Engineered yeast could produce low-cost plastics from renewable resources

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Scientists have engineered a yeast to produce a monomer acid that can be converted into bioplastics similar to polyethylene. Image credit: Kriplozoik.

(PhysOrg.com) -- With the goal to reduce our dependence on fossil fuels, scientists are looking for alternative methods to produce plastics that are based on renewable oils. In a new study, scientists have developed a method to produce a bioplastic by engineering a strain of the Candida tropicalis yeast. Their results demonstrate the possibility of producing low-cost, commercially viable yields of omega-hydroxyfatty acids, a new family of monomers that can be converted to bioplastics which could eventually be used for a variety of applications.

The researchers, Wenhua Lu, et al., from the Polytechnic Institute of New York University and DNA2.0 Incorporated in Menlo Park, California, have published their study on the biosynthesis technique in a recent issue of the Journal of the American Chemical Society.

The researchers engineered C. tropicalis to transform fatty acids into omega-hydroxyfatty acids, a monomer that when polymerized provides a variety of options for developing new bio-based plastics with attractive physical properties. Usually, these acids are difficult and expensive to prepare using traditional methods. The key to getting the yeast to produce large amounts of omega-hydroxyfatty acids was eliminating certain enzymes that further oxidize these acids into unwanted diacids. The researchers identified and eliminated 16 genes and other oxidation pathways, which resulted in a 90% reduction in the activity that converts omega-hydroxyfatty acids to diacids.

As the scientists explained, this new engineered strain of C. tropicalis provides a foundation for the development of low-cost methods of producing omega-hydroxyfatty acids for conversion into plastics. Plastics produced by this method could have a variety of uses, as previous research has shown that plastics produced from a very similar omega-hydroxyfatty acid are strong, ductile materials. The plastics could have applications in lubricants, adhesives, cosmetics, and anti-cancer therapies, and could also be recycled through a conversion process that results in a biofuel similar to biodiesels such as Soy Gold.

In the future, the researchers plan to investigate ways to further modify the strain to allow for more direct conversion of various triglyceride feedstocks and introduce new pathways to increase the efficiency of omega-hydroxyfatty acid production.

"We are currently up-scaling the fermentation, preparing polymers from omega-hydroxyfatty acids and determining what unique properties these

new biomaterials bring to currently available plastics," coauthor Richard Gross, a professor of chemical and biological science from the Polytechnic Institute of New York University told *PhysOrg.com*. "Furthermore, we are sampling large chemical companies that are polyester producers so that they can assess the commercial potential of the bioplastics. These activities are being conducted by SyntheZyme, a new company started in 2008, to commercialize new innovations developed in our laboratory at NYU-POLY. The company is currently seeking commercial partners to help enable future development and scale up work for microbial production of the monomer as well as the corresponding bioplastic materials."

More information: Wenhua Lu, et al. “Biosynthesis of Monomers for Plastics from Renewable Oils.” *J. Am. Chem. Soc.* ASAP. DOI:10.1021/ja107707v