Abstract

The ARP2/3 complex is a heteroheptameric protein complex conserved across eukaryotes. Its role is the polymerization of actin filaments from monomeric actin. In amoebae and animal cells, the ARP2/3 complex is crucial for the formation of lamellipodia and pseudopodia, which are plasma membrane protrusions essential for cell motility. Given the presence of a cell wall, it is evident that the conserved ARP2/3 complex in plants must play a different role than in cell motility. During my PhD, I studied the role of the ARP2/3 complex in plants in various contexts of plant cell biology, and I participated in the research of this complex on several levels, from the role of individual subunits in the functioning of the complex to its interaction with the cytoskeleton and cell organelles and its influence on cell growth and morphogenesis. We described new double mutants in both ARPC1A and ARPC1B and revealed the ARPC3 subunit has different importance in the ARP2/3 complex, depending on the cellular context, specifically in vegetative and generative tissues, indicating a specific role of this subunit in plant ARP2/3 complex. We also demonstrated a unique role of the ARPC2 subunit, which interacts not only with actin filaments but also with microtubules, which is significant considering the role of both in plant cell morphogenesis. We studied how the ARP2/3 complex regulates the actin cytoskeleton, together formin FH1, and how that affects cell morphogenesis. Results from our research of ARP2/3 in pollen tubes indicate that it may be involved in specific modifications in cell wall pectins through endocytosis of pectin-modifying enzymes. This mechanism could explain other phenotypes of ARP2/3 complex mutants like problems in cell morphogenesis and adhesion. We also discovered that the ARP2/3 complex is responsible for the autophagic degradation of peroxisomes in plant cells, which further connects the role of the plant ARP2/3 complex to membranes and their remodeling. Throughout my dissertation, these studies collectively highlight the multifaceted role of the ARP2/3 complex in plant cell biology, describing how its involvement in cytoskeletal dynamics affects plant cell morphogenesis and adhesion, apical growth of pollen tubes, and also endocytosis and pexophagy. Finally, I present a hypothetical universal framework explaining how plant ARP2/3 complex may be involved in all these seemingly unrelated processes.