Enzyme Activity in Terrestrial Soil in Relation to Exploration of the Martian Surface.

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Our purposes were to study enzyme activities in soil, to devise sensitive tests for soil enzymes where plausible, and to study enzyme action at solid-liquid water interfaces and at low humidity.

The most sensitive procedure devised was to utilize ^{14}C-Urea as a substrate for soil urease. It was found that urease can be active at a relative humidity as low as 60%, but this humidity is orders of magnitude greater than on Mars. With this technique, soils as old as 10,000 years were found to possess urease activity. A less sensitive assay was that for soil phosphatase; it was based on ultraviolet radiation fluorescence of a product of phosphatase hydrolysis, namely napathol. Irradiation sterilized soils were sometimes used to rule out artifacts resulting from microbial growth.

We found a way of extracting humus from soil by a method so mild as to result in preservation of its enzyme activity. The humus-enzyme complex with urease activity was resistent to hydrolysis when mixed with proteolytic enzymes, which may explain the persistence of urease activity in soil.

Soluble chitinase was isolated from a streptomyces culture and characterized. This enzyme was adsorbed to chitin and kinetics of hydrolysis of chitin was examined. The rates do not obey Michaelis Kinetics and a new Kinetics scheme for soluble enzyme-insoluble substrate was devised.

Finally, as a problem of consecutive reaction in a soil profile, a kinetic scheme, based on growth of microorganisms and oxidation of ammonium to nitrite and then to nitrite, was devised and tested. It was found possible to determine rates per organism per unit flow rate with considerable precision and the mathematical model was vindicated.

During the course of the work it was found by NASA that there is a very low humidity on Mars and a paucity of nitrogen. Hence we do not feel that investigation along the lines we have followed should be continued. There seems to be a low probability of detecting extracellular enzyme activity in Martian soil.

There follows a list of our publications which have just been summarized.

Articles

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14. Skujins, J. J. and Pukite, A. Extraction and determination of N-acetyglucosamine from soil. Soil Biol. Biochem. 2:141-143, 1970.

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16. Skujins, J. J. and McLaren, A. D. Urease reaction rates at low water activity. Space Life Sciences, 33:3-11, 1971.

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