Evaluation of high electric field chamber for shelf life extension of food and agricultural commodities

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Introduction
A high voltage electric field (HVEF or HEF) is known to provide several effects on both physical and biochemical aspects, such as enhancements of water vaporization and drying rates of food materials, reduction of respiration rate, and quality maintenance of fresh fruits and vegetables. Application of HEF might also cause this occurrence of corona discharge between electrodes, and the important reason for considering coronas is the production of ozone around conductors undergoing corona processes. Ozone is widely known to have high oxidation activity and microbial growth inhibition effect under certain level of concentration. Additionally, it is expected that the high electric field chamber will have a potential to generate the ozone gas which affects the reduced growth rate of microorganisms on food and the quality preservation of fresh fruits and vegetables during storage. In this study, effects of voltage and temperature on the ozone concentration in the HEF chamber were analyzed. Effects of HEF chamber on quality preservation and microbial growth were also examined.

Materials and Methods
High Electric Field (HEF) chamber: Alternative current HEF chamber (NPT 757T Medical, Feel Technology Inc., Japan) was used & voltages were set to 0, 25, 50, 75 and 100% of the maximum (7000V).

Food materials: Radish sprout, spinach, peach fruit, and tuna.

Ozone measurement: UV ozone monitor (EG-2001 and/or EG-5000, Ebara LTD, Japan) & data were stored at 10 second interval by data logger (Thermocodac F, Eto Denki Co., Japan).

Temperature measurement: Fiber optic thermometer (FL-2000, Anritsu Meter Co., Ltd., Japan) equipped with fiber optic sensor (FS-100, Anritsu Meter Co., Ltd., Japan) & data were stored at 20 second interval by data logger.

Physicochemical analysis: Ascorbic acid and sugar contents by HPLC, Brix value by digital refractometer, Respiration rate by GC, Hardness by texture analyzer, and K-value (ATP-related compounds) by HPLC.

Microbiological evaluations: Aerobic plate count on raw tuna slices and growth of Cladosporium sphaerospermum and Rhizopus stolonifer during storage at 5 ºC were examined.

Conclusion
- Ozone accumulation was observed in the chamber and its concentration was dependent on the levels of voltage and temperature.
- Ozone production within the chamber might be due to the corona discharge occurrence.
- From our results, there were some advantages of HEF on quality preservation of fresh food. Ozone might be one of the possible reasons to have effect of quality preservation. However, the cost of the HEF chamber used in this study is considerably high when compared with ordinary refrigerator. A cost effective ozone generation method combined with low temperature might enable the commercial use for supply chain of fresh foods.