# The mechanism of polysaccharide container formation by the ultrasonication method

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Microcontainers obtained by low-frequency ultrasound are an oil core coated with a shell of biopolymers - proteins, polysaccharides or their combination. Due to the simplicity of their preparation, such containers are of interest for the delivery of hydrophobic target compounds that can be dissolved in the oil core. We previously proposed application of chitosan/xanthan gum polysaccharides to form the shell of the containers, and using IR spectroscopy it was shown that cross-linking occurs in the shell due to the formation of amide bonds between carboxyl groups xanthan gum and amino groups of chitosan [1].

In this work, a more detailed study of the mechanism of the containers formation was carried out. Using the method of atomic force microscopy, the mechanical properties of the containers were studied, and their stability over time was assessed using microscopic observations. A comparison was made of emulsions with a shell of chitosan, xanthan gum, as well as a pair of chitosan/xanthan gum, obtained by exposure to low-frequency ultrasound, as well as by mechanical dispersion.

Mechanically dispersed emulsions differ from ultrasonic emulsions, firstly, in size - for mechanically dispersed particles the average size is approximately 10 times higher, and secondly, mechanically obtained emulsions are less stable - during centrifugation coagulation occurs followed by partial destruction. The containers coated with xanthan gum, as well as chitosan/xanthan gum pairs obtained using ultrasound, are not destroyed after washing keeping stability for several months. The containers with a chitosan shell are less stable - particles coagulate over time; in addition, when washed with water, aggregation and coagulation of particles occurs. These results indicate that ultrasonication results in the formation of chemical bonds that provide a stronger coating compare to mechanical dispersion. The mechanical strength of the containers obtained using ultrasound was determined by atomic force microscopy. The Young's modulus values were 20, 36 and 48 GPa for xanthan gum, chitosan and chitosan/xanthan gum pair containers, respectively. The higher Young's modulus for chitosan/xanthan gum containers confirms the formation of chemical bonds in the shell, which makes it stronger.

## Literature

[1] T.N. Borodina, D.O. Grigoriev, M.A. Carillo, J. Hartmann, H. Moehwald, D.G. Shchukin. *ACS Appl. Mater. Interfaces*. 2014. 6 [9]. 6570-6578.