Title: Cryo-EM Structure of a Zinc Uptake Transporter in the Closed State

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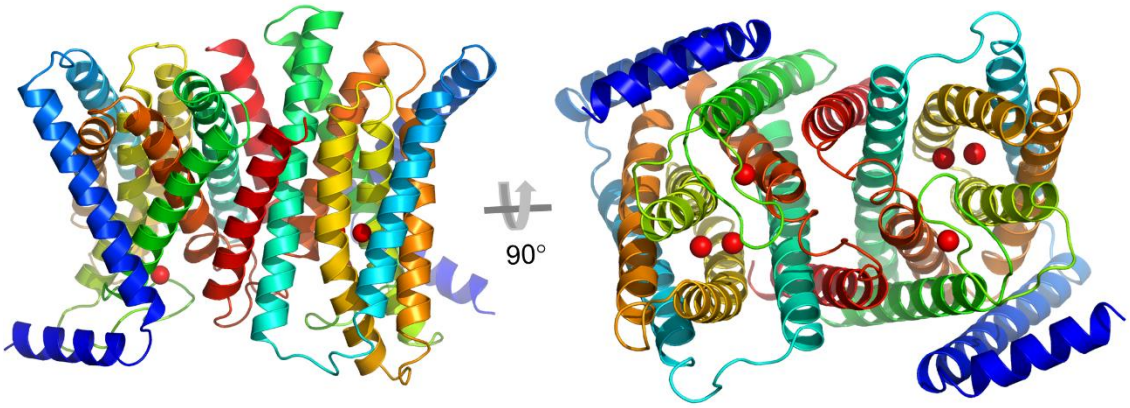
Project Goals: To improve zinc-stress resilience of bioenergy crops, an understanding of how they have evolved to deal with deficient or excess metal bioavailability is needed to support gene selection, breeding and biosystem design strategies. The goal of this project is to perform structural and functional characterization of zinc uptake transporters to understand the zinc transport process across membranes. The gained knowledge will be used to develop strategies that will promote growth of bioenergy crops in acclimation to zinc availability.

Abstract Text: Zinc is an essential micronutrient and supports all living organisms through regulating biological processes such as gene regulation, structure stability, enzymatic metabolism, immune response, cell division and cell growth. Deficiency of zinc is detrimental to crop yield and bioproduct quality. In US, about sixty percent of farmland is zinc deficient. To understand the physical basis of the zinc uptake process, we have determined a cryo-EM structure of a zinc uptake transporter at 3.1 Å resolution in an inward facing closed conformation. The transporter forms a homodimer, each containing nine transmembrane helices and three zinc ions. Two zinc ions are in the middle of the transporter and form a binuclear pore structure, and the third zinc is located at the transporter's egress site facing cytoplasm. The egress site is covered up by a histidine-rich two-stranded β-sheet which blocks the release of the zinc into cytosol. Two histidine residues on the β-sheet interact to the egress-site zinc and regulate its release. Cell-based functional characterization of the wild-type protein and structure-inspired mutants provide further insights into the understanding of the zinc uptake process.



Funding Statement:
This research was supported by the DOE Office of Science, Office of Biological and Environmental Research (BER).