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Encapsulation of vitamin B_{12} into nanoengineered capsules and soft matter nanosystems for targeted delivery

Larissa A. Maiorova[a,*], Svetlana I. Erokhina[b,c], Michela Pisani[d,*], Gianni Barucca[d], Massimo Marcaccio[e], Oscar I. Koifman[a,g], Denis S. Salnikov[a], Olga A. Gromova[f], Paola Astolfi[d], Valentina Ricci[b], Victor Erokhin[b,c,**]

[a] Institute of Macroheterocyclic Compounds, Ivanovo State University of Chemistry and Technology, Sheremetevskii pr., 7, 153000, Ivanovo, Russia
[b] Institute of Materials for Electronics and Magnetism, CNR-IMEM, Parma, 43124, Italy
[c] Institute of Fundamental Medicine and Biology, Kazan Federal University, Kazan, 420008, Russia
[d] Department SIMAU, Università Politecnica delle Marche, 60131, Ancona, Italy
[e] Dipartimento di Chimica "G. Ciamician", Università di Bologna, via Selmi 2, 40126, Bologna, Italy
[f] Institute of Pharmacoinformatics, Federal Research Center "Computer Science and Control", Russian Academy of Sciences, 119333, Moscow, Russia
[g] Institute of Solution Chemistry, Russian Academy of Sciences, 1 ul. Akademicheskaya, 153045, Ivanovo, Russia

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ABSTRACT

Targeted delivery of vitamins to a desirable area is an active branch in a modern pharmacology. The most important and difficult delivery of vitamin B_{12} is that to bone marrow and nerve cells. Herein we present a first step towards the development of two types of smart carriers, polymer capsules and lyotropic liquid-crystalline nanosystems, for vitamin B_{12} targeted delivery and induced release. A vitamin B_{12} encapsulation technique into nanoengineered polymeric capsules produced by layer-by-layer assembling of polymeric shells on $CaCO_3$ templates has been developed. The effectiveness of the process was demonstrated by optical absorption spectroscopy, transmission electron microscopy (TEM), atomic force microscopy (AFM) and small-angle X-ray diffraction. TEM and AFM analyses performed on capsules after their drying, confirmed the presence of the vitamin B_{12} inside the capsules in the form of crystalline nanoaggregates, 50–300 nm in diameter. Soft lipid nanovectors consisting of amphiphilic phytantriol molecules, which in water excess spontaneously self-assembly in 3D well-ordered inverse bicontinuous cubic bulk phase, were used as alternative carriers for vitamin B_{12}. It was shown that about 30% of the vitamin added in the preparation of the soft lipid system was actually encapsulated in cubosomes and that no structural changes occurred upon loading. The Vitamin stabilizes the lipid system playing the role of its structure-forming element. The biocompatible nature, the stability and the feasibility of these systems make them good candidates as carriers for hydrophilic vitamins.

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