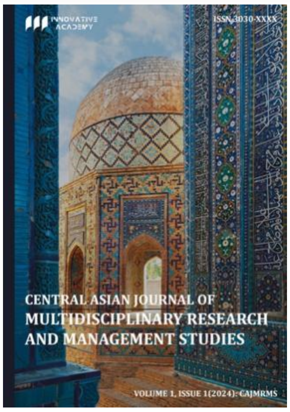

MOLECULAR-MASS AND CONFORMATIONAL CHARACTERISTICS OF Na-KMS AND CHITAZONE POLYSACCHARIDES AND OBTAINING POLYCOMPLEXES BASED ON THEM

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ABSTRACT

This article studies the molecular-mass and conformational properties of sodium carboxymethylcellulose (Na-KMS) and chitazone polysaccharides, as well as the mechanism of polycomplex formation based on them. The article is based on scientific research by Uzbek scientists and provides detailed information on the physicochemical characteristics of polysaccharides, conformational changes, and their applications in industry, pharmaceuticals, and ecology

Introduction. Polysaccharides belong to the family of natural polymers and are the main components of biological systems. Sodium carboxymethylcellulose and chitazone polysaccharides are distinguished in many scientific studies by their high biological activity, chemical stability, and water solubility. Therefore, the study of their molecular mass and conformational characteristics, as well as the synthesis of new polycomplexes based on them, is scientifically and practically relevant. In the research conducted by the Academy of Sciences of the Republic of Uzbekistan, in particular, in the scientific works of Turgunov H. (2018), Kuchkarov MS (2016) and Buranova AM and Sobitova SM (2019), the molecular mass indicators and conformational changes of Na-KMS and chitazone are covered. The mechanism of formation of polycomplexes based on the interaction of these polysaccharides and their physicochemical properties are widely used in the pharmaceutical, agricultural, and food industries.

Molecular mass and conformational properties of sodium carboxymethylcellulose . Sodium carboxymethylcellulose (Na-CMC) is a chemical modification of cellulose, in which the hydroxyl groups are replaced by sodium carboxymethyl groups. This modification increases the water solubility of the polymer and turns it into a biologically active material. According to the Uzbek scientist Turgunov H. (2018), the molecular mass of Na-CMC varies from 90,000 to 700,000 g/mol, and with an increase in their molecular mass, their viscosity in liquids increases significantly. The increase in molecular mass also causes conformational changes in the Na-CMC chains, which form stable gel structures through hydrogen bonds and electrostatic forces. These properties are important in the production of new biomaterials in the pharmaceutical and agricultural sectors.

Molecular and conformational characteristics of the polysaccharide chitazone . Chitazone is a chemical modification of chitosan, which contains hydroxyethyl groups. It has a cationic nature, which increases its ability to form ionic interactions at different pH conditions. Uzbek scientists Buranova AM and Sobitova SM (2019) confirmed that the molecular mass of chitazone is in the range of 50,000–300,000 g/mol, and that it undergoes conformational changes depending on pH and ionic strength. The conformation of chitazone directly affects its hardness, elasticity, and rheological properties. These properties ensure the mutual flexibility of polymer chains and the stability of polycomplexes during complex synthesis.

Results and analysis. For the study, Na-KMS $_{tex,}$ a typical representative of water-soluble polysaccharides, intended for technical purposes, and Na-KMS $_{pure,}$ intended for use in the medical biology and pharmaceutical industries, were selected. Rheological studies of the samples were carried out at different concentrations ($C = 0.4 \div 2$ %) and temperatures ($T = 25 \div 80\ ^oC$) on the MCR300 SN501453 device . Based on the results, graphs of the relationship between the effective viscosity (η_{eff}) of solutions of different concentrations and the velocity gradient (γ) were constructed (Fig. 2.1-2.2). In this case, the amount of effective viscosity was controlled as the velocity gradient increased and decreased. As can be seen from the graphs, in small areas of the velocity gradient $\gamma < 100\ s^{-1}$ the effective viscosity decreased sharply for all selected concentrations

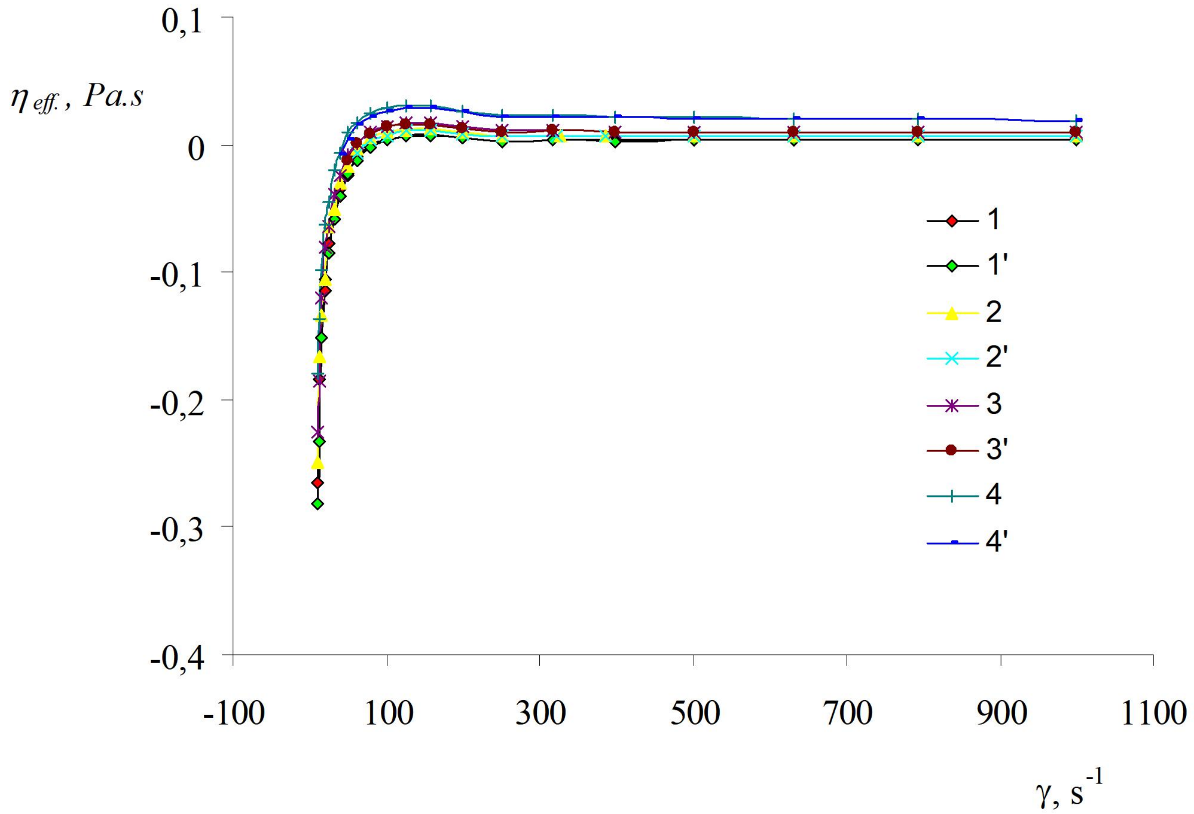

Figure 2.1. Graphs of the dependence of the effective viscosity (η_{eff}) on the velocity gradient (γ *) for a Na-KMS* $_{tex}$ solution with different concentrations : 1, 1'- *C = 0.5 %* ; 2, 2'- *C = 0.77%* ; 3, 3'- *C = 1.01%* ; 4, 4'- *C = 1.49%* .

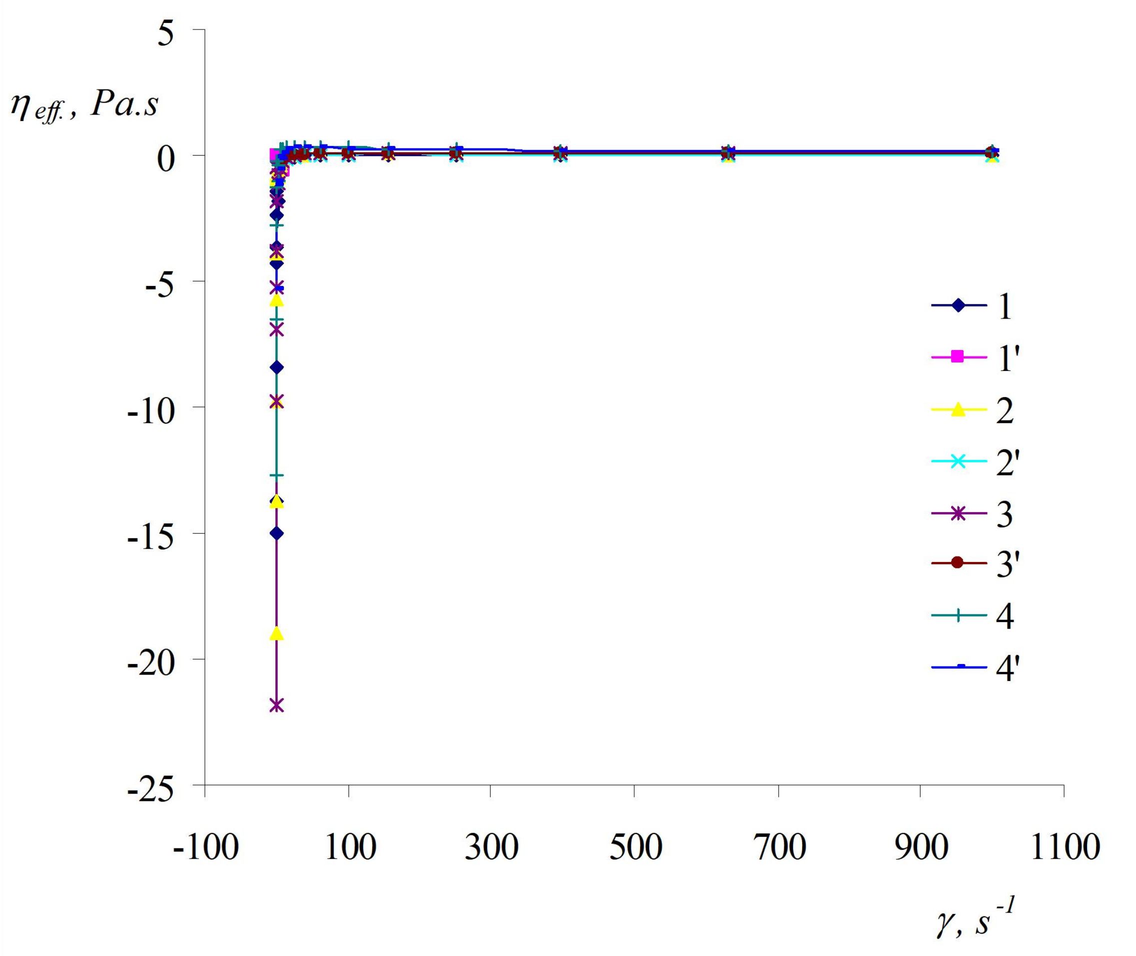

Figure 2.2. Graphs of the dependence of the effective viscosity ($_{eff}$) on the velocity gradient ( ) for Na-KMS 2'$_{pure\ solutions\ of\ different\ concentrations:\ 1,\ 1'\ –\ C=0.\ \%;\ 2,}$ - C= 0.67 %; 3, 3'- C = 0.94 %; 4, 4'- C = 1.4 %.

increase (decrease) and the effective viscosity (*$_{eff}$) remains relatively constant in the large velocity gradient region* *> 100 s^{-1} ≈ ± 0.2 Pa.s*). In this case, the effective viscosity in the range *< 100 s^{-1}* for Na - KMS $_{tex}$ is one order of magnitude larger (*$_{eff}$* ≈ It was found that the decrease in the viscosity of the purified Na-KMS pure sample was due *to* the $_{absence}$ of fractions that form insoluble gel phases, which usually increase the viscosity, i.e., reduce the flowability. In general, *in* the range of *> 100 s^{-1},* *$_{eff}$* The increase in the shear field is due to the deformational ordering of macromolecules in the shear field, which manifests the "rheopex" effect characteristic of "dilatant" liquids. These effects are observed in polysaccharides, for example, in aqueous solutions of starch.

The effect of temperature on the rheological properties of the samples, i.e. the effective viscosity, is shown in Figures 2.3-2.4 below. In this case, changes in the effective viscosity were monitored during the cooling and heating processes of the solutions.

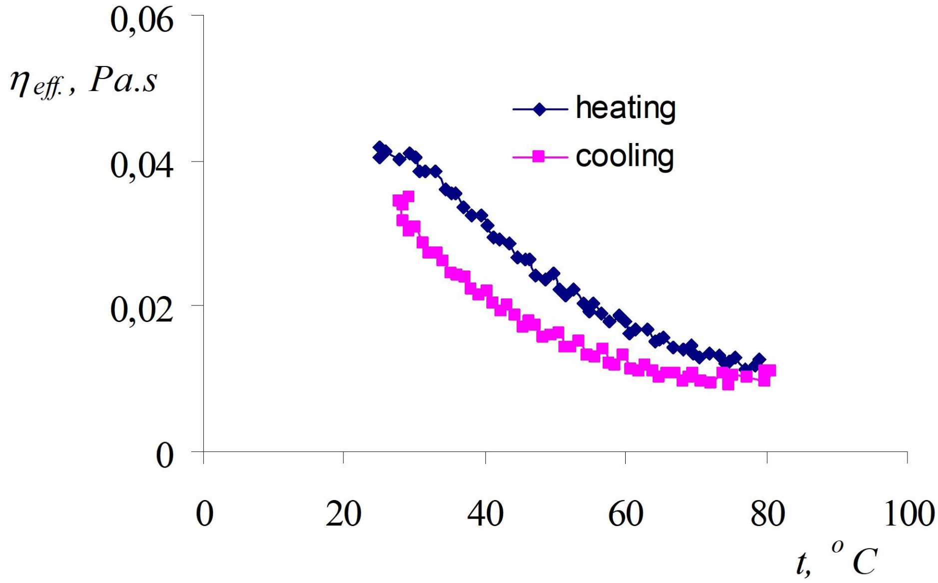

Figure 2.3 . Na - KMS $_{tex}$ solution for effective viscosity ($_{eff}$) versus temperature (T) graph : = 100 s $^{-1}$; C = 1.9 %.

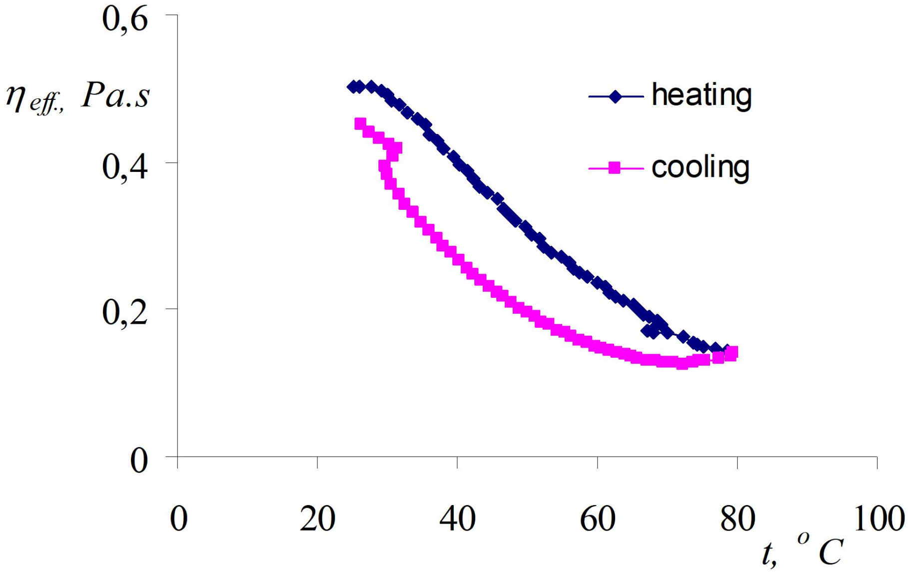

Figure 2.4. Graph of the effective viscosity ($_{eff}$) versus temperature (T) for a Na-KMS pure solution : = 100 s $^{-1}$; C = 2.0 %.

There are differences between the effective viscosity changes during cooling and heating processes for both melt samples, which are reflected in the hysteresis loop. This hysteresis loop is relatively larger for the Na-KMS $_{pure}$ sample, indicating that this sample undergoes structural changes more efficiently in the shear field.

Mechanism of polycomplex formation and studies in Uzbekistan . Polycomplexes are stable structures formed by mutual ionic or hydrogen bonds of various polysaccharides. Stable polycomplexes are formed based on electrostatic interactions between the anionic carboxymethyl groups of Na-KMS and the cationic amino groups of chitazone. In studies conducted by Uzbek scientists Turgunov H. and Shamshidinov I. (2021), this process was determined by FTIR spectroscopy, dynamic light scattering (DLS), and X-ray diffraction methods. According to experimental results, the formed polycomplexes have a high molecular mass and a stable conformation, and their stability varies depending on pH and ionic strength. This expands their potential for use as drug delivery vehicles in pharmaceuticals and biomedicine.

Physicochemical and biological properties of polycomplexes . Polycomplexes are characterized by their stable structure, non-toxic natural base. Their physicochemical properties, including hydrophilicity, rheological properties and biological activity, are covered in many Uzbek scientific sources. These polycomplexes have a high water retention capacity, which makes them important for use in pharmaceuticals, the food industry and as environmental materials. Their biologically active properties ensure their effective use in tissue regeneration and antimicrobial activity in the human body.

Practical application and promising directions. Polycomplexes based on Na-KMS and chitazone open up new opportunities in the field of creating natural and environmentally friendly biomaterials in the conditions of Uzbekistan. They are widely used in the pharmaceutical industry as drug carriers, and in agriculture as soil fertility and water-retaining materials. In addition, their biologically active properties are of great importance in the production of biomaterials and bandages. The Uzbek scientific school continues research in this direction and is a leader in the creation of new complex materials.

Conclusion. Scientific research by Uzbek scientists shows that the molecular-mass and conformational characteristics of sodium carboxymethylcellulose and chitazone polysaccharides determine their ability to form polycomplexes. The resulting polycomplexes have high bioactivity, stability and environmental safety, and are promising for widespread use in various fields.

References:

1. Turgunov H. "Chemistry and Technology of Polysaccharides", Tashkent: Science, 2018.

2. Kuchkarov MS "Theory of high molecular compounds", Tashkent: Iqtisod, 2016.

3. Buranova AM, Sobitova SM "Structural properties of biopolymers", Tashkent: Higher Education, 2019.

4. Turgunov H., Shamshidinov I. "Synthesis of polycomplexes based on natural polymers", Uzbekistan Chemical Journal, 2021, No. 2.