

Physiological Responses of Common Market Cactus Species to 2.4 GHz Wi-Fi Exposure

Abstract

This study investigates the physiological effects of continuous 2.4 GHz Wi-Fi exposure on three cactus species commonly sold in Turkish markets: *Opuntia microdasys*, *Mammillaria elongata*, and *Cereus peruvianus*. Plants were grown under controlled environmental conditions and exposed to Wi-Fi radiation for 30 days, with non-exposed control groups maintained in parallel. Measurements included growth dynamics, biomass change, oxidative stress markers (MDA), chlorophyll index, surface temperature, and volatile organic compound (VOC) emissions. Results indicate species-specific sensitivities: *Opuntia* showed the highest stress response, *Mammillaria* demonstrated resilience, and *Cereus* exhibited intermediate patterns.

1. Introduction

Non-ionizing electromagnetic radiation generated by household wireless devices is widespread, yet its effects on succulent plants remain poorly understood. Cactus species, commonly kept indoors, may serve as useful biological indicators of non-ionizing radiation exposure. This study evaluates the responses of three market-available cactus species to continuous 2.4 GHz Wi-Fi radiation.

2. Materials and Methods

Plant Material: Three cactus species were selected: *Opuntia microdasys*, *Mammillaria elongata*, and *Cereus peruvianus*. Each species included three exposed and three control plants.

Wi-Fi Exposure: A 2.4 GHz Wi-Fi router operating at 18 dBm transmission power was placed 1 meter away from experimental plants. Exposure was continuous for 30 days. Controls were shielded from radiation.

Environmental Conditions: Temperature remained at $24\pm 1^{\circ}\text{C}$, with $45\pm 5\%$ humidity and 12-hour daily light cycles.

Measured Parameters: Growth height (mm), biomass percentage, chlorophyll index, infrared surface temperature, MDA oxidative stress levels, and qualitative VOC emissions.

Statistical Approach: Mean values and descriptive comparisons were used due to limited sample size.

3. Results

Growth and Biomass: *Opuntia* gained 12 mm height and lost 12% biomass. *Mammillaria* gained 9 mm and lost 4% biomass. *Cereus* gained 10 mm with no biomass change.

Oxidative Stress: MDA levels increased by 35% in *Opuntia*, 12% in *Mammillaria*, and showed no change in *Cereus*.

VOC and Temperature: *Opuntia* exhibited the highest VOC increase, *Mammillaria* showed minimal change, and *Cereus* displayed moderate elevation. Temperature changes remained minimal.

4. Discussion

Opuntia demonstrated the strongest stress response, which may relate to its anatomical structure and metabolic activity. *Mammillaria*'s compact morphology appeared to confer resilience, while *Cereus* showed moderate sensitivity. These differences support the use of cactus species as potential low-cost indicators of electromagnetic exposure.

5. Conclusion

Continuous exposure to 2.4 GHz Wi-Fi radiation produced measurable physiological effects in

cactus species, with *Opuntia* showing the strongest stress indicators, *Mammillaria* remaining most stable, and *Cereus* exhibiting intermediate behavior.

References

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