Contribution ID: **85**   Type: **Sectional reports**

Explanation of NMR mobility of peptide dendrimers using distributed computing

Tuesday, 6 July 2021 16:20 (15 minutes)

We applied distributed computing to study new peptide dendrimers with Lys-2Lys and Lys-2Arg repeating units in water. These molecules are promising nanocontainers for the drug and gene delivery. The dendrimers have recently been synthesized and studied by NMR (Sci. Reports, 2018, 8, 8916; RSC Advances, 2019, 9, 18018) and successfully tested as carriers for gene delivery (Bioorg. Chem., 2020, 95, 103504; Int. J. Mol. Sci., 2020, 21, 3138). Both dendrimers have approximately the same molecular weight and the same charge. However it was found by NMR that the orientational mobility of HH vectors in CH2-N groups of side chains of 2Arg spacers in Lys2Arg dendrimers is close to slow mobility of the inner (main chain) CH2-N groups of branched Lys residues of both dendrimers, while mobility of CH2-N groups in side chains of 2Lys spacers of Lys2Lys dendrimer is close to fast mobility of the Lys terminal groups of both dendrimers. It has been suggested that the reason of unexpected slowdown of side CH2-N groups in 2Arg spacers of Lys2Arg dendrimer is caused by the Arg-Arg pairing effect in water, which could lead to long-living pairs of Arg residues belonging to different dendrimer branches. The other possible reason could be a semiflexibility effect, because the distance from the end of side chain of spacers to NMR active CH2-N groups in 2Arg and 2Lys spacers is different. We used the molecular dynamics simulation and Gromacs package in order to check possible contribution of both effects. It was obtained that size and shape of Lys-2Lys and Lys-2Arg dendrimers are similar. All other structural characteristics, including radial density and radial charge profiles are also similar. We found that the similar internal groups have similar slow mobility and similar terminal groups have similar fast mobility in both dendrimers. Mobility obtained from simulation results are also very close to that obtained in NMR experiment. However, the orientational mobility of the H-H vector in side CH2-N groups of 2Arg spacers in Lys-2Arg dendrimer is significantly slower than the mobility of the simmilar vector of 2Lys spacer in the Lys-2Lys dendrimer. Exactly the same result was obtained earlier in NMR experiment. We revealed that this difference is not due to the arginine-arginine pairing, but is due to the semiflexibility effect associated with the different contour length from CH2-N group to the end of the side arginine or lysine segment in spacers. This work was supported by RSCF grant 19-13-00087. All calculations were perfomed using computer facilities of SPbSU and MSU Supercomputer Centers.

Summary

Primary authors: BEZRODYI, Valeriy (St. Petersburg State University, 7/9 Universitetskaya nab., 199034 St. Petersburg, Russia; ITMO University, Kronverkskiy pr. 49, 197101 St. Petersburg, Russia); MIKHTANIUK, Sofia (ITMO University, Kronverkskiy pr. 49, 197101 St. Petersburg, Russia); SHAVYKIN, Oleg (St. Petersburg State University, 7/9 Universitetskaya nab., 199034 St. Petersburg, Russia; ITMO University, Kronverkskiy pr. 49, 197101 St. Petersburg, Russia; Tver State University, Zhelyabova 33, Tver, Russia); NEELOV, Igor (St. Petersburg State University, 7/9 Universitetskaya nab., 199034 St. Petersburg, Russia; ITMO University, Kronverkskiy pr. 49, 197101

St. Petersburg, Russia); DARINKII, Anatoly (Institute of Macromolecular Compounds RAS, Bolshoy pr.V.O. 31, St. Petersburg, Russia); POTEMKIN, Igor (Moscow State University, 119992, Moscow, Russia); SHEVELEVA, Nadezhda (St. Petersburg State University, 7/9 Universitetskaya nab., 199034 St. Petersburg, Russia); MARKELOV, Denis (St. Petersburg State University, 7/9 Universitetskaya nab., 199034 St. Petersburg, Russia)

Presenter: SHAVYKIN, Oleg (St. Petersburg State University, 7/9 Universitetskaya nab., 199034 St. Petersburg, Russia; ITMO University, Kronverkskiy pr. 49, 197101 St. Petersburg, Russia; Tver State University, Zhelyabova 33, Tver, Russia)

Session Classification: Distributed computing, HPC and ML for solving applied tasks

Track Classification: 10. Distributed computing, HPC and ML for solving applied tasks