Biodegradable polythene from plants

While genetically engineered or genetically modified food crops like tomato or fibre crops like cotton or oil seeds like soybean have prompted considerable controversy from environmental activists (i.e. Greenpeace) and consumer groups (recently in India and UK), recent trends toward interdisciplinary collaboration between molecular biologists and synthetic chemists have resulted in environmental-friendly biotechnology. For example polythene, one of the most important and discussible invents in modern science, is widely used all over the world. It is easy to handle and in most cases, free of charge or very cheap. Recently, it has been reported (after a devastating flood in Bangladesh) that about 60 lakh polythene bags are used daily in Dhaka city alone. As an aftermath of these floods, people all over the world have become aware of the negative aspects of using polythene bags, i.e. these result in: (i) environmental pollution, (ii) blockages of drains and outlets of water sewerage systems, and (iii) other health hazards. Although the Western countries are re-using this polythene through special cycling method and use it only for non food stuff purposes, the Third World countries do not have enough funds for such special cycling methods. The pace of recession of flood water via sewerage system from many city areas of developing countries has been largely affected by the clogging of the mouths of outlets in the city drains. May be South Asian countries could partly overcome this problem by using modified jute fibre bags—a good substitute of polythene.

Since the chemical polythene is not biodegradable, we have to seriously think about alternatives of these plastic polymers. Therefore, we would like to propose here one of the vehicles to overcome this problem as well as to use polythene which is recyclable, environmental friendly and poses no health hazards. In this context, bacteria can play an important role in the production of biodegradable polymers.

The idea is to use a particular bacteria, which is already known to produce polyester, polyhydroxyalkanoate (PHA), or poly-3-hydroxybutyric acid (PHB) as a carbon and energy storage compound, which can be easily processed into a biodegradable plastic. Unfortunately, the cost of fermenting glucose to produce PHA has restricted its ability to compete with traditional polymers. To get around this problem, researchers in England, ICI chemical company, have already started the production of biodegradable polymer from the bacteria alcaligenes *eutrophus*, marketed as 'Biopole'. At Monsanto researchers are also moving the production line back a step by inserting the genes for PHA synthesis directly into plants. Currently, the scientists from the same company are focusing on producing this polymer in a tissue-specific manner in plants, so that corn stalks or sugarcane leaves, which are normally left in the field to rot, could instead be used as valuable agriculture products.

While Monsanto is one of the large life science companies entering the plastic business, they may find themselves competing with a giant plastics company now entering biotechnology. At Du-Pont company as well, scientists have developed a bacterial fermentation process to produce precursors of a type of polyester from plant carbohydrates. The resulting plastic is completely recyclable and friendly to the environment. They are also developing a broad range of chemical and biotechnological approaches to use biological raw materials for polymers.

If industrial biotechnology is going to reach beyond novelty products for environmentalists, most experts agree that it will have to be part of an interdisciplinary approach. We think that the integration of biotechnology and traditional chemical engineering will make this feasible. Thus, a genetically engineered plant or a bacterial fermentation process might be used to produce intermediates for traditional polymer synthesis, which will allow companies to eliminate costly low-yield steps without retooling an entire manufacturing process. Such considerations are quite crucial in industrial biotechnology, where the ultimate success of an approach is usually determined more in the market place than in the laboratory.

In the light of the above facts, it appears to be possible to apply microbial production of biodegradable polythene on a commercial scale by developing biotechnology industries. But, unfortunately, no research on the production and application of microbial polymers has so far been taken up in the South Asian countries like India, Bangladesh, Pakistan, etc. If SAARC (South Asian Association for Regional Cooperation) scientific cooperation or DBT (Department of Biotechnology, India) or even any government or any private industry takes some initiatives for funding such type of research work or else actively establish bilateral collaboration with such western industries, the days are not far when biodegradable polybags will become a reality.

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