

Electronic Supplementary Information for

Fabrication of collagen scaffolds impregnated with sago starch capped silver nanoparticles suitable for biomedical applications and its physicochemical studies

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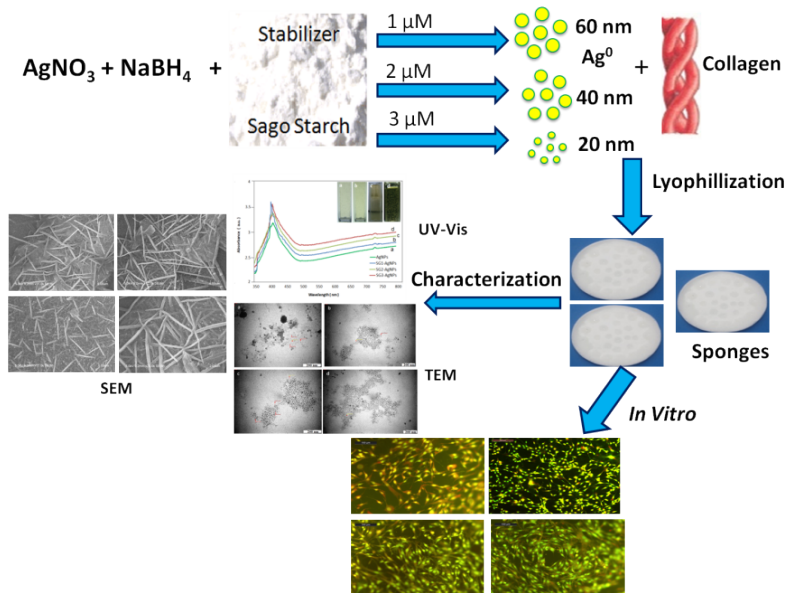


Fig. S1. Schematic representation of the fabrication and characterization of biocompatible collagen scaffolds impregnated with sago starch capped silver nanoparticles.

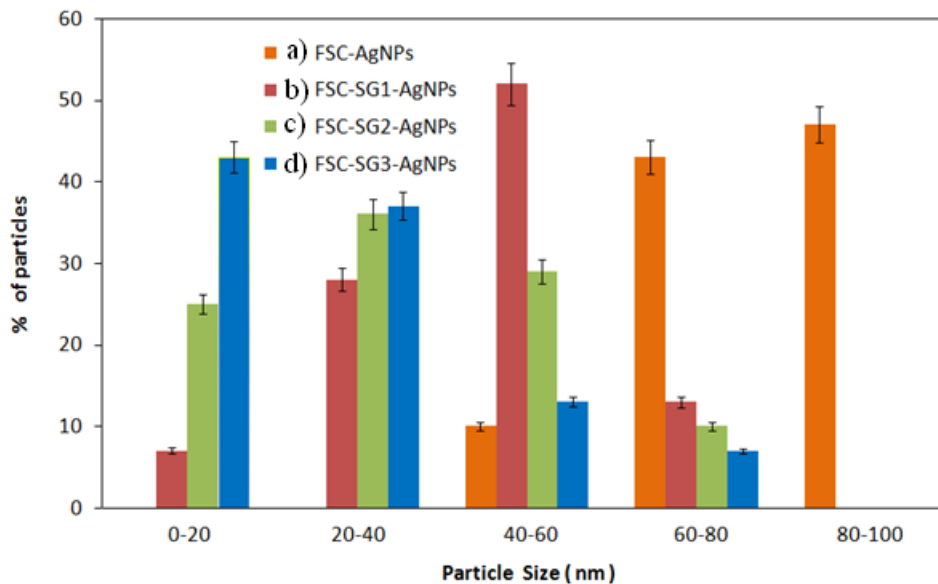


Fig. S2. Particle size analysis of synthesized silver nanoparticles: a) bare, b) 1 μM , c) 2 μM and d) 3 μM sago starch, respectively.

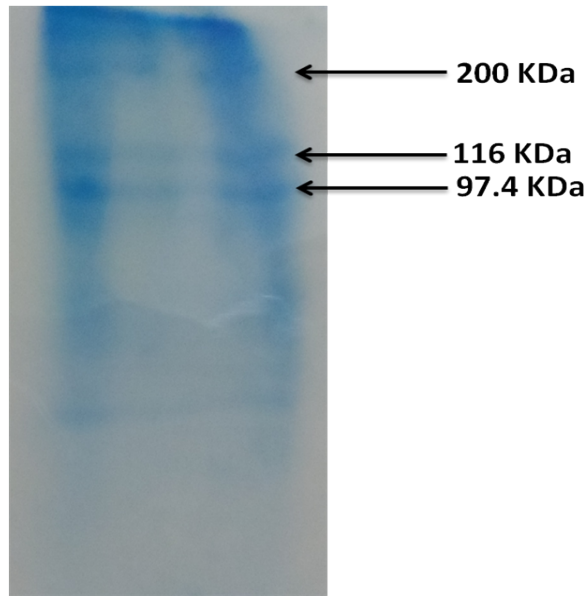


Fig. S3. SDS-PAGE of collagen isolated from the Lates Calcarifer fish scales.

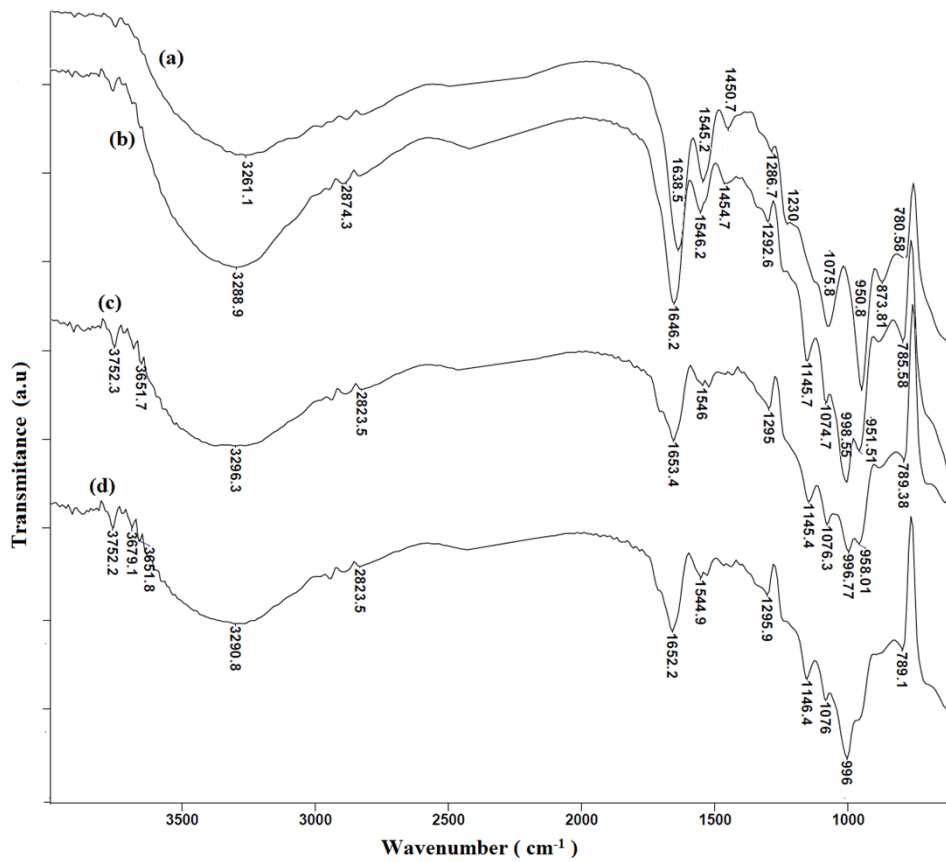


Fig. S4. ATR-FTIR spectra of various collagen based scaffolds: a) FSC-AgNPs, b) FSC-SG1-AgNPs, c) FSC-SG2-AgNPs and d) FSC-SG3-AgNPs, respectively.

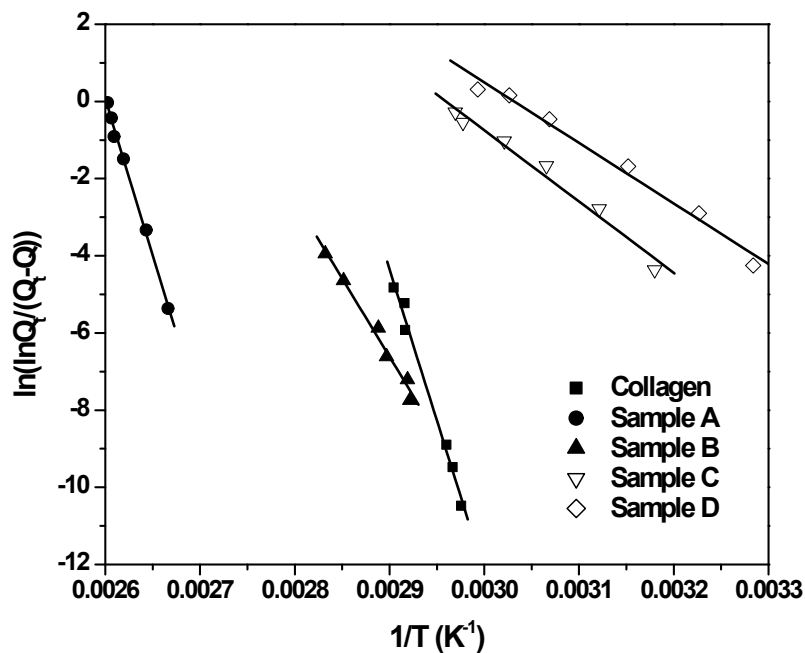


Fig. S5. Arrhenius plot for the first melting region (T_{m1}) for the prepared collagen and collagen-based scaffolds A, B, C, and D refer to the same as that in Figure 2.

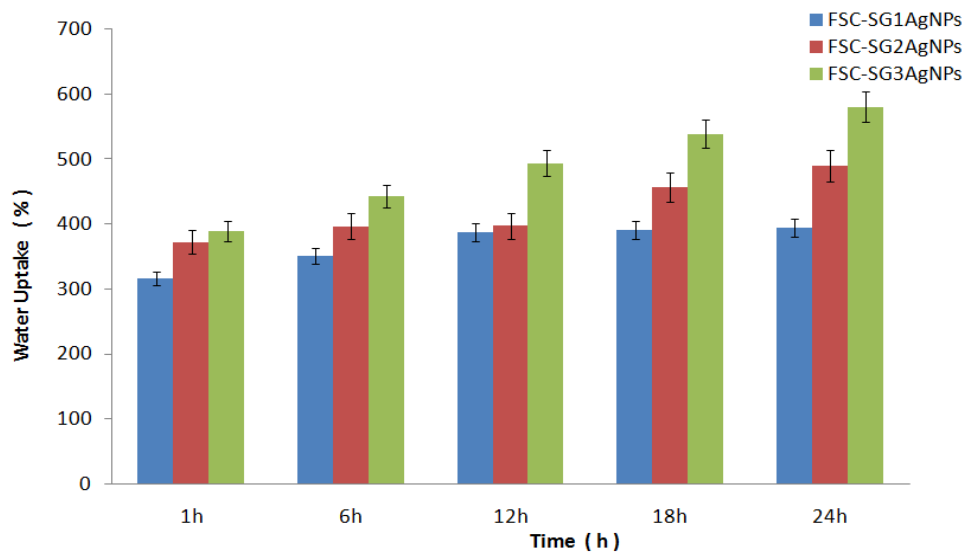


Fig. S6. The water uptake of the prepared scaffolds: a) FSC-SG1-AgNPs, b) FSC-SG1-AgNPs and c) FSC-SG1-AgNPs, respectively.

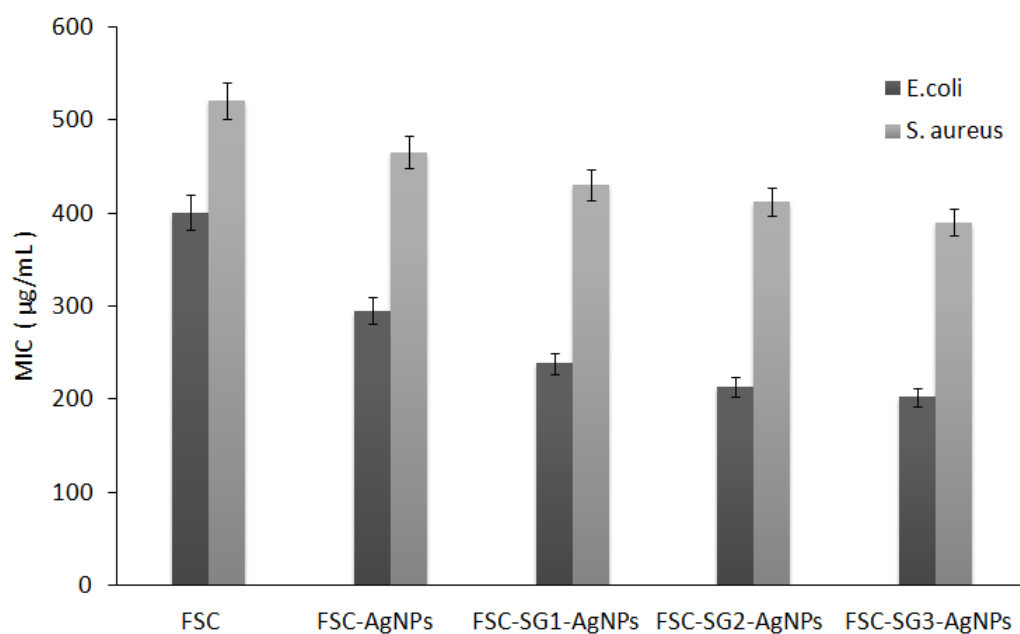


Fig. S7. The minimum inhibitory concentration (MIC) for collagen based scaffolds: **FSC**, FSC-AgNPs; FSC-SG1-AgNPs; FSC-SG2-AgNPs; and FSC-SG3-AgNPs tested against both gram positive and negative bacterial strains, respectively.

Table S1: The Zeta potential of AgNPs, and AgNPs capped by different concentrations of sago starch keeping the Ag concentration (0.01M) fixed during synthesis.

| Systems | Zeta potential (mV) |
|----------------|----------------------------|
| AgNPs | -15.2±0.5 |
| SG1-AgNPs | -20.1±0.8 |
| SG2-AgNPs | -21.4±0.6 |
| SG3-AgNPs | -23.3±0.5 |

Table S2: The ATR-FTIR spectroscopic data of uncapped AgNPs and different concentrations of sago starch capped AgNPs impregnated in fish scale collagen scaffolds (FSC) at 20°C

| Wavenumber (cm⁻¹) | | | |
|-------------------------------------|----------------------|----------------------|----------------------|
| FSC-AgNPs | FSC-SG1-AgNPs | FSC-SG2-AgNPs | FSC-SG3-AgNPs |
| 3753 | 3753 | 3752 | 3752 |
| 3261 | 3288 | 3296 | 3291 |
| | 2926 | 2927 | 2929 |
| 2878 | 2874 | 2824 | 2823 |
| 1638 | 1646 | 1653 | 1652 |
| 1545 | 1546 | 1546 | 1545 |
| 1450 | 1454 | 1454 | 1454 |
| 1286 | 1292 | 1295 | 1296 |
| 1230 | 1145 | 1146 | 1147 |
| 1075 | 1074 | 1075 | 1076 |
| 950 | 989 | 997 | 996 |
| 873 | 951 | 958 | 961 |
| 780 | 786 | 789 | 789 |

Table S3: Thermal parameters of the scaffolds: collagen, collagen/silver nanoparticles and collagen containing different concentrations of starch capped silver nanoparticles respectively.

| System | Thermal properties | | | | | | | |
|---------------------------|------------------------|-------------------------|-------------|--------|----------------------------|----------------|-------------------------|-------------------------|
| | T _d (°C) | T _{m1} (°C) | ΔH (J/g) | Slope | E _a (kJ/mol) | R ² | T _{m2} (°C) | T _{m3} (°C) |
| Fish scale collagen (FSC) | 38 | 91 | 69 | -78356 | 650 | 0.9902 | 122 | 225 |
| FSC-AgNPs | 52 | 121 | 94 | -81074 | 675 | 0.9962 | 156 | 227 |
| FSC-SG1AgNPs | 50 | 103 | 74 | -40529 | 337 | 0.9829 | 146 | 225 |
| FSC-SG2AgNPs | 45 | 101 | 34 | -18675 | 155 | 0.9780 | 145 | 220 |
| FSC-SG3AgNPs | 43 | 100 | 28 | -15699 | 131 | 0.9841 | 144 | 216 |

T_d= denaturation temperature; T_m= melting temperature; ΔH= enthalpy change; E_a= activation energy and R²= correlation coefficient.

Table S4: Thermogravimetric analysis of collagen, collagen-AgNPs and collagen-SG-AgNPs systems, respectively

| System | Weight loss% | Temperature Range |
|-------------------|--------------|-------------------|
| | 11.6 | 20-80 |
| Collagen | 5.7 | 80-255 |
| | 46.4 | 255-361 |
| | 17.0 | 361-568 |
| | 1.5 | 20-90 |
| Collagen-AgNPs | 12.5 | 90-190 |
| | 24.5 | 190-395 |
| | 6.0 | 395-550 |
| | 1.8 | 20-88 |
| Collagen-SG1AgNPs | 11.2 | 88-188 |
| | 27.0 | 188-315 |
| | 16.0 | 315-512 |
| | 2.5 | 20-85 |
| Collagen-SG2AgNPs | 9.0 | 85-180 |
| | 27.0 | 180-312 |
| | 16.0 | 312-500 |
| | 2.6 | 20-95 |
| Collagen-SG3AgNPs | 9.5 | 95-200 |
| | 29.0 | 200-297 |
| | 14.5 | 297-445 |

Table S5: Porosity of the collagen scaffolds impregnated with different concentration of sago starch capped silver nanoparticles. The values were expressed as mean \pm standard error (n=3).

| Scaffold Composition | Porosity (%) |
|----------------------|----------------|
| FSC-SG1-AgNPs | 86.8 \pm 2.1 |
| FSC-SG2-AgNPs | 89.6 \pm 1.7 |
| FSC-SG3-AgNPs | 91.3 \pm 1.3 |