

Pulsed Power Applications for Agriculture and Food Processing

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Repetitively operated compact pulsed power generators with a moderate peak power were developed for the applications in several stages of agriculture and food processing. Pulsed high-voltage produces intense high-electric field which can cause some biological effects such as stress response (stimulation) and electroporation. Types of pulsed power that also have biological effects to plants are caused with gas and water discharges which include reactive species such as ROS and RNS [1].

The repetitive pulse discharge was used for promoting growth of the vegetables and fruits. The growth rate of the vegetables and sugar content in the strawberry harvested after the cultivation increased by the plasma irradiation to the hydroponic solution. **Figure 1** shows photographs of *Brassica rapa var. perviridis* at 28 days of cultivation for various treatment times using a magnetic-compression pulsed power (MPC) generator. The leaf size of the plants increased with the treatment time [2]. In addition, ROS works as pesticide. Number of colony forming units (CFU) of *R. solanacearum* in the liquid fertilizer decreased from 10^7 to 10^2 CFU/mL using the plasma treatment. Seedlings with plasma treatment were relatively healthy; in contrast, all seedlings in the positive control wilted and died from infection of *R. solanacearum* after 12 days [3]. The μ s-pulse high-voltage improvement of mushroom yield. The yielding rate of Shiitake mushroom (*L. edodes*) was also improved with the high-voltage stimulation in fruit-body formation phase. **Figure 2** shows a photograph of cultured *L. edodes* taken on the same day. The upper bed-log was used in cultivation without applying a high voltage. The lower bed-log was used in cultivation and a 50 kV voltage was applied 50 times as stimulation. *L. edodes* in the stimulated log grew faster than that in the bed-log without stimulation [4].

The AC high-voltage keeping freshness for a relatively longer period of agricultural, and marine products [5]. The electrostatic effects can contribute to remove airborne bacteria and fungi spore from the storage house and container [6]. This removal contributes to reduce the infection risk with fungi and bacteria. Some

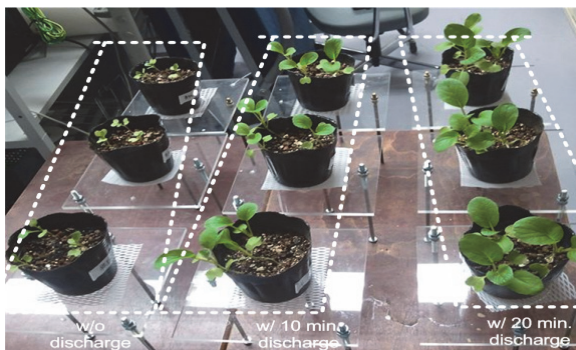


Fig. 1 Photographs of *Brassica rapa var. perviridis* cultivated for 28 days at (a) w/o plasma and with (b) 10 min. or (c) 20 min. treatment per day.



Fig. 2 Typical photograph of the cultured *L. edodes* with and without electrical stimulation.

kinds of fruit and vegetable emit the ethylene gas which accelerate a degradation of other kind fruits and vegetables. The repetitive μ s-pulse DBD remediation of air and liquid to inhibit degradation of agricultural products via ethylene removal via oxidization reaction [7].

Recently, the technology for conformational change of protein by applying electric field was tried to utilize in applications of food processing. Activity of α -amylase using pulsed electric field (PEF) was evaluated using an α -amylase Assay kit. The α -amylase activity decreased with the increasing electric field as shown in **Fig. 3**. These applications can contribute a sustainable food supply chain in the world.

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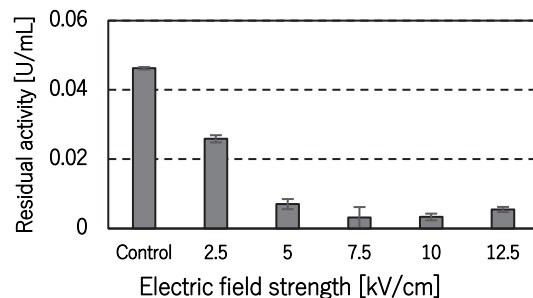


Fig. 3 Residual activity of α -amylase as a function of applying electric field strength.

References

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