The relevance of biofuels

Sudarsan and Anupama[1] rightly point out the need for alternate renewable bioresources. The current reliance on petro-based fuels and chemicals is not sustainable as the energy demand is projected[2] to grow by more than 50% by 2025. Several authors[3,4] have pointed out that future reductions in the ecological footprint of energy generation will reside in a multifaceted approach that includes nuclear, solar, hydrogen, wind, and fossil fuels (from which carbon is sequestered), and biofuels. Producing biodiesel from crops is not a new concept as the use of biodiesel from a variety of crops was first demonstrated by Rudolph Diesel in 1900. However, the widespread availability of inexpensive petroleum during the 20th century determined otherwise. Generally shifting society's dependence away from petroleum to renewable biomass contributes to the development of sustainable industrial society and effective management of greenhouse gases[2].

A major criticism often levelled against biomass, particularly against large-scale fuel production, is that it could divert agricultural production away from food crops, especially in developing countries. However, this so called 'food versus fuel' controversy appears to have been exaggerated in many cases. The subject is far more complex than has generally been presented, since agricultural and export policy and the politics of food availability are factors of far greater importance. Credible studies show that with plausible technology developments, biofuels could supply some 30% of global demand in an environmentally responsible manner without affecting food production[5]. Certainly no one expects oil to disappear overnight – or even in the next one or two decades. Even after the recent surge, farm-grown biofuels like ethanol and biodiesel still account for only a small fraction of fossil-fuel use, as do other renewables such as wind and solar power. However, thanks to skyrocketing oil prices, worries about climate change and growing anxiety over the future security of the world's supply of crude, the prospects for ethanol and other biofuels to make major inroads in oil use are bright. Brazil is the only exception where favourable agricultural conditions and flexible processing infrastructure allow the majority of the country's road transport to be powered economically with cane-derived ethanol[5].

The energy plantation[1] is groundwork laid by India's leading oil and gas companies to become biofuel producers and suppliers in the coming years, and this is a step in the right direction[6]. However, other alternatives like microalgae, whose potential is not fully exploited, should also be focused as a renewable energy resource. These microscopic algae use a photosynthetic process similar to that of higher developed plants and can complete an entire growing cycle every few days. They are veritable miniature biochemical factories, and appear more photosynthetically efficient than terrestrial plants[7] and are efficient CO_2 fixers[8]. The ability of algae to fix CO_2 has been proposed as a method of removing CO_2 from flue gases from power plants, and thus can be used to reduce emission of greenhouse gases. Bioreactors for microalgae to trap CO_2 and NO_x are under active development. Algae contain fat, carbohydrates and protein. Some of the microalgae contain up to 60% fat. Once the fat is 'harvested' – some 70% can be harvested by pressing – what remains becomes a good animal feed or can be processed to produce ethanol. Further, there is ongoing research towards oil-rich algae, whose yield per hectare is considerably higher than that of sunflower or rapeseed[9]. The use of hydrogen gas is another attractive alternate source. Attributed by its numerous advantages (environmentally clean, efficient and ability to renew), hydrogen gas is considered to be one of the most desired alternatives. Cyanobacteria are highly promising microorganisms for hydrogen production[10]. In comparison to the traditional ways of hydrogen production (chemical, photoelectrical), cyanobacterial hydrogen production is commercially viable[11].

Petroleum is not only used as fuel, but is also a raw material for the production of a variety of chemicals. Petroleum alternatives should be developed prior to the exhaustion of petroleum supplies. The majority of petroleum has its origins in algae, which were grown using CO_2 as a sole carbon source. Research into the production of petroleum alternatives using energy crops and microalgae is important to the future of mankind. This is a multidisciplinary task in which biologists, agronomists, chemical engineers, fuel specialists and social scientists must work to integrate and optimize several disjoint activities[5]. The combination of breeding and biotechnological tools should result in a 'Bioenergy Revolution' having greater impact than that of the Green Revolution.

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