



Official Journal of the
Neuroscience Society of Nigeria
(NSN)

ISSN 1116-4182

GEOTACTICAL AND NEUROCHEMICAL PHENOTYPES OF *Drosophila melanogaster* FOLLOWING *Nigella sativa* OIL EXPOSURE

Royhaan Folarin¹, Kayode Ayodele¹, Muinat Adeyanju², Thomas Adenowo¹,
Joshua Olugbode¹, Esther Obadeyin¹

¹Neurophytotherapy Unit, Department of Anatomy, Olabisi Onabanjo University, Sagamu, Nigeria

²Department of Biochemistry, Olabisi Onabanjo University, Sagamu, Nigeria

Received: May 2019

Accepted: August 2019

ABSTRACT

Drosophila melanogaster is a holometabolous frugivorous fly with neurobiological and neurogenetic modelling importance, owed to its small size, short life cycle, fast reproductive rate, low cost in maintenance and a small tetra-chromosomal genome. *Nigella sativa* (Black seed) is a widely researched medicinal plant considered by some sources as a miracle plant, capable of curing all diseases. Being the most abundant neurotransmitter in *Drosophila*, glutamate plays an important role in learning and memory, neuroexcitation, and also neuro-inhibition. This research investigated the impacts of *Nigella sativa* oil on the survival, glutamate levels and geotactical locomotion in Harwich strains of *Drosophila melanogaster*. These were executed using the survival assay, spectrophotometric glutamate assay and negative geotaxis assay, respectively. The flies were divided into control, lower dose and higher dose groups. The groups were exposed to *Nigella sativa* oil for five days at 0 mL, 0.1 mL and 0.6 mL *Nigella sativa* per mL of feed medium. The results showed a higher survival rate, glutamate level and negative geotactic ability for the flies exposed at lower dose, while the higher *Nigella sativa* dose recorded lesser values in the trio. This indicates that *Nigella sativa* administered at 0.6 mL/mL of feed may be lethal to the general survival and physiological functions of adult *Drosophila*. The lower dose however shows a high potential of maintaining and improving the geotactical/locomotive and neurochemical activities in the flies, as further studies are on to further identify the most therapeutic dose of *Nigella sativa* in *Drosophila melanogaster*, with a range suggested based on the findings of this research.

Key words: *Drosophila melanogaster*, *Nigella sativa*. Survival, Glutamate, Negative geotaxis

INTRODUCTION

There has always been need to develop animal models that accurately recapitulate human disorders in a bid to identifying alternative drugs for such disorders. This need has accorded more popularity to *Drosophila melanogaster* (common fruit fly) particularly for its low maintenance cost, fast reproductive rate, small size, short life cycle, and tetra-chromosomal genome. It is therefore considered widely as a valid genetic model for several human disorders including Alzheimer's,

Parkinson's, Huntington's, and spinocerebellar ataxia, especially as over 65% of human disease-associated genes have a correlate (homologue) in *Drosophila* (Markstein 2019).

Nigella sativa (also referred to as Habbatus-sawdaa or black seed) is considered one of the most widely used medicinal plant across the world (Ahmad et al.

Correspondence: Royhaan Folarin, PhD, Neurophytotherapy Unit, Department of Anatomy, Olabisi Onabanjo University, PMB 2002, Sagamu, Nigeria. royhaan.folarin@oouagoiwoye.edu.ng; +2347032064419

REFERENCES

- Abolaji, A.O., Kamdem, J.P., Lugokenski, T.H., Farombi, E.O., Souza, D.O., da Silva Loreto, É.L. and Rocha, J.B.T. (2015) Ovotoxicants 4-vinylcyclohexene 1,2-monoepoxide and 4-vinylcyclohexene diepoxide disrupt redox status and modify different electrophile sensitive target enzymes and genes in *Drosophila melanogaster*. *Redox Biology*. 5:328-339. <https://doi.org/10.1016/j.redox.2015.06.001>
- Ahmad, A., Husain, A., Mujeeb, M., Khan, S.A., Najmi, A.K., Siddique, N.A., Damanhoun Z. and Anwar, F. (2013) A review on therapeutic potential of *Nigella sativa*: A miracle herb. *Asian Pacific Journal of Tropical Biomedicine*. 3(5):337-352. [https://doi.org/10.1016/S2221-1691\(13\)60075-1](https://doi.org/10.1016/S2221-1691(13)60075-1)
- Al-Bukhari, M. (1997) The translation of the meanings of Sahih Al-Bukhari. Riyadh: Dar-us-Salam Publications.
- Ali, B.H. and Blunden, G. (2003) Pharmacological and toxicological properties of *Nigella sativa*. *Phytotherapy Research*. 17(4):299-305.
- Bae, J.-E., Bang, S., Min, S., Lee, S.-H., Kwon, S.-H., Lee, Y.-H., Chung, J. and Chae, K.-S. (2016) Positive geotactic behaviors induced by geomagnetic field in *Drosophila*. *Molecular Brain*. 9(1). <https://doi.org/10.1186/s13041-016-0235-1>
- Callier, V., Hand, S.C., Campbell, J.B., Biddulph, T. and Harrison, J.F. (2015) Developmental changes in hypoxic exposure and responses to anoxia in *Drosophila melanogaster*. *Journal of Experimental Biology*. 218(18): 2927–2934. <https://doi.org/10.1242/jeb.125849>.
- Ikeda, M., Nakazawa, T., Abe, K., Kaneko, T. and Yamatsu, K. (1989) Extracellular accumulation of glutamate in the hippocampus induced by ischemia is not calcium dependent -- in vitro and in vivo evidence. *Neuroscience Letters*. 96(2):202-206. [https://doi.org/10.1016/0304-3940\(89\)90058-X](https://doi.org/10.1016/0304-3940(89)90058-X)
- Linderman, J.A., Chambers, M.C., Gupta, A.S. and Schneider, D.S. (2012) Infection-related declines in chill coma recovery and negative geotaxis in *Drosophila melanogaster*. *PLoS ONE*. 7(9):e41907. <https://doi.org/10.1371/journal.pone.0041907>
- Liu, W. W. and Wilson, R. I. (2013) Glutamate is an inhibitory neurotransmitter in the *Drosophila* olfactory system. *Proceedings of the National Academy of Sciences*. 110(25):10294–10299. <https://doi.org/10.1073/pnas.1220560110>
- Markstein, M. (2019) *Drosophila Workers Unite!* (1st ed.). Retrieved from <http://marksteinlab.org/wp-content/uploads/2019/01/MicheleMarkstein-DrosophilaWorkersUnite-PREPRINT-JAN2019.pdf>
- Naz, H. (2011) *Nigella Sativa*: The miraculous herb. *Pakistan Journal of Biochemistry and Molecular Biology*. 44(1):44-48.
- Paithankar, J.G., Deeksha, K. and Patil, R.K. (2017) Gamma radiation tolerance in different life stages of the fruit fly *Drosophila melanogaster*. *International Journal of Radiation Biology*. 93(4):440–448. <https://doi.org/10.1080/09553002.2016.1266056>
- Randhawa, M.A. and Alenazi, S.A. (2016) Neuropsychiatric effects of *Nigella sativa* (black seed) – A Review. *Alternative & Integrative Medicine*, 05(01). <https://doi.org/10.4172/2327-5162.1000209>
- Shin, M., Copeland, J.M. and Venton, B.J. (2018) *Drosophila* as a model system for neurotransmitter measurements. *ACS Chemical Neuroscience*. 9(8):1872-1883. <https://doi.org/10.1021/acscchemneur.7b00456>
- Zimmerman, J.E., Chan, M.T., Lenz, O.T., Keenan, B.T., Maislin, G. and Pack, A.I. (2017) Glutamate is a wake-active neurotransmitter in *Drosophila melanogaster*. *Sleep*. 40(2). <https://doi.org/10.1093/sleep/zsw046>