

# Mildos Stankevičiūtės disertacija

**Autorius:** Milda Stankevičiūtė

**Disertacijos pavadinimas:** **EXPERIMENTAL STUDIES OF XENOBIOTICS GENOTOXICITY AND CYTOTOXICITY IN FISH ERYTHROCYTES**

**Mokslo sritis:** Biomedicinos mokslai, ekologija ir aplinkotyra (03B)

**Mokslinis vadovas:** Habil. dr. Janina Baršienė

**Doktorantūros studijų laikotarpis:** 2014 – 2018 m.

**Gynimo data:** 2018 m. spalio 1 d.

## Summary

The thesis addresses the problem of chemical mixtures and seeks to contextualise the work in real EU context. This thesis contributes with the new scientific information on tissue-specific, time-, concentration-dependent, multiple stressors influenced geno- and cytotoxicity responses and fluctuations during organism's recovery. The effects of metal (Zn, Cu, Ni, Cr, Pb, Cd) mixtures and CdSe/ZnS-COOH quantum dots (QDs) as multicomponent chemical stressors and oomycetes *Saprolegnia parasitica* as a biological stressor on the induction of cytogenetic lesions have been disclosed under controlled laboratory conditions. The measurement of cytogenetic effects in aquatic organisms in situ provided early warning signals on adverse effects of multiple stressors.

Exposure to metal mixture at MPC causes time-dependent and tissue-specific responses of geno- and cytotoxicity in *S. salar*. Recovery of *O. mykiss* from cytogenetic damage is time-, tissue- and concentration-dependent; fluctuations of cytogenetic lesions is inherent to depuration period. Reduction of MPC of a certain metal in complex mixture markedly increases the levels of geno- and cytotoxicity in erythrocytes of *S. salar* and *R. rutilus*. DNA strand breaks in *O. mykiss* embryos and larvae following exposure to CdSe/ZnS-COOH QDs was indicated; genotoxic potential of *S. parasitica* in *O. mykiss* larvae was detected.

## Santrauka

Disertacijoje pateikti eksperimentiniai tyrimai apie daugianarių metalų mišinių (Zn, Cu, Cr, Ni, Pb, Cd), esant didžiausioms leistinoms koncentracijoms (DLK), daugiakomponentinių nanodalelių (CdSe/ZnS-COOH kvantinių taškų (KT)), *Saprolegnia parasitica*, kaip biologinio stresoriaus indukuotą genotoksinį ir citotoksinį poveikį žuvyse. Galiausiai, po metalų mišinio poveikio žuvyse įvykę citogenetiniai pokyčiai toliau tirti organizmų atsistatymo procese. Baltijos jūros aplinkos geno- ir citotoksiškumo tyrimai leido palyginti pasirinktų biožymenų atsakus vyraujančią aplinkoje įvairiems stresoriams.

Rezultatai parodė, kad metalų mišinio poveikis (esant DLK) sukelia nuo laiko priklausomus ir specifinius audiniui geno- ir citotoksiškumo atsakus *S. salar* eritrocituose. Eksperimentiniai tyrimais nustatyta, kad tam tikro metalo DLK sumažinimas mišinyje 10 kartų gali žymiai padidinti geno- ir citotoksinį poveikį *S. salar* ir *R. rutilus* eritrocituose. Citogenetinių pažeidimų dažnių pokyčiai *O. mykiss* eritrocituose vykstant atsistatymui priklauso nuo atsistatymo trukmės,

metalų mišinio koncentracijos bei yra specifiniai tiriamam audiniui. DNR grandinės trūkiai po poveikio CdSe/ZnS-COOH KT nustatyti *O. mykiss* embrionuose ir lervose; genotoksinis *S. parasitica* potencialas stebėtas *O. mykiss* lervose.

## Publikacijos

Publications with an impact factor on the Clarivate Analytics Web of Science database:

1. **Stankevičiūtė M**, Butrimavičienė L, Valskienė R, Greiciūnaitė J, Baršienė J, Vosyliene MZ, Svecevičius G (2016) Analysis of nuclear abnormalities in erythrocytes of rainbow trout (*Oncorhynchus mykiss*) treated with Cu and Zn and after 4-, 8-, and 12-day depuration (post-treatment recovery). *Mutation Research - Genetic Toxicology and Environmental Mutagenesis* 797: 26–35
2. **Stankevičiūtė M**, Sauliūtė G, Svecevičius G, Kazlauskienė N, Baršienė J (2017) Genotoxicity and cytotoxicity response to environmentally relevant complex metal mixture (Zn, Cu, Ni, Cr, Pb, Cd) accumulated in Atlantic salmon (*Salmo salar*). Part I: importance of exposure time and tissue dependence. *Ecotoxicology* 26 (8): 1051–1064
3. Rotomskis R, Jurgelėnė Ž, Stankevičius M, **Stankevičiūtė M**, Kazlauskienė N, Jokšas K, Montvydienė D, Kulvietis V, Karabanovas V (2018) Interaction of carboxylated CdSe/ZnS quantum dots with fish embryos: Towards understanding of nanoparticles toxicity. *Science of the Total Environment* 635: 1280–1291
4. **Stankevičiūtė M**, Sauliūtė G, Makaras T, Markuckas A, Virbickas T, Baršienė J. (2018) Responses of biomarkers in Atlantic salmon (*Salmo salar*) following exposure to environmentally relevant concentrations of complex metal mixture (Zn, Cu, Ni, Cr, Pb, Cd). Part II. *Ecotoxicology* 27 (8): 1069–1086
5. Baršienė J, Butrimavičienė L, Grygiel W, Stunžėnas V, Valskienė R, Greiciūnaitė J, **Stankevičiūtė M** (2016) Environmental genotoxicity risk assessment along the transport routes of chemical munitions leading to the dumping areas in the Baltic Sea. *Marine Pollution Bulletin* 103(1–2): 45–53
6. Valskienė R, Baršienė J, Butrimavičienė L, Grygiel W, Stunžėnas V, Jokšas K, **Stankevičiūtė M** (2018) Environmental genotoxicity and cytotoxicity levels in herring (*Clupea harengus*), flounder (*Platichthys flesus*) and cod (*Gadus morhua*) inhabiting the Gdansk Basin of the Baltic Sea. *Marine Pollution Bulletin* 133: 65–76
7. Butrimavičienė L, Baršienė J, Greiciūnaitė J, **Stankevičiūtė M**, Valskienė R (2018) Environmental genotoxicity and risk assessment in the Gulf of Riga (Baltic Sea) using fish, bivalves and crustaceans. *Environmental Science and Pollution Research* 25 (25): 24818–24828

Further publications with peer review process:

8. Valskienė R, **Stankevičiūtė M**, Butrimavičienė L, Greiciūnaitė J, Svecevičius G (2015) Induction of nuclear abnormalities in rainbow trout (*Oncorhynchus mykiss*) after exposure to model mixture of heavy metals (Zn, Cu, Ni, Cr, Cd, Pb) at maximum permissible concentration. *Proceedings of the 18th Conference for Junior Researchers “Science – Future of Lithuania”* ISSN 2029-5456. Vilnius, Technika. p. 100–105

9. Kazlauskienė N, Cibulskaitė Ž, **Stankevičiūtė M**, Baršienė J (2016) Experimental studies on the toxicity and geno-cytotoxicity effects of cadmium in embryos and larvae of rainbow trout, *Oncorhynchus mykiss*. *Proceedings of the 13th International Conference on Protection and Restoration of the Environment* ISBN 978-960-6865-94-7. Mykonos island, Greece. p. 449–459
10. Cibulskaitė Ž, **Stankevičiūtė M**, Kazlauskienė N, Baršienė J, Kulvietis V, Rotomskis R (2016) Long-term toxicity and geno-cytotoxicity of quantum dots to rainbow trout *Oncorhynchus mykiss* embryos. *Proceedings of the 13th International Conference on Protection and Restoration of the Environment* ISBN: 978-960-6865-94-7. Mykonos island, Greece. p. 460–470
11. Sauliutė G, **Stankevičiūtė M**, Svecevičius G, Baršienė J, Valskienė R (2017). Assessment of heavy metals bioconcentration factor (BCF) and genotoxicity response induced by metal mixture in *Salmo salar* tissues. *10th International Conference on Environmental Engineering*, eISBN 978-609-476-044-0 (doi: <https://doi.org/10.3846/enviro.2017.043>)
12. **Stankevičiūtė M**, Sauliutė G, Markuckas M, Virbickas T, Baršienė J (2018) Erythrocytic nuclear abnormalities, DNA damage, bioconcentration factor and haematological changes induced by metal mixture at environmentally relevant concentrations in *Rutilus rutilus*. *Proceedings of the 14th International Conference on Protection and Restoration of the Environment* ISBN: 978-960-99922-4-4. Thessaloniki, Greece. p. 785–794.
13. **Stankevičiūtė M**, Jurgelėnė Ž, Greiciūnaitė J, Markovskaja S, Kazlauskienė N, Baršienė J (2018) Geno-, cytotoxicity and toxicity induced by *Saprolegnia parasitica* and cadmium alone and in combination to *Oncorhynchus mykiss*. *Proceedings of the 14th International Conference on Protection and Restoration of the Environment* ISBN: 978-960-99922-4-4. Thessaloniki, Greece. p. 795–804.
14. Jurgelėnė Ž, **Stankevičiūtė M**, Kazlauskienė N, Montvydienė D, Baršienė J, Jokšas K, Markuckas A (2018) Investigation of quantum dots toxicity, genotoxicity, cytotoxicity, and uptake in rainbow trout *Oncorhynchus mykiss* larvae. *Proceedings of the 14th International Conference on Protection and Restoration of the Environment* ISBN: 978-960-99922-4-4. Thessaloniki, Greece. p. 775–806.