Environmental impact assessment of nanoparticles on the behaviour of heavy metals

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The world scenario of large-scale production, use and disposal of manufactured nanoparticles, require studies of their fate and impact in the environment. Accidental or authorized release of industrial or medical effluents in aquatic systems may result in direct exposure of humans to nanoparticles (*e.g.*: ingestion of contaminated drinking water or organisms such as molluscs and crustaceans). Nanohydroxyapatite (nHAp) is one of such materials used in nuclear medicine as drug delivery, which has also been widely applied for the remediation of contaminated soil and purification of wastewaters polluted with heavy metals. However, there is limited information regarding effects of nHAp applications as drug delivery and its final disposal in sewage systems. This report was performed as part of a CNPq project (409409/2016-2) to evaluate the environmental impact of the discharge of nanomaterials used in nuclear medicine [1]. The part discussed here refers to the impact of nHAp in a multi stressor aquatic scenarios through mesocosm experiments (Figure 1).

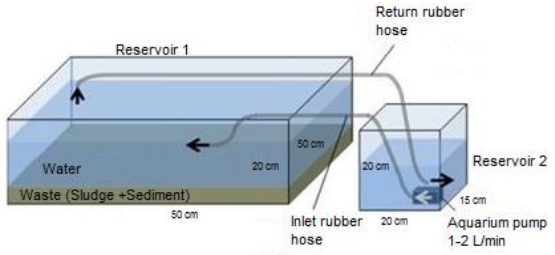

Figure 1. The mesocosm system.

In this study, the environmental scenario of sludges of water treatment plants from Juturnaíba reservoir was chosen as basis for the mesocosm experiments. The lake water was contaminated with $CuSO_4$ and also modified to consider possible environmental changes according to the follow operational conditions per mesocosm: (1) **Control**: Lake water (25 L) + 4.77 g/L of $CuSO_4$; (2) **Acidified:** Control + 130 mL of HCl (0.1 M); (3) **HA**: Control + 40 mg of humic acid (HA).

Figure 2(a) shows the percent of Cu that remains in solution with time in the control and after physical-chemical changes. The control shows that dissolved Cu decreases naturally to 50% of its initial amount after 120 h. The acidification of the system accelerated this processes to 52% of initial amount after 2h. The input of HA also contributed to decrease the dissolved Cu content, but it was more effective at 120 h with 25% less of content observed in a control at the same time. Figure 2(b) shows that nHAp act as captors of dissolved Cu of lake water, promoting its decrease during the whole period of observation: from 68% to 48% less dissolved Cu than observed in the control. However, the presence of HA in the system seems to inhibit and delay the effect of nHAp capturing Cu, being more effective at the first stage of contact with 22% more dissolved Cu than observed in the control with nHAp. At the acidified lake water system, the presence of nHAp at the first stage of contact, inhibits the acidification effect observed for Cu, presenting, in this case, similar or slightly higher Cu concentration to that observed in control system with nHAp. These preliminary results show the complexity of evaluating the impact of nanomaterials in the sewage systems, since it modifies the fate of pollutants already at the first hours of contact and the changes depends on physicochemical conditions of aquatic system.

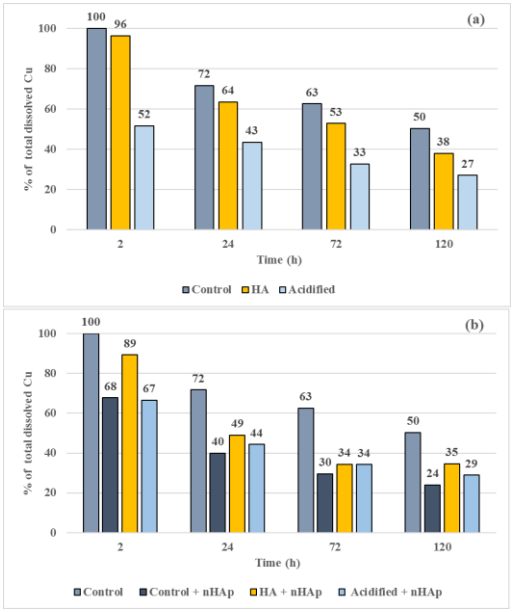

Figure 2. Percent of total dissolved Copper: (a) effect of environmental modifications (b) Effect of treatments in presence of 300 mg of nHAp.

Reference

[1] SILVA, M. M. et. al. The effect of nanohydroxyapatite on the behavior of metals in a microcosm simulating a lentic environment. **Environmental Nanotechnology, Monitoring & Management**, Amsterdam, v. 8 [s.n], p. 219-227. 2017.