Supporting Information

Copper Deposited Diatom-biosilica with Enhanced Photothermal and Photodynamic Performance for Infected Wound Therapy

Xin Cong[a,1], Yuzhi Mu[a,1], Di Qin[a], Xiaojie Sun[a], Chang Su[a], Tongtong Chen[a], Xiaoye Wang[a], Xiguang Chen[a,b], and Chao Feng[a,*]

[a]College of Marine Life Science, Ocean University of China, 5# Yushan Road, Qingdao 266003, Shandong Province, China. E-mail: fengchao@ouc.edu.cn

[b]Qingdao national laboratory for marine science and technology, 1# Wenhai Road, Qingdao 266000, Shandong Province, China

[1]Co-first author: Xin Cong and Yuzhi Mu contributed equally to this work

Calculation of the photothermal conversion efficiency.

the photothermal conversion efficiency (η) can be calculated as following equation (1).[1]

$$\eta = \frac{hA(\Delta T_{max,\ min} - \Delta T_{max,H_2O})}{I(1-10^{-A\lambda})} \quad (1)$$

The lumped quantity hA was determined by equation (2).

$$\tau = \frac{Cm}{hA} \quad (2)$$

where C and m were the heat capacity (4.2 J g^{-1}) of water and mass (2 g), respectively.

In order to get the hA, θ was introduced in, which was defined as the ratio of ΔT to ΔT_{max} (3).

$$\Theta = \frac{\Delta T}{\Delta T_{Max}} \quad (3)$$

Where τ can be calculated by linear relationship of time versus -ln(θ):

$t = k \times (-\ln(\theta)) + b$

where t was the irradiation time, k and b were constants. τ was equal to k in the formula.

Thus, the photothermal conversion efficiency (η) of DBs and Cu-DBs could be calculated.

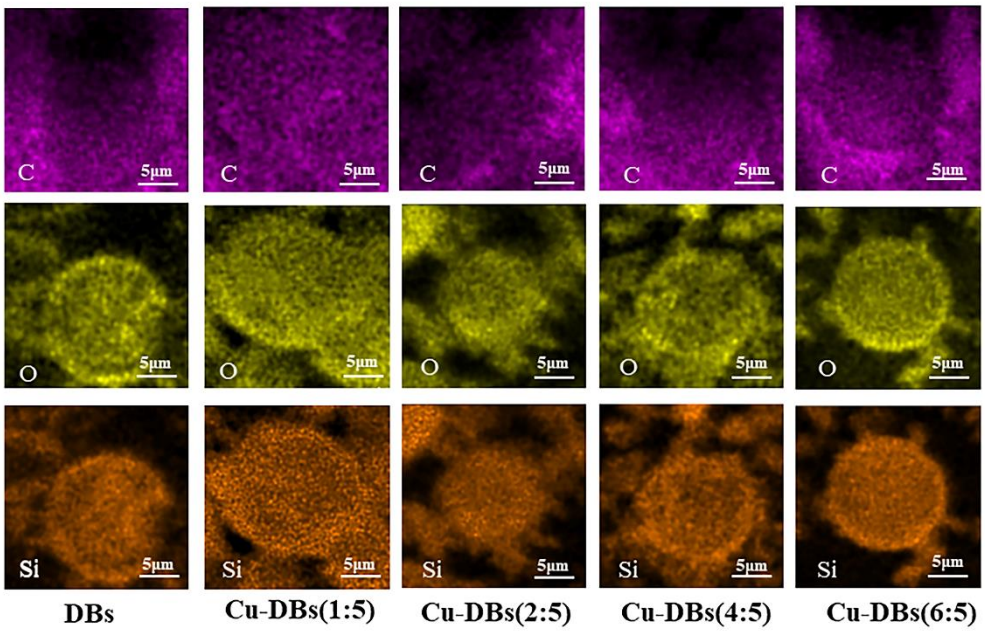

Figure S1. Elemental mapping images of DBs, Cu-DBs (1:5), Cu-DBs (2:5), Cu-DBs (4:5) and Cu-DBs (6:5).

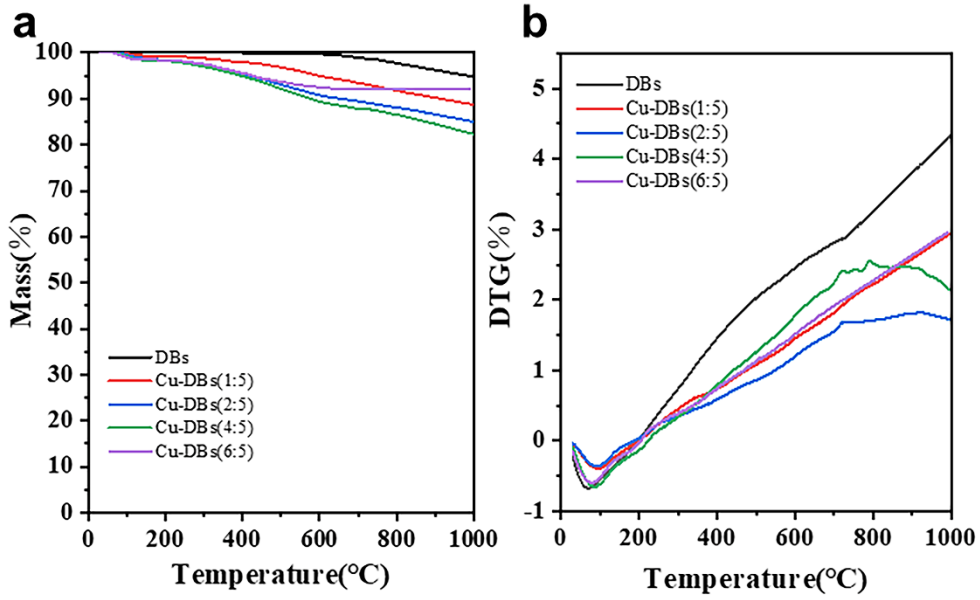

Figure S2. Thermogravimetric analysis of DBs and Cu-DBs: (a) Mass curve; (b) DTG curve.

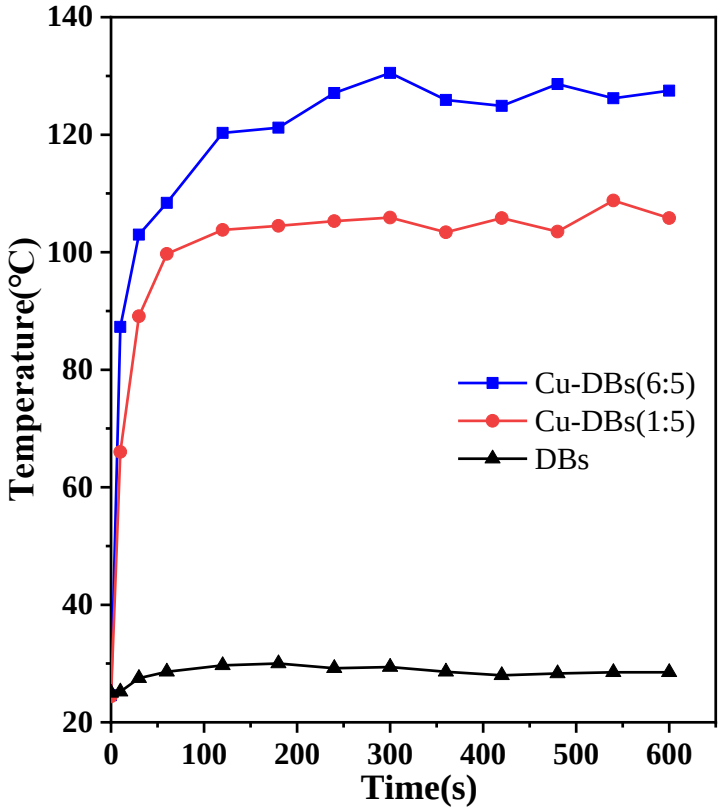

Figure S3. Photothermal curves of DBs, Cu-DBs (1:5) and Cu-DBs (6:5) powders (0.65 W cm^{-2} for 10 min).

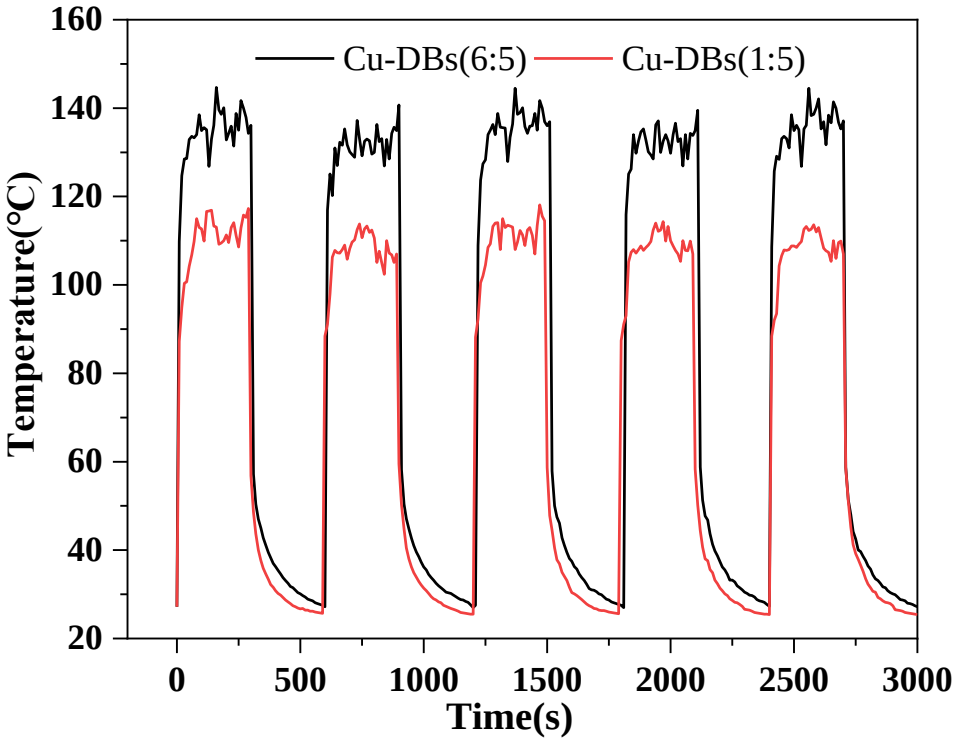

Figure S4. Photothermal stability tests of Cu-DBs (1:5) and Cu-DBs (6:5) with 10 min laser irradiation (0.65 W cm^{-2}) in five repeated times.

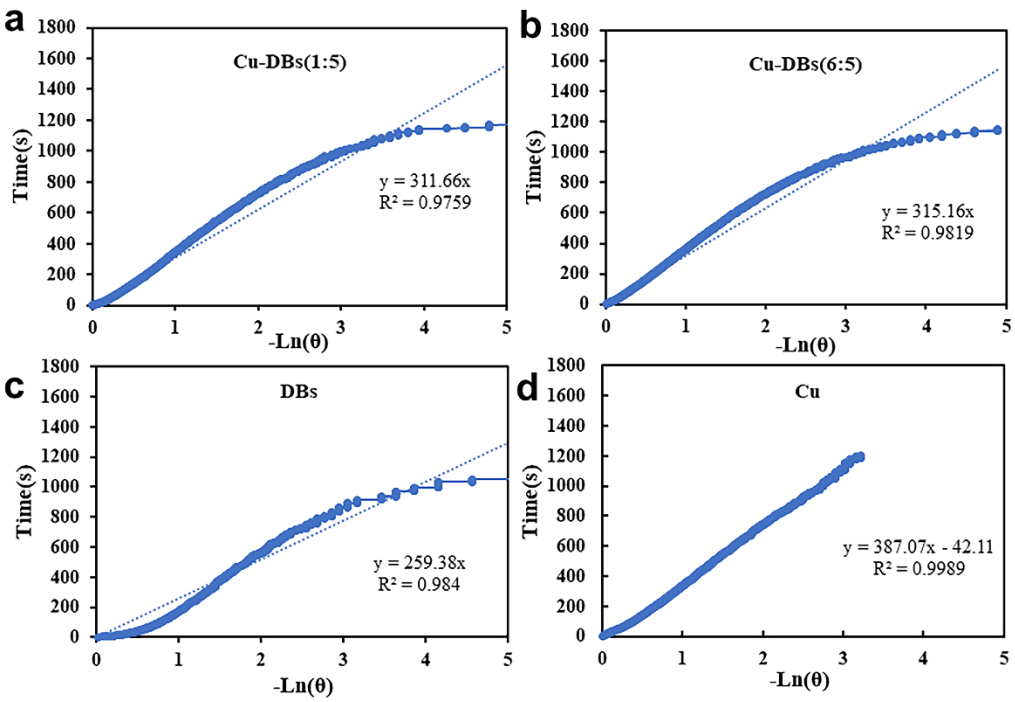

Figure S5. The linear relationship between time and minus ln (θ). By using the linear time data of the cooling time of the panel, the heat transfer time constants of the Cu-DBs (1:5) system, the Cu-DBs (6:5) system, the DBs system and the Cu nanoparticles system under the condition of 2W cm^{-2} were τs1= 311.66 s, τs2= 315.16 s,τs3=259.38 s and τs4=387.07 s, respectively.

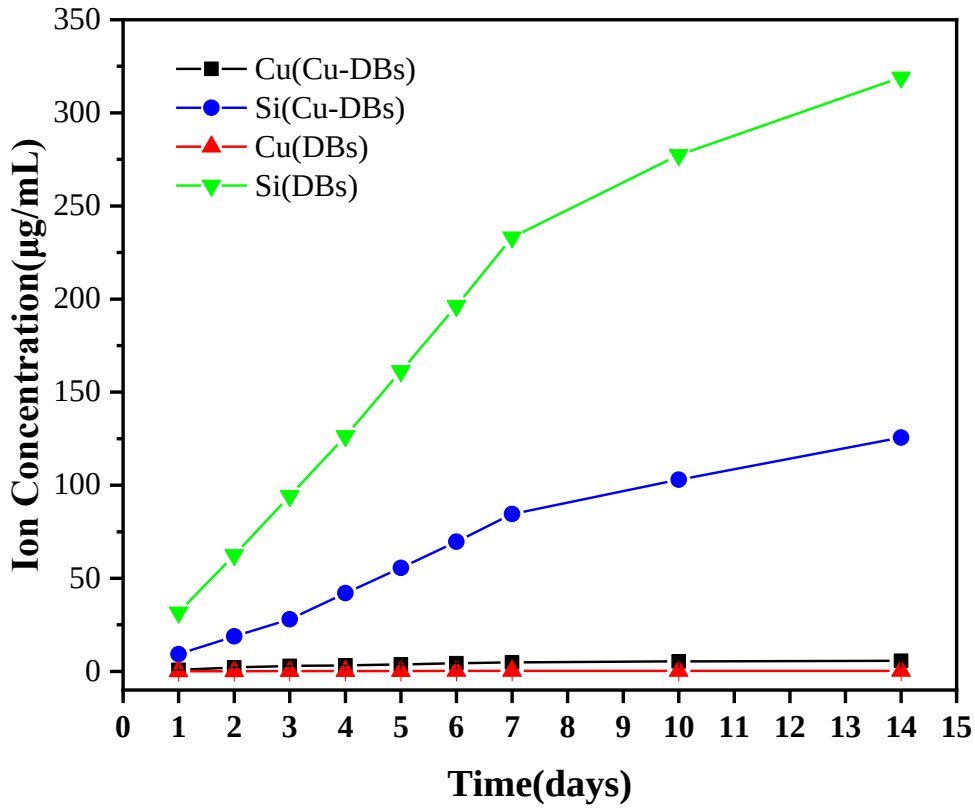

Figure S6. Si and Cu ions concentrations released from DBs and Cu-DBs (6:5) after immersion in PBS (PH=7.4) at 37 ◦C for 14 days. (*n* = 3).

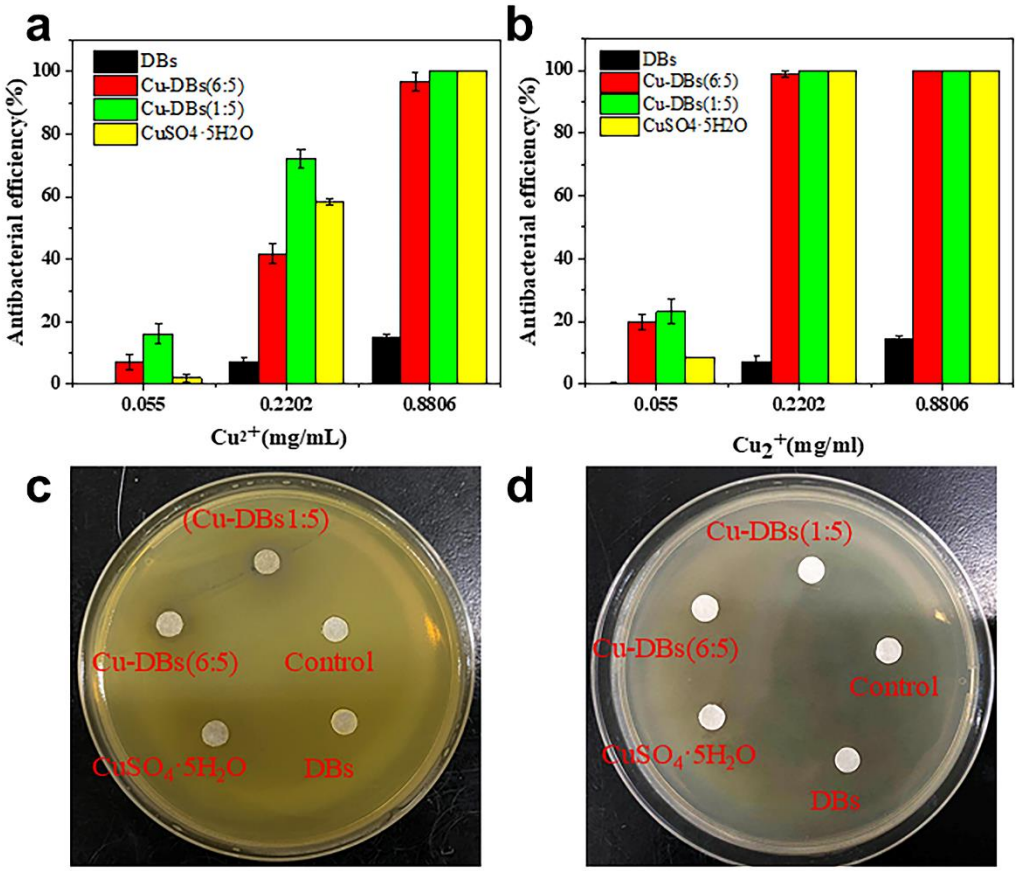

Figure S7. Statistical results of DBs, Cu-DBs and $CuSO_4·5H_2O$ antibacterial activities against (a) *S.aureus* and (b) *E.coli* at the same concentration of Cu ions (mean± SD, **p* < 0.05, ***p* < 0.01, and ****p* < 0.001, *n*=3); Inhibition rings of different bacteria in DBs, Cu-DBs and $CuSO_4·5H_2O$: (c) *S.aureus* and (d) *E.coli*.

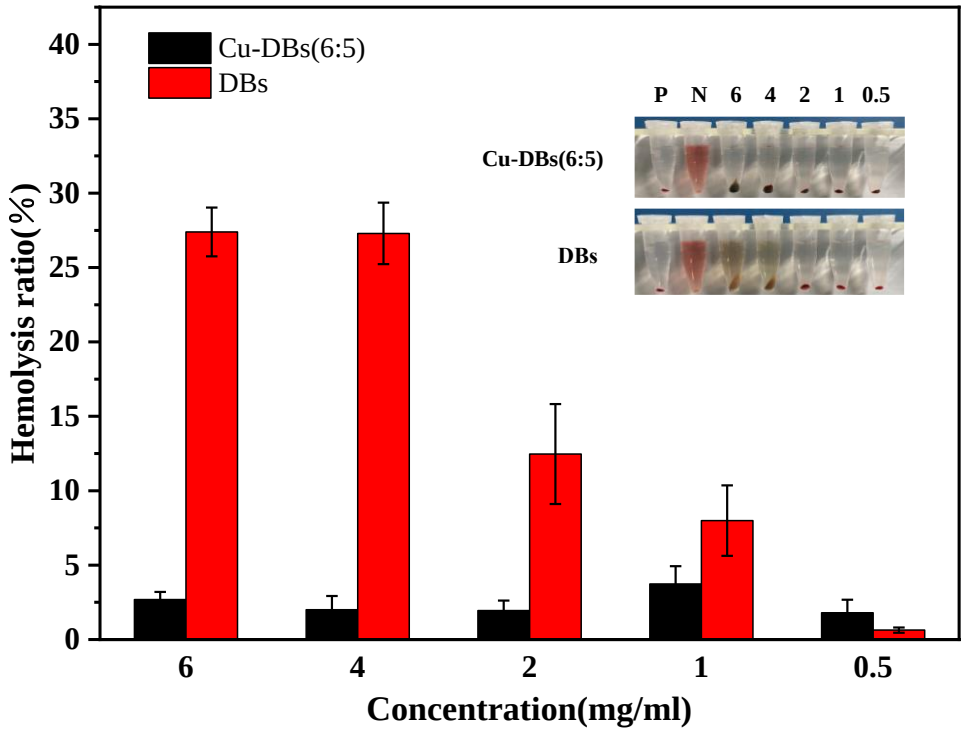

Figure S8. Hemolysis rate and photographs of DBs and Cu-DBs (6:5) at different concentrations. Data represents the mean ± SD (*n*=5).

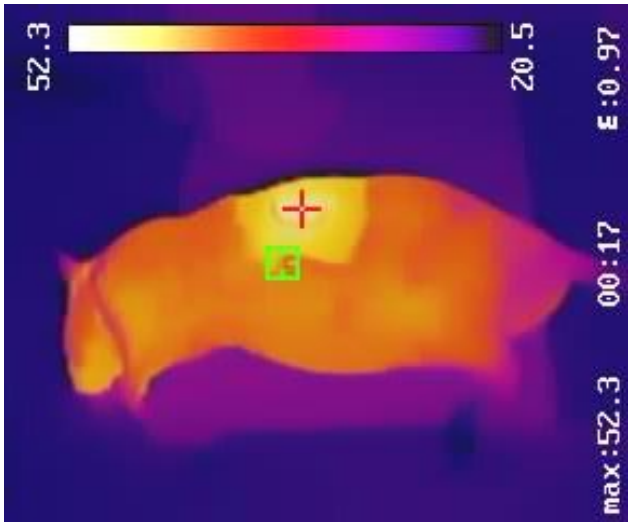

Figure S9. Photothermal images of rat treated with Cu-DBs (6:5) after 5 min NIR irradiation (808 nm, 2 W cm^{-2}).

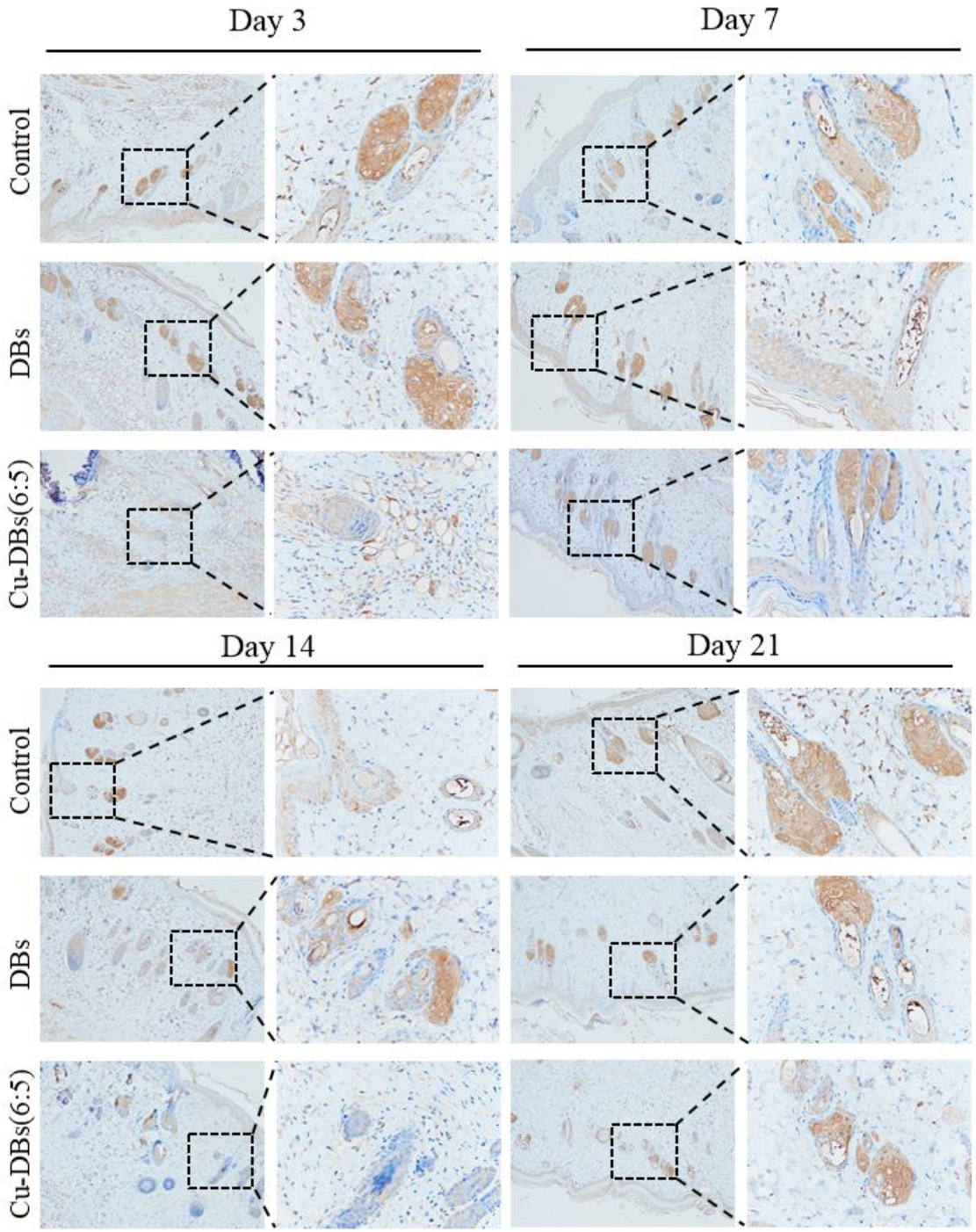

Figure S10. Immunofluorescence staining of TNF-α at 3, 7, 14 and 21 days.

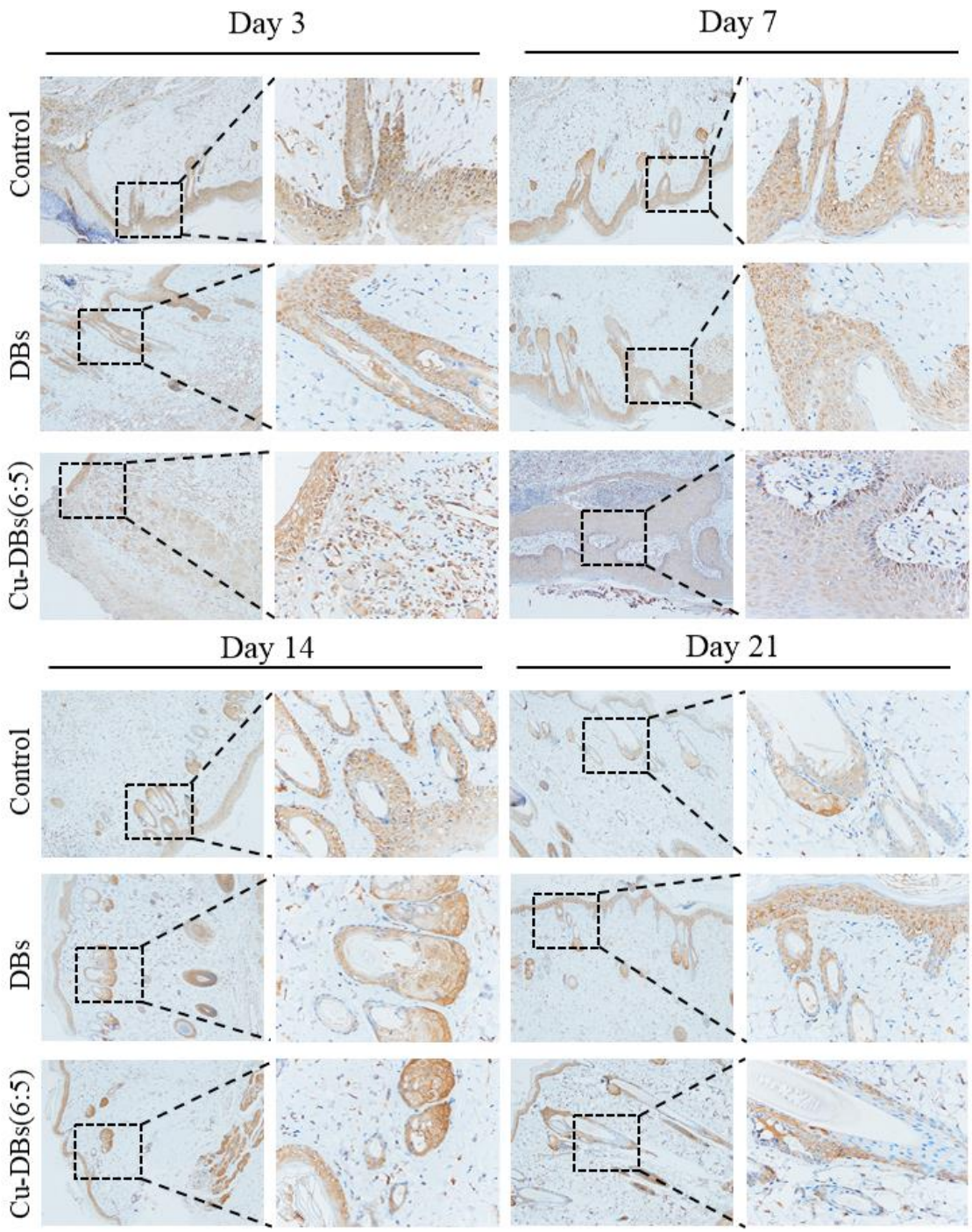

Figure S11. Immunofluorescence staining of IL-4 at 3, 7, 14 and 21 days.

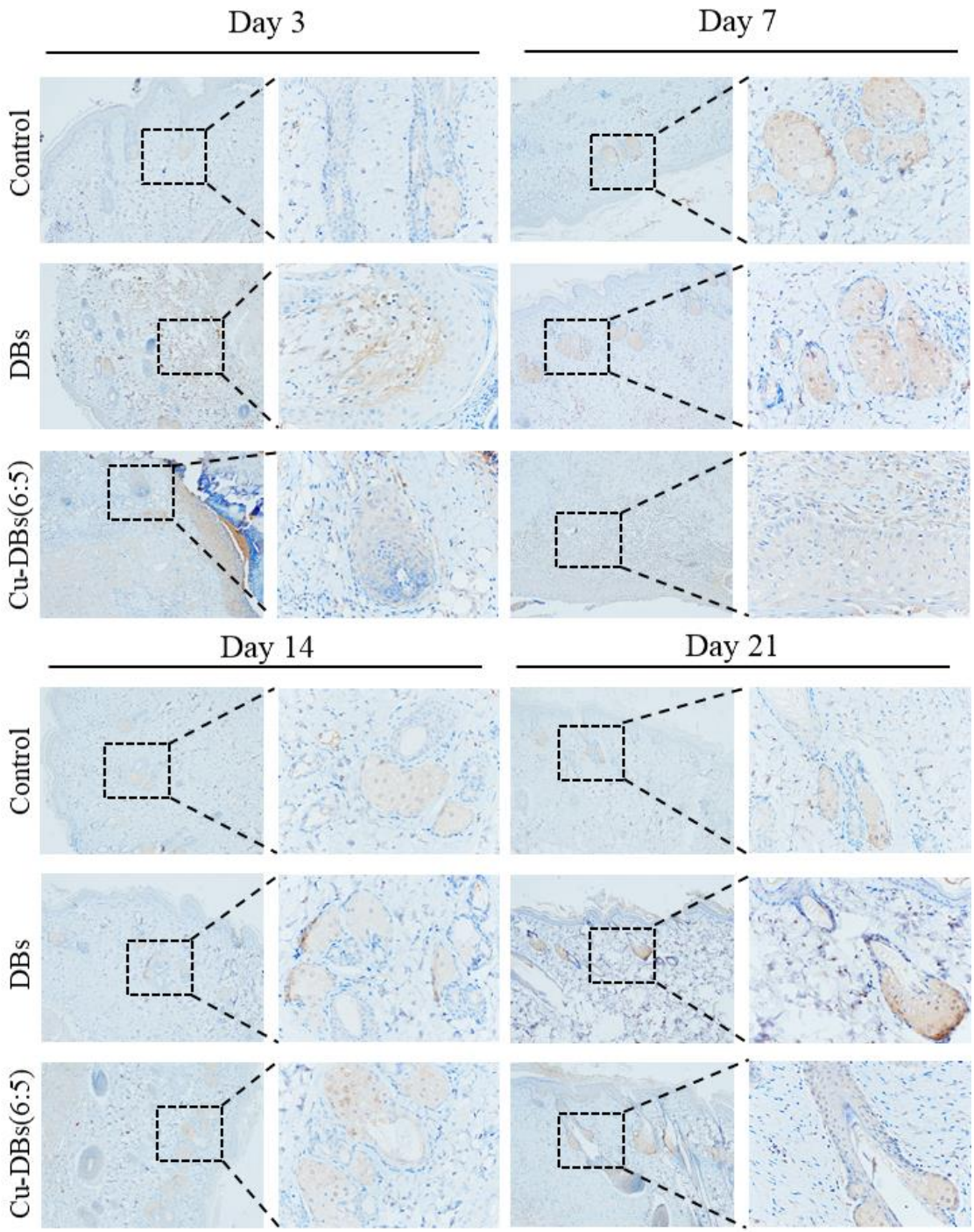

Figure S12. Immunofluorescence staining of IL-10 at 3, 7, 14 and 21 days.

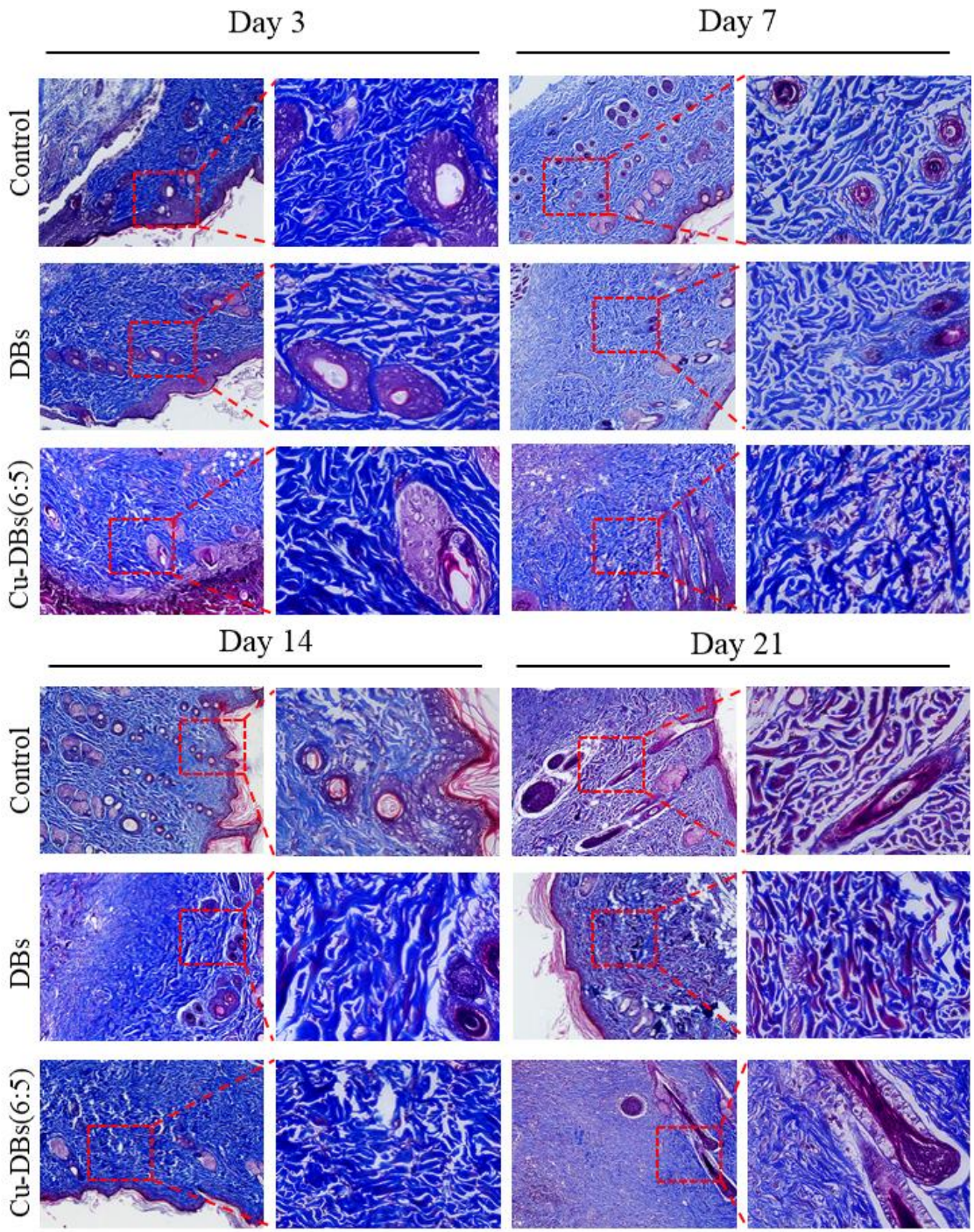

Figure S13. Masson staining of wound tissues treated with DBs and Cu-DBs (6:5) at 3, 7, 14 and 21 days.

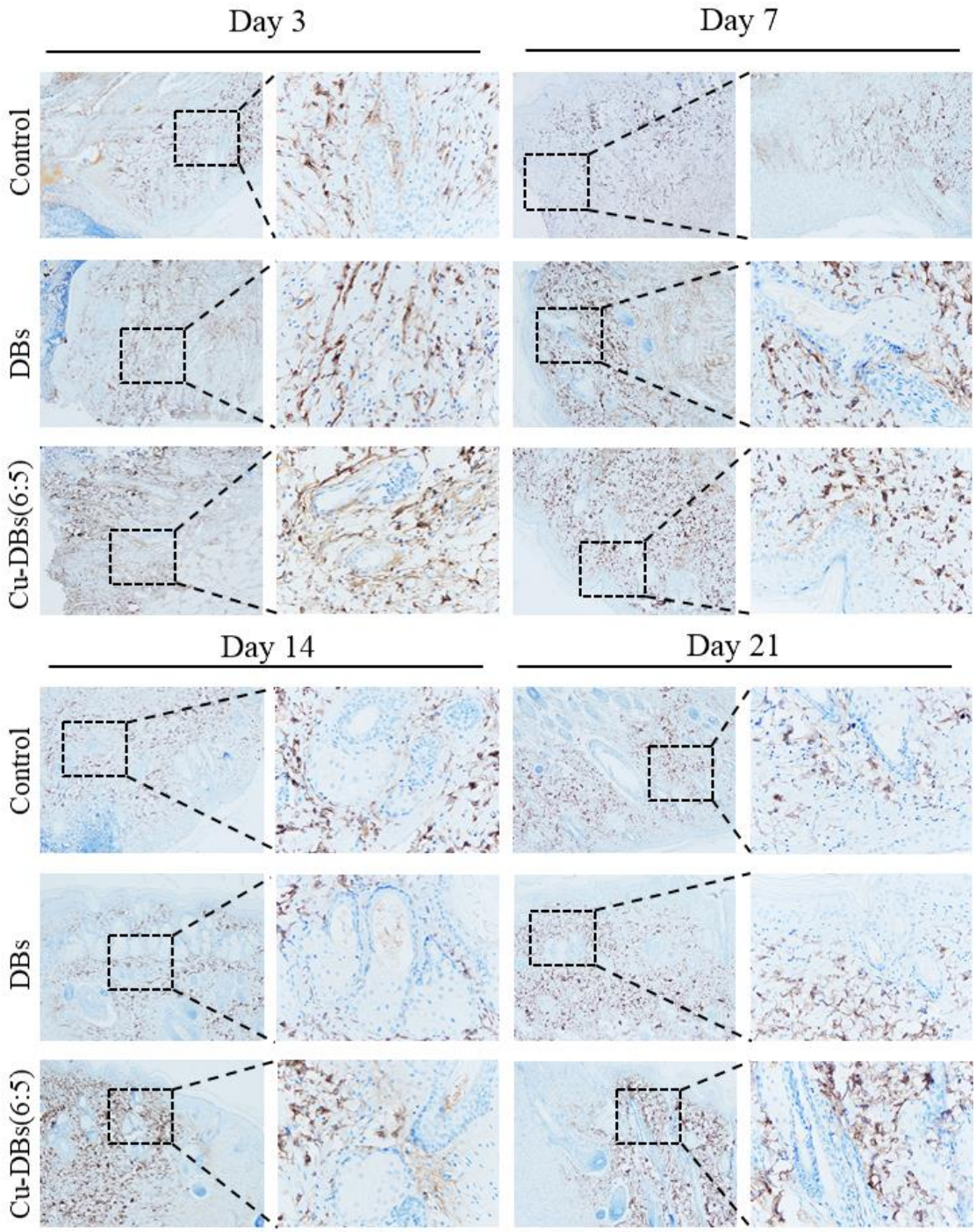

Figure S14. Immunofluorescence staining of type-III collagen at 3, 7, 14 and 21 days.

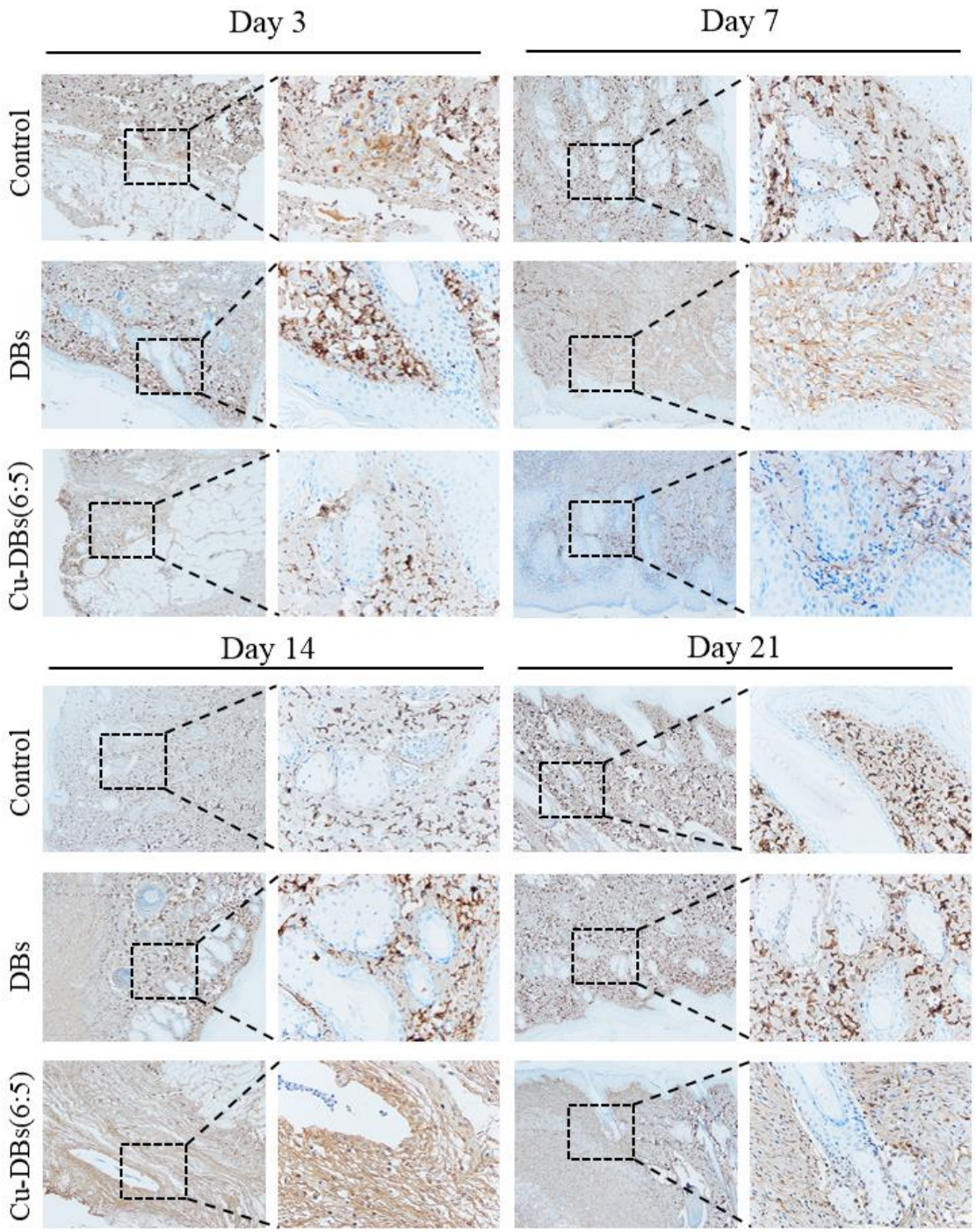

Figure S15. Immunofluorescence staining of type-I collagen at 3, 7, 14 and 21 days.

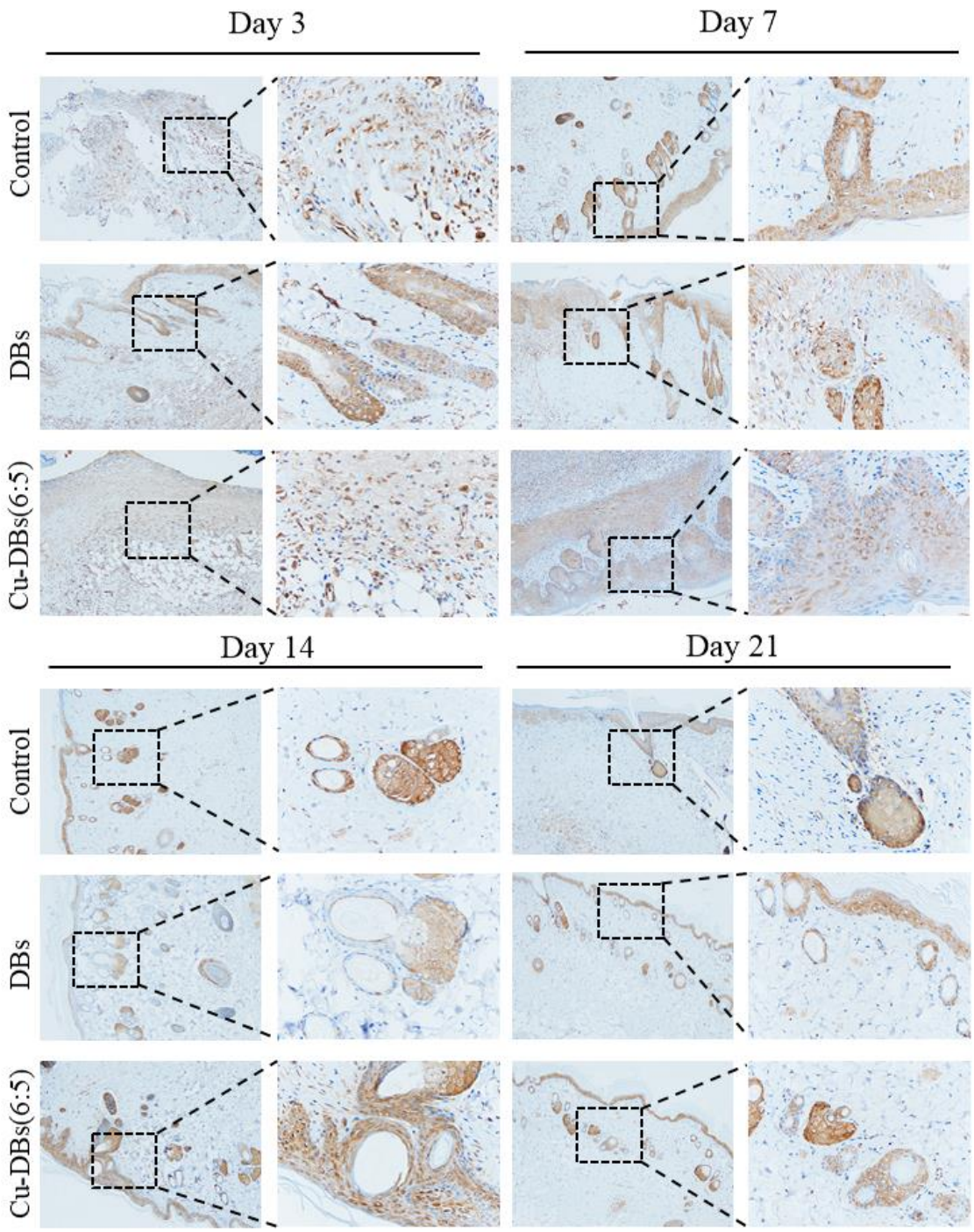

Figure S16. Immunofluorescence staining of HSP90 at 3, 7, 14 and 21 days.

References

[1] W. Ren, Y. Yan, L. Zeng, Z. Shi, A. Gong, P. Schaaf, D. Wang, J. Zhao, B. Zou, H. Yu, G. Chen, E. M. Brown, A. Wu, Adv Healthc Mater 2015, 4, 1526.