Bacterial synthesis and decomposition of bioplastics

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Introduction

More than 10 million tons of plastic waste are washed away into the sea every year, and microplastics pollution is a problem. We wanted to isolate marine bacteria from sun-dried salt and make bioplastics that would be degraded in the ocean.

Two types of bioplastics

Biomass plastics (Resource recycling type)
Biopolycarbonate
PET　PTT
BioPE　BioPP
BioPET　etc

(Both properties)
PLA
PHBH
BioPBS

Polylactic acid, Polybutyric acid

Biodegradable plastics (Natural biodegradation type)
PCL
PBS etc

Ocean degradability

Purpose

①Let marine bacteria synthesize biodegradable plastics

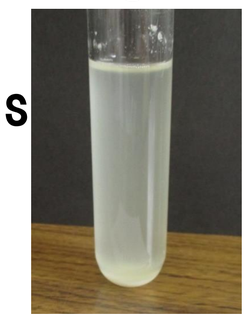
②Are biomass plastics environmentally friendly?

Expt.① Culturing marine bacteria in commercially available sun-dried salt

Liquid culture in marine broth medium⇒Colony on flat plate agar

12 kinds of sun-dried salt in the world ⇒ 66 strains

Origin of sun-dried salt	Strain	Origin of sun-dried salt	Strain
①China	19 species	⑦South Africa	6 species
②Australia	6 species	⑧Argentina	2 species
③Italy	14 species	⑨Australia2	2 species
④Spain	4 species	⑩Southern France	5 species
⑤Mexico	4 species	⑪Japan / Okinawa	1 species
⑥France	2 species	⑫Tokyo / Oshima	1 species



Expt.② Synthesize bioplastics with bacteria ①

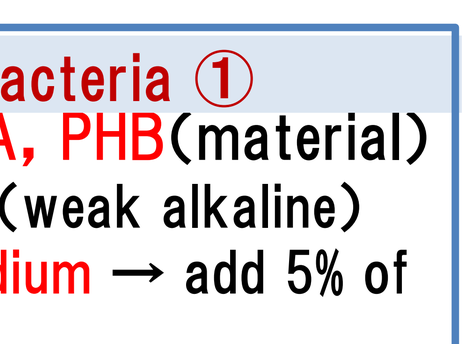
Thought of synthesis conditions with PLA, PHB(material)

- make alkaline medium →add Na_2CO_3 (weak alkaline)
- change C/N concentration ratio of medium → add 5% of sucrose
- change into hyperosmotic medium →add 10% ofNaCl

Verify and extract bioplastic storage and secretion

- intracellular storage ：Lofflere's methylene blue solution
- exocrine secretion ：ink dye⇒observe with microscope
- centrifuge, NaOH dissolve precipitate, deposit ethanol

type	supernatant	precipitation	type	supernatant	precipitation
I3-3	○	○	SA3-6	○	○
I3-1	○	○	F3-1	×	○
SA3-1	×	○	C10-4	×	○



staining results and extract

<Results>

◎was able to synthesize, extract bioplastics materials from many bacteria
◎was able to verify that materials aren't neither protein, polysaccharide nor nucleic acid
◎was able to disassemble extracted materials with soil bacteria

Expt.③ Biomass plastics formulation check the disassembly speed of plastic shopping bags

Fill the plastic shopping bag with biomass plastic (mixing ratio 10%, 25%, 30%, 50%) in the soil.

2 months later

Only the plastic shopping bag with a compounding ratio of 30% had several holes of about 4 mm (the other compounding ratios did not change).

【Forecast】
It takes more than a year to disassemble, and it may not be completely disassembled.

Consideration

○There are bacteria in the sun salt that can synthesize biodegradable plastics
○Biomass plastics shopping bags are not environmentally friendly

Research tasks from now on

① study about the decomposition speed of the bioplastics we made
② develop our study and make it practical for the SDGs
③cooperate with partnership schools to save ocean environment
(ex.) find out where the plastic bottle flowed from/testing different types of plastic bags including bioplastics/participate in idea contest about environment preservation

Harvest from the research

- we realized what we can do to save the environment as students
- noticed what's "good" in the society doesn't always be "good"
- learned that students like us can make success by making effort
- we want to be a researcher and do something useful to the society