

In Vivo Evaluation of Exposure to Electromagnetic Fields at 27 Ghz (5G) of *Danio Rerio*: A Preliminary Study

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Abstract—5G Technology is evolving to satisfy a variety of service requirements that may allow high data-rate connections (1Gbps) and lower latency times than current (<1ms). In order to support a high data transmission speed and a high traffic service for eMBB (enhanced mobile broadband) use cases, 5G systems have the characteristic of using different frequency bands of the radio wave spectrum (700 MHz, 3.6-3.8 GHz and 26.5-27.5 GHz), thus taking advantage of higher frequencies than previous mobile radio generations (1G-4G). However, waves at higher frequencies have a lower capacity to propagate in free space and therefore, in order to guarantee the capillary coverage of the territory for high reliability applications, it will be necessary to install a large number of repeaters. Following the introduction of this new technology, there has been growing concern over the past few months about possible harmful effects on human health. The aim of this preliminary study is to evaluate possible short term effects induced by 5G-millimeter waves on embryonic development and early life stages of *Danio rerio* by Z-FET. We exposed developing zebrafish at frequency of 27 GHz, with a standard pyramidal horn antenna placed at 15 cm far from the samples holder ensuring an incident power density of 10 mW/cm². During the exposure cycle, from 6 h post fertilization (hpf) to 96 hpf, we measured a different morphological endpoints every 24 hours. Zebrafish embryo toxicity test (Z-FET) is a short term test, carried out on fertilized eggs of zebrafish and it represents an effective alternative to acute test with adult fish (OECD, 2013). We have observed that 5G did not reveal significant impacts on mortality nor on morphology because exposed larvae showed a normal detachment of the tail, presence of heartbeat, well-organized somites, therefore hatching rate was lower than untreated larvae even at 48 h of exposure. Moreover, the immunohistochemical analysis performed on larvae showed a negativity to the HSP-70 expression used as a biomarkers. This is a preliminary study on evaluation of potential toxicity induced by 5G and it seems appropriate to underline the importance that further studies would take, aimed at clarifying the probable real risk of exposure to electromagnetic fields.

Keywords—Biomarker of exposure, embryonic development, 5G waves, zebrafish embryo toxicity test

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