Electronic Supplementary Material (ESI) for Soft Matter. This journal is © The Royal Society of Chemistry 2023

## **Supplementary Information**

#### Fullerene-Polysacchride Supramolecular Hydrogel for Antioxidation/Antiglycation Behavior

Hong-Mei Yu, Xiao-Yong Yu, Yong Chen and Yu Liu\*

<sup>a</sup> School of Materials Science and Engineering, University of Science and Technology Beijing, Beijing 100083, China;

Cosmetics Tech Center, Chinese Academy of Inspection and Quarantine, Beijing 100176, China

<sup>b</sup>College of Chemistry, State Key Laboratory of Elemento-Organic Chemistry, Nankai University, Tianjin 300071, P. R. China

#### 1. Generial information

All reagents and solvents were commercially available and used without further purification, unless otherwise noted. Hydroxypropyl- $\beta$ -cyclodextrin are purchased from Zhiyuan Biotechnology Co. LTD.(The degree of substitution of hydroxypropyl in hydroxypropyl- $\beta$ -cyclodextrin is between 4 and 5). Bentonite are purchased from Shanghai Acmec Biochemical Co., Ltd. Chitosan are purchased from Shanghai Aladdin Biochemical Technology Co., Ltd. (The degree of deacetylation is  $\geq$ 95%, and the viscosity is 100-200 mpa.s). Sodium hydroxide are purchased from Shanghai Aladdin Biochemical Technology Co., Ltd. UV-Vis absorption spectra were recorded on a Thermo Fisher Scientific EVO300 PC spectrophotometer in a conventional rectangular quartz cell (10 × 10 × 45 mm) at 25 °C. Thermo-gravimetric (TG) analysis was finished in an argon at mosphere using a Netzsch STA 409 PC Luxx simultaneous thermal analyzer. Disc-shaped samples with thicknesses of 2 mm and diameters of 20 mm were used to perform the rheological tests on an AR 2000ex (TA Instrument) system at 20 °C. Photoluminescence measurements (for solution) were performed in a conventional quartz cuvette (light path 10 mm) on a Cary Eclipse equipped with a Cary single-cuvette peltier accessory. SEM images were obtained with a JSM-7500F scanning electron microscope.

### 2. The calculation formula of encapsulation ratio of the fullerene in fullerene@HPβ-CD inclusion complex

The calculation formula of encapsulation ratio is  $\frac{the concentration of fullerene in fullerene - cyclohexane solution}{the absorbance of fullerene - cyclohexane solution at 330 nm} \\ \times \frac{the absorbance of C60@HP - \beta - CD inclusion complex solution at 344 nm \times the vo}{amount of the fullerene added}$ 

#### 3. The experimental process for the antiglycation ability test

A mixture of 80mg/mL bovine serum albumin and 240 mg/mL glucose was prepared with 0.1 mol/L phosphate buffer solution (PBS). The mixture was filtered by 0.22  $\mu$ m filter membrane and used as 2x glycoylation reaction solution. The saccharification system and PBS solution without the substance to be tested and the saccharification system and PBS solution with the substance were prepared respectively. The final concentration of bovine serum albumin and glucose in each group was 40 mg/mL and 120 mg/mL respectively.

The components were mixed evenly and incubated at 55°C for 4 days. PBS was used as negative control and 1% aminoguanidine hydrochloride was used as positive control. After the reaction, the incubated solution was cooled to room temperature for determination, and 200  $\mu$ L of the reaction solution was added to the 96-well plate successively. The inhibition rates of AGEs were

detected and calculated by using a fluorescent enzyme label under the excitation wavelength of 370 nm and the emission wavelength of 440 nm.

## 4. the calculation formula of the AGEs inhibition rate

A - B

The AGEs inhibition rate =  $[1-(\overline{C-D})] \times 100$ 

A- Fluorescence intensity of glycosylation system with the substance to be tested

B- Fluorescence intensity of PBS solution with the substance to be tested

C- Fluorescence intensity of glycosylation system without the substance to be tested

D- Fluorescence intensity of PBS solution without the substance to be tested

# 5. The calculation formula of the content of fullerene in the fullerene@HP- $\beta$ -CD inclusion complex

The calculation formula of the content of fullerene in the fullerene@HP- $\beta$ -CD inclusion complex is

 $\frac{1}{amount of the Hp - \beta - CD}$ 

 $1 + \frac{1}{the \text{ encapsulation ratio} of fullerene \times amount of the fullerene added}$ 

# 6. Supplement figures



Figure S1. MALDI-TOF spectrum of HP- $\beta$ -CD



Figure S2. MALDI-TOF spectrum of fullerene@HP- $\beta$ -CD



Figure S3a. IR spectrum of chitosan/bentonite xerogel



Figure S3b. IR spectrum of bentonite



Figure S3c. IR spectrum of chitosan



Figure S4. SEM images of chitosan/bentonite xerogel



Figure S5. SEM images of chitosan/bentonite xerogel loaded with fullerene@HP- $\beta$ -CD

Concentration (%, V/V)	Inhibition rate (%)	SD (%)	<i>P</i> -value (vs negative)
negative	0.00	1.00	/
positive	89.83	0.09	0.001
0.63	17.62	0.76	0.001
1.25	21.50	0.31	0.006
2.50	23.90	0.28	0.005
5.00	26.96	0.47	0.001
10.00	29.24	0.08	0.007

Figure S6. The inhibition rate of chitosan/bentonite hydrogel (1% aminoguanidine hydrochloride is used as positive control group).

Concentration (%, V/V)	Inhibition rate (%)	SD (%)	<i>P</i> -value (vs negative)
negative	0.00	1.00	/
positive	89.83	0.09	0.001
0.63	30.31	1.07	<0.001
1.25	33.74	0.77	<0.001
2.50	35.89	0.17	0.004
5.00	40.56	0.42	<0.001
10.00	43.99	0.17	0.002

**Figure S7.** The inhibition rate of chitosan/bentonite hydrogel with fullerene@HP-β-CD (1% aminoguanidine hydrochloride is used as positive control group).

Concentration (%, V/V)	Inhibition rate (%)	SD (%)	<i>P</i> -value (vs negative)
negative	0.00	0.90	/
positive	69.89	0.16	0.0001
0.63	0.36	0.33	0.3117
1.25	0.37	0.19	0.2946
2.50	0.32	0.26	0.3672
5.00	0.41	0.29	0.2513
10.00	0.42	0.27	0.2368

**Figure S8.** The inhibition rate of fullerene@HP- $\beta$ -CD (1% aminoguanidine hydrochloride is used as positive control group).

Concentration (%, V/V)	Inhibition rate (%)	SD (%)	<i>P</i> -value (vs negative)
negative	0.00	0.90	/
positive	69.89	0.16	0.0001
0.63	0.40	0.32	0.2778
1.25	0.44	0.35	0.2346
2.50	0.35	0.31	0.3443
5.00	0.39	0.27	0.2934
10.00	0.49	0.30	0.1854

Figure S9. The inhibition rate of HP- $\beta$ -CD (1% aminoguanidine hydrochloride is used as positive control group).