

R&D activities in Asia need attention: Dr Syed Shams Yazdani

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The International Center for Genetic Engineering and Biotechnology (ICGEB) is a global organization dedicated to advanced research and training in molecular biology and biotechnology, with special regard to the needs of the developing world. The ICGEB boasts of 85 signatory countries, including 61 member states, 40 affiliated centers, spread across three host countries (located in Cape Town, South Africa; Trieste, Italy; and New Delhi India). Scientists at the synthetic biology and biofuel group, at the center are conducting ground breaking work in bio-energy research in an independent and collaborative manner. The group is performing cutting-edge research in the field of bioenergy using genomics, metagenomics, synthetic biology and systems biology approaches.

Dr Syed Shams Yazdani has been heading the synthetic biology and biofuel group at the ICGEB since 2011. Dr Yazdani, who previously worked as a postdoctoral associate at the Department of Chemical and Biomolecular Engineering, Rice University, Houston, US, speaks to *BioSpectrum*, regarding the various innovative projects that his group has ventured into to develop second generation biofuels.

Could you kindly shed some light on the research that you are conducting at the Synthetic Biology and Biofuel Group at the ICGEB? What are the various projects that you are working on?

Dr Yazdani: Our research utilizes combination of genomics, metagenomics, synthetic and systems biology approaches. Using these tools, we focus on three major research areas: screening, identification and design of novel cellulolytic enzymes,

engineering microbe for production of bioethanol from cellulosic biomass using consolidated processing approach, and engineering microbe for production of biofuels of longer carbon chain length. We have established the capabilities to screen cellulolytic microbes in high throughput manner and identified several novel enzymes that would ease in the degradation of cellulolytic biomass. We select the promising ones and perform thorough genetic and biochemical characterization to understand its functional mechanism and to further improve its functional characteristics. We express these enzymes in high quantities in heterologous host and construct bifunctional hybrid enzymes to reduce the production cost further.

Expressing cocktail of cellulolytic enzymes in heterologous host also gives us the opportunity to save cost for production of cellulosic ethanol by expressing these enzymes in ethanologenic microbes, which can then directly convert cellulose to ethanol, bypassing the expensive enzyme hydrolysis step, via an approach known as consolidated bioprocess (CBP). We have already succeeded in metabolically engineer a bacterium to produce high yield of ethanol from C5 and C6 sugars through rearrangement of its endogenous pathway and we are now in the process of demonstrating its potential for use in CBP.

While we are still trying to workout the best strategy to produce cellulosic bioethanol in the most cost effective manner, we are aware of that bioethanol is perhaps not the best alternative liquid fuel. We are at the advance stage of engineering a laboratory microbe that would give us high yield of bio-butanol, a molecule that is considered closer to petroleum fuel in terms of its properties. We are also applying various systems and synthetic biology approaches to construct a microbe for production of hydrocarbon for use as fungible fuel.

You have had a prolific research career. What have been your most important achievements?

My overall career goal had been to perform research that would have direct implication to the benefit of human kind. I feel content that the projects that I worked in the past could come out of the academic laboratory and have been undertaken by the industry. These include the recombinant streptokinase that I worked during my graduate study at Jawaharlal Nehru University and three malaria vaccine candidates that I worked at ICGE. All these biomolecules were transferred to the Indian Biotech industries and were produced at industrial scale.

However, the most important achievements of my life had been to establish a full fledged synthetic biology and biofuel laboratory at ICGE, which is the first-of-its-kind in India to perform research in biofuel area at the molecular level.

What are your views on the life science-related R&D, activities and trends in Asia?

Life science R&D activities in Asia have seen a lag period in the last century and needs huge attention. We had been largely dependent upon the Western countries for innovation in life sciences and we are used to follow the path that has been built by them. There is a serious demand of committed people to undertake R&D activities in Asia. Until the time research remains the least priority area for majority of the people, R&D activities will keep on suffering in Asian countries. There is a need to stimulate the young mind at the grass root level to generate interest in the innovation so that the talented students take-up the research as their first choice in the career, not as last choice. At the same time, there should be enough research infrastructures in the country to retain these brilliant talents and make them feel financially comfortable.

Another important point that needs attention in the Asian countries is the huge gap between academia and industry. I think there is a lack of trust on academic research outcome due to which industry is not readily willing to adopt them. Industry is more comfortable in buying ready-made technology from the western countries. Industry needs to fund research at the academic institutions and involve them from the beginning to take the research to the meaningful conclusion.

How different do you think is the research scenario in Asia from the rest of the developed nations of the world?

Research scenario in Western world is at a much advance stage due to their long-term vision of innovation, awareness at the school level, higher proportion of gross domestic product (GDP) in research and intense involvement of industry in the academic research program.

What are the various challenges being faced by you?

While there were many scientific challenges that I faced in my research career, the most important challenge was

establishing biofuel research activity at ICGEB. ICGEB research is primarily focused on human health and plant biology. Initiating research on completely new area of bioenergy needed consent and approval of higher authorities. While I was able to successfully convince these authorities, this would not have been possible without full support of my mentor and director, Prof VS Chauhan, whom I consider a great visionary of contemporary science.

Following your work in the malaria group at ICGEB, you had a successful stint as a postdoctoral associate at the Department of Chemical and Biomolecular Engineering, Rice University, US. What brought you back to India?

My purpose of visiting US was to gain knowledge in the field of metabolic engineering and synthetic biology. In the year 2005-06, scientists like Dr Jay Keasling, Dr Greg Stephanopoulos and Dr Craig Venter exemplified this field and inspired me of the potential this field could bring in to produce molecule of choice. I worked with a very dynamic young investigator Dr Ramon Gonzalez at Rice University, Houston, who gave me an opportunity not only to learn about the field but also apply my own ideas in various applications. I decided to come back when I felt confident that I could contribute my learning to the development of science in India.

You began your career as a malarial scientist and now you are heading a biofuels research unit. How do the two work profiles vary from each other?

Well, the two disciplines vary hugely in their outcome, malaria research hope to find solution for the disease, biofuel research hope to find solution for the energy crisis. I was involved in development of processes for production of malaria vaccine candidate and interaction with industry for transfer of technology and helping the industry to scale-up and produce vaccine candidate under certified good manufacturing practices (cGMP) facility. My responsibility regarding biofuel research had been to establish this field at ICGEB and attract funding to support the innovative ideas. My expertise in molecular biology, protein chemistry, fermentation technology and translational research helped in establishing myself in this field.

What are your future plans?

Our bioenergy research activity at ICGEB got a boost when DBT decided to fund for setting-up of a collaborative 'DBT-ICGEB Center for Advanced Bio-Energy Research'. This Rs17.13 crore initiative will certainly help us in expanding our cutting-edge research in synthetic biology and biofuel area. Scientists working in the diverse bioenergy fields of microbial engineering, biochemical engineering, algal engineering and systems biology would join hand under the Bioenergy Center's umbrella to have significant impact in the field. I foresee that my full energy will be invested in successfully establishing the Bioenergy Center at ICGEB. I am hoping that the translational research performed at the Center will benefit humankind.