“Genome Analysis and Gene Expression Analysis Conducted on Decomposition Bacteria Suitable for Plastic Additive ‘P-Life’ that Imparts Biodegradability!”— A Major Step Toward Improving the Efficiency of Microbial Plastic Degradation — PS Containing the P-Life Additive

A research team consisting of **P-Life Japan Inc.** (President: Isao Tomiyama, Head Office: Setagaya-ku, Tokyo), Keio University (President: Kohei Itoh, Location: Minato-ku, Tokyo), Ito En, Ltd. (President: Daisuke Honjo, Head Office: Shibuya-ku, Tokyo), SI Resin Industry Co., Ltd. (President: Nobuyuki Sakashita, Head Office: Makinohara City, Shizuoka), Keio Leading-Edge Laboratory of Scientific and Technology (Director: Hiroyuki Tsuda, Location: Yokohama City, Kanagawa), and Shonan Trading Co., Ltd. (President: Norio Hashimoto, Location: Yokohama City, Kanagawa) has conducted **genome analysis and gene expression analysis** on decomposition bacteria suitable for **Polypropylene (hereinafter PP) containing the additive P-Life**, which imparts biodegradability to plastics. Consequently, the team successfully identified **genes considered to be involved in the decomposition process.**

RESEARCH FINDINGS

This achievement marks an important step toward realizing **improved efficiency** in the **microbial decomposition treatment** of **persistent polyolefin-based plastics.**

PRINCIPAL RESEARCHERS

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PRESENTATION DETAILS

These results will be presented at the **2026 Annual Meeting of the Japan Society for Bioscience, Biotechnology, and Agrochemistry** in Kyoto. The meeting will be held on March 10, 2026.

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KEY POINTS OF THIS RESEARCH

- **Conducted genome analysis of decomposition bacteria for P-Life-containing PP.**
- **Performed gene expression analysis using low-molecular-weight compounds created by heat-treating P-Life-containing PP as a carbon source.**
- **Discovered that metabolic decomposition occurs via pathways such as the beta-oxidation pathway.**

RESEARCH BACKGROUND

In recent years, the leakage and accumulation of **plastic** in the environment has become a **major social issue**. Among these, polyolefin-based plastics are **persistent (difficult to decompose).**

PP (polypropylene) in particular is extremely difficult to biodegrade in nature. Under these circumstances, President Toyama of our company developed **"P-Life," a revolutionary additive that imparts biodegradability to polyolefin-based plastics**. P-Life gradually transforms PP into low-molecular-weight compounds possessing functional groups.

These low-molecular-weight compounds are slowly metabolized and decomposed by microorganisms living in the natural environment.

Last year, we succeeded in isolating decomposition bacteria for the first time by optimizing search sources and separation conditions. In this study, we conducted genome analysis and gene expression analysis aimed at elucidating the mechanism of these decomposition bacteria.

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RESEARCH CONTENT & RESULTS

When the T6-1 strain eats P-Life-containing PP, the decomposition speed is relatively slow. Therefore, it was thought that the fluctuation in expression of genes related to decomposition would be small. We **heat-treated P-Life-containing PP to lower its molecular weight** and further extracted only the **low-molecular-weight compounds soluble in acetone**. We then cultured the T6-1 strain using these. low-molecular-weight compounds and performed **gene expression analysis**.

As a control experiment, we compared this with expressed genes under conditions where glucose was used as the carbon source. As a result, we were able to discover **multiple candidate genes whose expression increased** when cultured with low-molecular-weight compounds, meaning they are considered to be **involved in the decomposition of P-Life-containing PP**.

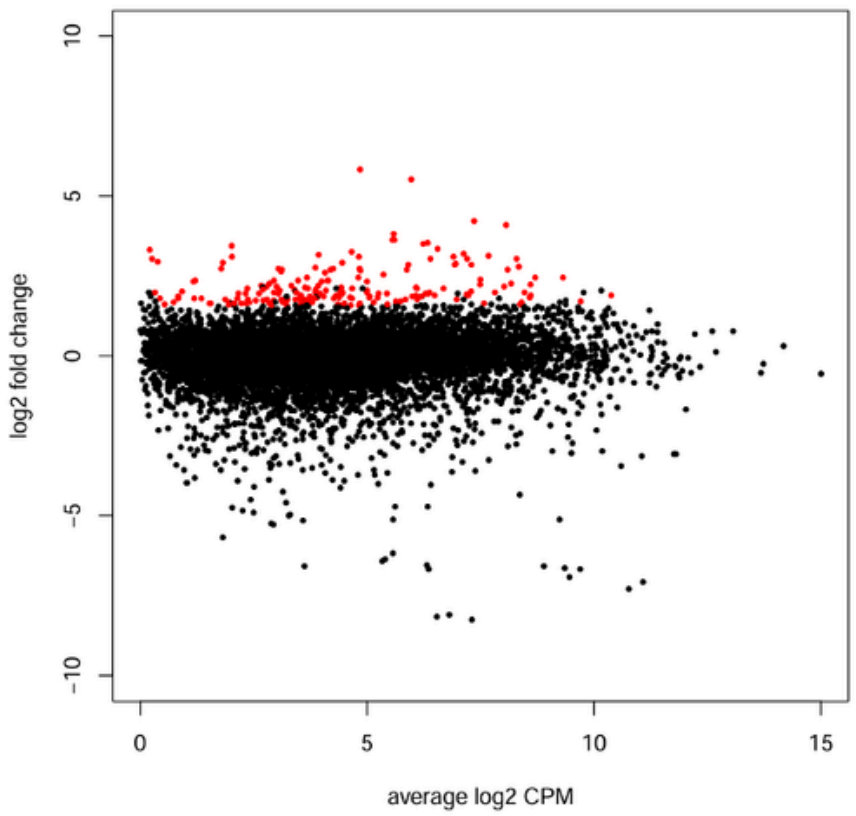

Figure 1: Analysis of Differentially Expressed Genes (Graph Legend: • Red dots indicate genes that increased 3-fold or more).

Upon detailed investigation of the genes with increased expression, we were able to identify **multiple genes related to the beta-oxidation pathway. P-Life-PP Low-Molecular Compounds**.

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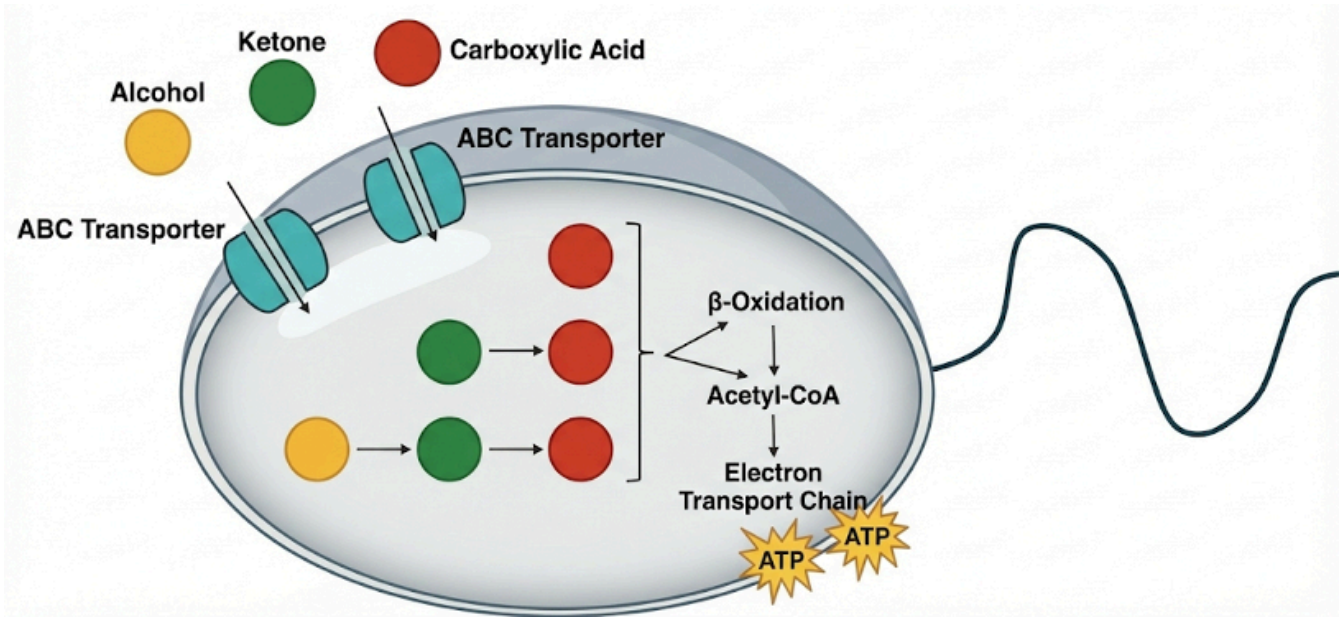

Figure 2: Schematic Diagram of Decomposition Mechanism of P-Life-PP Low-Molecular Compounds.
(Diagram labels: P-Life-PP low molecules (Alcohol -> Ketone -> Carboxylic Acid) enter the cell via ABC Transporter. Then, Beta-oxidation occurs, producing Acetyl CoA. This enters the Electron Transport Chain, resulting in ATP production.)

FUTURE PROSPECTS

We have clarified the full decomposition mechanism by decomposition bacteria for P-Life-containing PP!

Now that the decomposition pathway of the **T6-1 strain** has been revealed, it becomes possible to **improve decomposition efficiency through genetic manipulation.**

Furthermore, by metabolically modifying the **T6-1 strain**, a path has been opened toward producing **useful substances using plastic as a carbon source (upcycling).**

It is expected that the decomposition bacteria in this study will make a **significant contribution toward solving the problem of persistent plastics.**

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CONFERENCE PRESENTATION INFORMATION

Event:
2026 Annual Meeting of the Japan Society for Bioscience, Biotechnology, and Agrochemistry
Date / Venue:
March 10, Doshisha University, Imadegawa / Muromachi Campus
Title:
Elucidation of Decomposition Mechanism of P-Life-containing Polypropylene
Presenters:
Ayaka Futaki | Ying Huang | Isao Toyama
Yoshito Abe | Shuji Uchiyama | Norio Hashimoto | Kenji Miyamoto
Research Funding:
This research was supported by the JST Program on Open Innovation Platform with Enterprises, Research Institute and Academia (COI-NEXT), Grant Number JPMJPF2111.

Term Explanations:
P-Life: A revolutionary additive that guides *persistent plastics*, which are considered difficult to biodegrade, toward *microbial decomposition*. Persistent plastics are transformed by P-Life into. *low-molecular-weight compounds possessing functional groups*, making them easier for microorganisms to decompose. Furthermore, P-Life is manufactured from *plant oil* and is highly safe. Also, P-Life does not affect the physical properties or processability of PP.
Polyolefin-based plastics: A general term for high-molecular compounds synthesized using simple olefins as monomers. Representative examples include Polyethylene (PE) and Polypropylene (PP). Generally, *biodegradation by microorganisms is difficult*.
Gene Expression Analysis: A method to investigate which genes are working and to what extent within a cell. RNA-Seq, used in this study, is a method to *quantitatively analyze gene expression levels* by comprehensively reading the base sequences of mRNA using a *next-generation sequencer*.

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