Biochemistry of Ammonification

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I. INTRODUCTION

Ammonification denotes the processes by which organic nitrogenous compounds are transformed in enzymically-catalyzed reactions to yield \( \text{NH}_4^+ \) as a reaction product. Organic N of soils has been partly characterized, usually after chemical hydrolysis, as amino acids, amino sugars, purines, and pyrimidines (Chapt. 3, F. J. Stevenson). Such compounds represent prime organic substrates in deamination reactions. In this chapter, however, we discuss not only the mechanisms and enzymology of deamination reactions, but also the formation of the prime organic substrates by decomposition of materials of high molecular weight. Presumably degradation of the latter involves enzymic hydrolyses of the proteins, aminopolysaccharides, and nucleic acids, which are present in soil in living and dead cells, and as exocellular, stabilized residues.

In addition to organic N of cellular origin, soils may receive organic N as urea, a major nitrogenous constituent of the urine of grazing animals, and an applied fertilizer. Decomposition of urea by ureases is an important reaction in the ammonification process and is the subject of an increasing number of studies, to the extent that urease is now the most thoroughly examined of all soil enzymes.

In soils, therefore, substrates which participate directly and indirectly in ammonification processes are of different origins, belong to different chemical classes, and are present in very different microenvironments. In the same way, hydrolases, oxidases, deaminases, and lyases, which act upon these substrates, may originate directly from various plant, animal, and microbial sources. The enzymes may function endocellularly, in dead autolysing cells, free in the soil solution, and when adsorbed to soil colloids. For these reasons soils are unlikely to be rich sources for obtaining pure enzymes in high yields. Also, detailed studies of enzyme properties involving estimates of the kinetic constants of enzymes assayed in whole soils are not especially useful. Nevertheless, limited studies with soils and soil extracts are of importance in determining the states in which enzymes occur in soils, their potential activities towards specific substrates, how they are...