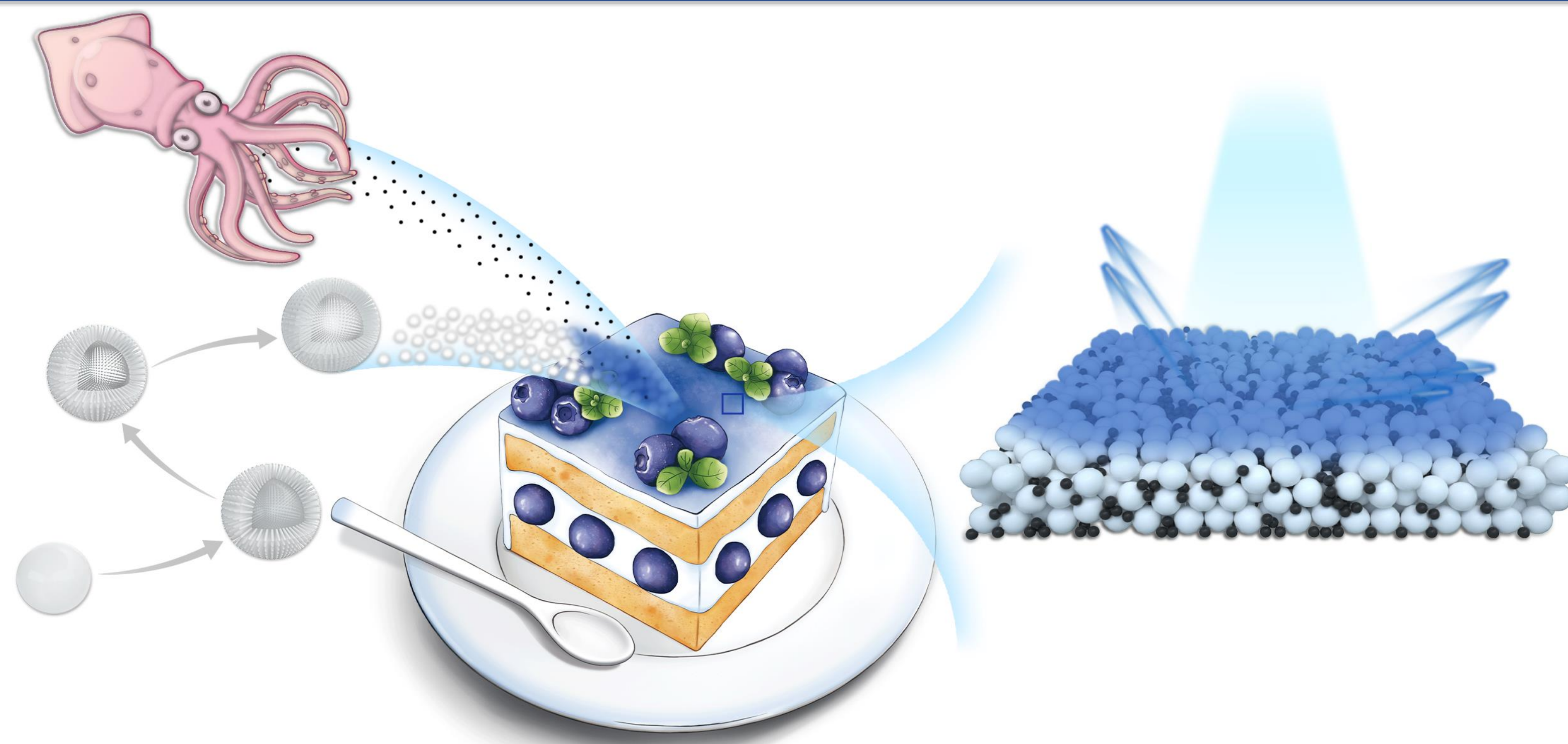
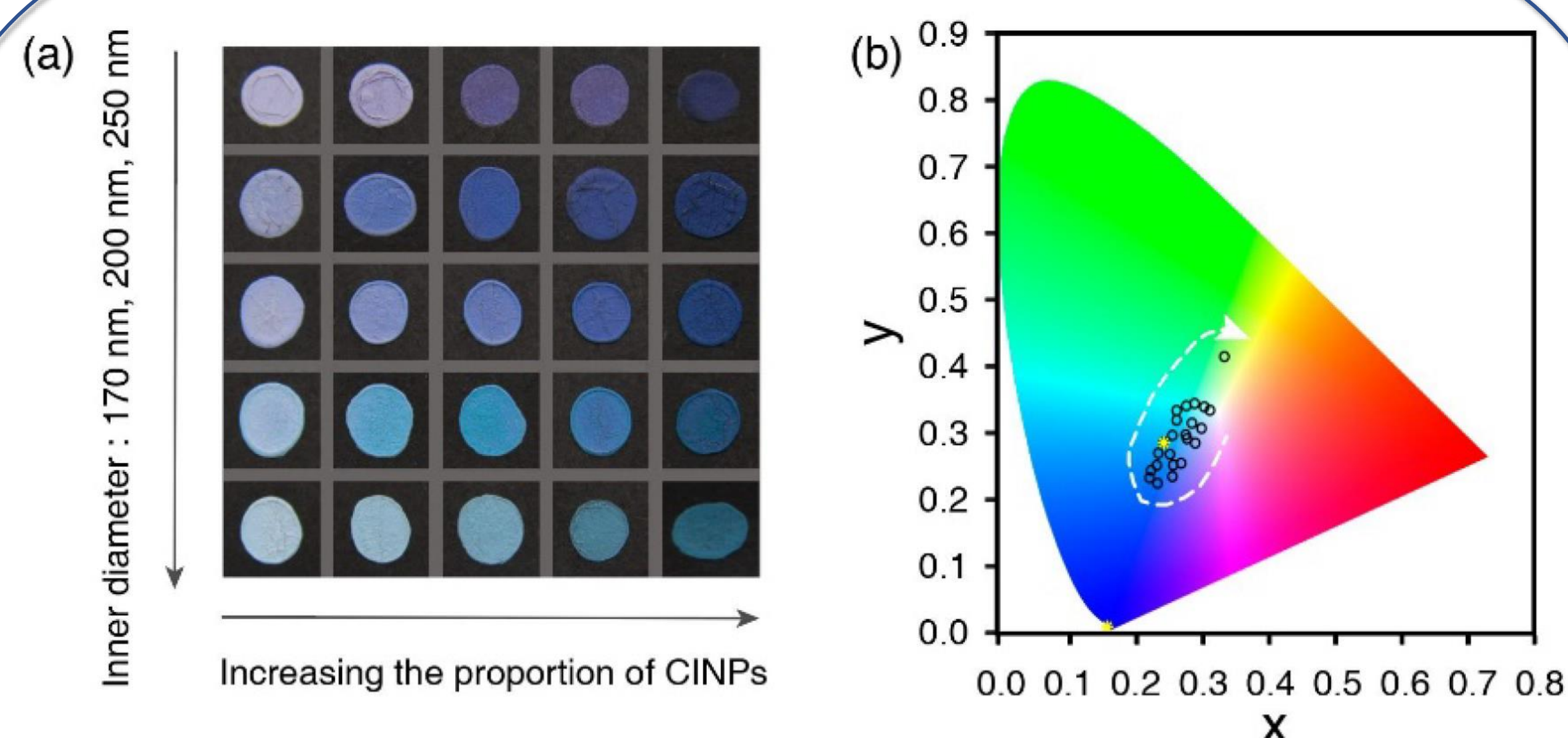


# Edible amorphous structural color

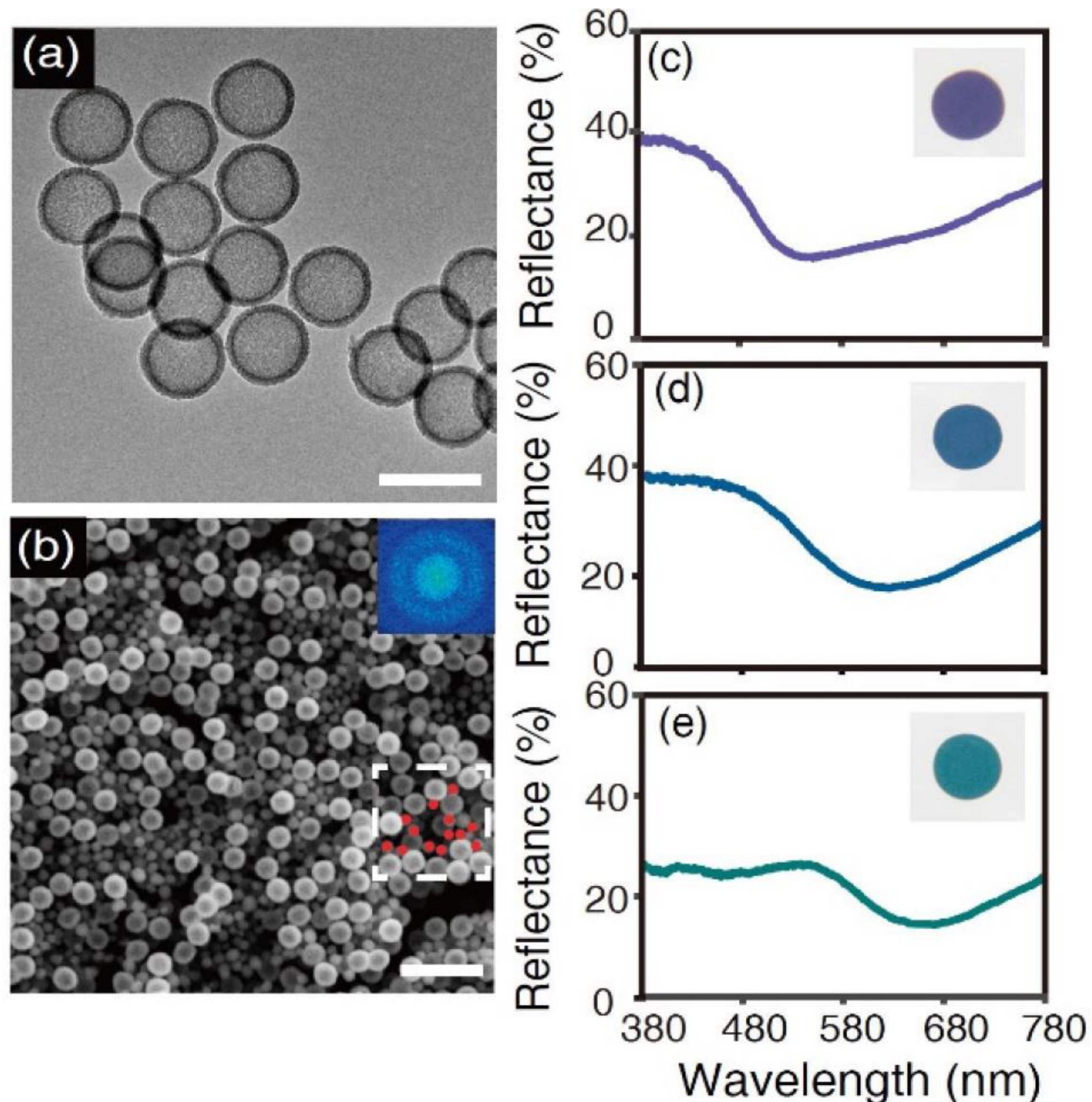
Jiao Chu, Yan Chen, Shi-Ying Tan, Yuan-Yuan Liu, Wenzhe Liu, Xiaohan Liu, Lei Shi, Haifang Wang, Wei Li, Jian Zi. *Advanced Optical Materials* 10.4 (2022): 2102125.



**Figure 1.** Schematic illustration of the fabrication of amorphous photonic structures (APSs). I. Synthesize the ethanol dispersible silica templates. Utilize some modification to prepare SiO<sub>2</sub>@TiO<sub>2</sub> sub-microspheres. II. Remove the hard template of SiO<sub>2</sub> sub-microspheres to get the hollow TiO<sub>2</sub> structures. III. Directly annealing the hollow TiO<sub>2</sub> structures to synthesize the mesoporous shell. IV. Mix the hollow TiO<sub>2</sub> sub-microspheres and CINPs with different concentrations. V-VI. Drop the mixture onto a substrate, dried under room temperature and humidity. Finally, the blue edible colorants with high visibility are obtained.



**Figure 3.** a) Color palette offered by the fabricated APSs. b) CIE 1931 chromaticity of x and y values corresponding to the APSs.



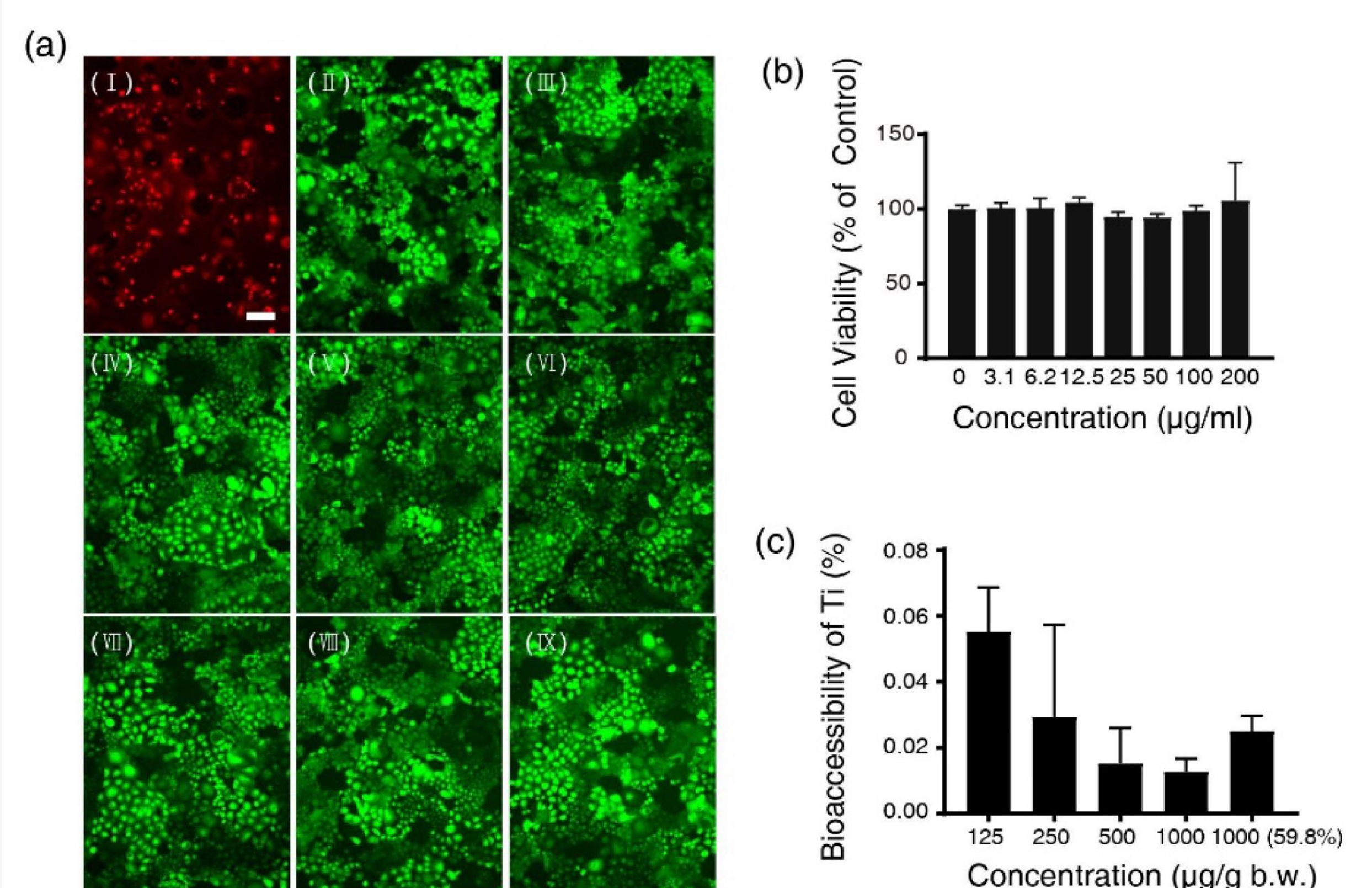
**Figure 2.** a) TEM image of mesoporous hollow TiO<sub>2</sub> sub-microspheres b) SEM image of an APS. c-e) Measured reflectance spectra for typical APSs. Scale bar: a) 200 nm and b) 1  $\mu$ m.

## Conclusion

An edible structural colorant between blue and green is proposed and demonstrated. The edible structural colorant is with flexible adjustment and displays an excellent visibility. A series of biotoxicity assay confirm that the edible structural colorants does not cause overt cytotoxicity, indicating that they could be potential blue even green edible colorants for food, drug and cosmetics fields.



**Figure 4.** Optical photographs of biscuits and cake with edible structural colorants. Scale bar: a) and b) 3.5 cm, 2 cm



**Figure 5.** a) Representative live/dead staining images of Caco-2 cells after exposure to gradient concentration of edible colorant for 24 h. b) Viability assay of Caco-2 cells after 24 h exposure to edible colorant. c) The simulated absorption of TiO<sub>2</sub>-CINPs in gastrointestinal tract in vitro by using the RIVM method.