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Aqueous Chlorine Dioxide Treatment to Activate Plant Immunity by Inducing Programmed Cell Death (PCD) and PR (Pathogenesis-related) Genes

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[Introduction]
Reactive oxygen species (ROS; containing superoxide, hydroxyl, hydrogen peroxide, oxides of nitrogen, and so on) are related to various plant physiological reaction like cell signaling and stress resistance reaction. Our goal is to trigger plant immunity by inducing ROS with chlorine dioxide (ClO_2), which known as strong oxidant. Two plants (Arabidopsis (*Arabidopsis thaliana*) Columbia-0 (Col-0) and Pepper (*Capsicum annuum*)) were used to identify the relationship between ClO_2 treatment and PCD, PR protein and ROS related genes to pathogen.

[Materials and Methods]
Arabidopsis Columbia-0 (Col-0) and Pepper (*Capsicum annuum*) were used in this study. The surface of arabidopsis seeds was sterilized by 75% ethanol and they were grown on Murashige and Skoog (MS) media containing 4.42 g MS, 0.5g MES (2-morpholinoethanesulfonic acid), 2% phyto agar and 2% sucrose. Plates were stored for 3 days in the dark at 4℃ and then placed in a growth chamber set at 20℃ with 24 hours light for 14 days. ClO_2 was treated 20 μm with 10 ppm, 50 ppm, 100 ppm for 1, 2, 6 and 24 hours. Pepper seeds was sterilized by 1% NaClO solution and were grown same condition as Arabidopsis seeds. Root of pepper seedlings was soaked into aqueous ClO_2 with 10 ppm, 20 ppm, 100 ppm for 5 min, 10 min, 30 min, 1 h and 2 h. Gene expression analysis was performed by real-time quantitative PCR by using a CFX96 real-time system (Bio-Rad).

[Results and Discussion]
In Arabidopsis, the increased concentration and time of ClO_2 treatment showed the tendency of increasing expression level of all genes including MPK3, MPK6, FRK1, AP2C1, CYP81F2, Retox and PHI-1. For this reason, the longer the treatment time of chlorine dioxide at a higher concentration, the more PCD occurs due to hypersensitivity reactions. Also, in pepper, ROS related genes and PR10 expressed. This results indicate that chlorine dioxide treatment could strengthen plant immunity which is expected to be applicable to other crops.

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