Electronic Supplementary Material (ESI) for RSC Advances.

Supporting Information

Toxic effect of zinc oxide nanoparticles combined with vitamin C and caseinphosphopeptides on gastric epithelium cells and intestinal absorption of mice

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Cytotoxicity Evaluation

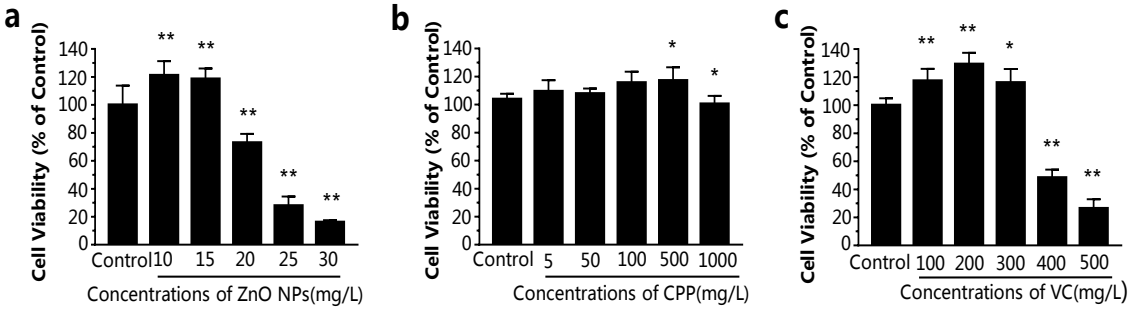

Fig. S 1 Cytotoxicity evaluation of ZnO NPs, CPP, Vc treatment in GES-1 cells for 24 h. (a) Different concentrations (mg L^{-1}) of ZnO NPs; (b) Different concentrations (mg L^{-1}) of CPP; (c) Different concentrations (mg L^{-1}) of Vc. Data are presented as the mean ±S.D. $^{*}P<0.05$ compared with the control group, $^{**}P<0.01$ compared with the control group.

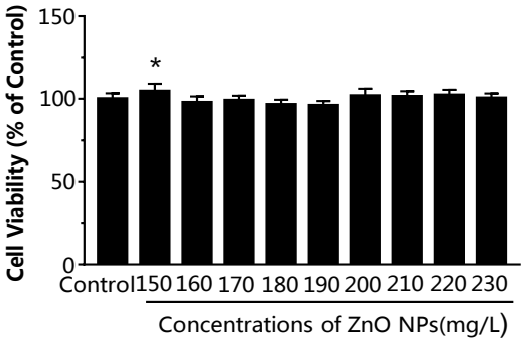

Fig. S 2 Cell viability analysis of GES-1 cells with different concentrations (mg L^{-1}) of ZnO NPs for 2 h. Data are presented as the mean ±S.D. *P<0.05 compared with the control group.

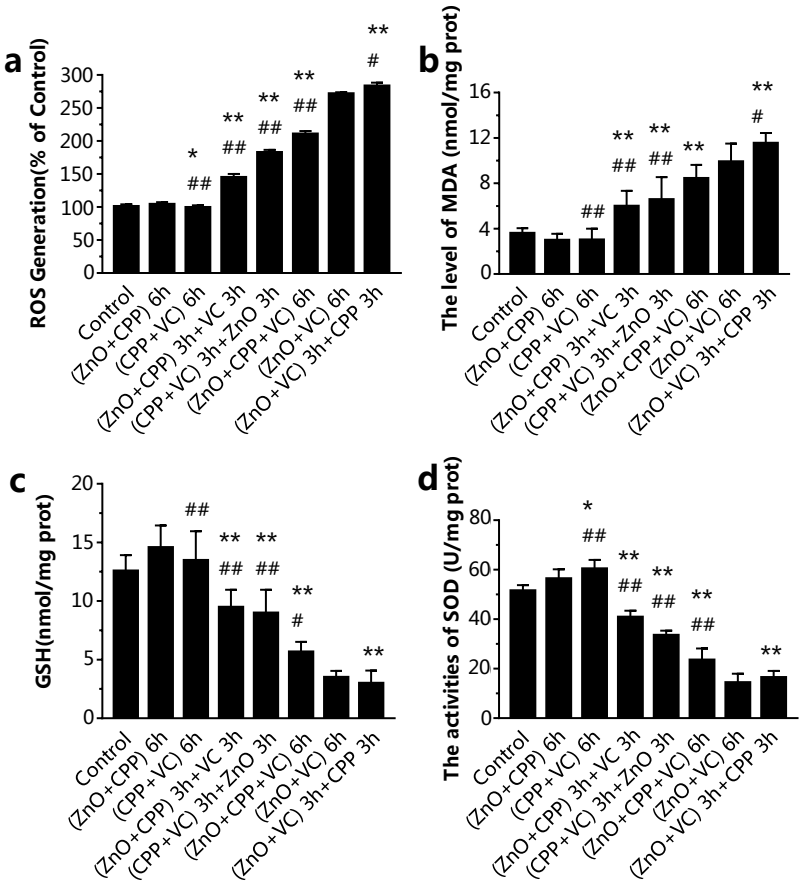

Fig. S 3 Intracellular redox production after incubation with ZnO NPs, CPP and Vc in different systems treatment for 6 h. (a) ROS generation; (b) MDA concentration; (c) GSH concentration; (d) SOD activity. Data are presented as the mean ±S.D. $^{*}P<0.05$ compared with the group of ZnO NPs plus CPP, $^{**}P<0.01$ compared with the group of ZnO NPs plus CPP, $^{\#}p<0.05$ compared with the group of ZnO NPs plus VC, $^{\#\#}p<0.01$ compared with the group of ZnO NPs plus VC.

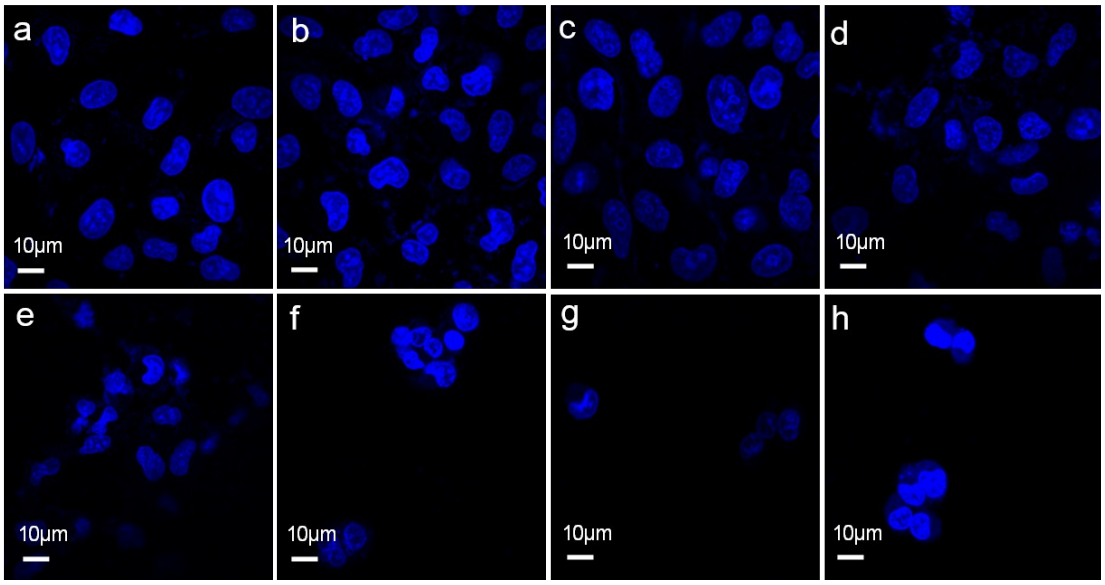

Fig. S 4 Observation of the morphological changes of GES-1 after co-incubation in 120 mg L^{-1} ZnO NPs, 500 mg L^{-1} CPP, 300 mg L^{-1} VC with different systems for 6 h. The cell nuclei are stained with DAPI. (a) The control cells; (b) The cells treated with (ZnO+CPP) 6 h; (c) The cells treated with (CPP+VC) 6 h; (d) The cells treated with (ZnO+CPP) 3 h + VC 3 h; (e) The cells treated with (CPP+VC) 3 h + ZnO 3 h; (f) The cells treated with (ZnO+CPP+VC) 6 h; (g) The cells treated with (ZnO+VC) 6 h; (h) The cells treated with (ZnO+VC) 3 h + CPP 3 h.

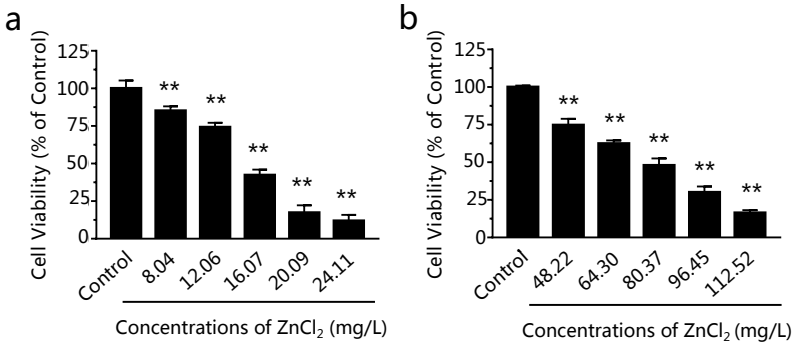

Fig. S 5 Cell viability analysis of GES-1 cells with different concentrations (mg L^{-1}) of $ZnCl_2$. (a) for 24 h; (b) for 6 h. Data are presented as the mean ±S.D. *P<0.05 compared with the control group., $^{**}P$<0.01 compared with the control group.

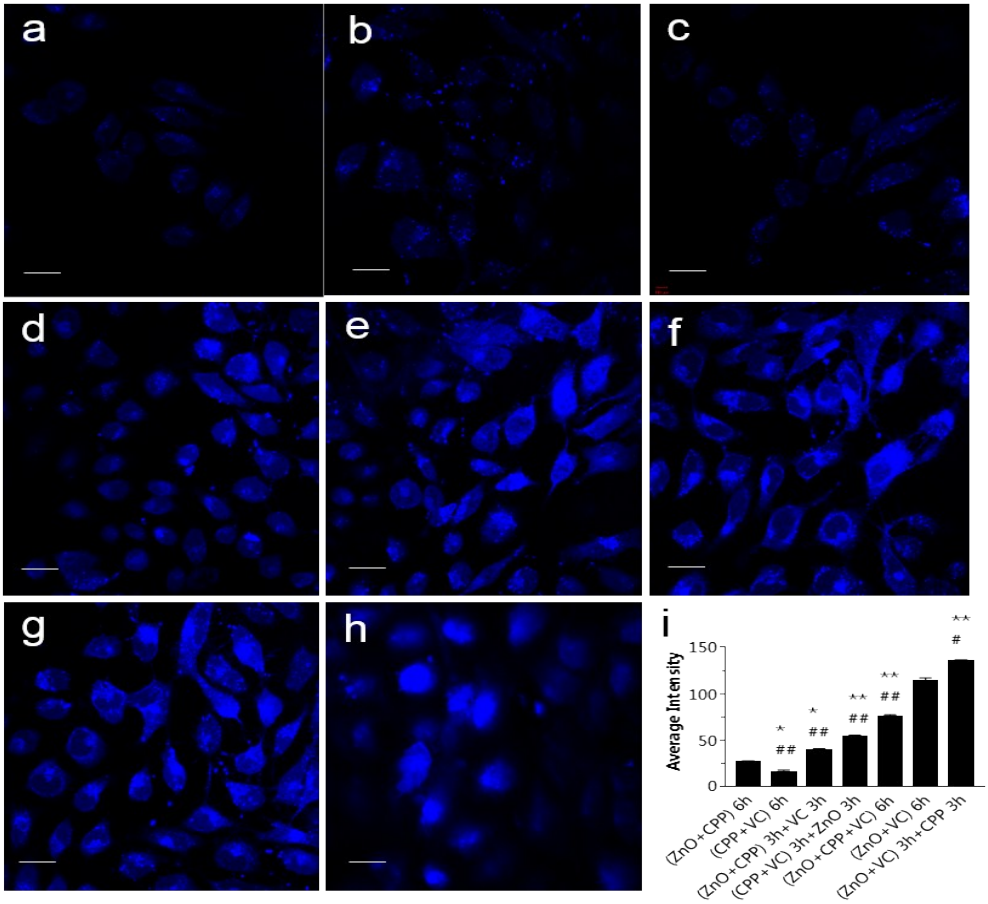

Fig. S 6 Observation of the morphological changes of GES-1 after co-incubation in 120 mg L^{-1} ZnO NPs, 500 mg L^{-1} CPP, 300 mg L^{-1} VC with different systems for 6 h stained by TSQ. Each image scale is 100 μm.(a) The control cells; (b) The cells treated with (ZnO+CPP) 6 h; (c) The cells treated with (CPP+VC) 6 h; (d) The cells treated with (ZnO+CPP) 3 h + VC 3 h; (e) The cells treated with (CPP+VC) 3 h + ZnO 3 h; (f) The cells treated with (ZnO+CPP+VC) 6 h; (g) The cells treated with (ZnO+VC) 6 h; (h) The cells treated with (ZnO+VC) 3 h + CPP 3 h; (i) Analysis of the average fluorescence intensity of zinc ions in GES-1 cells after incubation with different systems for 6 h. $^{*}P$<0.05 compared with the group of ZnO NPs plus CPP, $^{**}P$<0.01 compared with the group of ZnO NPs plus CPP, $^{\#}p$<0.05 compared with the group of ZnO NPs plus VC, $^{\#\#}p$<0.01 compared with the group of ZnO NPs plus VC.

The process of the study

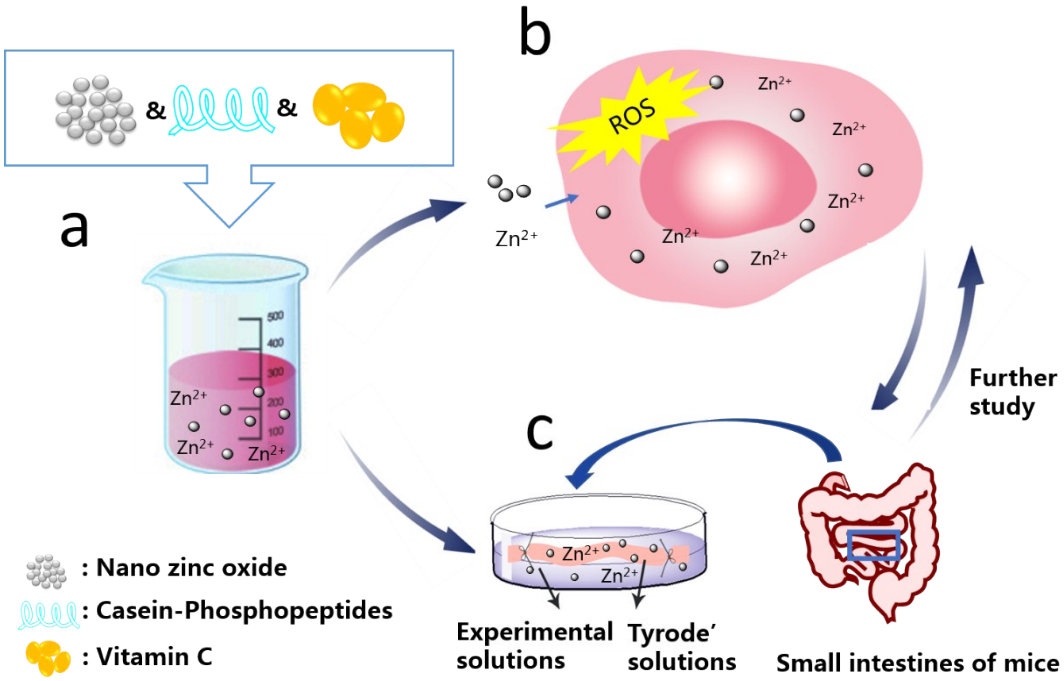

Fig. S 7 The whole process of this study. (a) The dissolved Zn^{2+} from ZnO NPs in different combined groups plays the key role of the combined toxic effect. (b) Cell apoptosis and oxide stress on GES-1 cells induced by the combined groups of ZnO NPs, VC and CPP. (c) Zn^{2+} absorption of mice small intestine with the everted gut sac model.