Synthesis of hydroxide iron(III), which stabilized by fulvic acid. Comparison and characteristic iron binding capacity

Zhirkova A.M.[1], Kydralieva K.A.[1,2], Sobolev P.S.[1], Lebedev V.A.[1], Volikov A.B.[1], Zykova M.V.[3], Perminova I.V.[1]
[1]Lomonosov Moscow State University, Moscow, Russia nastya12349@mail.ru
[2]Moscow Aviation Institute, Moscow, Russia
[3]Siberian State Medical University, Tomsk, Russia

Keywords: fulvic acid, iron, anemia, ferrozine method, iron binding capacity

doi: 10.36291/HIT.2019.zhirkova.053

Iron Deficiency Anemia is the global health problem both for humans, animals, and plants. Iron replacement therapy is the most adopted method of iron deficiency correction. Iron(III) hydroxide stabilized with polysaccharides is among the most prospective medications. However, it may induce specific adverse reactions (e.g., anaphylactic shock). The alternative medications are needed. In our research, we used fulvic acids instead as polymaltosate for stabilization of iron(III) hydroxide. Fulvic acids are natural macroligands with high binding affinity for iron(III). We hypothesized that they can serve as prospective ligands for stabilization of Fe(III) hydroxide. To achieve this goal, we carried out syntheses with polymaltosate and fulvic acid.

Firstly, we prepared iron(III) hydroxide by mixing solutions of $FeCl_3$ and $NaHCO_3$ at pH 7. The precipitate of $Fe(OH)_3$ was collected and added with the heated-up solution of maltodextrin. The precipitate was centrifuged and the product was designated as PMFe1. The similar synthesis was carried out with fulvic acid and the obtained product was designated FAFe2. The obtained samples were analyzed using X-ray diffraction analysis (XRD), TEM and Moessbauer spectroscopy. It was found that the both samples contained ferrihydrite nanoparticles. Moessbauer spectroscopy confirmed that iron was located in octahedral oxygen package.

The obtained samples and the parent FA were analyzed for iron-binding capacity using ferrozine test. Ferrozine and Fe^{2+} form a complex with violet color. Addition of both FA, FAFe2 and PMFe1 caused a decrease in color intensity. It is indicative of inhibitory activity and binding capacity of these samples. The control experiment was carried out with EDTA. The results are presented in Fig. 1.

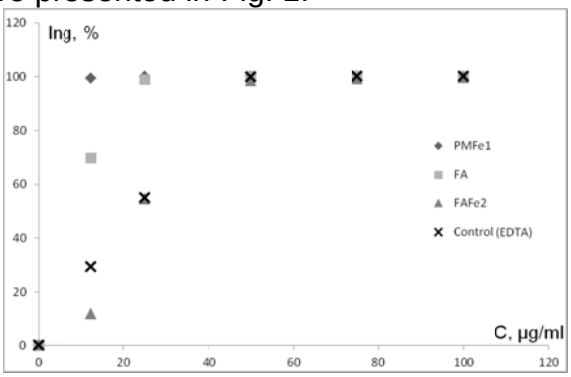

Figure 1. Concentration dependence of inhibition activity of the samples tested

The highest activity was characteristic of PMFe1 and FA, who should very high activity in binding Fe(II). Activity of FAFe2 was similar to control, indicative of high activity of all samples tested. The obtained results may open a way for preparing FA-based iron-containing compounds for iron replacement therapy. They can be also used for designing biocatalytic systems for facilitating microbial redox-reactions.

Acknowledgements. This research was partially supported by the Russian Foundation for Basic Research (grant 18-29-25065).