Ibaraki Prefectural Government

NEWS RELEASE

Research Suggests Human Immune Function and Viral Infection Suppression Can Be Enhanced by *Bacillus subtilis* BN

Results of joint experiments are announced by the Industrial Technology Innovation Center of Ibaraki Prefecture and Teijin Meguro Institute

Tokyo, Japan, August 30, 2023 --- The Industrial Technology Innovation Center of Ibaraki Prefecture and Teijin Meguro Institute Co., Ltd. a Teijin Group company, today announced results from their joint research into the human immunity enhancement and virus protection potential of *Bacillus subtilis* BN known as “natto-kin” in Japanese. *In vitro* experiments by the two organizations showed that, when added to both normal immune cells (M1-phenotype macrophages) and immune cells model mimicking viral infection, *Bacillus subtilis* BN appeared to trigger significant secretion of proteins (cytokines) involved in immune enhancement. This finding suggests that *Bacillus subtilis* BN strengthens the immune function in the human body and may contribute to suppression of viral infections.

Natto is a popular traditional Japanese food made from whole soybeans that have been fermented with *Bacillus subtilis* natto. Ibaraki Prefecture is home to major producers of natto. Teijin Meguro Institute manufactures *Bacillus subtilis* BN and other probiotics.

The two organizations will continue to study the effects of *Bacillus subtilis* BN regarding its potential for the prevention and reduction of viral infections.

The Industrial Technology Innovation Center of Ibaraki Prefecture supports business creation and pioneering research in a wide range of industries. It has engaged in many projects related to foods such as natto, a major product in Ibaraki Prefecture. Teijin Meguro Institute uses advanced technology for culturing *Bacillus subtilis* natto and lactic acid bacteria used for pharmaceuticals, health food raw materials and feed additives.

APPENDIX 1: Significance of this joint research and future possibilities

The spread of infectious diseases triggered by various viruses such as influenza and COVID-19 poses serious social problems. M1-phenotype macrophages, the immune cells used in this study, work to protect the human body from infectious diseases by exhibiting inflammatory and immune responses.

As previously reported, *Bacillus subtilis* BN enhances the immune function of mouse-derived macrophages, as shown through *in vitro* tests. (*1). The current study builds on that work, finding that *Bacillus subtilis* BN enhances the immune function of human M1-

phenotype macrophages in normal immune cells and immune cells model mimicking viral infection. The results suggest that *Bacillus subtilis* BN may enhance immune function in the human body and suppress viral infection.

The results of this research were presented at the 2023 Annual Meeting of the Kanto Branch of Japan Society for Bioscience, Biotechnology, and Agrochemistry, which was held on August 25, 2023, at Meiji University's Ikuta Campus.(2)

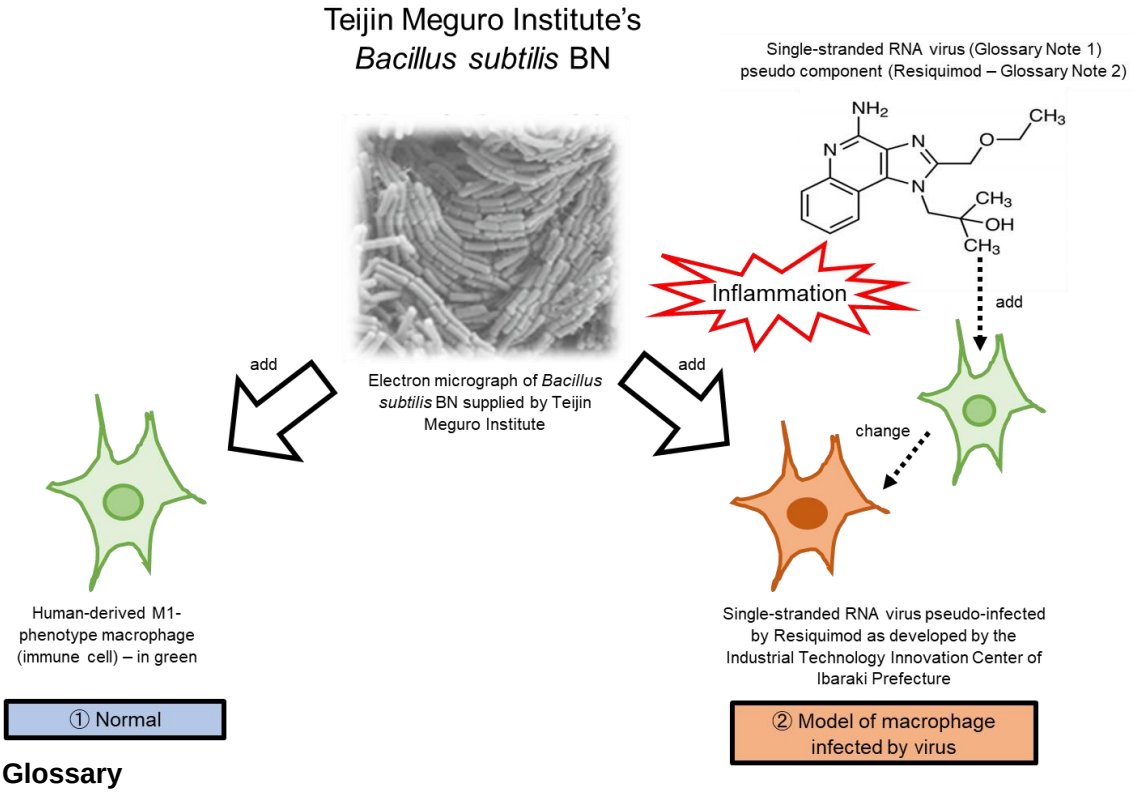
The Industrial Technology Innovation Center of Ibaraki Prefecture and Teijin Meguro Institute will use their research to promote the efficacy of natto and encourage companies in Ibaraki Prefecture that manufacture supplements and processed foods to use *Bacillus subtilis* natto to develop new products.

Reference:

(*1) Tobita K, Meguro R. *Bacillus subtilis* BN strain promotes Th1 response via toll-like receptor 2 in polarized mouse M1 macrophage. Journal of Food Biochemistry. 46 (2), e14046, 2022.

(*2) Tobita K, Kotsuna K. Immunoregulatory effect of *Bacillus subtilis* natto (BN strain) in virus pseudo-infected cell model. The 2023 Annual Meeting of the Kanto Branch of Japan Society for Bioscience, Biotechnology, and Agrochemistry.

APPENDIX 2: Overview of the results from this joint research



Glossary

Note 1) Single-stranded RNA virus: Viruses can be divided into two types. DNA viruses have deoxyribonucleic acid (DNA) as their genomic nucleic acid. RNA viruses have ribonucleic acid (RNA) as their genome. RNA viruses can be either single-

or double-stranded. SARS-CoV-2 and influenza viruses are classified as single-stranded RNA viruses..

Note 2) Resiquimod: One of the imidazoquinoline derivatives. Also known as an agonist of toll-like receptors 7 and 8 (TLR7/TLR8) that recognizes virus-derived single-stranded RNA.

Note 3) Interferon: A type of cytokine produced as a protein in the human body to protect against viral infections.

About the Industrial Technology Innovation Center of Ibaraki Prefecture

The Industrial Technology Innovation Center of Ibaraki Prefecture supports business creation and helps to organize joint research projects among industry, government and academic entities. It also contributes to the industrial development in Ibaraki Prefecture by promoting transformation and growth of enterprises in the prefecture, including developing human resources.

About the Teijin Group

Teijin (TSE: 3401) is a technology-driven global group with two core businesses: high-performance materials and healthcare solutions. Established in 1918 as Japan's first rayon manufacturer, Teijin today comprises some 170 companies employing 20,000 people in 20 countries. Through "Human Chemistry, Human Solutions," Teijin relentlessly strives to aims to be a company that supports the society of the future by protecting the global environment and addressing the needs of people and communities. Teijin posted consolidated sales of JPY 1,018.8 billion (USD 7.6 billion) and total assets of JPY 1,242.4 billion (USD 9.2 billion) in the fiscal year ending March 31, 2023.

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