Alkanes Replacing Alkanes: Frontiers in Renewable Fuel

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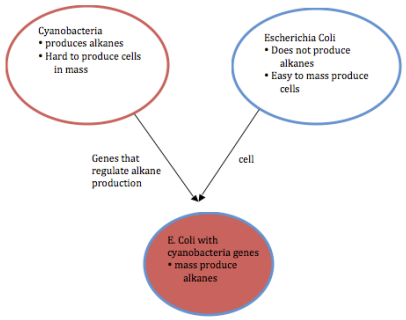
As news of the oil spill in the Gulf of Mexico dies out, the world once again focuses its efforts towards finding alternative and/or renewable fuels as natural resources diminish. Additionally, much of the activity associated with obtaining naturally occurring fuels is highly implicated in global warming and the degregation of the biosphere. At Lake Forest College, Dr. Lori Del Negro studies air toxins, particularly those released from incomplete combustion of petroleum. One example of these toxins is benzene. A diverse number of species are known to naturally produce alkanes, the major component of natural fuels such as petroleum. However, the genetics and biochemistry behind this have never been explored before Schrimer et. al started working on the report, Microbial Biosynthesis of Alkanes (2010).

Schrimer et al., proposed a mechanism for the biosynthesis of alkanes in cynobacteria and suggested that this mechanism can be carried out in a cheaper, mass producible way using the organism E. Coli. This organism naturally does not synthesize alkanes, however, genes can be inserted into the organism so that it produce them. These newly synthesized alkanes can then be sequestered as renewable petroleum to use for transportation and industrial use. Replacing alkanes with alkanes may not seem logical when talking about "alternative and/or renewable fuel", given that alternative fuels are defined as "nonpetroleum fuels that yield substantial energy security benefits, and offer substantial environmental benefits" (2009, November). It is also known that "renewable energy resources are constantly replenished and will never run out for example, wind and solar energy" (2009, September). However, it is the method of deriving these alkanes that matters and the implications of burning this fuel the same way as before by way of combustion.

Alkane production by cyanobacteria and the genomes of many strains of cyanobacteria available to the public have been consistently studied before Schrimer et. al. began working on this report. The authors chose to analyze eleven strains of cyanobacteria for alkane production. Interestingly, one strain of the cyanobacteria strains analyzed, Synechococcus sp., did not produce alkanes. Thus by deduction methods the authors could infer which genes were responsible for the biosynthesis of alkanes.

Expression of these genes in E. coli conferred the production of alkanes and alkenes by E. coli. The proposed mechanism of decarbonylation of fatty aldehydes to alkanes held true in experiments designed to evaluate this model. However, the authors failed to mention anything about the reproducibility of these results. Also, the motivation for writing this report seems questionable since it is affiliated with a biotechnology company, LS9 that is described as "rapidly commercializing" (LS9, Inc. 2007).

LS9 might be correct in saying that petroleum should be replaced with petroleum since petroleum carries more energy per gram than any of the common alternative fuels such as ethanol. However, as Dr. Del Negro of the Lake Forest College Department of Chemistry said, "The problem with fuel is that it is still used in the same inefficient combustion pathway to release energy. If we could find a better way to release energy from alkanes, say by an enclosed mechanism such as the electron transport chain where the products are collected and can be reused, that would be perfect." Dr. Del Negro is conducting research on Urban Air Pollution and has lately been measuring benzene quantities in the air near airports and high traffic areas. Benzene is a component of fuel and is one of the side products of the inefficient combustion of alkanes (fuel). In contrast to the many other side products of combustion that are causing global warming, benzene is a carcinogen, which can cause cancer. Even though the Environment Protection Agency (EPA) has regulations on air pollutants such as benzene, it is not possible to say at what amounts these carcinogenic pollutants start affecting humans, since their mechanism of action in the human body is not known. Therefore, it is not enough to control the levels of air pollutants from fuel burning. New, more efficient methods of burning fuel that decrease toxic air pollutants should be investigated at the same time as new fuels are explored.
Although the idea of renewable petroleum is very appealing since it eliminates the deleterious effects of acquiring fossil fuels, it still does not solve the problem of toxic and environmentally unfriendly side products of fuel combustion. Meanwhile, as the search for the most reasonable renewable fuel proceeds, measures should be taken to reduce harmful pollutants in the atmosphere. Unfortunately, we continue to learn the hard way to protect our environment through incidents such as the oil spill in the Gulf of Mexico and pollution fogs to name a few.



An increasing number of fuel efficient cars are released in the USA each year allowing consumers to take action in decreasing toxic gases in the atmosphere.

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