Fuel from fuel: converting biodiesel waste into ethanol

Researchers have discovered that under the correct conditions, glycerol, a major by-product of biodiesel production, can be turned into ethanol by harmless strains of the bacterium *Escherichia coli*. Furthermore, yields of ethanol obtained from this method are higher than those obtained from conventional means of production.

As society looks for alternative sources of energy to replace the use of fossil fuels, the production of renewable fuels such as biodiesel has significantly increased. However, biodiesel production creates large amounts of glycerol, a by-product of the conversion process from vegetable oil to fuel. Nearly one kilogram of glycerol is created for every ten kilograms of biodiesel produced. Although refined glycerol is used extensively by the chemical industry in the manufacture of cosmetics, drugs and food products, there remains a surplus of glycerol which some biodiesel manufacturers must pay to have removed.

Ethanol is produced by using bacteria to ferment glycerol. Although widely used in the biotechnology industry, researchers had previously thought that the bacterium *E. coli* was unable to ferment glycerol, because the bacterium did not produce a vital chemical, 1,3-propanediol, (1,3-PDO) required during the process. However, this research has identified mechanisms which overcome this barrier and enable *E. coli* to convert glycerol into ethanol. Yields of ethanol produced in this way are greater than yields produced by the standard means of ethanol production, which converts plant sugars from crops such as corn into fuel. Furthermore, production costs are lower using this method.

In addition, a greater understanding of *E. coli* has allowed the researchers to genetically modify the bacteria to allow the glycerol to be used to produce other chemicals, such as formic and succinic acids, both of which have higher commercial values than ethanol. Formic acid can be used in fuel cells, while succinic acid is usually derived from fossil fuels and is widely used in non-toxic solvents, pharmaceuticals and the food industry.

The study has therefore shown that extra value can be added to the production of biodiesel by turning the glycerol waste into another fuel, ethanol, and other valuable chemicals. However, in order to meet the demand for ethanol, conventional production processes will still be required as not enough biodiesel is manufactured to produce the amounts of glycerol required, even under the envisaged expansion of the biodiesel industry.


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