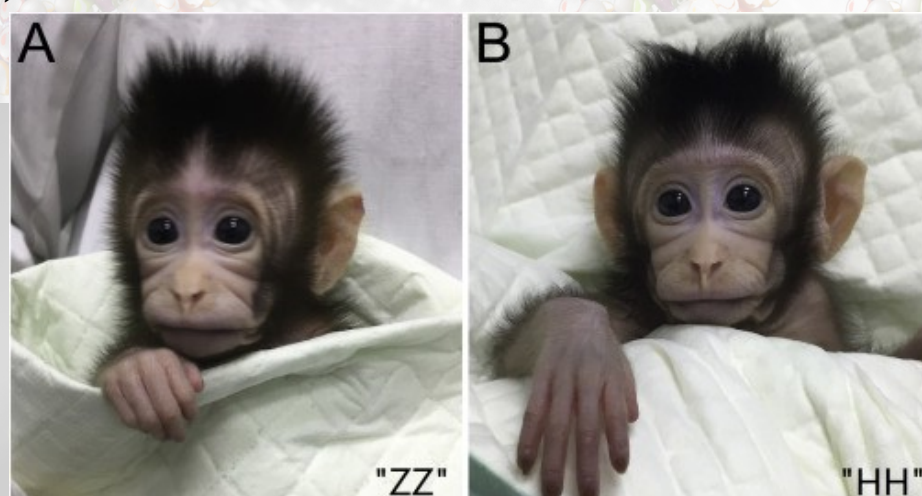
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- The Bharat Biotech International Limited of India has developed a new typhoid vaccine 'Typbar-TCVR' which is the first typhoid vaccine that is effective, safe and confers long-term protection for children aged six months to adults. The vaccine also obtained pre-qualification from World Health Organisation (WHO) and it can be procured through UN agencies like UNICEF, GAVI, etc.

https://www.bharatbiotech.com/press_releases.html/

- Zhong Zhong and Hua Hua are the first primates (long-tailed macaques) to be cloned by Chinese scientists. Both are produced by a process called somatic cell nuclear transfer (SCNT).



Cell 172: 881–887 (2018);

<https://doi.org/10.1016/j.cell.2018.01.020>

- A research team at SISSA (Scuola Internazionale Superiore di Studi Avanzati, International School for Advanced Studies) has introduced a new computerized simulation model (SPlit-and-conQueR model; SPQR) which can successfully predict different structures of the RNA filament starting from a sequence of nucleotides.

Nucleic Acids Research 46: 1674–1683(2017);

<https://doi.org/10.1093/nar/gkx1269>

- For the first time, a novel antibiotic producing bacterium belonging to the phylum Planctomycetes has been reported by researchers from University of Hyderabad, India. It is named as 'Anamox (Anaerobic ammonia oxidising) bacteria', as it can clean up ammonia waste from the environment besides producing antibiotic.

The Journal of Antibiotics (2018);

<https://doi.org/10.1038/s41429-018-0035-1> and

<http://uohherald.commuoh.in/antibiotic-producing-bacterium-found-in-buffalo-lake/>

- After the controversial breakthrough of pig–human hybrid in 2017, scientists have created the first interspecies sheep–human chimeric embryo which was grown up to 28 days. It was created by introducing human stem cells to sheep's embryo and it looks 99% like sheep, whereas tiny portions look like *Homo sapiens*.

<https://aaas.confex.com/aaas/2018/meetingapp.cgi/Paper/20877>

Compiled By Dr. Lukumoni Buragohain

State of Assam has adopted the Biotech Policy for the first time

Assam is now one of the few states of India having a separate Biotech Policy. This is certainly a landmark achievement in the journey of the relatively new Biotech sector in the state of Assam. The government has planned to implement different objectives within four years from 2018 to 2022. The Ministry of Science and Technology, Govt. Assam, working in tandem with few noted academicians of the state, related to the field has formulated the road map for the future of biotechnology in Assam. Dr. Probodh Borah, Co-ordinator of the Advanced State Biotech Hub, Assam Cum Professor & Head, Department of Animal Biotechnology, Faculty of Veterinary Science, Assam Agricultural University was also a part the five membered core group behind the preparation of the draft of the policy. The policy has been considered to be a comprehensive master plan for the biotechnology education, research and application in industrial sector. Following are the objectives of the policy:

- To create a vibrant ecosystem in the state for the development of human resources and industrial ventures.
- To promote education and research and development in biotechnology and allied areas.
- To promote employment generation through application of biotechnology for enhancement of production and growth in agriculture and allied sector.
- To encourage biotech industries in the state establishment of commercial biotechnology ventures.
- To support biotechnology business for wealth creation and enhance the contribution of biotechnology sector to state's economy substantially.
- To develop high quality infrastructure with the required support services for manufacturing units through state of art biotechnology parks.
- To leverage the existing biological (Agriculture, horticulture, forest, animal etc.) and natural (Oil, coal, etc.) resources through use of biotechnology

for socio economic development of the state.

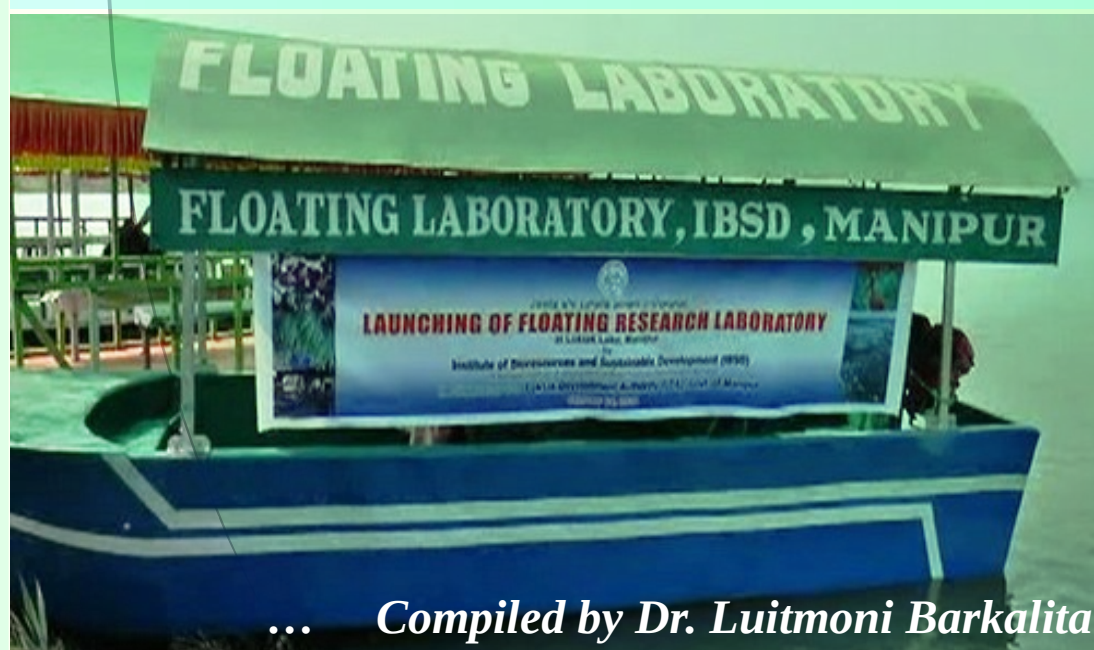
Academicians, Scientists students and entrepreneurs related to the field of biotechnology has whole heartedly welcomed and appreciated the timely step of the state government. Even though, everyone related to this sector is delighted to have the policy, at the same government's initiative for meaningful implementation of the objectives on ground will be monitored carefully by different sections of the society and that is going to be reflected in the next few years down the line.

Download link:

<https://advantageassam.com/assets/front/pdf/Biotechnology-Policy.pdf>

Floating Laboratory in Loktak lake, Manipur

Institute of Bio-resource and Sustainable Development (IBSD), a DBT institute in Imphal has launched a floating laboratory in the Loktak lake of Manipur. The laboratory was inaugurated by Manipur's Forest and Environment Minister, Thounaojam Shyamkumar Singh in Imphal on February 24th/2018. It is a laboratory on board, a boat. It took the institute about four months, to transform a ordinary boat to a fully functional laboratory laced with different modern equipments capable of monitoring many key parameters related to both biotic and abiotic component of the lake ecosystem. Dr. D. Sahu, Director of IBSD, Imphal is hopeful that the floating laboratory will be very helpful in conserving the now under threat lake ecosystem in Loktak.



... *Compiled by Dr. Luitmoni Barkalita*

Virulence profiling and molecular typing of *Staphylococcus aureus* isolated from bovine mastitis

A total of 60 *Staphylococcus aureus* isolates were recovered from clinically affected and normal cow milk. All the isolates were characterized based on their virulence gene profiles (*spa*, *nuc* and *coa* genes) and antibiotic sensitivity patterns. Four different restriction patterns were identified using PCR-RFLP of coagulase (*coa*) gene. *Spa* typing of these isolates revealed two different types, i.e. *t165* and *t1611*. Based on molecular typing by pulsed field gel electrophoresis (PFGE), type *t165* was reported to be endemic in the study area causing subclinical mastitis in cows.

Study on polymorphism of prolactin and prolactin receptor genes in indigenous ducks

A study was conducted to investigate the occurrence of polymorphism of Prolactin (*PRL*) and Prolactin receptor (*PRLR*) genes related to egg production traits in indigenous ducks of Assam. PCR-RFLP analysis of *PRL* gene using restriction enzyme *DraI* revealed three genotypes, AA, AB and BB with the frequency of 0.812, 0.069 and 0.119, respectively. It was found that the A variant of *PRL* gene was predominant in the indigenous ducks of Assam with the highest frequency of occurrence of the AA genotype.

Formulation of a suitable medium for vitrification of goat follicular oocytes

Standardized a medium supplemented with 0.5 M sucrose in 5 M Ethylene glycol and 5 M Propylene glycol cryoprotectants suitable for vitrification of goat follicular oocytes, which can ensure higher survivability rate of vitrified oocytes.

Application of Chitosan nanoparticles as vaccine adjuvants

Standardized a procedure of synthesis of Chitosan nanoparticle (ChNP) adjuvanted *Salmonella* Typhimurium outer membrane vesicle (OMV) complex vaccine. The ChNP-OMV (*S. Typhimurium*) vaccine was found capable of inducing quick immune response in mice and chicken.

New R & D project on metagenomics initiated

A new DBT-funded research project on “Analysis of Gut Metagenome of Duck (*Anas platyrhynchos*) with special reference to Identification of Bacteria having Probiotic Potential” has recently been initiated in the Advanced State Level Biotech Hub in collaboration with Department of Animal Nutrition and Department of Animal Genetics and Breeding, College of Veterinary Science, Assam Agricultural University, Guwahati, Assam. Dr. Probodh Borah, Coordinator, ASBTHub and Head, Department of Animal Biotechnology is the Principal Investigator of the project.

Isolation, toxin profiling and molecular characterization of *Clostridium difficile* from raw meat, meat products and fish products

A total of 17 *Clostridium difficile* isolates were recovered from raw meat, meat products and fish product samples, six of which were found positive for toxin production. Toxigenic isolates from chicken samples possessed both *tcdA* and *tcdB* genes (A+B+), while all the pork isolates carried variant toxin genes (A-B+). All the (A-B+) isolates from pork were found to harbour the binary toxin genes (*cdtA* and *cdtB*). Detection of PaLoc region comprising regulatory genes *tcdC*, *tcdR* and *tcdE* revealed that the toxigenic chicken isolates (A+B+) possessed *tcdC* and *tcdE*, while the toxigenic pork isolates (A-B+) carried *tcdR* and *tcdE*, respectively. *Clostridium difficile* isolates from pork and dry fish were found sensitive to the ciprofloxacin and cefotaxime, while chicken isolates were sensitive to only ciprofloxacin.

Isolation of bifidobacteria with probiotic potential from animal sources

A total of 12 isolates of *Bifidobacterium spp.* were recovered from various sources, viz. milk, faeces and ruminal contents. Based on in vitro assay, two of these isolates obtained from faeces of piglets belonging to *B. animalis* subsp. *lactis* possessed promising probiotic potential.

Cultivation of pig fibroblasts in cell culture

Pig fibroblast cells were isolated and characterized at primary and subsequent subcultures. The time required to attain 70% confluence in primary culture of fetal fibroblast cells was found significantly lower than the adult fibroblast culture. Cell viability was found to be significantly better from the third subculture onwards up to the sixth subculture.

Application of Aluminium hydroxide nanoparticles as vaccine adjuvant

Standardized the procedure of preparation of an aluminium hydroxide nanoparticle-adjuvanted bivalent *Pasteurella multocida* outer-membrane protein (capsular types A and D) complex vaccine. Evaluation of the immunopotential of the bivalent vaccine in mice revealed that it was highly efficient in stimulating IgG response against *P. multocida* capsular type A.

... **Compiled by Dr. Rupam Dutta**

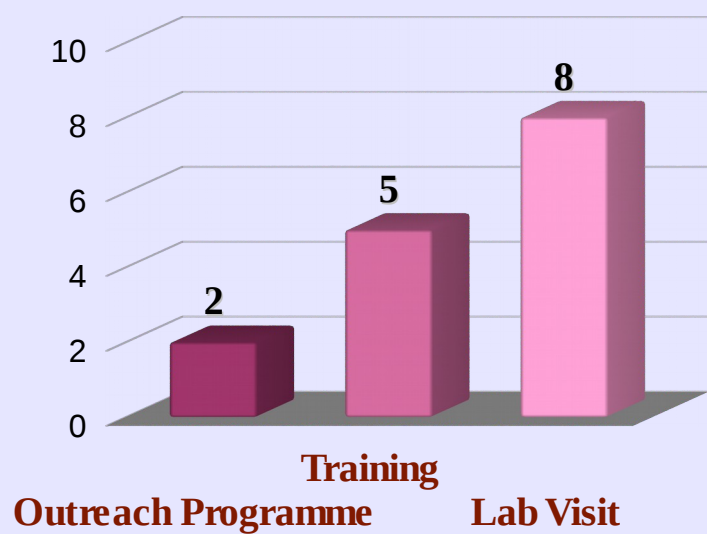
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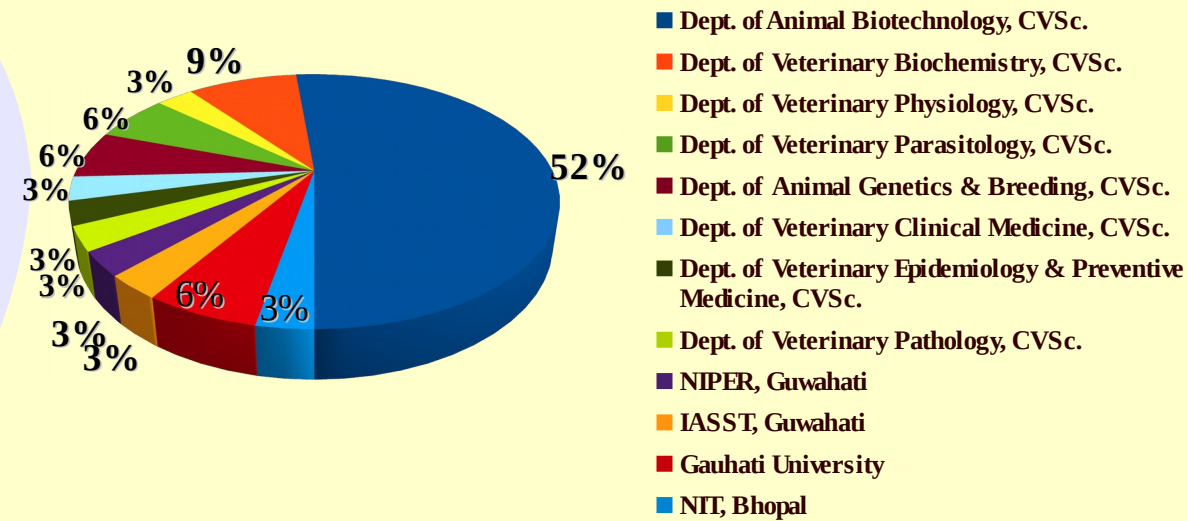
Paper presented

- Borah, P.** (2018). Molecular diversity and virulence profile of *Salmonella* isolates from various sources. Invited paper presented in the ADNAT Silver Jubilee Convention and International Symposium on Biodiversity and Biobanking (Biodiverse 2018) held at IIT, Guwahati from 27-29 January, 2018.

Activities at Advanced State Biotech Hub (Assam)



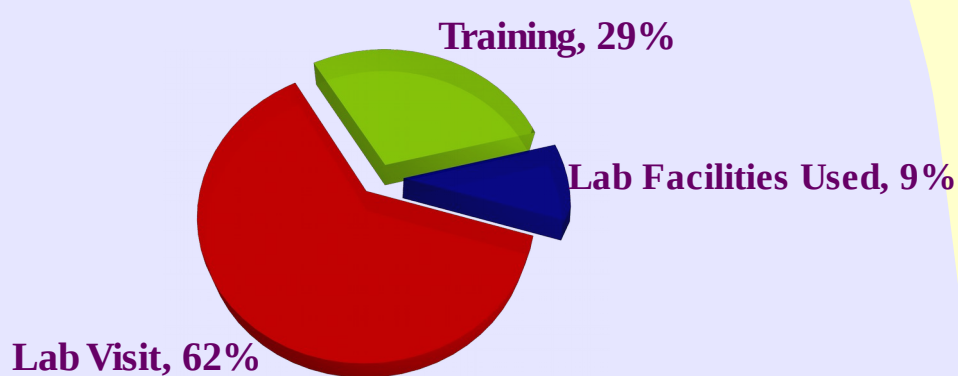
Number of programmes held in the period from 1st May, 2017 to 31st March, 2018



Students from different institutions using the Laboratory facilities at ASBT Hub from 1st May, 2017 to 31st March, 2018

Training Programmes Conducted in This Year

No.	Title of Training	Duration & Date	No. of Participants	Level of Participants
1	Mammalian Cell Culture, Oocyte Manipulation and in-vitro Fertilization	5 days, 2-6 May, 2017	10	Research Scholars, Teachers
2	Molecular Tools for Genomics & Proteomics Research	5 days, 20-24 Nov., 2017	10	Research Scholars, Teachers
3	Animal Cell Culture and Molecular Typing of Microbes	5 days, 12-16 Feb., 2018	10	Scientists, Research Scholars, Teachers
4	Basic tools and Techniques in Molecular Biology	5 days, 12-16 March, 2018	10	Research Scholars, P.G. Students
5	Capacity Building of Teachers, Researchers and Biomedical Practitioners of North Eastern Region on Advanced Techniques in Molecular Biology and Microbiology (Funded by Ministry of DoNER and organized in collaboration with Dept. of Animal Biotechnology)	10 Days, 30th May to 8th June, 2017	30	Teachers, Researchers and Biomedical Practitioners



Number of participants in different programmes of ASBT Hub during 2017-18

... Compiled by Dr. Leena Das

Advanced State Biotech Hub (Assam)

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Co-coordinator: Dr. Rajiv Kumar Sharma, Prof., Veterinary Microbiology

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Laboratory Attendants: Mukut Sarma



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