Biotransformation- A Revolutionary Approach Towards Chemical Modification By Microbes

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ABSTRACT

Biotransformation is the chemical modification (or modifications) made by an organism on a chemical compound. If this modification ends in mineral compounds like CO_2, NH_4^+, or H_2O, the biotransformation is called mineralisation.

Biotransformation means chemical alteration of chemicals such as nutrients, amino acids, toxins, and drugs in the body. It is also needed to render non polar compounds polar so that they are not reabsorbed in renal tubules and are excreted. Biotransformation of xenobiotics can dominate toxicokinetics and the metabolites may reach higher concentrations in organisms than their parent compounds

INTRODUCTION

Biocatalysis scope of study involving microbial transformation is increasing significantly from limited interest into highly active area in chemistry today including preparation of pharmaceutical products. Biotransformation can be clarified as the specific modification of a definite compound to a distinct product with structural similarity, by the use of biological catalysts including microorganisms like fungi [4]. The biological catalyst can be described as an enzyme, or a whole, inactivated microorganism that contains an enzyme or several enzymes produced in it. Bioconversion is another term related to microbial transformation for this study in particular. There is only slight difference between a biotransformation and a bioconversion. A bioconversion utilizes the catalytic activity of living organisms and hence can involve several chemical reaction steps. A living microorganism will be continuously producing enzymes and hence bioconversions often involve enzymes which are quite unstable for used substrates. The properties of biotransformations and bioconversions are very similar and in many cases the terms are cited as interchangeable (1)

SCOPE OF BIOTRANSFORMATION

Although there are hundreds of bio-transformations known, only a selected few of them are useful for the synthesis of commercially important products. The significance of bioconversion reactions becomes obvious when the production of a particular compound is either difficult or costly by chemical methods. Further, bio-transformations are generally preferred to chemical reactions because of substrate specificity, stereo specificity and mixed reaction conditions (pH, temperature, and pressure).

Microbial transformations are of considerable economic importance in the manufacture of

alkaloids, antibiotics, vitamins, amino acids, fermented beverages and fermented foods. They also catalyze simple and chemically well-defined reactions like conversion of acrylonitrile to acrylamide. This has matured to an industrial process where the production is carried out at 10,000 tons per year. In addition, microorganisms are employed in many studies of synthetic, structural, stereochemical and kinetic problems in organic chemistry to functionalize non-activated carbon atoms including (i) to introduce centers of chirality into optically inactive substrates, and (ii) to carry out optical resolutions of racemic mixtures (2)

BIOTRANSFORMATION FOR DEGRADATION OF POLLUTANTS

Biotransformation is the basis of life. Microbes have been widely applied for steroid biotransformation to prepare specific derivatives, the production of which is difficult by traditional synthetic methods. Biotransformation is also good to handle the environmental problems like degradation of xenobiotics and petroleum hydrocarbons as they are real world problem. Therefore, based on the present review, it may be concluded that microbial biotransformation is a boon for the current world with its wide range of applications (3,4)

EXAMPLE OF BIOTRANSFORMATION IN VITRO

Microbial biotransformation of four amino- and hydroxyanthraquinones catalyzed by Beauveria bassiana ATCC 7159 has been studied. Incubation of 1,2-diaminoanthraquinone (1) with B. bassiana ATCC 7159 afforded 1-amino-2-(4′-O-methyl-2β-N-D

-glucopyranosylamino)anthraquinone (5) in a hitherto unprecedented biotransformation involving N-glycosylation of an amine. Biotransformation of 1-aminoanthraquinone (2) yielded 1-amino-2-(4′-O-methyl-2β-O-D-glucopyranosyloxy)anthraquinone (6) as a result of microbial hydroxylation of C-2 followed by 4′-O-methyl- glucosylation of the newly introduced hydroxyl group. 1,8-Dihydroxyanthraquinone (3) and 1,2-dihydroxyanthraquinone (4) afforded 8-hydroxy-1-(4′-O-methyl- 1β-O-D-glucopyranosyloxy)anthraquinone (7) and 1-hydroxy-2-(4′-O- methyl-2β-O-D-glucopyranosyloxy)anthraquinone (8), respectively, resulting from 4′-O-methyl-glucosylation of the existing hydroxyl groups of the substrates. The efficiency of these conversions suggests that microbial biotransformation reactions offer an attractive alternative to chemical 4′-O-methyl-glucosylation of amino- and hydroxyanthraquinones.

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