



L-menthol crystallization in an aqueous dispersion of biologically active nanoparticles of chitosan L- and D-aspartate

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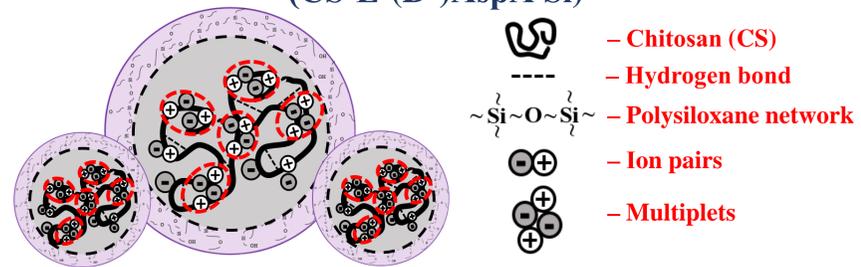
Abstract

Phase separation in an ethanol solution of L-menthol in an aqueous dispersion of biologically active nanoparticles of chitosan L- and D-aspartate (CS·AspA) was studied. The process was found to proceed through the mechanism of selective extraction crystallization and to combine two types of phase separation (liquid–liquid and liquid–crystal). Liquid phase separation involves spontaneous dispersion of the ethanol macrophase to form an oil-in-water microemulsion and subsequent coalescence of the dispersed phase; and crystalline phase separation involves L-menthol crystallization into optically anisotropic fibrillar particles. The size of microdroplets and fibrils and their packing density in the condensed phase are significantly affected by the concentration of the components and surface tension of the aqueous macrophase and the enantiomeric form of chitosan aspartate.

In the medium of individual enantiomers of L- and D-aspartic acid (AspA) two types of phase separation L-menthol are also observed—liquid–liquid and liquid–crystal. However, the size of phase-separated microdroplets is significantly smaller (submicron size), the onset time of coalescence of emulsion droplets increases, and the condensed phase is mainly represented by optically isotropic needle-like crystals and their aggregates.

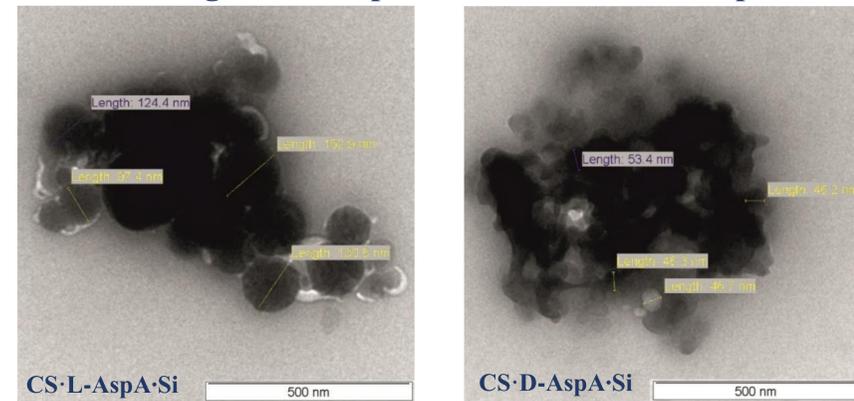
It has been suggested that the system under study is promising for the development of new approaches to studying the fundamental principles of phase separation during intracellular communication and regulation.

Nanoparticles chitosan L- and D-aspartate (CS·L-(D-)AspA·Si)



Lugovitskaya T.N., Shipovskaya A.B., Shmakov S.L., Shipenok X.M. *Carbohydrate Polymers*. 2022. Vol. 277. 118773. DOI: 10.1016/j.carbpol.2021.118773

TEM images of nanoparticles of CS·L-(D-)AspA·Si



Shipovskaya A.B., Ushakova O.S., Volchkov S.S., Shipenok X.M., Shmakov S.L., Gegel N.O., Burov A.M. *Gels*. 2024. Vol. 10, No. 7, ID. 427. DOI: 10.3390/gels10070427



$t = 0 \text{ s}$

$t = 4 \text{ s}$

$t = 10 \text{ s}$

$t = 20 \text{ s}$

Petri dishes with the initial dispersion of CS·D-AspA·Si nanoparticles and the initial stage of applying the ethanol solution of L-menthol onto its surface at a contact time between the ethanol and aqueous macrophases

Concentration of aqueous phase components		Surface tension σ , mH/m	PM photos of forming droplets, fibrillar structures and their supramolecular aggregates				
C_{CS} , g/dL	C_{AspA} , g/dL		Contact time t , h				
			0.02	0.5	24	48	
CS·L-AspA·Si							
Surface tension of water $\sigma(\text{H}_2\text{O}) = 70.7 \text{ mH/m}$	0.3	0.3	58.5±0.4				
	1.2	1.2	59.0±0.2				
CS·D-AspA·Si							
0.3	0.3	62.8±0.9					
1.2	1.2	62.9±0.9					