15th International Conference on

Environmental Chemistry and Engineering

August 15-16, 2019 | Rome, Italy

Comparison of Oligonucleotides as receptors for detection of heavy metals

Anna N Berlina, Nadezhda S Komova, Anatoly V Zherdev and **Boris B. Dzantiev**
A.N. Bach Institute of Biochemistry, Russia

Heavy metals play an important role in environmental pollution and cause significant risks for human health [1]. Traditional methods of their detection, such as atomic spectroscopy, voltammetry, can be implemented only by high-qualified staff with the use of expensive equipment. In contrast, bioreceptor-based methods are simple, low-cost and convenient, which make them the preferred ones for rapid onsite screening control [2]. However, the question about the best structure of receptor molecules for sensitive and selective recognition of heavy metals is still opened [2-4].

The presented study was implemented in the frame of Program of the Presidium of the Russian Acad. Sci. "Fundamental Foundations and New Effective Methods of Chemical Analysis and Investigation of the Structure of Substances and Materials" and directed to comparison of oligonucleotide aptamer molecules conjugated with gold nanoparticles (GNPs) as tools for homogeneous colorimetric detection of heavy metals (see the Image below).

Four oligonucleotide sequences were immobilized at the GNPs surface: 1 - SH-(CH2)6-GG-GTG-GGT-GGG-TGG; 2 - SH-(CH2)6-CC-CCC-CCC-CCC-CCC; 3 - HS-(CH2)6-TT-TTT-TTT-TT; 4 - SH-(CH2)6-AA-AAA-AAA-AA. The sequences were selected in accordance to the preliminary results [5]. T- and A-rich linear aptamers are expected to be selective for mercury, G,T-aptamer – for lead and mercury, poly-C sequence –for silver ions.

Interaction of GNPs-conjugated oligonucleotides was accessed by colorimetric measurements at 595 and 620 nm. All oligonucleotides interacted with Sb(III) at low concentration (up to 10 ng/mL). Pb(II) and Sn(IV) caused aggregation of GNPs conjugated with the aptamer 1 equally at concentration 111 ng/ml. Conjugate of the aptamer 2 showed aggregation when Cr(III) and VO3- ions were added at the concentration >600 ng/ml. As(III) and Hg(II) caused the aggregation of the conjugate of the aptamer 3 at 300 ng/ml, while Cr(III) - at higher concentrations. Thus, the chosen sequences are group-selective and could be used for the detection of heavy metals.

Recent Publications

1. Kanwal R, Fiza F, Waheed I, Akash MSH (2018) Prevalence of exposure of heavy metals and their impact on health consequences. Journal of Cellular Biochemistry 119:157-184.
2. Berlina AN, Zherdev AV, Dzantiev BB (2019) Progress in rapid optical assays for heavy metal ions based on the use of nanoparticles and receptor molecules. Microchimica Acta 186:172.
3. Farzin L, Shamsipur M, Sheibani S (2017) A review: Aptamer-based analytical strategies using the nanomaterials for environmental and human monitoring of toxic heavy metals. Talanta 174:619-627.
4. Zhou W, Ding J, Liu J (2017) 2-Aminopurine-modified DNA homopolymers for robust and sensitive detection of mercury and silver. Biosensors and Bioelectronics 87:171-177.
5. Berlina AN, Zherdev AV, Pridvorova SM, Gaur MS, Dzantiev BB (2019) Rapid visual detection of lead and mercury via enhanced crosslinking aggregation of aptamer-labeled gold nanoparticles. Journal of Nanoscience and Nanotechnology 19: 5489-5495.

Biography

Anna N. Berlina has completed her PhD from AN Bach Institute of Biochemistry, Russian Academy of Sciences. Her interests laid in the area of analytical chemistry, nanotechnology and alternative labelling in immunoassay.