JAPAN ROUNDUP

Japan is developing technology for new generation agrochemicals and the development and application of sex pheromones for use in insecticides. Shin-Etsu Chemical Co. (Tokyo) predicts the world market for these formulations will reach 170 billion Yen per year in ten years.

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Ube Industries, Ltd., has entered the agrochemicals business with its discovery of a new immunization agent for crop diseases and development of an herbicide that controls broad-leaved weeds. Ube is also moving towards developing devices that combine insects' sex pheromones with functional resins.

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The development of molecular electronics in Japan is focusing on organic solar batteries. Source material costs for organic semiconductors are low, and resulting products would be highly efficient. Dainippon Ink & Chemicals (Tokyo), Asahi Chemical Industry Co. (Osaka), and Hitachi Chemical Co. (Osaka) are working on developing these products.

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Sumitomo Pharmaceutical Co. (Osaka), a subsidiary of Sumitomo Chemical Co., has become the first Japanese firm to request government approval to import human growth hormones on the basis of West German clinical test data.

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The Ministry of International Trade and Industry (MITI) will begin R&D on producing hydrogen using a biological system. MITI is investing 7.5 billion Yen over six years in the project, geared toward supplying the petrochemical industry with a clean, stable alternative to fossil fuels.

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The Japanese Ministry of Agriculture, Forestry and Fisheries (MAFF) plans to establish a biotechnology R&D center. The center will be funded in its first year by tax revenues from tobacco sales, totaling about six billion Yen ($25m). As part of the program, the government will provide interest-free loans to companies.

MAFF is also proposing establishment of a genetics research center at the recommendation of the Ministry's Genetic Resources Study Group. The year-old Study Group, a private advisory panel, has been examining the use of genetic resources such as seeds, sperm, and eggs.

Japan's research association for farm chemicals and biotechnology is predicting that bioreactors will become an important part of agrochemical production in the future, and that molecular design techniques will facilitate modification of enzymes and natural compounds for agricultural use. Pest-preventing agents and herbicides derived from biotech will be used by large-scale farm operations. Bio-agrochemicals using antibiotics or sex pheromones are also expected to proliferate. Studies on tobacco mosaic virus (TMV) have been successful and may promise new agents.

MEETING REPORT

PHOTOBIOREACTORS TO HARNESS SOLAR ENERGY

CHICAGO—It may soon be possible to routinely recycle carbon dioxide and water to produce biomass using photobioreactors. These reactors utilize the photosynthetic capabilites of cyanobacteria (blue-green algae), green algae, and even plant cells to turn solar energy into desirable pharmaceuticals, chemicals, fuels, and foods. John Pirt (Queen Elizabeth College, London), enthusiastically discussed the potentials of photobioreactors at the American Chemical Society's semi-annual meeting here in September.

Algal aquaculture in the enclosed, tubular loop reactor developed by Pirt has several distinct advantages over conventional photobioreactors, which are of the open-pond or open-channel type. Pirt's reactor is a closed system, which allows a precise degree of control over environmental factors: open systems do not. Moreover, the tubular unit creates a larger surface-area-to-volume ratio than conventional systems, and it can be installed in many types of locations.

A tubular loop photobioreactor can maximize the yield and output rate of photosynthetic biomass from a given area. The cells can be packed tightly inside the loops, and the recycling of carbon dioxide, water, and oxygen makes unlimited photosynthesis feasible. The biomass can store up to 18 percent of the solar radiation captured by the reactor. In initial studies with the eukaryotic green alga *Chlorella*, Pirt found that he could achieve biomass concentrations of over 20 grams dry weight per liter, as compared with three grams per liter in open-channel type bioreactors.

In many industrial fermentations products are excreted by cells into the medium and have to be recovered from relatively dilute solutions. In contrast, algal products are extracted from the biomass itself. Macro-algae (seaweed) are easily separated from the aqueous medium, while micro-algae sediment or flocculate spontaneously at high densities. Factors that remain to be improved to achieve full control over the yield and composition of the biomass from bioreactors include simulated diurnal irradiation cycles, partial pressures of carbon dioxide and oxygen, availability of nutrients, salinity, pH, and temperature.

For large-scale production purposes, photobioreactor technology should be associated with industries that produce carbon dioxide effluents as part of their processes—industries such as chemical plants and oil refineries. Three to four tons of this effluent could be recycled to produce one ton (dry weight) of biomass.

The photobioreactor shows promise as an adjunct to conventional fermentation technologies. Pharmaceuticals and fine chemicals produced by algae include amino acids, essential oils, steroids, halogenated terpenes, vitamins, and toxins. Macro-algae have long been used to produce carrageenan, agar, and alginates. Micro-algae may be a good source of polysaccharides, as well.

Algae also have the capacity for concentrating minerals, although the ion-transport mechanisms involved in this ability are poorly understood, if at all. —**Jennifer Van Brunt**