

DESCRIPTION FOR THE GENERAL PUBLIC

Plant Defense System against Pathogens and Herbivores Based on Endoplasmic Reticulum (ER) Body

Dr. Kenji Yamada

Małopolska Center of Biotechnology
Jagiellonian University Krakow

Unlike animals, which can move to escape the danger, sessile plants have no choice in the environment they are planted in. Therefore, plants have developed sophisticated defense systems against changes in the environment, which differ from the ones used by animals. An endoplasmic reticulum (ER) derived organelle, called an “ER body”, will be one of such defense systems for the protection against insects or pathogens attacks.

The ER body is a spindle shaped organelle (~10 µm in diameter, 5 µm in width), observed in plant species of the order *Brassicales*, which includes the plant model organism, *Arabidopsis thaliana*. In *Arabidopsis thaliana*, ER bodies are observed in the seedlings and roots. ER bodies are absent in the rosette leaves, although, the wounding process induces ER bodies formation. The ER body is responsible for a high accumulation of β-glucosidase called PYK10. Recently, we found that PYK10 has a myrosinase activity toward glucosinolates. Glucosinolates are natural defense molecules that accumulate mainly in plant species of the order *Brassicales*, and belong to so-called “mustard oil bomb”. After the deglycosylation by myrosinase, glucosinolates are automatically converted to isothiocyanates, which are toxic to animals, bacteria and fungi. The isothiocyanates are underlining the pungency of many *Brassicaceae* agricultural crops such as mustard, cabbage, and horseradish. Thus, it is suggested that plant species of this order have developed a specific mechanism of defense against insects and pathogens by developing the ER bodies, involved in the “mustard oil bomb” system.

Investigating how and why ER bodies form, and how they function, will further explain the sophisticated defense system of plants, and could lead to innovations in agriculture. We are planning to investigate these aspects by:

- (1) Analysis of molecular mechanism of the ER body formation,
- (2) Analysis of the components for the inducible ER bodies,
- (3) Analysis of the ER body function.

The ER is an organelle that produces secretory proteins. However, plant species of the order *Brassicales* developed a new functional organelle from the ER: the ER body, which is used to protect them against insects or pathogens. Understanding the process of ER body formation and its' function should reveal the unique molecular mechanisms of defense that have never been reported up to this time. This project will reveal how plants have developed a sophisticated defense system in seedlings and roots. The knowledge of the root defense system is limited compared to leaves, although recent research indicated the importance of rhizosphere in plant growth. The preliminary results have shown the success in the artificial production of ER bodies in various plant cells by introducing genes necessary for the ER body formation. This finding will further support so called "organelle engineering", which could have far-reaching implications in agriculture to develop pathogen/insect resistant plants.