

1. PHD PROJECT DESCRIPTION (4000 characters max., including the aims and work plan, **all in English**)

Project title:

American cockroach, *Periplaneta americana*, as a model for studies of neurodegenerative diseases. Impact of environmental pollution on development of neurodegeneration.

1.1. Project goals

1. Determination of procedures enabling the use of cockroach (*Periplaneta americana*) as a model for studying neurodegenerative diseases.
2. Assessment of the impact of insecticide residues on pathophysiological processes underlying neurodegeneration.
3. Justification for using cockroach (*P.am*) for neurodegenerative disease research.

1.2 Outline

Neurodegeneration is a progressive loss of the nervous system structure and function leading to the deterioration of motor and cognitive activity. This is a key aspects of the huge number of neurodegenerative diseases (ND) that are a growing problem in the modern world. A lot of research has been done on neurodegenerative disorders of the nervous system, however humanity is still unable to effectively counteract the development of neurodegeneration and its effects. Many physiological pathways subjected to neurodegeneration are evolutionarily conserved and can also be observed in invertebrates, which in the last decade are increasingly used as model systems in studies of neurodegeneration (Haddadi 2019). Invertebrates have a relatively short lifespans, their breeding is inexpensive, working with them is easier than with mammals, their nervous system is easy accessible, their behaviour is less complex than in mammals. Genetically altered fly and worm, (*Drosophila melanogaster* and *Caenorhabditis elegans*) serve as excellent models to study the genes involved in the pathogenesis of various ND (Deal & Yamamoto, 2019), however because of their short life, more complex, long-lasting physiological observations (that more precisely mimic the vertebrate models) are not possible. Cockroach *Periplaneta americana* is considered a good model in basic research in neurobiology since long time (Huber et al., 1990; Troppmann et al., 2014). It has relatively long life cycle (70 weeks in adult stage)– important factor in study of neurodegeneration. For many years it has been used in our neurophysiological laboratory as a model for electrophysiological and biochemical research. Environmental pollution has already been proven to increase susceptibility to neurodegenerative diseases (Chin-Chan, 2015) however the assessment how chronic exposure, mainly to very low doses of pollutants (e.g. pesticides), is associated with the onset and development of neurodegenerative diseases, is very difficult. We propose the use of cockroach *Periplaneta americana* as an alternative invertebrate model for study of ND symptoms developing with age and as the consequence of chemical stress (exposure to extremely low insecticide concentration). We assume that

the development of new insect model of ND will contribute to the understanding of these diseases, and also enable to explore potential therapies in ways which would be impossible in humans.

1.3. Work plan

1. Characteristics of changes in physiological parameters during aging in control cockroaches.
2. Assessment of the level of chemical stress – estimation of the effectiveness of various doses and time of exposure to carbamate insecticides used in the sub-lethal range.
3. Assessment of the influence of the lowest effective insecticide doses on insect's physiological parameters.
4. Changes in the effectiveness of insecticide with insect age.

1.4. Literature

Britta Troppmann et al. (2014) Characterization of an Invertebrate-Type Dopamine Receptor of the American Cockroach, *Periplaneta americana*, 2014, Int. J.Mol. Sci 15: 629-653.

Chin-Chan M. et al. (2015) Environmental Pollutants as Risk Factors for Neurodegenerative Disorders: Alzheimer and Parkinson Diseases. Front. Cell. Neurosci. 9:124. doi: 10.3389/fncel.2015.00124

Deal S.L. & Yamamoto S. (2019) Unraveling Novel Mechanisms of Neurodegeneration Through a Large-Scale Forward Genetic Screen in *Drosophila*. Front. Genet. 9:700. doi: 10.3389/fgene.2018.00700

Haddadi M. (2018) *Drosophila melanogaster* as a Model to Study Human Neurodegenerative Diseases. Int J Basic Sci Med. 2018;3,9-12

Huber I. et al. 1990. Cockroaches as Models for Neurobiology: Applications in Biomedical Research, 1st ed.; CRC Press: Boca Raton, FL, USA.

1.5. Required initial knowledge and skills of the PhD candidate

1. Basic knowledge in neuroscience
2. Basic knowledge in physics and biochemistry
3. Ability to conduct biological experiments
4. Readiness to work with insects
5. Precision and patience at work- necessary for electrophysiological studies
6. Speaking and writing English

1.6 Expected development of the PhD candidate's knowledge and skills

1. Wide knowledge in neurosciences

2. Knowledge of the theoretical basis of neurodegenerative diseases
3. Knowledge of insect physiology
4. Practical skills in modern techniques used in neurobiology
5. Practice in international scientific contacts
6. Knowledge of specialized English