WATER TREATMENT

BIOREACTORS CRUNCH NITRATES

JÜLICH, Germany—With the impending enactment throughout Europe of the European Commission's (EC, Brussels) directive on nitrate levels in drinking water, opportunities for biological dentrification abound. Researchers in Germany, which already has tight limits on nitrate levels, are developing bioreactors to take advantage.

The Trinkwasserverordnung—the German drinking water ordinance—sets 50 mg/l as the maximum level for nitrate in drinking water. But ground water in Germany frequently contains 70 mg/l of nitrate and sometimes over 400 mg/l, according to the Kernforschungsanlage (KFA, Jülich). The EC directive would reduce the target to only 25 mg/l.

KFA has developed a novel pilot-scale bioreactor for nitrate removal—called the Roto-Bio-Reactor (RBR)—that is marketed in Germany by Ambs-Apparatebau (Emmendingen, Germany). RBR, with a volume of 1,700 liters, is made up of a column containing denitrifying bacteria immobilized on ceramic beads. It is continuously axially mixed, thereby avoiding the problems of clogging and channeling that have dogged other column reactors. RBR, which has run continuously for over a year, treats 120,000 liters of water a day, reducing nitrates levels from 65 mg/l to 5 mg/l. It also reduces microbial contamination to permitted limits. Success with the reactor lead to a larger-scale project for water bioremediation with the state government of Baden-Württemberg, says Ambs-Apparatebau's Freidel Hoppe.

Another solution to the denitrification problem is at an earlier stage of development at the Technical University (Berlin). Based on studies of natural denitrification in lakes, Wilhelm Ripl designed the Biofilm Ribbon Reactor. Ripl noted that natural denitrification often involves the close association of mixed cultures of bacteria and algae. In the water-sediment contact zone around the edge of a lake, chemoautotrophic bacteria create an anaerobic environment—a film some 100 μm thick—in which denitrifying bacteria thrive. Algae in the film provide the bacteria with carbon nutrients.

Ripl has simulated that environment in the biofilm reactor by immobilizing a mixed culture of algae and bacteria on a polyethylene sheet or a nylon ribbon sheet. Treated water is then continuously passed over the sheet, providing a form of mixing. The algae grow photosynthetically, so the biofilm reactor has a high surface to volume ratio, practically 20 m2/m3.

The biofilm reactor may have applications beyond denitrification. Ripl believes that the reactor's bacterial composition could be manipulated to deal with specific nitrogenous organic compounds. The presence of algae also means that the reactor could reduce high levels of inorganic phosphate.

—Jörg Bäsecke

DRUG DISCOVERY

PROSTAGLANDINS FROM YEAST COULD LOWER COST

LONDON—"Far-reaching implications for the pharmaceutical industry and science" are forecast by Johan Kock of the University of the Orange Free State (Bloemfontein, South Africa), following his finding of evidence for the existence of pharmacologically active prostaglandins in yeast. Kock is discussing the potential of what he calls his "goldmine" with Upjohn and other companies.

Prostaglandins are becoming widely used in clinical practice for purposes as diverse as inducing labor and inhibiting the aggregation of blood platelets. Their natural roles in mediating inflammatory responses and in acting as hyperalgesics suggest that they and the closely related prostacyclin may well find other applications in future. But they remain extremely costly, because of the complex chemical syntheses necessary in their manufacture. Production by yeasts, grown on inexpensive substrates, could result in a dramatic fall in their price.

In scientific terms, the new discovery raises the intriguing question of the role of prostaglandins in the metabolism of microorganisms. It may also offer a system to be used in studying more closely the biochemical basis of their diverse and potent effects in human physiology. The common threads behind certain of these effects are the control of adenylate cyclase and cyclic AMP levels. A similar adenylate cyclase system, which is involved in controlling growth and sexual reproduction, has been demonstrated in at least one yeast, *Saccharomyces cerevesiae.*

Kock's interest in examining yeasts as a source of prostaglandins stemmed from his earlier work on their fatty acids. Along with U.P.H. Augustyn at the Viticultural and Oenological Research Institute in Stellenbosch, he conducted radioimmunoassays of extracts from 35 different yeasts. These included *S. cerevisiae* and *Dipodascopsis uninucleata*, as well as other members of the Lipomycetaceae, drawn from culture collections in South Africa, The Netherlands, and Portugal. Every one of these yeasts was found to be synthesising significant quantities of prostaglandin F2a. Concentrations ranged from the 450 pg/g produced by a strain of *Lipomyces starkeyi* to the 4200 pg/g generated by *Zygozyma oligophaga.*

The possibility of cross reactions occuring with structurally related compounds, leading to over estimates of prostaglandin levels, led Kock to carry out two further types of experiment. First, he found that extracts of *D. uninucleata* inhibited the aggregation of platelets, induced by either ADP or collagen, in human plasma rich in platelets. Spent culture medium was effective, too, indicating that the yeast cells secrete prostaglandins into the medium.

Secondly, Kock grew *D. uninucleata* in culture medium to which they added arachidonic acid, the precursor of prostaglandins. Ion current chromatograms showed that two isomers of a prostacyclin metabolite, alpha-pentanor PGF2 alpha-y-lactone, were present in extracts of yeast harvested from the culture. Moreover, when Kock supplemented their medium with 1 mM aspirin—which at this concentration inhibits prostaglandin production in humans—formation of these substances was severely impaired.

As literature searches having revealed no previous papers describing prostaglandin production by yeasts, Kock feels confident that his work is the first of its sort.

—Bernard Dixon