

# Study of the Structure and Properties of Nanoparticles *Cynara scolymus* L. Encapsulated With Sodium Carboxymethyl Cellulose Polysaccharide

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## ABSTRACT

In recent years, the interests of researchers have increased towards nanodrugs based on nanoparticles. The main direction of this work was to study the physicochemical, structural properties, and stability of encapsulated nanoparticles with the components from medicinal plants. Nanoparticles were obtained from the extract of the medicinal plant *Cynara scolymus* L. using a metal salt. Initial experimental data have shown that the originally obtained nanoparticles were not stable. Therefore, the nanoparticles were then stabilized with added sodium carboxymethylcellulose polysaccharide. It was found that new nanoencapsulated nanoparticles with compounds from medicinal plants are very stable and can be a source of effective nanodrugs based on them.

## KEYWORDS

Encapsulation, Extract, Nanoparticles, Polysaccharide, Prickly Artichoke, Properties, Sodium Carboxymethylcellulose, Structure

## INTRODUCTION

In the development of modern nanotechnology, a significant role is played by research on nanoparticles obtained from extracts of a medicinal plant using solutions of metal salts. This is due to a wide range of possibilities for their practical application, in which the specific properties of both the nanoparticles themselves obtained from the extracts of medicinal plants and the materials modified by them are used (Evstigneeva & Pchelkin, 2006; Sergeev, 2003). Nowadays, the nanoscience developing at the intersection of physics, chemistry, and biology, where the rapid advance of the nanoscience in the last decade is primarily due to the development of new methods for synthesis, study, and modification of nanostructures (Sergeev, 2003). In addition, nanoparticles can be classified by their size, number of atoms in a particle, and number ratio of surface to bulk atoms. In nanoscience the key problem is to determine the influence exerted by the size of particles on their chemical activity. To find it, the methods for synthesis and stabilization of nanoparticles are important (Sergeev, 2003). Methods for analysis of the size and properties of nanoparticles are also very important (Sergeev, 2003).

In addition to the above, in recent years, researchers have increasingly put the attention to the creation of nanodrugs based on nanoparticles (nanoparticles are the sizes of medicinal particles at nanoscale levels, i.e. a billionth of a meter), which will be delivered by blood flow directly to the

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diseased human organ, which will increase the efficiency of its use and reduce side effects. In this regard, obtaining effective nanodrugs based on natural raw materials is relevant (Egorova, 2011a; Egorova, 2011b).

Among the methods for producing nanoparticles, a large group is formed by methods of chemical synthesis based on the reduction of metal ions to atoms in solutions under conditions favorable to the subsequent aggregation of atoms and ions with the formation of nanoparticles. One of these methods of obtaining metal nanoparticles is the method of biochemical synthesis, on the basis of which a new direction has emerged in the field of synthesis, research of properties and development of applications for metal nanoparticles. It can be said that the need to create such a direction stemmed from the needs for the development of research in nanochemistry, nanomedicine and nanopathology, focused primarily on solving applied problems using the achievements of nanotechnology (Egorova, 2011a).

The possibilities of studying the properties of metal nanoparticles, developing options for their practical application, as well as elucidating the mechanisms of their biological action largely depend on the method of preparation, which in many cases determines their structure, size, physical and chemical properties and, most importantly, stability - the lifetime in nanoscale state (Egorova, 2011a).

Thus, it can be argued that the determination of the ways and means of the effect of metal nanoparticles on a living organism is an extremely important and urgent work, which is necessary, firstly, to improve existing and create new drugs or methods of treatment, that is, for nanomedicine, in secondly, to clarify the causes of nanopathologies and, thirdly, to establish scientifically grounded permissible ranges of concentrations and sizes of nanoparticles in water, air, or in the composition of various materials with which a person comes into contact (Egorova, 2011b; Scientific foundations and prospects for the development of oncology, 2008).

In this regard, the main goal of this work is to study the physicochemical, structural properties and stability of encapsulated nanoparticles obtained from the medicinal plant of the prickly artichoke - "*Cynara scolymus*" and the development of new effective nanodrugs based on them.

## EXPERIMENT

### Materials And Methods

In this work, nanoparticles obtained from the medicinal plant artichoke prickly - "*Cynara scolymus*" are selected as the object of research. To obtain nanoparticles from "*Cynara scolymus*" prepared an aqueous-alcoholic extract from the leaves of prickly artichoke in the ratio: dry artichoke: 70% ethyl alcohol = 1:10. Nanoparticles were obtained from the extract with the introduction of metal salts of various concentrations (from 0.1% to 5%) by the method of biochemical synthesis. It should be noted that, in comparison with other chemical methods, biochemical synthesis has a number of advantages that are important for the practical application of metal nanoparticles. First, in biochemical synthesis, the formation of nanoparticles occurs in solution, while in many other methods to obtain nanoparticles, it is necessary to create a vacuum or an atmosphere of an inert gas. This circumstance, as well as other features of the synthesis procedure, allow avoiding the complications necessary in other methods, which significantly reduce the cost of the final product. Second, it turns out to be possible to obtain nanoparticles that are stable in solution for a long time, which is very important both for the study of their properties and structure, and for applied developments. Third, for some metals it is possible to increase the degree of conversion of metal ions into nanoparticles in comparison with that achieved by other methods. Fourth, the method of biochemical synthesis is more environmentally friendly. The nanoparticles obtained by the method of biochemical synthesis from the extract of prickly artichoke - "*Cynara scolymus*" had a spherical shape with an average particle size of 50 - 120 nm (Mirrakhimova & Yunuskhodzhaev, 2013; Mirrakhimova & Yunuskhodzhaev, 2014; Mirrakhimova & Yunuskhodzhaev, 2015).

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