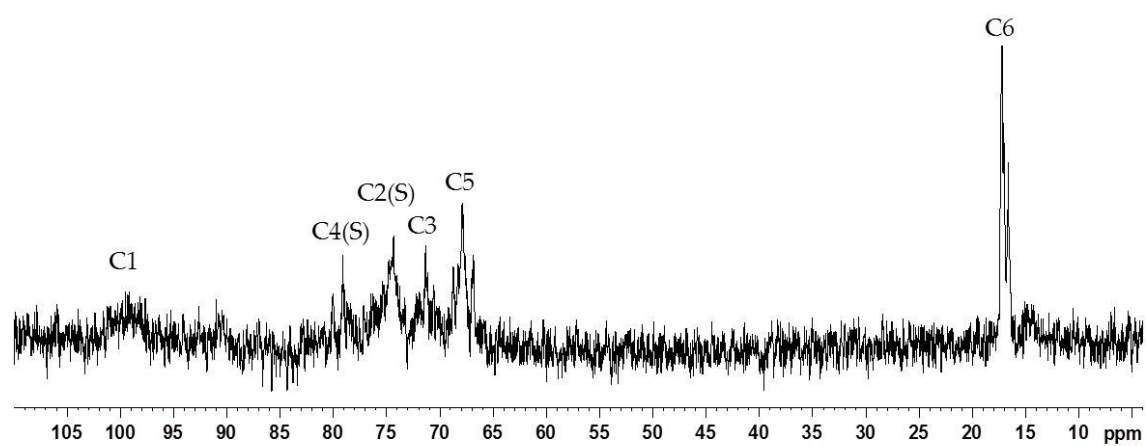
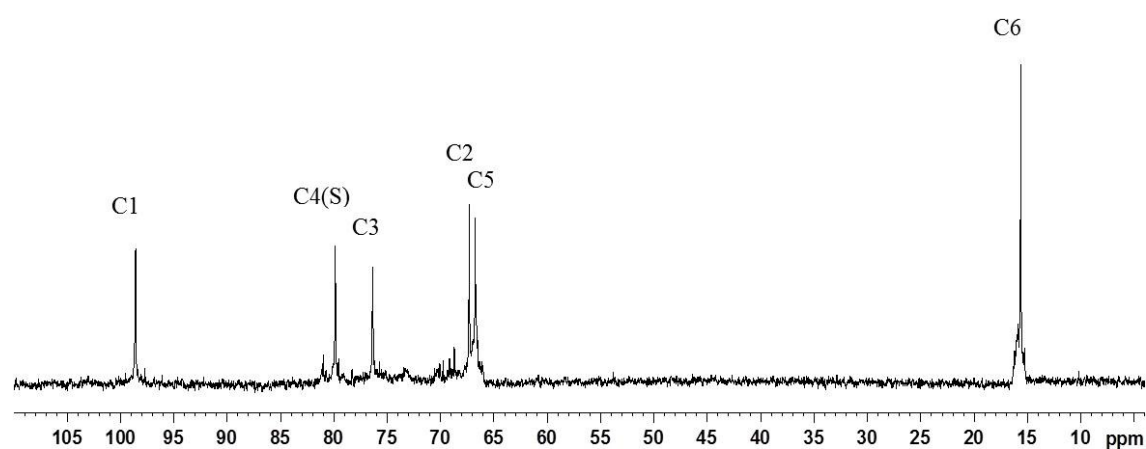


**a**

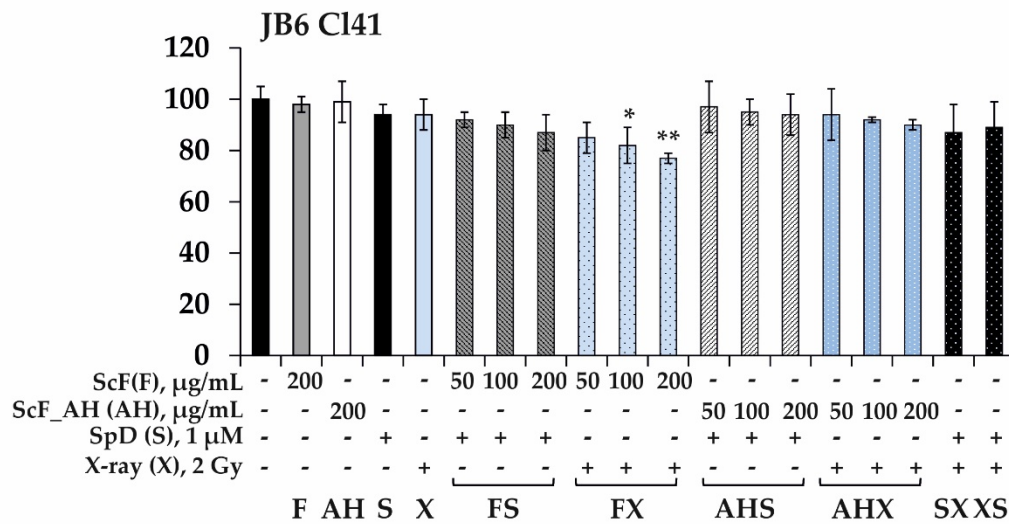


**b**

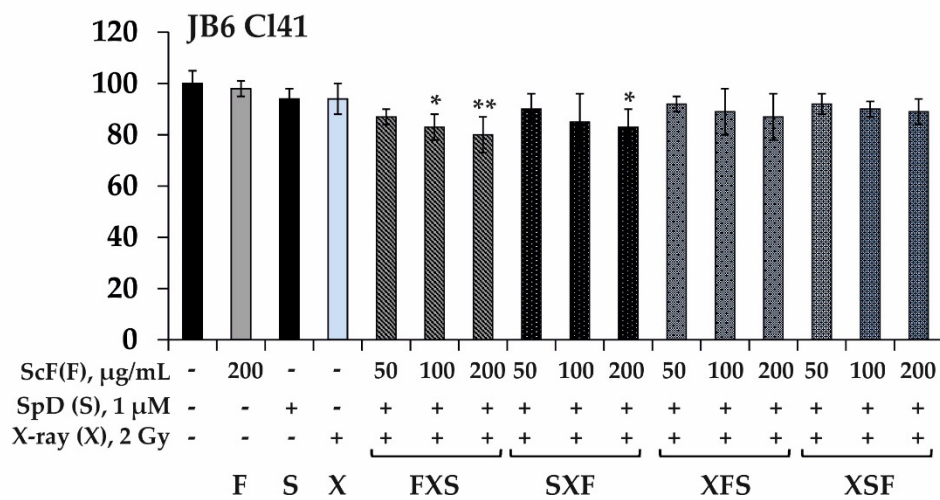


**Supplementary Figure S1.** <sup>13</sup>C NMR spectrum of (a) fucoidan ScF from *S. cichorioides* and (b) fucoidan derivative ScF\_AH obtained by autohydrolysis. Signals (C1–C6) of  $\alpha$ -(1 $\rightarrow$ 3)-L-fucopyranose residues of the main chain are indicated.

a



b



**Supplementary Figure S2.** Two-component (a) and three-component (b) combined effect of fucoidan from *S. cichorioides* (ScF), its derivative (ScF\_AH) with pacificusoside D from *S. pacificus* (SpD) or X-ray on the viability of 3D normal epidermal cells JB6 Cl41.

JB6 Cl41 spheroids were treated by (a) ScF (50, 100, 200  $\mu\text{g/mL}$ ) in combination with SpD (1  $\mu\text{M}$ ) (FS combination); ScF (50, 100, 200  $\mu\text{g/mL}$ ) in combination with X-ray (FX combination); ScF\_AH (50, 100, 200  $\mu\text{g/mL}$ ) in combination with SpD (1  $\mu\text{M}$ ) (AHS combination); ScF\_AH (50, 100, 200  $\mu\text{g/mL}$ ) in combination with X-ray (AHX combination); SpD (1  $\mu\text{M}$ ) in combination with X-ray (2 Gy) (SX combination); X-ray (2 Gy) in combination with SpD (1  $\mu\text{M}$ ) (XS combination) and (b) ScF (50, 100, 200  $\mu\text{g/mL}$ ) in combination with X-ray (2 Gy) and SpD (1  $\mu\text{M}$ ) (FXS combination); SpD (1  $\mu\text{M}$ ) in combination with X-ray (2 Gy) and ScF (50, 100, 200  $\mu\text{g/mL}$ ) (SXF combination); X-ray (2 Gy) in combination with ScF (50, 100, 200  $\mu\text{g/mL}$ ) and SpD (1  $\mu\text{M}$ ) (XFS combination); and X-ray (2 Gy) in combination with SpD (1  $\mu\text{M}$ ) and ScF (50, 100, 200  $\mu\text{g/mL}$ ) (XSF combination) for total 72 h. The cell viability was estimated using the MTS assay. Data show the mean of three independent experiments  $\pm$  SD. A one-way ANOVA and Tukey's HSD test for multiple comparisons indicated the statistical significance (\* $p < 0.05$ , \*\* $p < 0.01$ ).