Abstract

Cytokinins are adenine derivatives and a group of plant hormones that regulate many physiological processes, including cell division, root and shoot growth, and senescence delay. Cytokinins transported via xylem have a specific role; they act as messengers of nitrate availability in soil. Precise regulation of cytokinin distribution between roots and shoots thus allows effective communication among various parts of the plant body. In my thesis, I address two mechanisms contributing to this regulation. First, I present findings about the kinetics of cytokinin transport across the biomembranes. I characterize EQUILIBRATIVE NUCLEOSIDE TRANSPORTER 3 (ENT3) as a membrane-bound carrier recognizing cytokinin nucleobases and ribosides. Using computational methods, I estimate which ENT3 residues interact with cytokinins and discuss the conservation of these residues within the ENT family. I further show that the *ent3* mutation alters shoot phenotype and the expression of the cytokinin-induced transcription factor *WUSCHEL*. These findings indicate that ENT3 contributes to the regulation of cytokinin distribution in plants via the uptake of root-borne cytokinins from the xylem in shoots. Second, I show that CYTOKININ DEHYDROGENASE (CKX), a cytokinin-degrading enzyme, is active in the xylem sap and thus negatively regulates cytokinins travelling from roots to shoots via their metabolism. The CKX activity in the xylem sap is stimulated by cytokinin, and cytokinin concentration in turn increases in response to nitrate supply. These findings indicate that CKX in the xylem sap contributes to the overall cytokinin distribution by mediating negative feedback to the increased cytokinin flux from roots to shoots.