Full Paper _____ *Thematic Section:* Biochemical Research.
The Reference Object Identifier – ROI: jbc-01/20-63-7-92 *Subsection:* Medicinal Chemistry.
The Digital Object Identifier – DOI: 10.37952/ROI-jbc-01/20-63-7-92
Submitted on July 22, 2020.

Adsorption of antibiotics on hydroxyapatite

© **Vladimir V. Grishin**,[1,3]* **Vladimir V. Grishin**,[1] **Alexander S. Chukhno**,[2,3+]
Irina S. Ivanova,[2] **Alexey S. Popov**,[2] **Mikhail E. Zhalko**,[4]
Svetlana N. Vaganova,[4] and **Evgenia A. Korvyakova**[4]

[1] *Federal State Budgetary Educational Institution of Higher Education Academician I.P. Pavlov First St. Petersburg State Medical University of the Ministry of Healthcare of Russian Federation (FSBEI HE I.P. Pavlov SPbSMU MOH Russia). Lva Tolstogo St., 6/8, St. Petersburg, 197089. Phone: +7 (812) 338-64-08, (812) 338-64-04. E-mail: wgrishin54@mail.ru*

[2] *North-Western State Medical University Named after I.I. Mechnikov. Piskarevsky Ave., 47, Pav.5. St. Petersburg, 195067. Russia. Phone: +7 303-50-00 (add. 8213). E-mail: vanovaira1@yandex.ru*

[3] *Department of Physical and Colloid Chemistry. St. Petersburg State Chemical-Pharmaceutical University. Professor Popov St., 14. St. Petersburg, 197376. Russia. Phone: +7 (812) 499-39-00 (4140). E-mail: alex-chuhno@yandex.ru*

[4] *Department of technical disciplines. Perm National Research Polytechnic University. Lenin St., 2. Lysva, 618902. Russia. Phone: +7 (3424) 96-30-90. E-mail: korvyakova1989@mail.ru*

*Supervising author; +Corresponding author

Keywords: nanocrystalline hydroxyapatite, antibiotics, spectrophotometry, biological activity.

Abstract

Hydroxyapatite has properties to sorb various substances. When examining the surface of the tooth enamel, the interaction of enamel hydroxyapatite with various medicinal substances was found. One of the main issues was the possibility of creating protective adsorption films on the tooth enamel to protect against bacterial insemination. These films in the experiment are kept for a short time and do not withstand the processes of eating. The adsorption process is reversible and no chemical interaction with hydroxyapatite was observed. Since the adsorption process takes place on the surface of crystals and is caused by physical-chemical interactions, an increase in the adsorption surface can lead to the accumulation of a medicinal substance in the weight unit of the base. The experiments performed on dispersed hydroxyapatite showed the perceptivity of this area, but it was necessary to increase the dispersion of crystals

Mechanical and physical-chemical methods did not help to achieve the results. Chemical method for obtaining hydroxyapatite in an aqueous solution was chosen as an optimal one. Chemical synthesis of nanocrystalline hydroxyapatite was performed. Hydroxyapatite without additional purification and isolation was forced to interact with a solution of the appropriate antibiotic.

To control the interaction process, a spectrophotometric method of analysis in the ultraviolet range was chosen. Conducted studies of the interaction of hydroxyapatite with antibiotics by spectrophotometric method showed a change of the products of interaction of a suspension of hydroxyapatite with an antibiotic solution compared to the spectrum of the original antibiotic in the spectra in the ultraviolet range. Biological activity was tested on a culture of Staphylococcus aureus in comparison with a pure antibiotic. In comparison with a pure antibiotic, its complex with hydroxyapatite showed a delayed effect, but did not change the nature of the antibiotic in relation to the microorganism.

References

[1] J.V. Natarajan, C. Nugraha, X.W. Ng, S. Venkatraman. Sustained-release from nanocarriers: a review [Text]. *J. Controlled Release.* **2014**. Vol.193. P.122-138.

[2] J. Sanchis, F. Canal, R. Lucas, M.J. Vicent. Polymer-drug conjugates for novel molecular targets [Text]. *Nanomedicine.* **2010**. Vol.5. No.6. P.915-935.

[3] I.B. Dmitrieva, A.S. Chukhno, and E.Yu. Rodionova. The influence of asparagine on electrokinetic and adsorption properties of the iron(III) and nickel(II) oxides. *Butlerov Communications.* **2015**. Vol.41. No.1. P.83-89. DOI: 10.37952/ROI-jbc-01/15-41-1-83

[4] I.B. Dmitrieva, A.S. Chukhno, E.Y. Rodionova, R.V. Novichkov. Specific Adsorption of Aspartic Acid on Iron (III) and Nickel (II) Oxides. *Eurasian Chemico-Technological Journal.* **2012**. Vol.14. No.4. P.299.

[5] I.B. Dmitrieva, S.E. Erdny-Garyaev, A.S. Chukhno, E.Yu. Pavlova, M.O. Koryakovskaya, and A.A. Pyurbeeva. Adsorption of sodium diclofenac on activated carbon, oxide and iron(III) hydroxide. *Butlerov Communications.* **2018**. Vol.53. No.3. P.136-141. DOI: 10.37952/ROI-jbc-01/18-53-3-136
[6] I.B. Dmitriyeva, A.S. Chukhno, and R.V. Novichkov. Interaction of glycine with cations of Fe(III) and Ni(II) in water solutions and on surfaces of their oxides. *Butlerov Communications.* **2013**. Vol.35. No.8. P.133-137. ROI: jbc-02/13-35-8-133
[7] A.P. Belyaev, V.P. Rubets, and S.A. Belyaeva. Crystallization of cadmium telluride on single crystal substrates cooled with liquid nitrogen. *Butlerov Communications.* **2015**. Vol.41. No.2. P.155-159. DOI: 10.37952/ROI-jbc-01/15-41-2-155
[8] A.P. Belyaev, V.P. Rubets, V.V. Antipov, A.O. Ribnikov, and S.A. Belyaeva.Crystallization of paracetamol of rhombic form. *Butlerov Communications.* **2014**. Vol.37. No.3. P.113-119. ROI: jbc-02/14-37-3-113
[9] E.N. Kanyuka, D.V. Solovey, A.S. Chukhno, V.V. Grishin. Influence of antibiotics on enamel remineralization rate. *In the collection: Preventive medicine-2019. Collection of scientific papers of the all-Russian scientific and practical conference with international participation.* **2019**. P.204-209. (russian)
[10] Kipchuk A.V., Grishin V.V, Grishin V.V, Chukhno A. S. Influence of salts of singly and doubly charged metal cations on the sorption of H+ and OH- ions on the mycelium of basidiomycetes. *Butlerov Communications.* **2017**. Vol.51. No.9. P.67-75. DOI: 10.37952/ROI-jbc-01/17-51-9-67
[11] A.M. Zhibarev, E.A. Akhmetshin, E.V. Zharikov. Synthesis of hydroxyapatite for bioactive coatings. *Journal of inorganic chemistry.* **2013**. Vol.58. No.12. P.1573-1576. (russian)
[12] Russian Federation, Ministry of Health. *State Pharmacopoeia of the Russian Federation OFS.1.2.1.1.0003.15.* Vol.1. Moscow, **2015**. (russian)
[13] A.P. Belyaev, A.M. Skvortsov, V.I. Kuchuk, I.B. Dmitrieva, L.A. Bakholdina, A.S. Chukhno, V.V. Grishin, N.A. Kupina, E.E. Malakhova. Physical and colloidal chemistry. A guide to practical exercises: textbook. Under the editorship of Professor A.P. Belyaeva. *Moscow: GEOTAR-Media.* **2012**. 320p. (russian)
[14] N. Turro. Molecular photochemistry. *Moscow: Mir publishing house.* **1967**. 328p. (russian)