

Lipid Accumulating Microorganisms as Alternative Sources of Fuels

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The global economy heads for a severe energy crisis: A comparison of the forecasted energy demand and the accessible resources of crude oil shows that the future energy demand cannot be met solely by fossil fuels. Whereas the energy demand is going to rise, well accessible sources of crude oil are expected to be depleted in only a few decades. In addition, massive emissions of greenhouse gases are causing an irreversible change of the global climate. Consequently, it is inevitable to resolve the dependency on crude oil and the increasing impairment of the environment by establishing sustainable and competitive alternatives which could be based on renewable and abundant feedstock like biomass or on other regenerative sources. To prevent a serious decline of oil supply and the associated collapse of the economy, alternative biofuels that replace fossil fuel and do not further impair the environment and climate should be developed. At present, about 90% of the biofuel market is captured by bioethanol and biodiesel, which are already used at large scale as gasoline or diesel substitute and which are referred to as first generation biofuels. Their production mainly relies on simple carbohydrates (sucrose or starch) or vegetable oils (palm, soybean or rape seed) and is therefore competing with food supply which is ethically problematic. Biodiesel is composed of fatty acid alkyl esters (FAAE) and can be synthesized by chemical, enzymatic or *in vivo* catalysis from renewable resources. It is already established as it is compatible with the existing fuel infrastructure, non-toxic, and has superior combustion characteristics than diesel. The biotechnological production of FAAE from low-cost and abundant feedstocks like biomass would enable an appreciable substitution of petroleum diesel. To overcome high costs for immobilized enzymes, the *in vivo* synthesis of FAAE using bacteria represents a promising approach. Further subjects of research are other short-chain alcohols (butanol, propanol), biogas (methane and hydrogen), alkanes and isoprenoides. The lecture describes the potential of alternative biofuels which could be produced by enzymatic processes or by fermentation of microorganisms in biotechnology. It also emphasizes the flexibility of bacteria for production of lipids.