Characterization of high affinity Na^+ K^+ transporter gene from higher plants

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Summary

The ions concentration in plant cell is crucial for plant osmoregulation, which correlated to Na^+ tolerance and dehydration resistance. K^+ is the most abundant cation in higher plant cell at the concentrations of ca. 100mM, whereas Na^+ concentration inside cell maintains at the lower level. Na^+ uptake seems to occur without any specific mechanism due to high energy gradient of Na^+ between the inside cell and outside. The molecular mechanism for plant Na^+ uptake remains unknown.

Recently, a complementary DNA from wheat was isolated that encodes a Na^+-driven high-affinity K^+ uptake transporter. It suggests that plant cell possesses the Na^+ uptake mechanism to keep the Na^+ concentration inside at certain level.

To understand the role of Na^+ and K^+ uptake mechanism and Na^+K^+transporter more precisely, we tried to clone the Na^+ K^+transporter gene from Arabidopsis thaliana cDNA library on the basis of the data of wheat Na^+ K^+transpoter amino acid sequence. The predicted molecular size of the protein was about 58KD. It seems to have 10- 12 transmembrane segment. Its sequence and its hydropathy profile were very similar to those of the wheat one. ArHKT1 is a single-copy gene in ArBidopsis thaliana genome. The cation selectivity of ArHKT1 by voltage clamping ArHKT1 in Xenopus oocytes showed that inward Na^+ current at the hyperpolarized mambrane potential. However, the K^+ current was not detected although the wheat HKT1 conferred the K^+ uptake, which is a significant difference in K^+ selectivity between ArHKT1 and wheat HKT1

This report suggests that ArHKT1 may provide one of the pathways for Na^+ uptake to keep low concentrations of Na^+ inside cell although it remains unknown whether Na^+ is needed or not for plant cell growth. Our result in this study offer insight into a molecular pathway of Na^+ uptake in higher plants.