PRESS RELEASE

P-LIFE JAPAN INC

Microorganisms decompose persistent Plastic Straws!

Discovery of Degrading Bacteria for P-Life containing Polypropylene (PP) from the soil of Nishi-Kamakura Elementary School, Japan

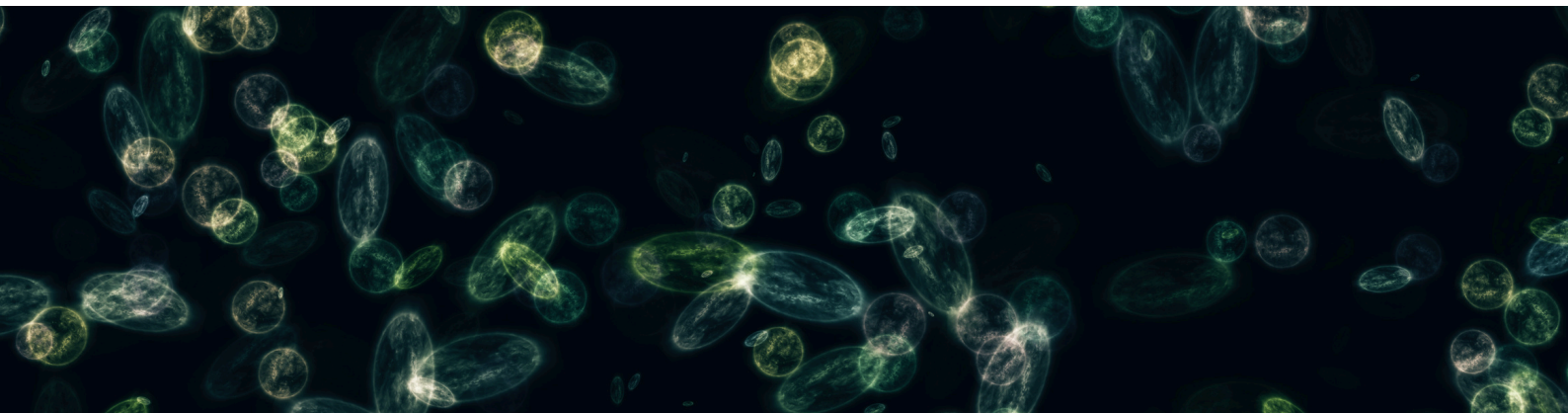
Our research team as Isao Toyama, President of P-Life Japan Inc., Kenji Miyamoto, Professor (Department of Biosciences and Informatics, Faculty of Science and Engineering, Keio University), Ayaka Futaki (Department of Biosciences and Informatics, Faculty of Science and Engineering, Keio University), Ying Huang, Researcher (Keio Leading-Edge Laboratory of Science and Technology), Yoshito Abe, SI Jushisangyou, Inc., and Shuji Uchiyama, ITO EN, Ltd. has succeeded in obtaining degrading bacteria for Polypropylene (PP) to which P-Life (*1) is added to render biodegradability to non-degradable plastics.

This achievement is an important step in realizing microbial degradation of persistent polyolefin-based plastics (*2). Furthermore, these degrading bacteria can be expected to be effective in decomposing and removing microplastics produced from polyolefin-based plastics and eliminating their accumulation in the global environment.

These results will be presented at The Molecular Biology Society of Japan on November 25, 2024.

Key Findings

- We discovered multiple bacteria that decompose P-Life containing PP in the soil of Nishi-Kamakura Elementary School in Kamakura City, Japan.
- PP straws incorporated with P-Life showed clear decomposition marks when they were incubated with these degrading bacteria.
- It was also found that these degrading bacteria biodegrade not only P-Life containing PP but also P-Life containing PE.



Research Background

In recent years, the outflow and accumulation of plastics in the environment has become a major social problem. Among them, polyolefin-based plastics are persistently degradable, in particular, PP is very difficult to decompose by microbial in nature.

Under these circumstances, ISAO TOYAMA of P-Life Japan Inc. has developed a revolutionary additive that imparts biodegradability to polyolefin-based plastics. P-Life gradually transforms PP into a lower molecule compound with a functional group that are slowly metabolized and degraded by microorganisms in the natural environment.

For the verification of its metabolization, we have measured and confirmed the biodegradability of PP straws with P-Life additive, based on the JIS K6955 method "Determination of the ultimate aerobic biodegradability of plastic materials in soil by measuring the amount of carbon dioxide evolved ".

However, due to the relatively slow rate of decomposition in soil, it was not possible to obtain the degrading bacteria through conventional methods. Therefore, in this study, for the first time, we succeeded in isolating the degrading bacteria for P-Life containing Polypropylene by devising the search sources and separating conditions.

Research Accomplishments and Results

In 2022, we implemented the "Project for Straws to Return to Earth" at Nishi-Kamakura Elementary School in Kamakura City as a part of the "Symbiotic Upcycled Society" connected with the JST Co-Creation Establishment Support Program (COI-NEXT).

In this demonstration experiment, conventional plastic straws used in school lunches were replaced with P-Life additive containing PP straws (“P-Life-PP Straws”) that were to be decomposed by microorganisms and returned to the soil. Therefore, we predicted that the soil used in the experiment contained excellent degrading bacteria that we have searched for in this study.

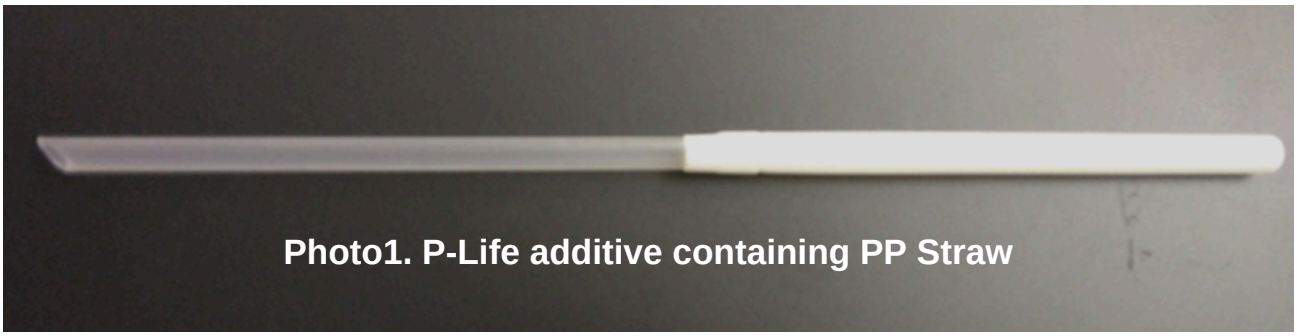


Photo1. P-Life additive containing PP Straw

For us to further increase the probability of discovering degrading bacteria, P-Life-PP Straws were pretreated under the thermal condition.

After pretreatment, P-Life-PP Straws were divided into a group of low molecule compounds soluble in acetone, which are thought to be relatively easy for microorganisms to assimilate and the other group of insoluble polymer compounds that are difficult to assimilate. Then, from the soil used for the experiment at Nishi-Kamakura Elementary School, we started searching for the degrading bacteria for two groups of compounds.

Finally, we succeeded in isolating two types of degrading bacteria from the low-molecular compound group and three types of degrading bacteria from the high-molecular compound group.

Subsequently, P-Life-PP Straws without any pretreatment were exposed to these discovering degrading bacteria and then they clearly showed the decomposition marks confirmed on the surface of the straws (right photo in Fig. 1).

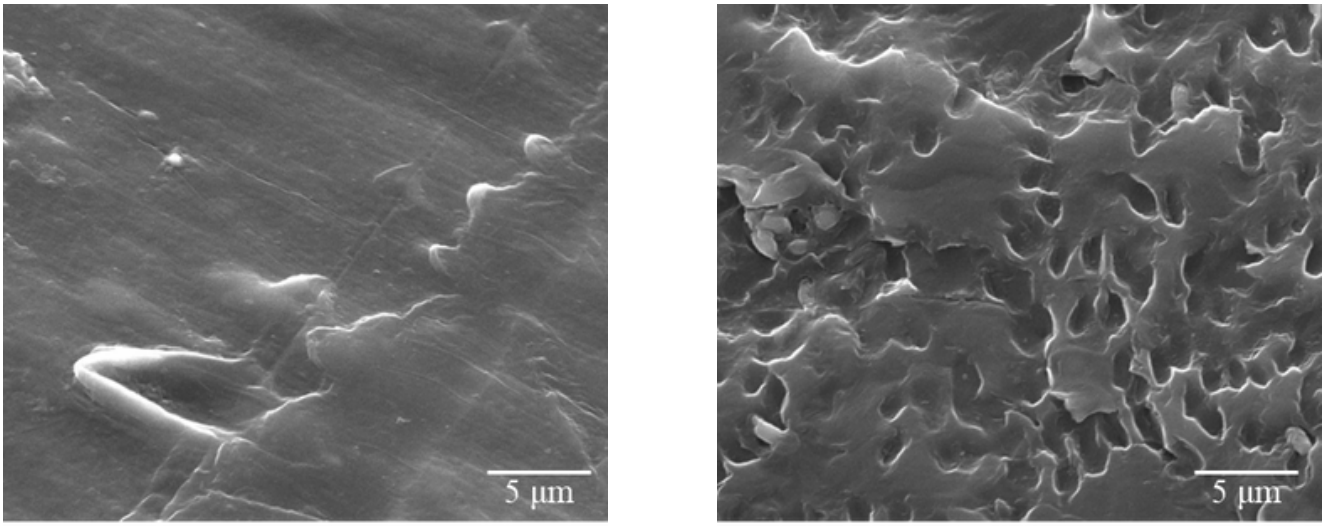
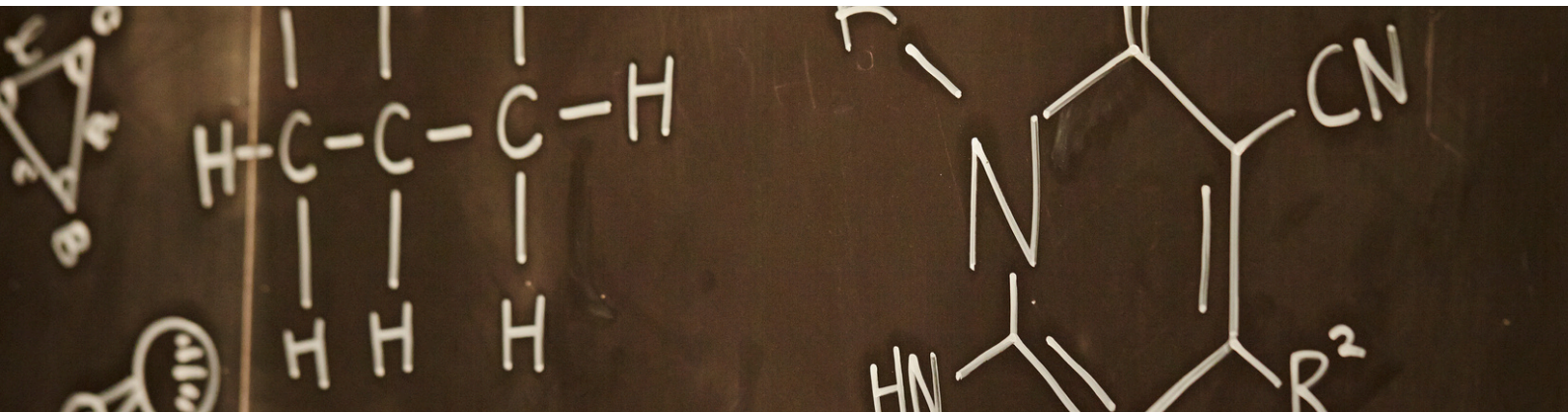
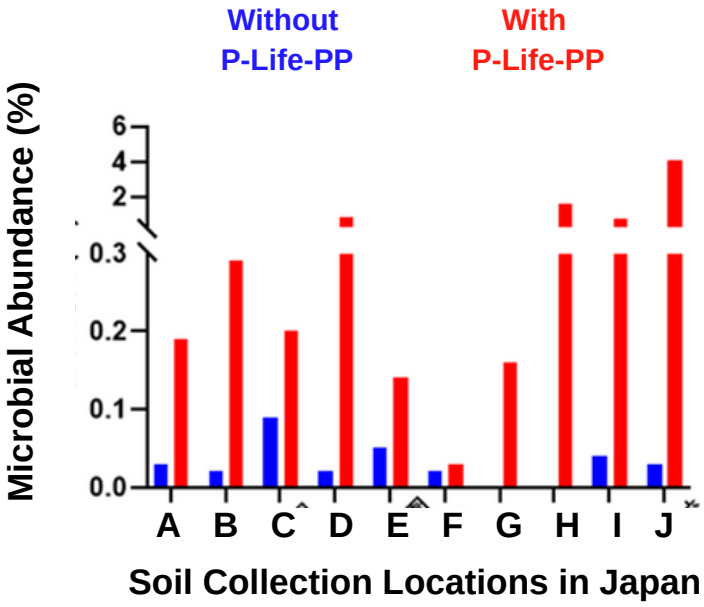


Fig. 1 Electron microscope of the surface of a PP straw containing P-Life. Untreated straws (left) and microbial treated straws (right)

In addition, the soil collected from various locations in Japan was studied for the microbial flora in the period of one month incubation with or without P-Life-PP Straws. As a result, in most of the soil samples, it clearly demonstrated that the presence of the degrading bacteria increased significantly when P-Life-PP Straws were added to the soil (Fig. 2).

Therefore, it was strongly suggested that this degrading bacterium plays a major role for microbial degradation of P-Life containing PP material.





A. Lake Yamanaka
B. Yabitsu Pass
C. Nagakubo Park
D. Kugenunma
E. Yumemigasaki Zoological Park
F. Shirogane Forest Road
G. Onabe Pass
H. Ito
I. Yugawara
J. Nishikamakura Elementary School

Fig. 2 Comprehensive microbiota analysis of the degrading bacteria in various locations of Japan

Future Developments

We discovered the multiple degrading bacteria that decompose P-Life containing PP material and found that they have a strong decomposing capability. Thus, by combining these degrading bacteria and P-Life, it is expected that the degradation efficiency will be greatly improved. Therefore, these multiple degrading bacteria are expected to make an important contribution towards solving the problem of persistent plastics.

Furthermore, we will verify the effects of microbial degradation on various products (caps, bottles, labels, etc.) made of not only Polyolefin based materials but also non-polyolefin-based materials such as Polystyrene (PS) and Polyethylene Terephthalate (PET) by combining these degrading bacteria and P-Life.

We will continue to make efforts to improve the circulation of persistent plastics in the natural environment by using P-Life Biodegradable Plastic Technology.

"Conference Presentation Information"

The 47th Annual Meeting of the Molecular Biology Society of Japan,
November 28, Fukuoka International Conference Center, Marine Messe Fukuoka
Title: “Elucidation of the microbial degradation mechanism of P-Life-containing Polypropylene Polymer”
Presenters: Ayaka Futaki, Ying Huang, Isao Toyama, Yoshito Abe, Shuji Uchiyama, Kenji Miyamoto

"Source of Research Expenses"

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"Glossary"

*1 P-Life: This is an epoch-making additive that leads to microbial degradation of persistent plastics, which are considered difficult to decompose by microorganisms. Persistent plastics are transformed into small molecule compounds with functional groups by P-Life, making them more easily degraded by microorganisms. In addition, P-Life is manufactured from vegetable oil and is highly safe. Moreover, P-Life does not affect the physical properties or processability of plastics.

*2 Polyolefin-based plastics: A general term for polymer compounds synthesized from simple olefins as monomers. Typical examples are polyethylene (PE) and polypropylene (PP). In general, biodegradation of Polyolefin-based plastics by microorganisms is difficult.

Inquiries about this release

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