Microsymposium

MS101.O01

Crystal structure of the plant nitrate transporter NRT1.1

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Nitrogen uptake and assimilation is a key limiting factor for plant growth and crop productivity and also acts a major signaling molecule, controlling many aspects of plant development. Many plants obtain nitrogen through the uptake of nitrate from the soil via specific membrane transporters. Two families of nitrate transporter have been identified that act within the root cell, termed NRT1 and NRT2. NRT1 members are predominantly low affinity transporters, with KM values in the millimolar range, whereas NRT2 members are high affinity transporters, with KM values in the low micromolar range. Dual affinity transporter systems are used in biology to allow the cell to respond to changes in an external nutrient supply. In the case of nitrate transport in plants, decreasing levels of external nitrate cause an increase in the expression of NRT2 family transporter genes, in particular NRT2.1, allowing the cell to take up more of the available nitrate. However, plants have evolved a faster way of responding to nitrate levels involving post-translational control of nitrate uptake. NRT1.1 also known as CHL1, is a dual affinity nitrate transporter. In response to decreasing levels of nitrate, NRT1.1 is capable of switching between low and high KM modes, a switch achieved through the post-translational phosphorylation of an intracellular threonine. Here I will present our recently determined crystal structures of NRT1.1 in both the apo and nitrate bound forms. Together with in vitro binding and transport data we identify key residues involved in nitrate recognition and provide the first biochemical explanation for the phosphorylation controlled 'dual affinity' switch observed in NRT1.1. Finally we present our model for the molecular basis of nitrate uptake via this transporter.

Keywords: Transporter, Major Facilitator Superfamily, POT/PTR/NRT1 Family