Abstract

Neonicotinoids: Agrochemicals with Toxic Impact on Reproductive Functions in Males †

Tomas Jambor *, Lucia Zuscikova, Hana Greifova, Nikola Knizatova, Anton Kovacik and Norbert Lukac

Faculty of Biotechnology and Food Sciences, Institute of Applied Biology, Slovak University of Agriculture in Nitra, Tr. A. Hlinku 2, 949 76 Nitra, Slovakia; xzuscikoval@uniag.sk (L.Z.); hana.greifova@uniag.sk (H.G.); nikola.knizatova@gmail.com (N.K.); anton.kovacik@uniag.sk (A.K.); norbert.lukac@uniag.sk (N.L.)

* Correspondence: tomas.jambor@uniag.sk; Tel.: +421-915160635


Keywords: acetamiprid; thiacloprid; leydig cells; Sertoli cells; toxicity

In general, agrochemicals are compounds used to control weeds and diseases in crops during many agronomic practices, and they have become an essential tool in crop protection [1]. Neonicotinoid pesticides are highly effective against some destructive crop pests, and their occurrence in aquatic ecosystems could represent a relevant risk. Acetamiprid N-[6-chloropyridin-3-yl]methyl]-N′-cyano-N-methylethanimidamide and thiacloprid (2Z)-3-[6-chloro-3-pyridinyl)methyl]-1,3-thiazolidin-2-ylidenecyanamide) are especially frequently used agrochemicals, with a wide spectrum of efficacy [2]. Currently, exact knowledge about the impact of neonicotinoid exposure on the reproductive system is limited as well as inconsistent. The scientific environment does not provide a relevant background for solving this problem. The objective of our in vitro study was to examine the potential effect of selected neonicotinoids on mouse Sertoli cells. TM4 cells were treated with experimental doses of acetamiprid (10 to 500 µM) and thiacloprid (7.8 to 500 µM) for 48 hours of exposure. Metabolic activity and cell membrane integrity were examined to determine the potential toxicity. The results of an alamarblue assay revealed that higher experimental doses of acetamiprid (200–500 µM) significantly (p < 0.0001) decreased the metabolic activity of exposed TM4 Sertoli cells. A similar tendency was confirmed after thiacloprid exposure when significant (p < 0.0001) cytotoxicity started from 125 to 500 µM. The cell membrane integrity, evaluated via a CFDA-AM assay, showed a significant (p < 0.01) decrease at 250 or 300 µM followed by significant (p < 0.001; p < 0.0001) inhibition at 350 and 500 µM of acetamiprid. In the case of thiacloprid, the presented parameter was significantly (p < 0.01) inhibited at 125 and 250 µM, while the highest concentrations, 300 and 500 µM, caused significant changes (p < 0.001; p < 0.0001). Considerably more detailed and systematic research on thiacloprid toxicology is definitely required for a better understanding of the risks associated with reproductive health.

Author Contributions: Conceptualization, T.J. and N.L.; methodology, T.J. and H.G.; validation, N.L. and A.K.; formal analysis, N.K.; original draft preparation, T.J. and L.Z.; writing—review and editing, N.L.; supervision, N.L. and A.K.; project administration, T.J., A.K. and N.L.; funding acquisition, N.L.

All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by the Scientific Agency of the Slovak Republic (VEGA), No. 1/0083/21, and the Slovak Research and Development Agency, Grant No. APVV-21-0168 and APVV-20-0218.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.
Data Availability Statement: Data sharing not applicable.

Conflicts of Interest: The authors declare no conflict of interest.

References


Disclaimer/Publisher's Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.