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Impact of Plastic Additives on the Biodegradation Efficiency of Polyhydroxybutyrate by a Single Bacterial Isolate

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INTRODUCTION & AIM

In recent years, environmental pollution caused by petroleum-derived plastics, which have a high environmental impact, has become a serious concern. Polyhydroxybutyrate (PHB) is a biodegradable polyester produced by microorganisms. It is considered a promising alternative to conventional plastics due to its biocompatibility and high crystallinity. However, plastic additives are often used in plastic products to enhance their functionality. Some of these additives are known to pose biotoxicity risks and may alter the properties of plastics in ways that affect the biodegradation process of PHB. Therefore, understanding how plastic additives influence the biodegradation of PHB is essential for selecting appropriate types and amounts of additives in future applications. Some additives exhibit toxicity and may leach from polymers into the environment. The presence of such additives could potentially affect the degradation behavior of PHB. Therefore, the aim of this study was to investigate the biodegradation behavior of PHB under environmental conditions containing various additives.

METHOD

Culture medium

- MS medium was prepared, and after adding the additives to reach the desired concentrations, PHB was added to obtain a 0.5 (w/v)% PHB medium.

Cultivation conditions

- The bacterial strain used was *Ralstonia* sp. C1.
- The preculture was carried out at 30℃ and 100 rpm for 18 hours, and the obtained cell suspension was added to the MS medium with 0.5 (w/v)% PHB as the single carbon source.
- The culture was carried out at 30℃ for 96 hours at 150 rpm.
- Every 24 hours sample was collected for the analysis. pH was adjusted to pH 7.0 during the incubation.
- The collected samples were pretreated using the method of Saito et al [1)].
- The residual amount of PHB in the sample was analyzed by HPLC.

Gram staining

- After Gram staining using a culture sample, the growth of C1 strain in culture medium was observed under an optical microscope.

RESULTS & DISCUSSION

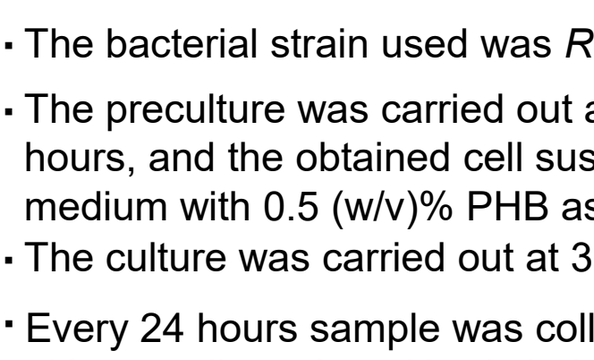

Figure 1. Time-dependent changes in PHB degradation when benzenesulfonamide is added

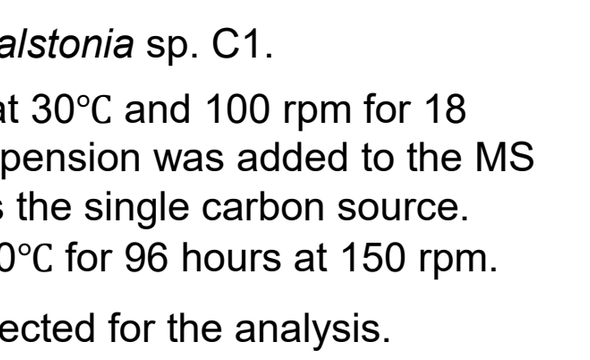

Figure 2. Time-dependent changes in PHB degradation when dipropylene glycol is added

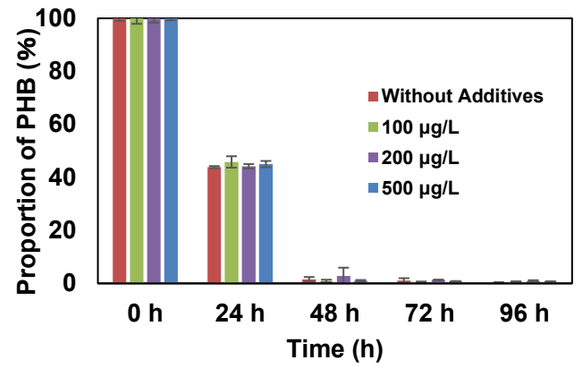

Figure 3. Time-dependent changes in PHB degradation when triethylene glycol is added

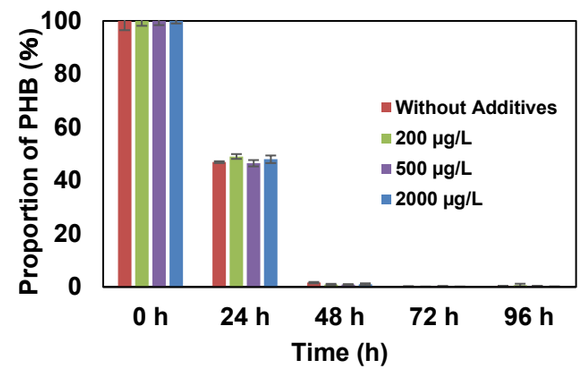

Figure 4. Time-dependent changes in PHB degradation when polyethylene glycol is added

In all conditions, approximately 50% of PHB was degraded within the first 24 hours, and more than 98% was degraded after 96 hours.

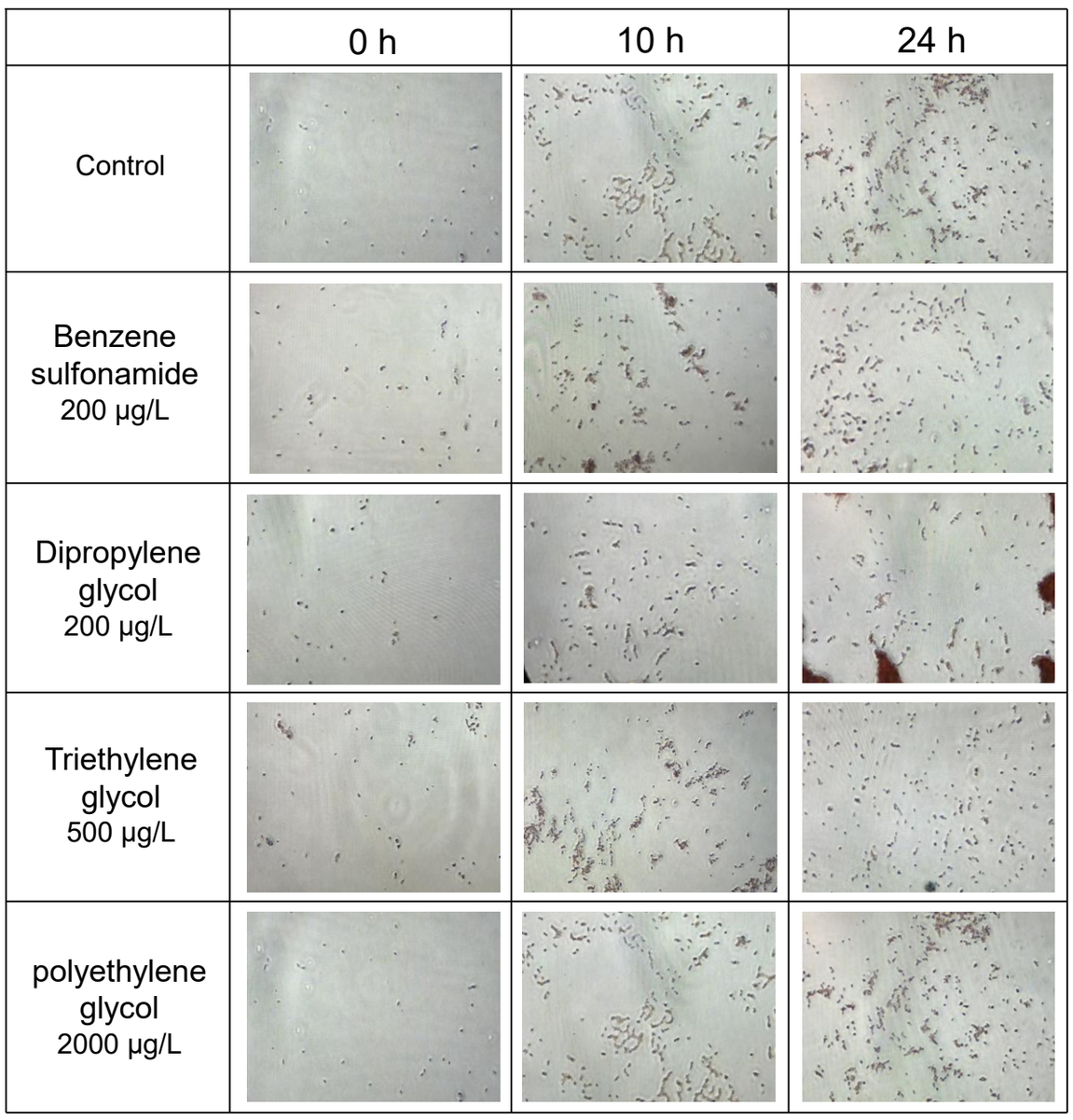

Figure 6. Results of observing bacterial cells in culture medium

CONCLUSION

These additives do not inhibit microbial activity and suggest that they do not alter the physicochemical properties that affect the bioavailability of PHB. Furthermore, *Ralstonia* sp. C1 does not appear to metabolize these additives, further supporting the conclusion that their presence does not interfere with the degradation process.

FUTURE WORK / REFERENCES

1. K. Saito et al. (2023) Quantification of the Monomer Compositions of Poly(3-hydroxybutyrate-co-3-hydroxyvalerate) and Poly(3-hydroxyvalerate) by Alkaline Hydrolysis and Using High-Performance Liquid Chromatography, *Bioengineering*, 10, 618.