Amazon fungi found that eat polyurethane, even without oxygen

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(PhysOrg.com) -- Until now polyurethane has been considered non-biodegradable, but a group of students from Yale University in the US has found fungi that will not only eat and digest it, they will do so even in the absence of oxygen.

(PhysOrg.com) -- Each year Yale University operates a Rainforest Expedition and Laboratory course, which includes an expedition to a tropical jungle in the spring recess and summer research on samples collected. Last year the group cultured microorganisms found on plants they collected in the Amazon, one of the most biologically diverse regions on Earth. Among the samples they discovered a fungus, Pestalotiopsis microspora, that will digest the plastic material, polyurethane.

Polyurethane is a synthetic polymer developed in the 1940s, that is often used to replaces rubber, paint, wood, or metals. Polyurethane is found in a wide variety of modern appliances, furnishings, paints, vehicle parts, foam insulation materials, glues, and shoes, among many other applications, and has the advantages of strength, durability and elasticity. Some of the polyurethane used can be recycled into other products, but it all ends as waste eventually. The environmental problem is that once it enters the landfill it could remain there almost indefinitely because nothing we know is able to metabolize and digest it (in other words, it is not biodegradable), and the chemical bonds within it are so strong they do not degrade readily. Polyurethane can be burnt, but this releases harmful carbon monoxide into the atmosphere, along with other toxic chemicals.

Last year's group, led by Professor Scott Strobel, a molecular biochemist, discovered P. microspora and found that it will not only eat polyurethane, but can survive on a diet consisting solely of polyurethane. Furthermore, it can survive in anaerobic environments, such as those existing in the oxygen-starved regions deep inside landfills.

The fungus was discovered in the jungles of Ecuador by Pria Anand, and another undergraduate student, Jonathan Russell, identified a serine hydrolase, the enzyme thought to enable the fungus to digest the polyurethane. Both students are studying in the Department of Molecular Biophysics and Biochemistry at Yale in Connecticut.

The newly-discovered fungus is an endophytic microorganism, which means it lives on or inside the tissues of host plants without causing them harm. Several other microorganisms were found that would degrade both solid and liquid polyurethane, but only P. microspora isolates could survive entirely on the plastic under aerobic and anaerobic conditions.

The paper describing the discovery was published in the journal *Applied and Environmental Microbiology*. The authors suggest endophytic fungi such as P. microspora could be used to deal naturally with waste products such as polyurethane—a process known as bioremediation.

More information: Biodegradation of Polyester Polyurethane by Endophytic Fungi, *Appl. Environ. Microbiol.* September 2011 vol. 77 no. 17 6076-6084. doi:10.1128/AEM.00521-11

ABSTRACT
Bioremediation is an important approach to waste reduction that relies on biological processes to break down a variety of pollutants. This is made possible by the vast metabolic diversity of the microbial world. To

explore this diversity for the breakdown of plastic, we screened several dozen endophytic fungi for their ability to degrade the synthetic polymer polyester polyurethane (PUR). Several organisms demonstrated the ability to efficiently degrade PUR in both solid and liquid suspensions. Particularly robust activity was observed among several isolates in the genus Pestalotiopsis, although it was not a universal feature of this genus. Two Pestalotiopsis microspora isolates were uniquely able to grow on PUR as the sole carbon source under both aerobic and anaerobic conditions. Molecular characterization of this activity suggests that a serine hydrolase is responsible for degradation of PUR. The broad distribution of activity observed and the unprecedented case of anaerobic growth using PUR as the sole carbon source suggest that endophytes are a promising source of biodiversity from which to screen for metabolic properties useful for bioremediation.