

# Direct Viral Aerosol Inactivation by Microwave Irradiation and its Mechanisms

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**Keywords:** Microwave Irradiation, Viral Aerosol

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Previously, we have studied the bacterial and fungal aerosol inactivation by direct microwave irradiation at 2450 MHz. Here, we further investigated its inactivation of airborne virus in laboratory controlled conditions. MS2 coliphage used as a human model virus were aerosolized using a Collison Nebulizer and exposed to the direct microwave irradiation for ~ 2 min at three different power levels (700 , 385, 119 W) in this work. The microwave irradiation unit investigated in our previous studies was used here. In addition to the survival rate, the viral envelope surface proteins with and without the microwave irradiation were also examined using PCR and gel electrophoresis.

Experimental data showed that direct exposure of MS2 virus in airborne state to the microwave irradiation at 700 W for less than 2 min resulted in more than 90% inactivation efficiency, and about 50% at the lowest power level (199 W). Water-borne MS2 virus exposure to the microwave irradiation revealed that the inactivation rate depended on the power level and irradiation time. Scanning electron images showed visible damages to the viral envelope. Results from PCR and gel electrophoresis showed that severe damages occurred to the viral envelope surface proteins such as the A protein, the capsid protein and the replicase protein, among which the A protein was completely damaged.

Damages to these functional proteins would result in the loss of viral ability to mount an infection. This study demonstrated that even without the filtration the direct microwave irradiation could also achieve high inactivation efficiency for viral aerosols. Among many efforts including the development of viral vaccines, engineering control solutions could provide unlimited potential in the battle against the emerging viral threats.

**Acknowledgements:** The authors acknowledge the supports from National Science Foundation of China Grant 21077005.