CJ Bioscience is improving health through deep analysis of the microbiome

Next-generation sequencing and artificial intelligence–powered analysis are creating substantial opportunities for microbiome therapeutics and wellness products

JON CHUN, PHD
CHIEF EXECUTIVE OFFICER,
CHIEF TECHNOLOGY OFFICER,
CJ BIOSCIENCE

Introduction

The human body hosts a complex and malleable microbiome with broad implications for health and disease states.[1,2] This diversity creates numerous opportunities in health and medicinal applications for companies like CJ Bioscience. CJ Bioscience uses next-generation sequencing (NGS) and other cutting-edge methods to develop innovative microbiome therapies and products. We spoke to Dr Jon Chun, Chief Executive Officer (CEO) and Chief Technology Officer (CTO) at CJ Bioscience, about how the company is leveraging the microbiome to improve human health.

Q: Can you tell us about CJ Bioscience?

Jon Chun (JC): At CJ Bioscience, our mission is to translate groundbreaking microbiome research into applications and solutions in health care, diagnostics, and wellness that promote better health.

We have three primary focus areas. The first and most important area is the development of novel therapies using our artificial intelligence (AI)–enabled microbiome database and discovery platform. We also look for biomarkers that can help identify potential responders to drug candidates in clinical trials. Currently, we have two promising therapeutic pipelines. Our oncology therapy candidate, targeting lung cancer and melanoma, is in clinical phase 1B, and an antiinflammatory therapy is in the preclinical stage.

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Our second focus is our business-to-business (B2B) services. A major component of our B2B services is providing companies like Illumina with advanced bioinformatic analysis of NGS results. We are extending this effort to the business-to-consumer (B2C) market with the launch in January 2025 of consumer microbiome testing and analysis.

Finally, our third focus is our wellness efforts. Our parent company, CJ CheilJedang, owns a food and nutrition business. We are working with them to develop science-driven next-generation wellness products, initially focusing on advanced probiotics products.

Q: What are the factors behind CJ Bioscience becoming a successful microbiome company?

JC: One of the most important factors driving CJ Bioscience becoming a global microbiome leader is our fully integrated discovery platform, which supports all our core business areas. Our comprehensive discovery platform allows for seamless integration from early-stage research to clinical implementation, making us uniquely positioned to deliver groundbreaking microbiome-based solutions. Central to that is our proprietary AI-enabled microbiome database. This database is supported by one of the largest strain banks in the industry, offering a robust foundation for identifying and developing promising therapeutic candidates.

We also have an in house screening system and preclinical assay capabilities that support efficient validation of strains with therapeutic potential. Our pilot-scale manufacturing capabilities, specifically for anaerobic strains, allow us to streamline the transition from discovery to production, which is a significant challenge in current microbiome research.

Finally, we have a global network for human clinical trials that ensures our developments are validated in diverse populations to meet international standards.

Q: Can you provide an overview of your current microbiome research?

JC: Our research revolves around three key areas. The first, and most important, is our therapeutic research where we are currently advancing two drug candidates. We have one in phase one clinical trials for non-small cell lung cancer (NSCLC) and another in the preclinical stage for inflammatory bowel disease (IBD). We are also exploring combinations of various microbial strains to address immune-related diseases.

Our second priority is our AI-based Ez-Mx platform. Our proprietary Ez-Mx platform allows us to develop cutting-edge analysis tools leveraging NGS data and AI algorithms to detect infectious pathogens with high accuracy.

The third area is our wellness-focused research. This includes development of microbiome diagnostics and personalized dietary recommendations to promote overall health and well-being.

Q: How has NGS contributed to the field of microbiome research?

JC: I did my PhD in bacterial taxonomy in 1995. As a student, I used 16S ribosomal RNA sequencing, a standard marker for bacterial identification, to identify many species. This was well before NGS, when we were unable to study an entire microbial community at once and researchers had to grow and isolate microbes in the lab to sequence them. Metagenomics changed that by enabling scientists to directly study all the DNA in a microbial sample, providing a comprehensive picture of the microbiome.

Shotgun metagenomics allows us to identify microbes that we were unable to study before, including ones we cannot culture in the lab. In fact, 72% of the bacterial species in our Ez-Mx database were only discovered and characterized because of shotgun metagenomics. This is crucial because if we miss potential microbial candidates, we risk overlooking new therapeutic opportunities.

Because shotgun metagenomics captures comprehensive microbial genomes, we have a greater ability to identify antimicrobial resistance (AMR) genes and other virulence factors that can help explain why infections vary in severity and why some treatments work better for certain individuals.

Q: How does CJ Bioscience use shotgun metagenomics in their biotherapeutics discovery efforts?

JC: Shotgun metagenomics is key to our current drug discovery process, beginning with sequencing and comparison of individual gut microbiomes in sick and healthy cohorts. Comprehensive sequencing even allows us to examine functional genetic differences within microorganisms. For instance, if the same microbe exists in both healthy and unhealthy groups, we can investigate whether certain genes are only present in bacteria that are associated with differences in outcomes. This gene-level analysis is critical for uncovering potential biotherapeutic mechanisms.

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We also use mouse models for our preclinical research. Because there are no established isolates or references for the mouse gut microbiome, shotgun metagenomics is the only way to achieve a full microbiome characterization. This research allows us to translate findings from our human studies into preclinical models and validate potential therapies.

Q: How is the Ez-Mx platform used to develop therapies?

JC: Our Ez-Mx platform supports the development of therapies based on microbiome data for a range of conditions. By identifying relevant microbes or microbial products, we aim to create treatments that alter immune responses or reduce inflammation in conditions such as cancer or autoimmune diseases. We can also identify predictive biomarkers in conditions like IBD or for immune checkpoint inhibitor therapies.

We also have applications in infectious disease research, such as identifying microorganisms involved in kidney cyst infections. This helps us to better understand the role of the microbiome in infections and potentially to develop targeted treatments to improve patient outcomes.

In addition to therapeutic pipelines, the platform supports research aimed at improving overall health. For example, we use the Ez-Mx platform to analyze how certain dietary changes impact microbial communities so we can develop strategies and interventions that promote a healthy microbiome.

Q: How does AI fit into your research?

JC: AI is at the core of our Ez-Mx platform. Microbiome research generates enormous amounts of complex data, making it challenging to identify significant species and genes with therapeutic potential. AI streamlines the analysis process, helping us efficiently pinpoint key insights. AI also allows us to discover patterns in microbiomes linked to specific phenotypes.

For example, we can analyze data from cancer patients to identify microbial differences between those who respond to a treatment and those who do not. It's possible that AI can use this data to predict whether a cancer patient will respond to a treatment before it starts, allowing patients to avoid ineffective treatments and to find alternative therapies sooner.

We also use generative AI to build genomic foundation models for analyzing large microbiome data sets faster than traditional bioinformatics methods allow. Using generative AI, tasks that once required months of effort by trained specialists can now be accomplished quickly and with reduced risk of human error.

Generative AI also allows us to do microbiome modeling, where we create a "digital twin" of an individual's microbiome and use that to predict how their microbiome would change in response to different diets or therapies. This approach could revolutionize personalized medicine by providing safe, predictive insights into therapeutic outcomes.

Q: When do you think we will see research-based microbiome biotherapeutics as a standard of care in the clinic?

JC: There is still much work to be done before that can happen. One of the biggest bottlenecks is standardization, including consistent methods for sample collection, sequencing, and data analysis. Clinical partners must also have the necessary infrastructure and technologies integrated into their clinical workflows. Without standardization, it's difficult to compare results across studies or apply findings in a clinical setting.

Q: Why did you chose Illumina NGS for your research?

JC: Illumina sequencing is a proven technology, which means there is minimal need for researchers to perform additional technical validation of the platform. The adoption of patterned flow cells and the recent introduction of XLEAP-SBS™ chemistry has further enhanced its capabilities and improved the quality of sequencing data. This has been instrumental in convincing and educating both researchers and our commercial clients about the platform's reliability and accuracy.

Q: What do you think is the future of microbiome research and biotherapeutics?

JC: The future of microbiome research and biotherapeutics is incredibly promising. There is substantial evidence that the microbiome plays a pivotal role in human health and the potential to revolutionize how we approach disease prevention, diagnosis, and treatment is immense. However, as with many emerging fields, microbiome science is still navigating the challenges with finding the best approaches for fully unlocking its potential.

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Ultimately, the future of microbiome biotherapeutics will be driven by organizations that can effectively combine scientific excellence, technological innovation, and a patient- or customer–centric approach. These players will be the ones to realize the full potential of the microbiome in transforming health care.

References

1. Réthi-Nagy Z, Juhász S. Microbiome's Universe: Impact on health, disease and cancer treatment. *J Biotechnol*. 2024;392:161-179. doi:10.1016/j.jbiotec.2024.07.002
2. Manos J. The human microbiome in disease and pathology. *APMIS*. 2022;130(12):690-705. doi:10.1111/apm.13225

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