SUPPORTING INFORMATION

Engineering copper nanoparticle/polysaccharide-immobilized cotton gauze for accelerated healing of *Staphylococcus aureus*-infected dermal wounds

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S1. Materials and Methods

1. Surface modification with HTCC and Dextran

First, medical-grade CG (5 × 5 cm^2) was immersed in a 3 wt.% aqueous solution of sodium tripolyphosphate (STPP) for 1 h at room temperature, and then dried in a hot-air oven at 70 °C. In the second step, the pretreated gauze was immersed in an aqueous solution containing 4 wt.% HTCC and 1 wt.% Dextran at room temperature. After 30 min, the gauze was removed, gently pressed to eliminate excess liquid, and dried at 70 °C. The samples were then thoroughly washed with DI water to remove loosely bound polymer, dried again in a hot-air oven, and stored in a clean, dry container for subsequent use (referred to as THD).

2. Air permeability

The air permeability of the modified gauze was assessed with a porosity tester (Global Engineering Corporation, GEC-P40113-B, India), wherein 200 mL of air was allowed to pass perpendicularly through the samples, and the total permeation time was recorded.

3. Moisture absorption and retention capabilities

The moisture absorption and retention capacities of the modified CG were investigated using DI water. To assess the moisture absorption capacity, both pristine and modified gauze samples (2 × 2 cm^2) were first dried in a hot air oven at 60 °C to eliminate residual moisture and weighed (W_i). The dried samples were then immersed in DI water at room temperature for 30 min to ensure complete saturation. After immersion, excess surface water was carefully blotted with tissue paper, and the samples were reweighed (W_o). The moisture absorption ratio (MAR) was subsequently calculated using Equation (1):

$$MAR\ (\%) = (W_o - W_i / W_i) \times 100 \quad (1)$$

Similarly, the moisture retention capability was determined by first drying the test samples in a hot air oven at 60 °C, followed by weighing (M_i). The samples were then immersed in DI water until equilibrium absorption was achieved. Thereafter, the samples were removed, placed on a clean Petri dish, and allowed to stand at room temperature. At predetermined time intervals, the samples were reweighed (M_0), and the residual water content was used to determine the moisture retention ratio (MRR) according to Equation (2):

$$MRR\ (\%) = (M_o - M_i / M_i) \times 100 \quad (2)$$

S2. Figures and Tables

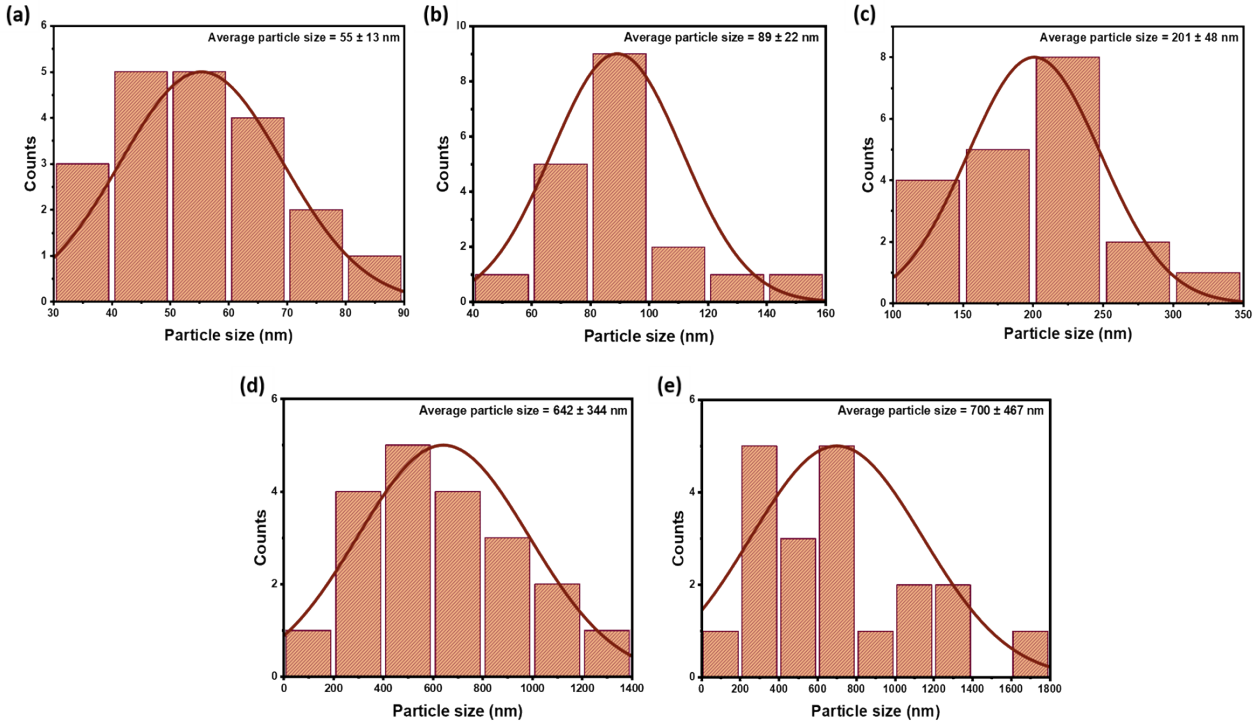

Figure S1. Particle size distribution histogram of (a) THD/Cu50, (b) THD/Cu100, (c) THD/Cu150, (d) THD/CuA30 and (e) THD/CuA60.

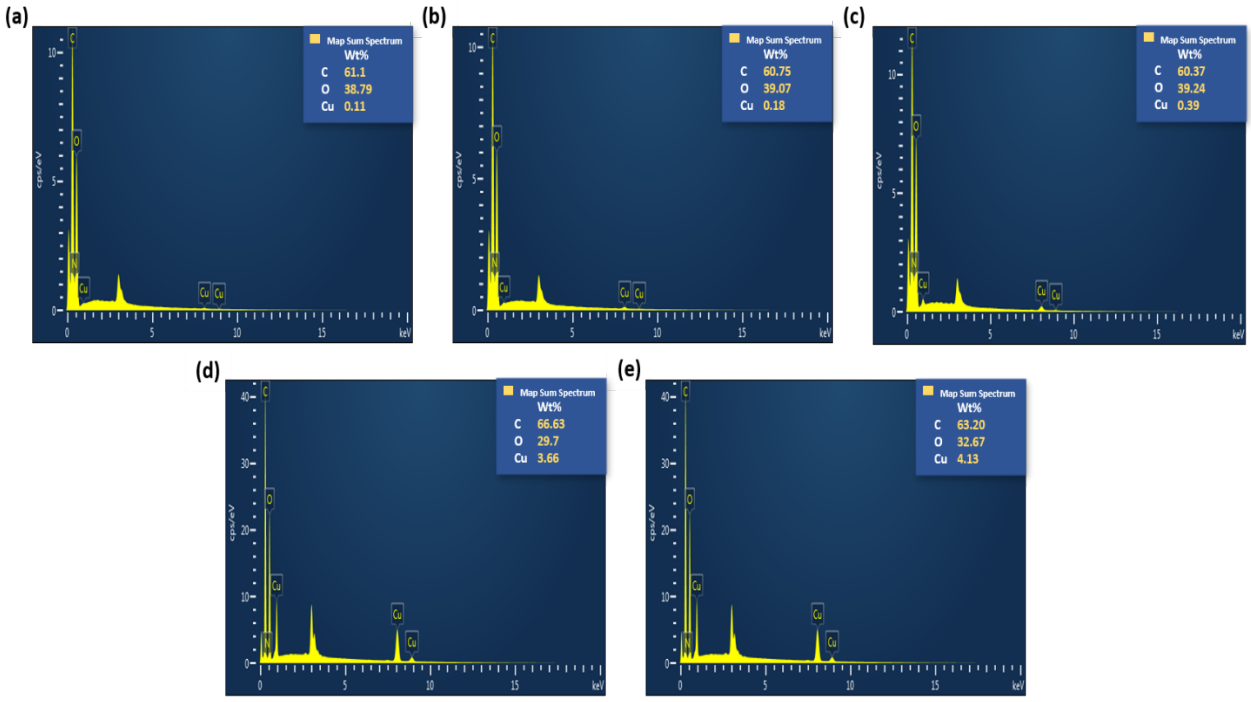

Figure S2. Energy-dispersive X-ray spectroscopy (EDXS) of (a) THD/Cu50, (b) THD/Cu100, (c) THD/Cu150, (d) THD/CuA30 and (e) THD/CuA60.

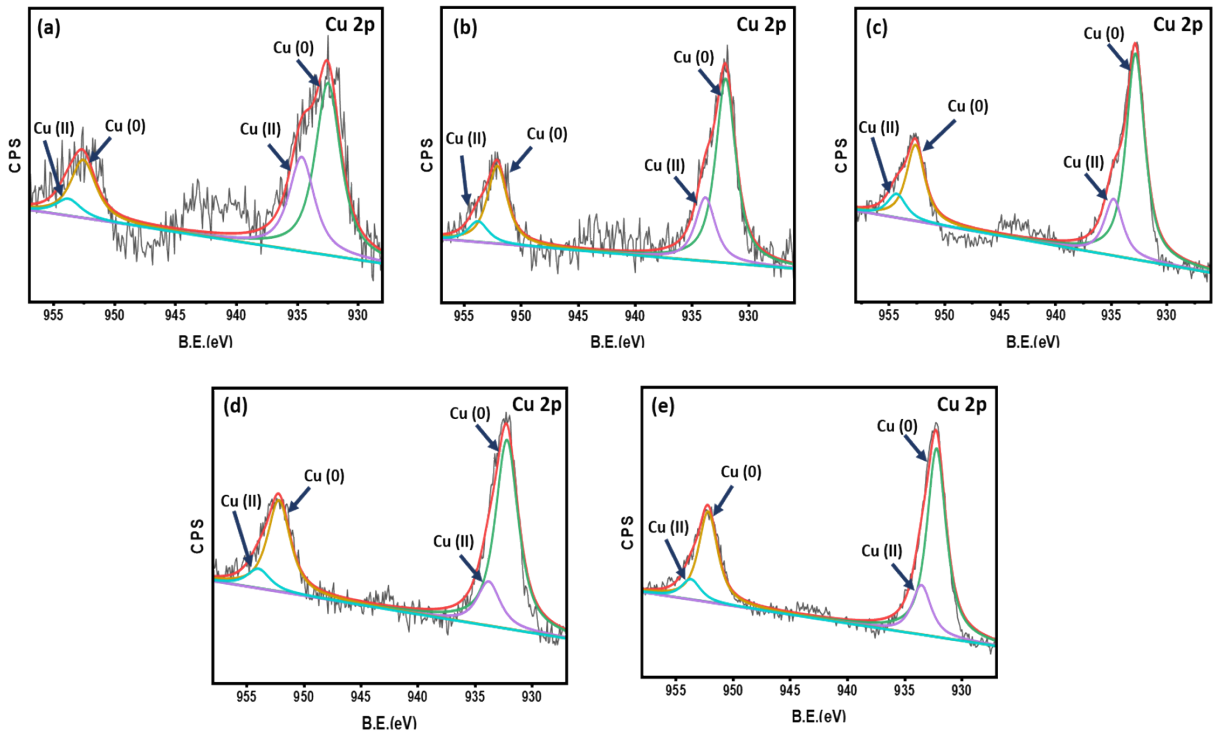

Figure S3. High-resolution Cu 2p spectrum showing oxidation states of Cu NPs on (a) THD/Cu50, (b) THD/Cu100, (c) THD/Cu150, (d) THD/CuA30 and (e) THD/CuA60 after 15 days of storage in a clean, airtight container.

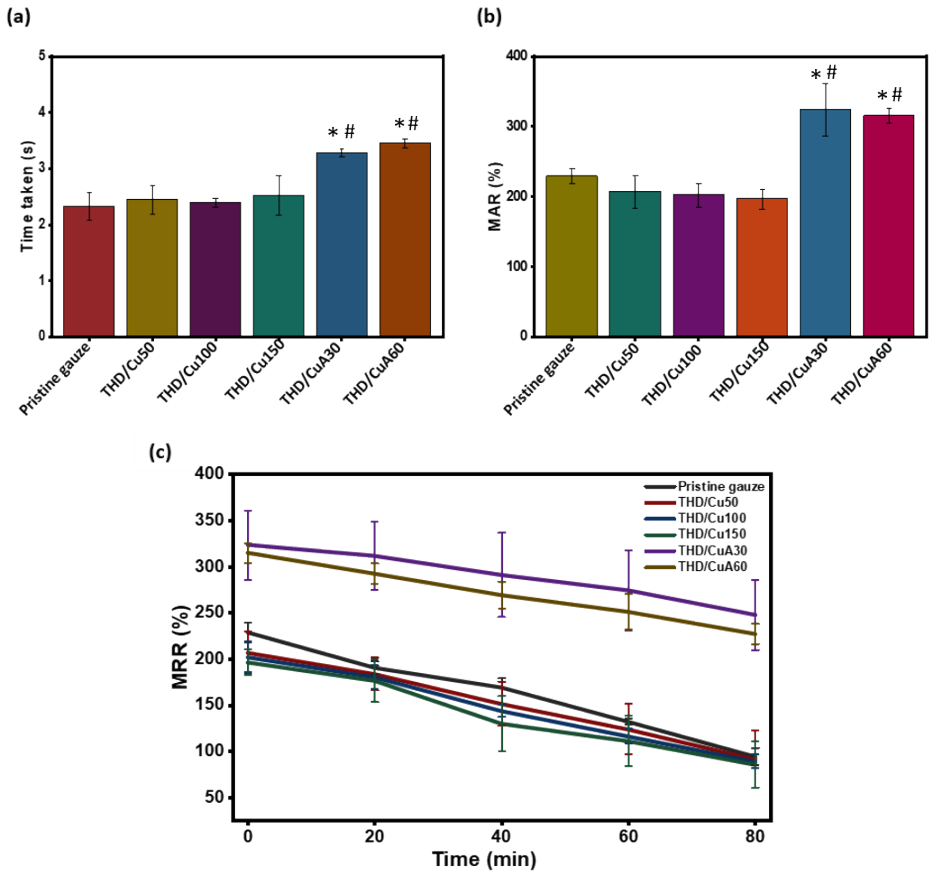

Figure S4. (a) Air permeability, (b) moisture absorption and (c) moisture retention capabilities of pristine and THD/Cu NPs-coated CG. * and # denotes significant difference compared to pristine gauze and THD/Cu samples (THD/Cu50, THD/Cu100, THD/Cu150) respectively and the exact *p* values are indicated as follows: Air permeability- THD/CuA30 (*p = 0.0013 and #p = 0.0041, 0.0023 and 0.0080 compared with THD/Cu50, THD/Cu100 and THD/Cu150 respectively) and THD/CuA60 (*p = 0.0003 and #p = 0.0009, 0.0005 and 0.0016 compared with THD/Cu50, THD/Cu100 and THD/Cu150 respectively); Moisture absorption- THD/CuA30 (*p = 0.02891 and #p = 0.01066, 0.008723 and 0.006953 compared with THD/Cu50, THD/Cu100 and THD/Cu150 respectively) and THD/CuA60 (*p = 0.04417 and #p = 0.01554, 0.01259 and 0.009928 compared with THD/Cu50, THD/Cu100 and THD/Cu150 respectively).

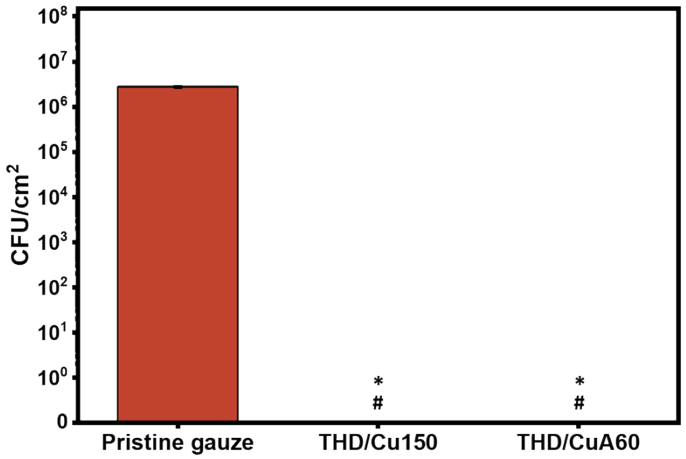

Figure S5. Quantitative analysis of viable *S. aureus* adhered to pristine, THD/Cu150 and THD/CuA60 CG, after being stored for over 6 months in a clean, airtight container at room temperature), followed by incubation in the bacterial suspension (~10^7 cells/mL in PBS) for 2 h at 37 °C. * denotes significant difference compared to pristine CG with $p = 4.193 \times 10^{-8}$ for THD/Cu150 and THD/CuA30. # denotes zero CFU observed.

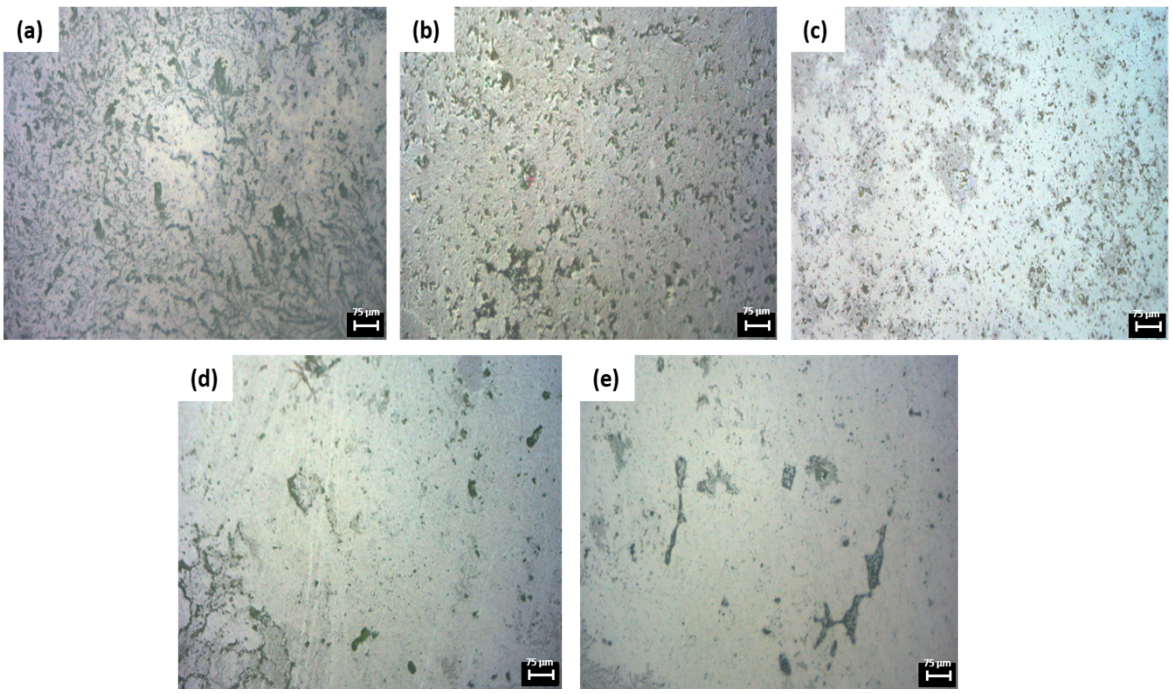

Figure S6. Optical microscopic images of biofilm formation on surfaces in contact with (a) pristine gauze, (b) THD/Cu50, (c) THD/Cu150, (d) THD/CuA30 and (e) THD/CuA60. The scale bar is 75 μm.

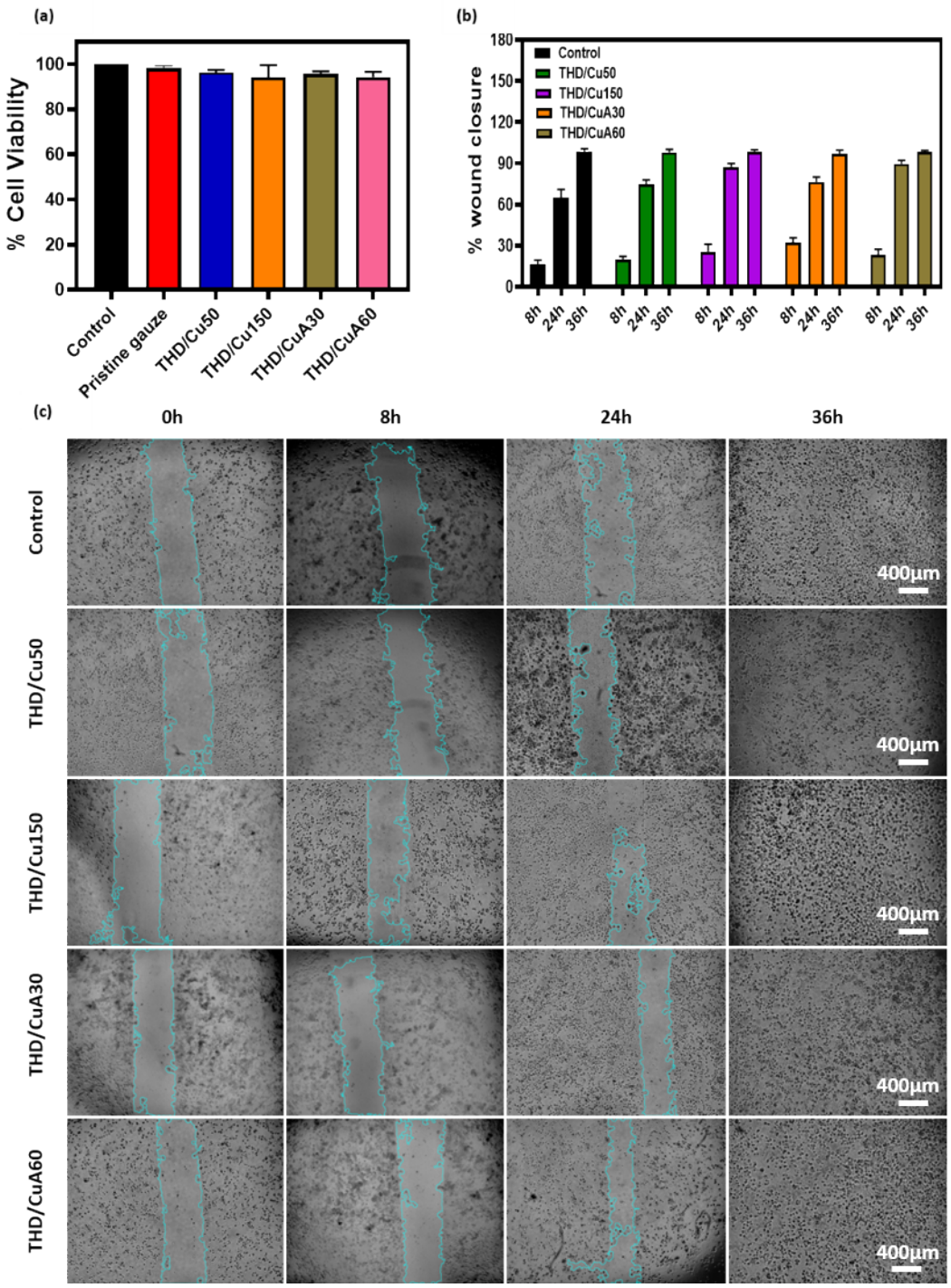

Figure S7. (a) Viability of NIH3T3 cells treated with pristine and modified gauze (THD/Cu50, THD/Cu150, THD/CuA30 and THD/CuA60), (b) wound closure rate and (c) microscopic images of cellular scratch post-treatment with pristine and THD/Cu NPs-coated CG samples. Scale bars are 400 μm.

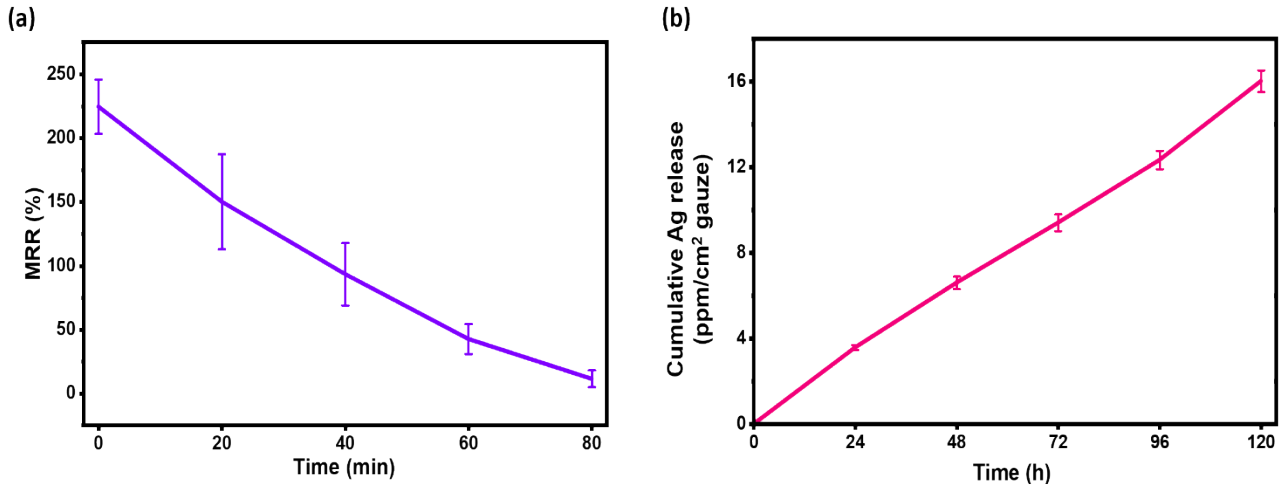

Figure S8. (a) Moisture retention capability of Acticoat™ assessed using DI water, (b) cumulative release profile of Ag from Acticoat™ in SWF over a period of 5 days.

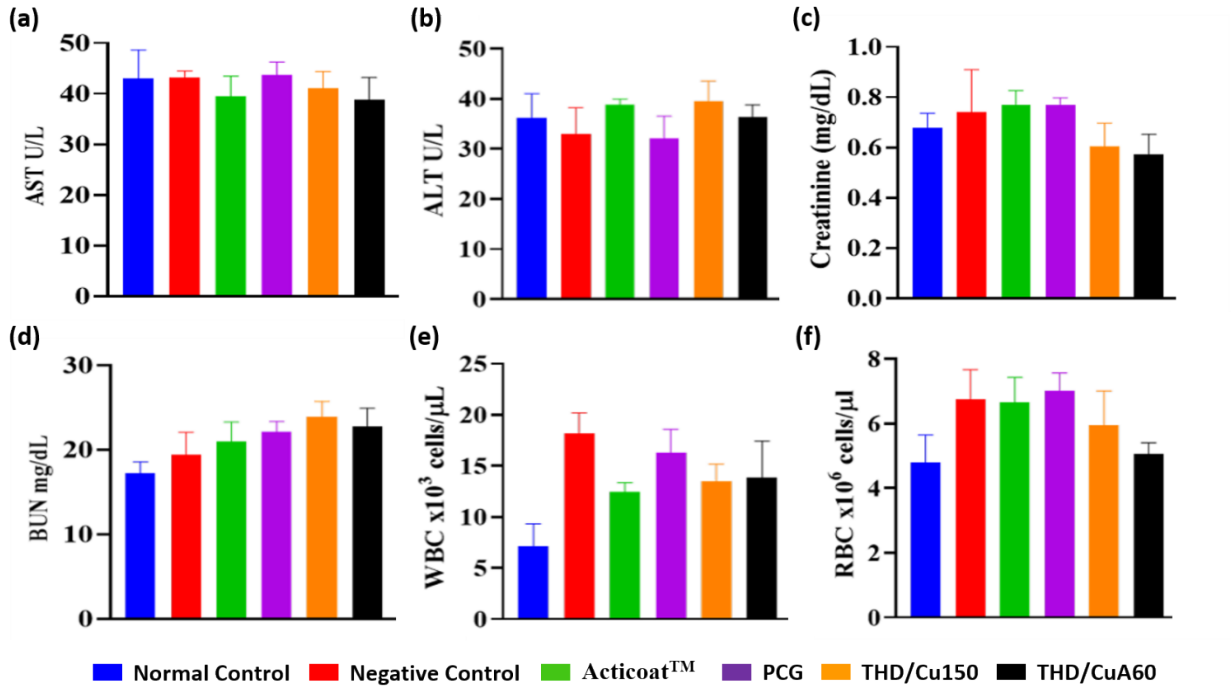

Figure S9. Evaluation of blood biochemical parameters of the animals from different treatment groups; (a) AST, (b) ALT, (c) creatinine, (d) BUN, (e) WBC count, (f) RBC count.