https://doi.org/10.22364/iarb.2021.05

Experimental evidence of the impact of low-frequency electromagnetic field on the reproductive success of fruit fly *Drosopfila melanogaster* and its potential to generate new point mutations at some candidate genes

Dalius Butkauskas*[1, 2], Dace Grauda[2], Andra Miķelsone[2], Dāvis Rašals[2], Rimantas Petrošius[1], Kamilė Kazlauskaitė[1]

[1] *Nature Research Centre, Akademijos Street 2, LT-08412, Vilnius, Lithuania*
[2] *Institute of Biology, University of Latvia, Jelgavas Street 1, Riga, Latvia, LV-1004*
* *Corresponding author: dalius.butkauskas@lu.lv*

Keywords: *Drosophila melanogaster*, LF electromagnetic field, reproductive success, Isocitrate dehydrogenase as a candidate locus

The effects of microwave frequency electromagnetic fields on the development of *Drosophila melanogaster* were already demonstrated (Atli and Ünlü, 2006). To collect data as new evidence regarding the impact of low frequency (50 Hz) electromagnetic field (LFEF) on fruitflies up to five generations of *D. melanogaster* of the Oregon line were exposed to LFEF by growing insects in plastic tubes placed inside Helmholc coil, producing a region of nearly uniform magnetic field (500–750 μT). All fruit flies were placed on a standard sugar-yeast-cornmeal medium at 24 ± 2 °C temperature. Initially, 50 larvaes were placed in each tube (10 tubes placed inside the coil represent directly affected group EM*, the next 10 tubes marked as control group K* were placed in 1.5 meters distance from the coil). To establish the next generation of K* and EM* groups two fertilised females were replanted from each of 10 tubes and placed in the same number of tubes to continue the collection of the data including fixation of the number of dead pupas and insects that reached imago stage. The experiment has been terminated after the fifth generation of fruit flies developed up to imago stage.

No alive flies of the fifth generation were obtained in one out of ten tubes at the control group and just a few flies of the fifth generation were found in four out of ten tubes in EM* group. In the rest six tubes, no alive flies were found in

the directly exposed to LFEF group, revealing the negative impact of electromagnetic field on reproductive success based on the current experimental model.

Taking into account the results of the study that revealed the role of the Isocitrate dehydrogenase in the protection of DJ-1 null dopaminergic cells from oxidative stress (Yang *et al*., 2017; Kocaman *et al*., 2018) we sequenced potentially variable part of Isocitrate dehydrogenase as candidate locus to detect LFEF born mutagenesis. No poin mutations of Isocitrate dehidrogenaze (Idh) 1218 bp fragment were found based on sequencing and alignment of DNA comparing representatives of EM* and K* groups.

The study should be extended including experiments devoted to the selection of the most informative and sensitive loci in combination with evaluation of the impact of electromagnetic fields of different intensity and frequency.

Acknowledgements

The study was financially supported by the EURECA project E!11170 "Innovative multifunctional bio-textile, integrated with silica dioxide and succinate development, and its impact on biosystems" IFSITEX.

References

Atli, E., Ünlü, H. 2006. The effects of microwave frequency electromagnetic fields on the development of Drosophila melanogaster. *International Journal of Radiation Biology*. 82: 435–441.

Kocaman, A., Altun, G., Kaplan, A. A., Deniz, Ö. G., Yurt, K. K., and Kaplan, S. 2018. Genotoxic and carcinogenic effects of non-ionizing electromagnetic fields. *Environmental Research.* 163: 71–79.

Yang, J., Kim, M. J., Yoon, W., Kim, E. Y., Kim, H., Lee, Y., Min, B., Kang, K. S., Son, J. H., Park, H. T., Chung, J., and Koh, H. 2017. Isocitrate protects DJ-1 null dopaminergic cells from oxidative stress through NADP+-dependent isocitrate dehydrogenase (IDH). *PLoS Genet*. 13, e1006975.