INTRODUCTION
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The basic requirements of all living systems are supplied by the environment in the form of inorganic and organic nutrients. These substances contain all the basic elements essential for the maintenance and functioning of biological systems. All substances required as constituents of cellular macromolecules, in enzyme and transport systems and as biologically utilisable energy sources are included in these.

Nitrogen is the most widespread nitrogenous compound on the earth, followed by ammonia. Nitrogen also forms an essential element required by living systems. The study of nitrogen assimilation and metabolism, thus takes on great significance and is essential in understanding the functioning of all biological systems.

The study of nitrogen metabolism (anabolism) can be roughly split into two parts. The first part involves the transport and assimilatory pathways which utilize available forms of nitrogen and incorporate them into primary cell metabolites. The second part comprises diverse metabolic (biosynthetic) pathways which utilize the primary metabolites to produce a diverse array of nitrogenous compounds required to sustain life. There are specific variations in the pathways followed from organism to organism but one feature common to virtually all systems is the primary metabolites which serve as the nitrogen donors for the biosynthetic pathways, glutamate and glutamine.

For many years the major route of nitrogen assimilation was considered to occur via, the reductive amination of \( \alpha \)-ketoglutarate catalyzed by the enzyme glutamate dehydrogenase. The possibility that
this was not so, was triggered by a set of beautifully simple and intelligent experiments done by Tempest and co-workers (Tempest et al., 1970a, 1970b). This led to the statement, that "all ammonia assimilation occurs via glutamate dehydrogenase", being replaced by a new one, which proposed the presence of two alternate pathways operating under different conditions of nitrogen and energy availability.

The primary features of this alternate pathway, which came to be known as the glutamine synthetase/glutamate synthase (GS/GOGAT) pathway, was that it involved the assimilation of ammonia into the amide position of glutamine (catalyzed by glutamine synthetase) followed by reductive transfer of this group to the second carbon of α-ketoglutarate to give the amino acid glutamate (catalyzed by the enzyme glutamate synthase).

The principal product, glutamate, is in turn the precursor of several amino acids and furnishes the amino group of others by transamination. It is also the precursor of glutamine whose amide group provides some of the nitrogen required for amino acids, purine and pyridine nucleotides and amino sugars.

GS/GOGAT pathway is now known to be operative in the majority of the plant, bacterial and cyanobacterial systems. The degree to which the GS/GOGAT cycle, rather than GDH, is the major assimilatory route varies from system to system and depends on environmental conditions.

In bacteria, the presence of GDH and GS/GOGAT is well established (Meers et al., 1970b; Meers and Pederson, 1972). The operation of both the pathways in this system appears to be quite balanced and can swing from one extreme to another in response to external environmental conditions i.e. the GDH pathway functioned in non-limiting conditions and was not energy dependent while the GS/GOGAT pathway functioned
under limiting nitrogen conditions and was energy dependent. This situation was found to occur with enteric bacteria (Tempest et al., 1970a), gram positive bacteria (Meers et al., 1970a; 1970b), nitrogen fixing bacteria (Dainty, 1972; Osburne and Signer, 1980) and some others (Bast, 1980; Kenealy et al., 1982).

In higher plants, assimilation is attributed mainly via the GS/GOGAT pathway with virtually no assimilatory role attributed to GDH. Besides the presence of the necessary enzymes, there was other evidence to support the contention that the assimilation of ammonia (or nitrate) into amino acids occurs via the GS/GOGAT pathway, with GDH playing a role only in circumstances of ammonia excess (Miflin and Lea, 1976; Kaiser and Lewis, 1980; Miflin, 1983).

Yeast and fungi appear to be the only systems which do not utilize the GS/GOGAT pathway for nitrogen assimilation and evidence is still in favour of the operation of the GDH pathway under almost all conditions (Sanwal and Lata, 1962; Brown and Johnson, 1970).

In cyanobacteria, more recent evidence suggest that the majority of the ammonium assimilation occurs via the GS/GOGAT pathway. A fraction of ammonia assimilation was attributed to GDH (Stewart and Rowell, 1975; Wolks et al., 1976; Rowell et al., 1977; Meeks et al., 1978).

The identification of glutamine as the central compound and GS as the central enzyme of inorganic nitrogen metabolism raises some fundamental queries, namely:

(i) How is such a central enzyme controlled?
(ii) What are its functions aside from channelizing ammonium into cell metabolites?
Pathways of ammonium assimilation in the enteric bacteria for the production of glutamate and glutamine and some of the roles of these compounds in intermediary metabolism.

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\begin{align*}
\text{NH}_3 + 2\text{-oxoglutarate} & \quad \text{NADPH} \\
\text{GDH} & \quad \text{NADP}^+ \\
\text{glutamate} & \quad + \\
\text{glutamine} & \quad \text{2-oxoglutarate} \\
\text{RCO COOH} & \quad \text{Transaminase} \\
\end{align*}
\]

- ATP
- ADP
- GlcN-6P
- Complex Polysaccharides
- p-amino benzoate
- oxidatve Phosphorylation
- PNH
- Carbamyl phosphate
- arginine
- aspartagine
- histidine
- tryptophan
- nucleotides
- Amino Acids
- Protein

Taken from Annual Review of Biochemistry, 1978. Tyler B.
Regulation of the assimilation of Nitrogen compounds. pp 1130.
(iii) Does it have a role in regulating nitrogen metabolism by virtue of its position?

In this thesis, an attempt has been made to answer some of these questions. It has been found that the enzyme GS itself is regulated by a complex set of mechanisms. In many systems it has been shown to be regulated by the energy status of the cell. Its activity is controlled via feedback inhibition by the end products of glutamine metabolism, divalent cations, covalent modification of the enzyme molecule, and by the source of nitrogen available for growth.

While a substantial amount of progress has been made towards understanding the complexities of nitrogen metabolism, the majority of the work has been done using bacterial systems and recently plant systems. Not much literature is available on inorganic nitrogen metabolism in cyanobacteria. Most of the work done in cyanobacteria has been focussed on azotrophs. However, it will be very relevant to study in detail the nitrogen assimilatory pathways and their regulatory mechanisms in the protein rich cyanobacterial strains, and also to investigate the reason why certain organisms have high inherent protein content.