T-Protein of Glycine Decarboxylase from Solanum tuberosum

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The Gly decarboxylase multienzyme complex (Gly cleavage system, EC 2.1.2.10) catalyzes the conversion of Gly into CO₂, NH₃, and 5,10-methylene-tetrahydrofolate, reducing NAD⁺ to NADH. The enzyme has been isolated from animals, plants, and bacteria—in animals and plants it occurs exclusively in the mitochondrial matrix, and in photosynthetic tissue it can be found in very large amounts (Bourguignon et al., 1988). In plants it is involved in the photorespiratory carbon oxidation cycle because it is the site of release of photorespiratory CO₂ and NH₃ (Keys et al., 1978).

The enzyme complex is composed of four subunits: 100-kD P-protein (pyridoxal phosphate binding), 14-kD H-protein (lipoamide containing carrier), 45-kD T-protein (tetrahydrofolate-dependent methylenetransferase), and 59-kD L-protein (lipoamide dehydrogenase), with a stoichiometry of 1 L-dimer:2 P-dimers:2 H:9 T (Oliver et al., 1990). The T-protein catalyzes the release of ammonia from the methyleneamine intermediate bound to H-protein after the decarboxylation of Gly and transfers the remaining one-carbon unit to tetrahydrofolate (Fujiwara et al., 1984).

cDNA sequences for all of the subunits of the Gly cleavage system from bacteria, animals, and human have been reported including the T-protein from chicken (Okamura-Ikeda et al., 1992), bovine (Okamura-Ikeda et al., 1991), and human (Hayasaka et al., 1993). Most of the cloning of plant Gly decarboxylase multienzyme complex components has been performed with pea, and the sequences of P, H, and L subunits have been published (Macherel et al., 1990; Turner et al., 1992a, 1992b). This is the first report of successfully cloning a cDNA encoding the complete T-precursor protein in a plant species.

In comparison with the T-precursor protein from bovine, the nucleotide and derived amino acid sequences are 57.1 and 48.9% homologous, respectively. The mature T-protein from potato is 51.5% homologous with both human and bovine sequences and 48.7% with the T-protein from chicken. From Southern analysis of Solanum tuberosum genomic DNA, it is highly probable that T-protein is encoded by a single gene.

Table 1. Characterization of the cDNA for T-protein of the Gly cleavage system from S. tuberosum

| Organism: | Solanum tuberosum cv Desiré. |
| Isolation: | A total leaf cDNA library in Agt11 was screened by hybridization to a partial cDNA clone from pea. |
| Sequencing: | Both strands by nested deletions. |
| cDNA: | 1418 bp, open reading frame from position 63–1283. |
| Protein: | cDNA encodes a 406-amino acid precursor protein of Mᵣ 44,276. The mature protein probably consists of 377 amino acids with a molecular mass of 41 kD. |
| Cellular Localization: | Nuclear encoded, single gene. |

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LITERATURE CITED


