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| الكلية | العلوم |
| القسم | علوم الحياة |
| المادة باللغة الانجليزية | Biotechnology and genetic engineering |
| المادة باللغة العربية | التقنيات الاحيائية والهندسة الوراثية |
| المرحلة الدراسية | الرابعة |
| اسم التدريسي | سعد طه مطلك حميدان بيكات |
| عنوان المحاضرة باللغة الانجليزية | Biological fuel generation |
| عنوان المحاضرة باللغة العربية | توليد الوقود البيولوجي |
| رقم المحاضرة | الثامنة |
| المصادر والمراجع | Jones and Bartlett Publishers, (October 20, 2010) Introduction to Biotechnology and Genetic Engineering, 1st Edition. |
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## 8.1. BIOLOGICAL FUEL GENERATION

In general, the gradual exhausting of fossil fuel energy led to the need to seek out **alternative sources of energy**. So far, these have included the harnessing of hydro, tidal, wave and wind power, the capture of solar and geothermal energy supplies, and nuclear power. There is now a growing appreciation of biological solar energy systems and biotechnological advances in this area will soon bring economic reality to selected processes. As fossil-fuel resources are depleted and become increasingly more expensive, conversion of organic residues to liquid fuels will become a more economically-attractive consideration.

There are three main directions that can be followed to achieve biomass supplies:

(1) cultivation of so-called energy crops
(2) harvesting of natural vegetation
(3) application of agricultural and other organic wastes.

The conversion of the resulting biomass to **usable fuels** can be accomplished by **either biological or chemical means or by a combination of both.** The **two main** end products that will be formed, will be either **methane or ethanol** although other products may arise depending on initial biomass and the processes utilized, for example, solid fuels, hydrogen, low-energy gases, methanol and longer-chain hydrocarbons.

Although biomass may ultimately only supply a relatively small amount of the world's energy requirements, it will nevertheless be of **huge** overall value. In some parts of the world, such as Brazil and countries of similar climatic conditions, biomass will surely attain wider exploitation and utilization. There may still be some disadvantages when comparing it with coal or oil, but the very fact that it is renewable and they are not must spur further research. In time, biomass will become much more easily available and economically useful as a source of energy for mankind.

## 8.2. SINGLE-CELL PROTEIN

One of the **biggest problems** facing the world today is **population growth**, especially in developing nations. Conventional agriculture may not be able to provide sufficient supply of food and, in particular, protein. Today, new agricultural practices are widespread, **high-protein cereals** have been developed, the cultivation of **soybeans** and **groundnuts** is ever expanding, and so on. The use of **microbes** as protein producers has also expanded wide experimental success. This field of study has become known as **single-cell protein production** (SCP) and reflects the fact that most microorganisms used as producers grow as single or filamentous individuals rather than as complex multicellular organisms such as plants or animals.

There are many reasons microbes are the prime candidate for SCP production. Some of the reasons include:

(1) microorganisms can grow at remarkably rapid rates under optimum conditions (some microbes can double their mass every 0.5 to 1 hour).

(2) microorganisms are more easily modified genetically than plants and animals (they are more amenable to large-scale screening programs to select for higher growth rate, improved amino acid content, etc., and can be more easily subjected to gene transfer technology).

(3) microorganisms have relatively high protein content, and the nutritional value of the protein is good

(4) microorganisms can be grown in vast numbers in relatively small continuous fermentation processes using a relatively small land area and are also independent of climate.

(5) microorganisms can grow on a wide range of raw materials, in particular low value wastes, and can also use plant-derived cellulose.

The acceptability of SCP, when presented as human food, depends not only on **its safety and nutritional value, but also on other factors**. People do not usually take to the idea of eating food derived from microbes. In many cultures, there are **guidelines** of what you can and cannot eat. Also, **odour, color, taste**, and **texture** need to be taken into consideration when dealing with people's desires. Thus, if SCP is to be used as direct food for humans, then the skills of the food technologist will be greatly challenged.

## 8.3. SEWAGE TREATMENT

**Waste** is known as any material or energy form that cannot be economically used, recovered or recycled at a given time and place. Growth in human populations has generally been matched by a **greater formation** of a wider range of **waste products**, many of which cause serious environmental pollution if allowed to **accumulate in the ecosystem**. In **rural communities**, recycling of human, animal, and vegetable waste has been practiced for centuries, providing in many cases valuable fertilizers or fuel. In **urban communities** where most of the deleterious wastes accumulate, efficient waste collection and specific treatment processes have been developed because it is **unreasonable** to discharge high volumes of waste into natural land and waters. The development of these practices in the last century was one of the main reasons for the spectacular improvement in health and well-being of humans.

Mainly by empirical means, a variety of biological treatment systems have been developed, ranging from **cesspits, septic tanks, and sewage farms to gravel**

**beds, percolating filters, and activated sludge processes coupled with anaerobic digestion**. The primary aim of all of these systems or biotreaters is to **improve health hazards** and to **reduce** the amount of **oxidizable organic compounds** and thus produce a final effluent or outflow, which can be discharged into the natural environment without producing any adverse effect. **Bioreactors** rely on the metabolic adaptability of mixed microbial populations for their efficiency. The fundamental feature of biotreaters is that they should contain a range of microorganisms with the overall metabolic capacity to degrade any compound entering the system. Controlled use of microorganisms has led to the virtual elimination of such water-borne diseases as typhoid, cholera, and dysentery in industrialized communities.

## 8.4. ENVIRONMENTAL BIOTECHNOLOGY

In industrialized countries, there is increasing public concern over the impact of human activities on the environment and the legacy we leave for future generations. Attention is being given to minimizing environmental damage, and to cleaning up past environmental damage, while trying to ensure that the standard of living to which we have been accustomed is maintained.

**The benefits of this research include:**

1- An increase in the productivity of crops, without an increase in the dependency on environmentally-damaging agrochemicals.
2- As a result of increased productivity, a reduced pressure to exploit the remaining uncultivated habitats.
3- As a result of increased productivity, a reduction in energy inputs (mostly from reduced agrochemical manufacture).
4- The creation of alternative, renewable, sources of energy (e.g., biodiesel).
5- The creation of new more environment-friendly raw materials for industry (e.g., biodegradable plastics from plant starches, or high-value speciality chemicals).
6- As a result of the development of genetically-modified crops (if properly used), a reduction in the amount of agrochemical (e.g., pesticides and herbicides) released into the environment.

## Environmental Concerns

Many environmental groups, and some biotechnologists, have concerns about the use of genetically-modified crops with respect to their effect on the environment. They warn that the environmental impact of their use might not become apparent until after their large-scale commercial use.

## These concerns include:

**Herbicide use**. The use of herbicide-resistant crops may increase rather than decrease herbicide use.

**Genetic pollution and superweeds**. Genes that have been copied from one species and inserted into another might 'escape' and spread to other organisms, thus causing 'genetic pollution.' For example, herbicide-resistant crops might cross-breed with related weeds and produce herbicide-resistant 'superweeds.'

**Antibiotic resistance**. Genes that code for antibiotic resistance are sometimes inserted into plant cells together with the 'useful' gene; these 'marker' genes enable scientists to select cells that have been successfully modified. Such antibiotic-resistance markers in crops might spread to animals or humans, rendering medical or veterinary use of the antibiotic ineffective.

**Unexpected effects**. Some genes that are inserted into genetically-modified plants might be unstable (there is a high probability that they will be lost from the plant cells), or might show unexpected effects because it is difficult to predict where in the plant genome the genes will insert.

**Pest resistance**. Genetically-modified crops that are designed to be resistant to a particular pest might have unintentional (and unpredictable) effects on harmless or beneficial organisms (e.g., ladybirds and bees).

**Persistence and weediness**. Genetically-modified plants might, purposely or accidentally, be more vigorous than their non-modified relatives. They can therefore effectively become 'weeds.' If plants are more 'persistent' (e.g., survive over winter better), they could rapidly dominate ecosystems at the expense of other plants. If they show 'weediness' characteristics, they could also spread to new habitats.

**Damage to wildlife and biodiversity**. Monocultures of pest-resistant crops may also harm beneficial insects and non-target organisms, with knock-on effects on the food chain.