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COMMENTARY OPEN ACCESS

THE DECADE OF OMICS

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[I] COMMENTARY

Etymologically, the suffix -ome originated from the Sanskrit word om implying fullness and completeness [1]. The word genome was first coined by Professor Hans Winkler by blending two words: gene and ome - the latter from chromosome. With the advent of the 'decade of measurements', omics technologies have generated huge amounts of data in different fields of biology from gene sequencing, protein expression, metabolite signatures in organs and molecular pathways in disease amongst others. Currently, the area is expanding as evidenced by the exploitation of the science well beyond genomics into other omics technologies such as transcriptomics, proteomics, pharmacogenomics, nutrigenomics and metabolomics. Henceforth, there is scope for future omics fields to be developed in the post-genomic era of biology and medicine for example at the level of physiology, cell biology and whole organs [2].

In this context, it is worth mentioning that the human genome sequence, along with implementation of novel high-throughput technologies, has empowered us with the blueprint of human health. The knowledge generated by this understanding makes a sound foundation for personalized medicine. Biomarkers based on omics technologies can be used to develop non-invasive diagnostics to identify people at risk of disease. From these, medicine developed using biomedical genomics needs to become a reality through cutting edge research and capability building which will enhance our knowledge of public health and diseases. The underlying pathophysiology of a disease and a patient's response to drugs can also be investigated. Proteomics has already allowed researchers to report and develop a large number of biomarkers from tissue and body fluid.

Currently, transcriptome-based studies on disease prognosis have been used to develop a gene expression-based breast cancer test, namely BCtect® by DiaGenic ASA, Norway, which detects breast cancer at the zero stage or very early by a simple blood test. Similarly, information obtained from pharmacogenomics and nutrigenomics has played a pivotal role not only in the formulation of a new generation of drugs and natural supplements but also in increasing the efficacy and decreasing the adverse effects of current drugs.

The Human Metabolome Project was initiated in Canada in 2005 to identify and quantify hundreds of novel metabolites present in human tissues and fluids with the eventual aim of covering the whole human metabolome. This information will form the Human Metabolome Database and the Human Metabolome Library [3], which will be publicly available in the near future. By 2006, 2200 metabolites had been identified and stored in −80°C for further investigation.

Tanaka in 2010 has postulated the 'three-generation paradigm' to explain the development of omics-based medicine: 'genomic medicine' is the first generation, followed by the '(post-genomic) omics-based medicine' generation and thirdly the 'omics-based systems medicine' generation [4]. This paradigm for molecular medicine works in the following manner: a. 'genomic medicine' allows us to develop tailor-made medicine designed on inborn genome differences; b. '(post-genomic) omics-based medicine' allows predictive medicine designed on both gene expression profiles and protein mass spectra, which are different for different disease stages, and c. 'systems medicine', holistically reveals a detailed understanding of a disease based on cellular pathway changes caused by the disease.

A synthetic biology approach using omics technology has contributed a lot in the preparation of several drug candidates. One example is the production of artemisinic acid, which is an anti-malarial drug precursor in engineered yeast, Saccharomyces cerevisiae [5]. The process yields high amounts of artemisinic acid through the engineered mevalonate pathway, which then resides on the outer surface of the engineered yeast and can be purified in an inexpensive way.

Likewise, in recent years the combination of systems biology, revealing the altered pathways involved in a particular disease condition, and omics has resulted in the development of many leads and some successful drugs, e.g. targeted anti-leukemic

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therapy with imatinib [6], which is a potent inhibitor of the BCR-Abl and the c-Kit tyrosine kinases [7]. The drug generates marked growth inhibition of CML cells and gastrointestinal stromal cell tumors (GIST). Also, the anticancer drug Herceptin is effective for breast cancer patients who over-express the human epidermal growth factor type 2 (HER2) receptor. It is recommended that the diagnostic test for the HER2 receptor must be performed with IHC and FISH for DNA prior to the therapy [8].

Significant developments have been made in the field of mental health, specifically psychiatric genetics. Thousands of scientists worldwide are actively engaged in finding pharmacogenomic and nutrigenomics based nutraceutical solutions to many psychiatric disorders such as psychosis, major depression, bipolar depression, and addictive behaviors (reward deficiency syndrome) among other impulsive and compulsive behaviors. Genome Wide Association Studies (GWAS) are yielding significant results that will ultimately lead to important chromosomal clusters and rare polymorphisms (e.g. SNPs) associated with the entire array of neuropsychiatric and neurological chronic disorders.

Noteworthy advancements have also been achieved in plant, agricultural, pharmaceutical, and industrial biotechnology based on tailor made omics approaches. Completion of Arabidopsis thaliana genome sequence in 2000 [9] and development of high throughput omics technologies over time have stimulated sequencing of various crop genomes including rice and subsequently utilization of these sequencing data for next-generation agri-biotechnology, utilizing integrative omics approaches and metabolic engineering. Successful examples are production of functional foods such as golden rice [10], molecular farming based production of pharmaceutically active agents such as insulin [11], erythropoietin, growth hormones, interferons, peptide vaccines etc [12-14] and various disease specific nutraceuticals [15]. Bioethanol and biodiesel are successful application of the combination of plant and industrial biotechnology [16, 17]. The success in these areas boosted due to the tremendous development of synthetic biology, systems biology, and downstream processing.

The future prospects of omics technologies are understood by developing countries; hence, apart from ongoing, individual work in different laboratories, some dedicated new institutes and centers are working on various disciplines of genomics and proteomics, like the Translational Health Science Technology Institute (THSTI), Faridabad, India; the Institute of Genomics and Integrative Biology (IGIB), New Delhi, India; the International Society of Nutrigenetics / Nutrigenomics, Italy; and the International Society of Psychiatric Genetics, USA.

The Institute of Integrative Omics and Applied Biotechnology (IIOAB)-India, West Bengal is one such organization that has been working since 2008 to provide a global platform for integrative-omics-based multidisciplinary research and advocacy to combat various global challenges. Although, its a non-Govt. organization and does not get any financial support from any source; due to its unique collaborative strategies and mode of research, involvement of multiple top ranked international research groups from interdisciplinary sciences, focused research areas, and high quality research publications; IIOAB has earned good reputation and is now well known to the global scientific community with in this short span of time. Introduction of its official Journal- the ***IIOAB Journal*** is an attempt towards fulfilling IIOAB's commitment in providing an international platform to the scientific community for sharing high quality innovative research works in any area of science, technology, and medicine.

We are highly delighted to become a part of IIOAB's activities and wish to see its continuous shining growth and contribution to the science and our society. We also look forward to publish your research articles, reviews, commentaries, hypotheses and letters to the Editor in the IIOAB Journal.

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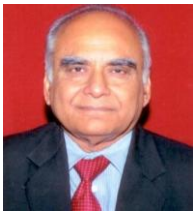

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