Plastic Eating Bacteria

A recent study in Japan found a bacterium(*Idonella sakaiensis*) that can eat a type of plastic called Poly(ethylene terephthalate) also commonly called PET. PET has been a growing environmental concern for many years now. This is because it does not readily break down in traditional landfills and has been growing in popularity for use as a container in water bottles and other commercial plastics.

PET does not readily degrade for a couple of reasons. The first being that it is composed of a repeating chain of monomers called ethylene terephthalate, which has an aromatic ring at the center of the polymer making it a very stable molecule. The second reason PET sits in a land fill for many years is because there are very few bacteria that are able to produce proteins which break down the ethylene terephthalate monomers into usable carbons sources for energy.

In the normal degradation of trash put into a landfill, bacteria either in the soil or introduced by the landfill operators are able to use the trash to produce energy by one of two methods. The first method is to absorb the molecules whole and break them down into simpler sugars inside the cell, such as with say a banana where the molecules are predominantly sugars which can readily be taken into and be broken down by the bacteria to produce energy. The second method by which common trash is broken down is that the bacteria will produce an enzyme that breaks down the material into smaller molecules which can then be taken into the cell and be broken down further to produce energy, such as if a cell were to use cellulose from cardboard to produce its energy.

With PET however, very few organisms in the world are known to be able to degrade this plastic. The few known species of organisms which can do this are mostly slow growing fungi (*Fusarium oxysporum* and *Fusarium solani*) which can degrade small amounts of PET to produce the energy needed for growth. These organisms have been proposed as a way to remove and degrade plastics from landfills. These solutions have not been commercially used because they are not cost effective strategies the significant amount of PET added to landfills each day.

The discovered bacterium however, is able to degrade plastic at a rate of almost double that of other known organisms. This study compared the time it took for the fastest known PET degrading fungus to that of the newly discovered organism to degrade 60 grams of PET. The study showed that the fungus required about 80 days to digest the 60 grams of PET while the new bacterium required about 40 days to digest the same 60 grams of PET. The new organism is now being further studied to determine the practicality for use as a commercial PET degradant in landfills. The organism is able to breakdown PET by producing a protein called ISF6\_4831. The study was able to purify the protein for further study of the activity. The protein was applied to the same 60 gram film of PET as both the novel organism and the known fungi and incubated at the same temperature. A mere 18 hours later, there was notable pitting on the film from enzymatic PET degradation. Further study is required, however, researchers are still hopeful that they have discovered a way to reduce the amount of PET in landfills and therefore, the human footprint on the planet.

Reference: A bacterium that degrades and assimilates poly(ethylene terephthalate). Shosuke yoshida et al. Science. 11 March 2016. Volume 351 Issue 6278 pg 1196-1199.