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Summary EN

Products developed using nanotechnology are widely used in everyday activities, making nanoparticles an integral part of our lives. However, with the rapid development of nanotechnology, nanoparticles may become a new group of environmental pollutants and have a negative impact on ecosystems. While nanotechnologies bring many benefits and innovations, their environmental impact needs to be assessed more carefully. The aim of this thesis was to investigate the accumulation of nanoparticles with different chemical compositions in salmonids at different life stages and to assess their effects on the gut microbiota and functional status of the fish. The stability of quantum dots was assessed by physicochemical methods, the accumulation of metals in nanoparticles in salmonid embryos, larvae, juvenile tissues and organs was studied, and the effect of nanoparticles on morphophysiological parameters of fish was investigated. The antibacterial activity of CdSe/ZnS-COOH and CuInS/ZnS-COOH quantum dots (QDs) and Cd2+ against bacteria isolated from the gut of salmonids was investigated using microbiological and molecular methods. Illumina® MiSeq™ next-generation sequencing was used to study the gut microbiota of brown trout (*Salmo trutta*) *in vivo* under QDs treatment. The results showed that graphene oxide reduced heavy metal accumulation in rainbow trout embryos and larvae, while Co and Fe accumulation in rainbow trout depended on the size of CoFe2O4 nanoparticles and the developmental stage of the fish. Dietary CdSe/ZnS-COOH QDs accumulate Cd2+ in the intestine, liver and gills of juvenile brown trout. Studies have shown that the nanoparticles have an effect on morphophysiological parameters (respiratory rate, heart rate) in salmonids. The data obtained showed that the concentrations of CdSe/ZnS-COOH and CuInS/ZnS-COOH at 4 nM QDs after 48 h had no effect on the gut bacteria isolated from juvenile salmon (*Salmo trutta*), while Cd2+ showed an antibacterial activity that was mostly temperature dependent. CdSe/ZnS-COOH QDs alter the composition of the salmonid microbiota, indicating the development of dysbiosis. Based on the results of the studies, an empirical model of the effect of nanoparticles on the functional status of fish was developed.

LIST OF PUBLICATIONS OF THE DISSERTATION TOPIC

**Publications with an Impact Factor included in Clarivate Analytics Web of Science database:**

1. Jurgelėnė Ž., Montvydienė D., Šemčuk S., Stankevičiūtė M., Sauliutė G., Pažusienė J., Morkvėnas A., **Butrimienė R.**, Jokšas K., Pakštas V., Kazlauskienė N., Karabanovas V. 2022. The impact of co-treatment with graphene oxide and metal mixture on *Salmo trutta* at early development stages: The sorption capacity and potential toxicity. *Science of the Total Environment*, 838: art. no. 156525. [http://dx.doi.org/10.1016/j.scitotenv.2022.156525](http://dx.doi.org/10.1016/j.scitotenv.2022.156525.)
2. Jurgelėnė Ž.,Jagminas A, Montvydienė D., Stankevičiūtė M., Sauliutė G., Pažusienė J., **Butrimienė R.,** Mikalauskaitė A., Jokšas K., Kazlauskienė N., Karabanovas V. 2024. Toxicity of different-sized cobalt ferrite (CoFe2O4) nanoparticles to *Oncorhynchus mykiss* at early development stages. *Environmental Science and Pollution Research*, 39735–39747. <https://doi.org/10.1007/s11356-024-33841-6>
3. **Butrimienė R.**, Kalnaitytė A., Januškaitė E., Bagdonas S., Jurgelėnė Ž., Butkauskas D., Virbickas T., Montvydienė D., Kazlauskienė N., Skrodenytė-Arbačiauskienė V. 2022. Interactions of semiconductor Cd-based quantum dots and Cd2+ with gut bacteria isolated from wild *Salmo trutta* fry. *PeerJ*, 10, 1–22. <https://doi.org/10.7717/peerj.14025>
4. Skrodenytė-Arbačiauskienė V., **Butrimienė R**., Kalnaitytė A., Bagdonas S., Montvydienė D., Stankevičiūtė M., Sauliutė G., Jokšas K., Kazlauskienė N., Karitonas R., Matviienko N., Jurgelėnė Ž. 2024. A multiscale study of the effects of a diet containing CdSe/ZnS-COOH quantum dots on *Salmo trutta fario* L.: potential feed-related nanotoxicity. *Science of the Total Environment*, 906, art. no. 167696. <https://doi.org/10.1016/j.scitotenv.2023.167696>

**Other peer-reviewed publications:**

1. Jurgelėnė Ž., **Butrimienė R**., Kazlauskienė N., Montvydienė D., Skrodenytė-Arbačiauskienė V., Stankevičius M., Rotomskis R. 2020. Investigations of QDs impact on fish trophic ontogenesis. Proceedings of conference Protecton and Restoraton of the Environment XV, Kalamata, Greece, July 7–10, P. 667. <http://www.preXV.civil.upatras.gr>
2. **Butrimienė R.,** Kalnaitytė A., Januškaitė E., Bagdonas S., Jurgelėnė Ž., Butkauskas D., Virbickas T., Montvydienė D., Kazlauskienė N., Skrodenytė-Arbačiauskienė V. 2022. An *in vitro* assay to assess the antibacterial efficacy of Cd-based, Cd free quantum dots and Cd2+ on gut bacteria from wild *Salmo trutta* fry. Proceedings 9th International Conference on Environmental Management, Engineering, Planning & Economics (CEMEPE 2022) and SECOTOX, Mykonos, Greece, June 5–9, pp. 258–267. ISBN: 978-618-5494-97-1
3. Jurgelėnė, Ž., Montvydienė, D., Šemčuk, S., Stankevičiūtė, M., Sauliutė, G., Pažusienė, J., Morkvėnas, A., **Butrimienė, R**., Kazlauskas, M.**,** Kazlauskienė, N., Karabanovas,V. 2022. Acute toxicity assessment of graphene oxide nanoderivatives on *Salmo trutta* at early development stages. Proceedings of conference Protection and Restoration of the Environment XVI, Kalamata, Greece, July 5–8, pp. 60–68.