Plant Gene Register

Nucleotide Sequence of a Transmembrane Protein (TMP-C) cDNA in Arabidopsis thaliana

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Channel-like proteins, including water channel proteins, belong to a family of major intrinsic proteins that was originally characterized in bovine lens fiber cells. They have structurally similar properties with six putative membrane-spanning domains and a well-conserved amino acid sequence in a loop between the second and third membrane-spanning domains. The major intrinsic proteins are thought to be ion channels in cell-cell junctions (Ehring et al., 1990). A bacterial homolog, GlpF, of this family facilitates the transport of glycerol (Heller et al., 1980), and another homolog found in human erythrocytes, CHIP28, is known to be a water channel (Preston et al., 1992).

In higher plants, many genes of this family have been reported (Fortin et al., 1987; Yamamoto et al., 1990; Hofte et al., 1992). One of them, γ-TIP (tonoplast intrinsic protein), was shown to function as a water channel when its mRNA is expressed in Xenopus oocytes (Maurel et al., 1993). Water plays a crucial role both in the maintenance of cell turgor pressure and for the transport of nutrients and ions in plants. Water channel proteins in membranes must be important in regulating the water balance in cells and tissues during wilting by desiccation and during dehydration at the late stage of seed maturation. These processes cannot be explained by simple diffusion of water molecules through the lipid bilayers of membranes.

We have isolated a cDNA clone (1100 bp) encoding a TMP homolog from a library from flower buds of Arabidopsis (Table I). The deduced amino acid sequence is very similar to those of TMP-A and TMP-B from Arabidopsis (Shagan and Bar-Zvi, 1993; Shagan et al., 1993). Therefore, we have designated it TMP-C. The TMP-C polypeptide (287 amino acids) is larger than TMP-A and TMP-B by a one-amino acid insertion. The insertion of Thr is found at the 28th amino acid position from the N terminus of the TMP-C polypeptide. TMP-C is 94 and 92% identical in amino acid sequence to TMP-A and TMP-B, respectively. The nucleotide sequence of the coding region of TMP-C shows 82 and 86% identity with TMP-A and TMP-B, respectively. The untranslated regions of these TMP cDNAs have no significant homology, and the 3' untranslated region of TMP-C is about one-half the length compared with TMP-A and TMP-B.

It is still unclear whether TMP-C functions as a water channel or another type of channel. TMP-C shows greater identity with the turgor-responsive 7a protein from pea (84% identity; Guerero et al., 1990) than α-TIP (37% identity) and γ-TIP (31% identity) from Arabidopsis. This suggests that the physiological function(s) of TMP-C may be related to turgor pressure. Further analyses of the tissue specificity and sub-cellular localization of TMP-C may elucidate the in vivo function of TMP-C at the molecular level.

Table I. Characteristics of A. thaliana TMP-C cDNA

| Organism: Arabidopsis thaliana (L.) Heynh., ecotype Lansberg erecta, Brassicaceae. |
| Location in Genome: Nuclear genome. |
| Strategy of Cloning: A cDNA library of flower buds in λ ZAP II (Stratagene) screened by DNA hybridization. |
| Sequencing Methods: Dideoxy sequencing of both strands of the deletion mutant in ϕ1suescript (Stratagene) was performed using Taq DyeDeoxy Terminator Cycle Sequencing Kit (Applied Biosystems, Foster City, CA) and analyzed by an automatic sequencer (model 373A, Applied Biosystems). |
| Features of cDNA: The clone is 1100 bp in length and consists of a 133-bp 5' untranslated region, an 861-bp open reading frame, and a 106-bp 3' untranslated region. |
| Structural Features of Protein: 287 amino acids (M, 30,691). Six putative transmembrane domains. Conserved sequence of channel-like protein, SGGHINPAVTF, exists between positions 109 and 120. |
| Location of Protein: Unknown |

Abbreviation: TMP, transmembrane protein.

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The nucleotide sequence data reported in this article will appear in
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with the accession number D26609.

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