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Silver nanoparticles biokinetics study by mathematical modelling of their transport in living organism

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In this work we demonstrate the possibilities of mathematical "chamber" model of inorganic nanoparticles (NPs) transport (absorption, distribution and bioaccumulation) in living organism, on an example of silver NPs in laboratory rats. When constructing a model, data of experimental work were used about the bioaccumulation and biodistribution of silver NPs with average diameter of 35 ± 15 nm, radiolabeled by 110mAg. In a minimally acceptable form model included all "chambers" in which the content of the NPs throughout the duration of the experiment was not lower than 20-25 % of the content in the blood, namely the gastrointestinal tract (GIT), blood itself, bone-muscular carcass, liver and spleen. Transport of NPs within these «cameras» was described by a system of 5 independent linear differential equations of the 1st order. Solution of this system in numerical form, taking into account a timing of the excretion of NPs from the GIT with the feces, made it possible to determine the rate constants of inter-organ NPs transfer. Using them the calculation was done of the peak (maximum) and quasi-stationary NPs content in critical organs targets, respectively for the cases of acute (single) and subchronic (repeated) administration into the GIT, depending on the dose of NPs. The results obtained indicate the prospects of the method of mathematical modeling for inter-organ transport and distribution of NPs to assess their possible toxic effects on the system level, using previously obtained in vitro results and biokinetic studies.
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