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Acyclovir release from its composites with silica as a function of the silica matrix modification and the drug loading

Ekaterina S. Dolinina, Elizaveta Yu. Akimsheva and Elena V. Parfenyuk

Synthesis of ACV-silica composites

For preparation of ACV-UMS composites, TEOS (10 g), ethanol (6.78 g), water (2.16 g) and 0.3 mL HCl (2M) were mixed at room temperature, and the mixture was stirred for 15 min. The initial phase separation disappeared. Then, a solution of ACV in water (27 mg or 54 mg in 22 ml) was added to the reaction mixture. The obtained mixture was stirred for 40 min and then aged at room temperature for 2 days.

For preparation of ACV-PhMS composites, the procedure of synthesis was similar to that described above, but instead of TEOS, its mixture with modifier (phenyltrimethoxysilane, PhTMOS) was taken (9.55 g of TEOS and 0.45 g of the modifier).

The synthesized materials were ground in a mortar, rinsed with ethanol and dried at 100^0C for 4 days.

The amount of the encapsulated drug was calculated as difference between the amounts of ACV loaded in the reaction mixture and removed during washing. The amount of ACV remaining in the solution after washing was determined by UV/VIS spectroscopy using the calibration plots.

Synthesis of UMS and PhMS matrixes

The procedure of preparation of UMS and PhMS matrixes was similar to that described above, but without the addition of acyclovir.

In vitro ACV release measurements

The ACV release profiles were obtained by incubation of 0.25 g of the composite in 100 ml 50 mM citric buffer solution (pH 1.6) or phosphate buffer solution (pH 7.4) under stirring (100 rpm) at 37^0C. At appropriate time intervals, 5 ml samples were withdrawn and replaced by fresh buffer. The withdrawn samples were centrifuged at 10,000 rpm for 10 min. The amount of released drug was calculated from the absorbance value measured spectrophotometrically (UV/VIS spectrometer Carry 100) at 255 nm (pH 1.6) and 253 nm (pH 7.4) using the calibration curves obtained at given pH. The cumulative release of the drug was calculated as

$$Cumulative\,release\,\% = \frac{100 \times \left(VC_t + v\sum C_{t-1}\right)}{w},$$

where C_t is the drug concentration at time t, C_{t-1} is the drug concentration at time (t-1), V is the total volume of release medium, ν is the removed volume of release medium, w is the content of the drug in the composite.

Differential scanning calorimetry (DSC) analysis of ACV and its composites with silica

The DSC measurements were carried out using a NETZSCH DSC 204 F1 apparatus under Ar gas purge of 40 ml/min. Samples of ACV or its composites (2.15 – 3.34 mg) were sealed in aluminum pans; an empty pan was used as reference standard. Heating rate was kept 10^0 C/min in the 25-300^0C temperature range.

N_2 adsorption/desorption measurements

The parameters of porous structure of the synthesized silica matrixes were determined using Nova Series 1200e (Quantachrome Instruments, USA) after pre-treatment for 5 h at 523 K. The average pore size was calculated using Barrett-Joyner-Halenda (BJH) method.

Powder X-ray diffraction analysis

As an example, powder X-ray diffraction patterns of ACV-PhMS(H), ACV-PhMS(L) and ACV-UMS(H) composites were recorded at room temperature using a 2D PHASER diffractometer ((Bruker AXS GmbH, Germany) equipped with a CuKa monochromatic emission source. The 2θ scanning range varied from 4^0 to 55^0, with 0.02^0 steps.

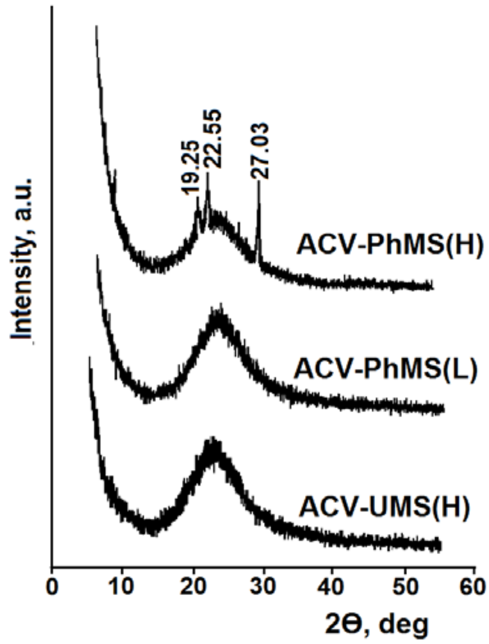

Figure S1 XRD patterns of ACV-silica composites.

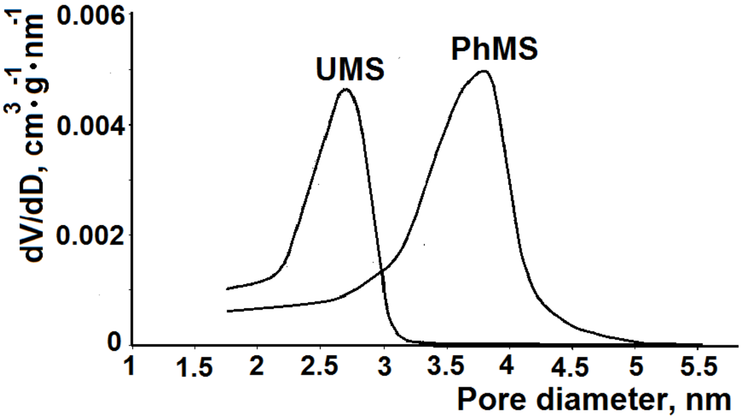

Figure S2 Pore size distribution for UMS and PhMS matrixes.