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Radiofrequency 2.4 GHz radiation prolonged exposure induces cellular stress and inflammatory responses in rats- a molecular insight

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Exposure to radiofrequency (RF, 300 MHz–300 GHz) radiation has expanded enormously over the past few decades as a result of its widespread use in a variety of civilian and military fields. 2.4 GHz (S-band) is broadly utilized in wireless telecommunication, Wi-Fi, Bluetooth-based, and directed energy devices. There are serious concerns about the potential adverse impacts of the increased use of RF-driven devices on human health.

The present study investigated the effects of 2.4 GHz radiation exposure (3h/day, for 30 days) at different average power densities (PD) of 5, 7, 11, 15, and 18 mW/cm^2 (average SAR 1.2-4.0 W/kg) in the experimental rats. Animals (whole-body) were exposed to a 2.4 GHz radiation source signal generator coupled with a high output power amplifier connected through a horn antenna in the far-field region.

The present findings demonstrated that 2.4 GHz radiation exposure caused cellular stress, oxidative damage, and inflammatory responses at higher PD (11 mW/cm^2 and above) as evidenced by significantly ($p < 0.05$) increased serum angiotensin-II, and epinephrin levels in comparison to sham-exposed. Irradiation to 2.4 GHz showed a similar pattern of elevated TNF-α, IL-1β, COX-2, and substance-P receptor levels at higher PD in rat skin, suggesting enhanced inflammation and pain. Molecular results were further well corroborated by histopathological findings, which showed inflammatory cells in the rat skin exposed to 2.4 GHz at higher PD. These markers showed no changes at PD of 7 mW/cm^2 and below.

Overall, the present findings revealed that rats exposed to 2.4 GHz for 30 days (3 h daily) at higher power densities instigated molecular stress responses as evidenced by increased cellular stress, inflammatory responses, and oxidative injury.