CHEMICAL TAILORING OF ENZYMES FOR PRACTICAL APPLICATIONS[1]

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Enzyme are promoters of the chemical processes upon which our life, health, and even our wealth depend. As catalysts, they influence the speed at which the numerous interdependent biochemical reactions in living organisms occur. In contrast to most industrial catalysts, enzymes promote reactions effectively under mild life-supporting environmental conditions with much lower levels of energy and by-product waste or pollution. Their usefulness in processes designed by man has been greatly limited, however, by their fragility (case of biodegradation and environmental inactivation) and lack of compatibility with physiological systems not closely related to their native one (i.e., their rejection as "foreign proteins" by immunological or antibody systems different from that of their living source).

Some successful effort has been invested in recent years towards overcoming these limitations to the use of these splendid catalysts. Covalent linkage of enzymes to other chemical materials has enabled man to stabilize many of these bio-catalysts against degradation or inactivation and/or to attach the enzyme to a "handle" by which the operator (user) can control its location. A goal of our research effort has been to develop more gentle procedures for linking enzymes to other materials, thereby decreasing the cost and improving the yield of stabilized bio-catalysts.

Many diseases of man result from defects in one or more of our natural enzyme systems. On the other hand, many disease-causing agents (such as leukemic cells) lack certainn necessary enzymes, being dependent upon the supply of certain materials by normal cells. Lymphoblastic

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leukemia, and (untill recently) usually fatal form of cancer, has been found to respond favourably to treatment with the enzyme asparaginase because this enzyme removes from the blood a nutrient which the leukemic cells require but, in contrast to normal cells, cannot produce from other nutrients. Since this enzyme has not been available in large quantities from human cells, its therapeutic value has been limited by its antigenicity (immune rejection). We are attempting to overcome this and other undesirable traits (such as fragility and difficulty of separation from a mixture of other materials) of enzymes useful in medicine and industry, by fastening the enzymes to other suitable materials in a reaction dependent upon light instead of heat for the energy requirements. In this way, the enzyme can be "tailored" for particular uses in a very gentle manner, since most enzyme are much more compatable with intense light than with intense heat energy.

We have developed this procedure to the point of allowing the binding of the antileukemic enzyme asparaginase to other materials to produce ang immobilized enzyme much superior in catalytic function to that previously obtained by heat-dependent processes. This new and gentle enzyme treatment procedure holds great promise for "tailoring" this and other useful biological catalysts to function better in environments foreign or or hostile to them.

This new photo-chemical technology has a wide range of applications in agriculture, industry, medicine, environmental control and analytical work.