

Novel plastics and textiles from waste with the use of microbes

March 16 2012

New biotechnological and chemical methods will facilitate efficient production of chemicals, materials and fuels from renewable natural resources. The Academy of Finland Centre of Excellence (CoE) in White Biotechnology – Green Chemistry Research focuses on the research and development of microbial cells, or cell factories, for producing new useful compounds from sugars in plant biomass. These compounds can be used, for example, for manufacturing bioplastics or in medical applications.

"By means of gene technology, we can modify microbial metabolism and thereby produce organic acids for a wide range of industrial applications. They can be used, among other things, for manufacturing new plastic and textile materials, or packaging technologies," explains Merja Penttilä, Research Professor and Director of the Centre of Excellence from VTT Technical Research Centre of Finland.

New methods play a key role when various industries are developing environmentally friendly and energy-efficient production processes. Use of renewable natural resources, such as agricultural or industrial waste materials, to replace oil-based [raw materials](#) will make industries less dependent of fossil raw materials and, consequently, reduce carbon dioxide emissions into the atmosphere.

The CoE also develops highly sensitive measuring methods and investigates microbial cell functions at molecular level. "We need this information to be able to develop efficient bioprocesses for the future.

For instance, we build up new micro- and nanoscale instruments for measuring and controlling microbial productivity in bioreactors during production."

Alternatives for oil

The metabolism of microbes is modified so that they will convert plant biomass sugars into sugar acids and their derivatives. These compounds can potentially serve as raw materials for new types of polyesters, whose properties – such as water solubility and extremely rapid degradation into natural substances – can be used, for example, in medicine. By modifying sugar acids, it is also possible to produce compounds that may replace oil-based aromatic acids in the manufacture of thermosetting plastics and textiles.

"Sugar acids can be used to produce biodegradable technical plastics, including polyamides, or functional components that increase the ability of cellulose to absorb water. Novel materials could replace the currently available non-biodegradable absorbent components in hygiene products. Sugar acids are also a source of hydroxy acids, such as glycolic acid, whose oxygen-barrier properties make it suitable for food packaging," explains Professor Ali Harlin, the head of the CoE Green Chemistry team.

In order to be able to replace, in the future, industrial production that is based on petrochemicals with new production processes based on waste biomass, such new processes must be extremely efficient. "A major challenge is how make the production organisms used in bioprocesses, that is, the microbes, to utilise the sugars of the biomass and to convert them into desired compounds in the most effective manner. This development work calls for multidisciplinary competence ranging from biosciences to engineering."

Provided by Academy of Finland

Citation: Novel plastics and textiles from waste with the use of microbes (2012, March 16)
retrieved 24 April 2024 from <https://phys.org/news/2012-03-plastics-textiles-microbes.html>

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