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Gene synthesis (End-to-End) now in India at Barcode Biosciences

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Barcode Biosciences (BBS), a fast-expanding Bengaluru-based genomic company, has come forward and succeeded in synthesising artificial genes in its inhouse facility and become the FIRST Biotech Company to initiate the End-to-End gene synthesis in India at commercial scale. Since inception in 2018 with two employees, the company was able to process 1000 – 1500 DNA Sanger sequencing samples per month. Today, BBS with its state-of-the-art technologies, has catapulted to become one of the fastest growing genomic companies in India with over 60 employees, a large network of clients pan India, and overseas. Currently, they are processing over 2000 samples per day and also offering versatile genomic services. BioSpectrum India spoke to Dr Ramprasad Kuncham, Managing Director & Chief Executive Officer, Barcode Biosciences to know more about gene synthesis, its scope, value addition, company's growth, and the other services that BBS is offering in India.

What is the main objective behind initiating a gene synthesis unit in India?

At this moment in time, the Indian scientists will have to depend on other developed countries for their gene synthesis needs as there are no in-house gene synthesis operations in India. In consequence, during the recent global pandemic of COVID-19, the Indian scientists (especially those who were looking for novel drug candidates viz; mRNA vaccines/heterologous proteins/viral spike proteins) had faced many challenges in getting their desired synthesised genes in time. Now companies and scientists look towards a post-COVID future when gene synthesis will be deployed to tackle a variety of other investigations/studies.

With a mission to settle the current gap and to accelerate the advanced genomic research in India, also to firmly echo the Make-in-India initiative which has come from the government, BBS has come forward and established an indigenous in-house gene synthesis unit in Bengaluru.

By nature of its operations, BBS is housing the great infrastructure, progressive technology and expertise that are required for the gene synthesis. Leveraging on this, our scientist group could manage the end-to-end steps in gene synthesis under one roof without having dependency on any third-party agencies. Therefore, we were able to cut short the turnaround time (TAT) for synthesising a gene than the current TAT in the market.

With all the inspiration from the legacy of Dr Har Gobind Khorana, the one who paved the way to synthesise a gene, today BBS has turned out to be the first organisation in India to start in-house gene synthesis at a commercial scale.

Please share more details about the process of gene synthesis? What are its applications?

Gene synthesis refers to chemically synthesising a desired gene of interest base-by-base with desired/custom sequence utilising oligonucleotides. Various scientific methods are available to assemble these generated stretches of double-stranded DNA which, further usually cloned into a plasmid vector.

As the gene synthesis technologies keep getting advanced, scientists over the world were able to modify/synthesise various types of genes in search of answers for many unanswered questions across the science disciplines including virology and vaccine designing, therapeutic antibody engineering, cancer biology, neurosciences, agriculture, environmental health sciences and the list goes on.

For instance, through gene synthesis scientists **c**an efficiently clone the synthetic therapeutic genes into custom viral vectors to optimise expression and specificity of gene delivery. The scientists can also engineer novel enzymes that fight cancers.

Countries can improve their crop yield and reduce vulnerability to the plant diseases that may disrupt food supplies and contribute to global hunger.

Further applications include detecting and breaking down environmental pollutants in the soil, air and water; building designer metabolic circuits using interchangeable synthetic parts; generating novel biological functions and systems with CRISPR and other gene editing technologies; and using codon-optimised genes to rapidly express recombinant protein for structure determination in gene-to-protein pipelines etc.

What are the latest advances being made with gene synthesis?

Today, scientists are equipped to quickly synthesise any newly identified viral genes that are crucial for developing a potential vaccine candidate to fight against the future novel pathogens that are of global threat (pandemics), thus accelerating vaccine development around the globe.

To give you an example, gene synthesis is the technology that is behind two of the biggest “products” of the past year: the mRNA vaccines from Pfizer and Moderna. This duo has developed a mRNA vaccine as soon as the Chinese C.D.C. first released the genomic sequence of SARS-CoV-2 to public databases in January 2020, they were able to synthesise the gene that corresponds to a particular antigen on the virus, which is called the spike protein. This meant that their vaccines, not like the traditional vaccines which teach the immune system to recognise a virus by introducing a weakened version of it, could deliver genetic instructions prompting the body to create just the spike/antigenic protein, to be recognised and attacked during an actual viral infection.

The global gene synthesis market size is projected to reach $872.3 million by 2028, from $353.7 million in 2021, at a CAGR of 13.6 per cent during 2022-2028.

Please tell us more about the work being done at BBS?

As I quoted earlier, BBS is equipped with cutting-edge technologies and high throughput laboratories, manned by highly qualified professionals with over 17+ years of experience, dedicated and stringent measures to avoid cross-contamination, robust processes to enhance the quality of services and products. With an excellent track record, BBS has become the most

reliable and affordable genomics services provider in India.

Barcode Biosciences' core focus is genomics R&D, with highly experienced PhDs working through the complexities of genomic services, and bespoke projects like, chicory identification in coffee, protozoan identification in drinking water, adulterants in spices, cereals and herbs, identification of origin of cultivation, cattle genotyping, halal testing, authenticity of honey, cereals, spices and many more.

BBS has different business verticals, offering versatile services, products, which are marketed independently through divisions namely **Genomic Synthesis (**Cloned genes and gene fragments, modified and unmodified oligonucleotides, probes, SiRNA oligos, molecular beacons etc.); **Genomic Information (**Sanger sequencing, microbial identifications, plant, animal, insect barcoding, genotyping, fragment analysis, primer walking, gene expression etc.); **Food Genomics (**DNA authenticity of spices, cereals, plants, fruits, animals, birds, eggs, fish, prawns etc., GMO testing, food adulterants, basmati authenticity etc.); **Infectious disease testing (**COVID-19 RT PCR, COVID-19 Surface testing) ; and **Molecular Biology products (**Offering a wide range of genomic isolation kits, RNA isolation kits, DNA ladders, PCR Master mix, enzymes, plastic ware, glass ware, chemicals, and pipettes etc.)

BBS has been awarded as the exclusive distributing partner for Andhra Pradesh, Goa, Karnataka, Kerala, Puducherry Territory, Tamil Nadu, Telangana, Odisha, Madhya Pradesh and Maharashtra by NimaGen, Netherlands.

We offer complete NimaGen portfolio and exclusively BrilliantDye™ Terminator Cycle Sequencing Kits, NimaPOP, 10x CE Running Buffers, AmpliClean™ Cleanup Kit Magnetic Beads, ExS-Pure™ Enzymatic PCR Purification Kits, Orange-500/600 DNA Size Standards (500 bp and 600 bp), Seq-DI™ Formamide solutions, EasySeq™ 16S rRNA Bacterial ID Kits, EasySeq™ 18S and Cyp51A rRNA Fungal ID Kits, IDseek® forensic kits and all other NimaGen products.

What are the major future plans of BBS?

The current success in gene synthesis has given us confidence and encouragement to invest more into Research and Development. With our highly passionate team and cutting-edge technologies, BBS is always striving to contribute to solve the existing unsolved long due problems and also to equip the global scientific community to handle the future unforeseen global pandemics/natural calamities. In the near future, BBS is going to expand its operations and services into European countries to explore new markets and challenges. In the long term, we would like to offer high quality genomic and analytical services across the globe and aim to become the global leader.