ACCSCIENCE PUBLISHING

International Journal of Bioprinting

RESEARCH ARTICLE

# Development, characterization, and *in vitro* evaluation of TEMPO-oxidized microcellulose-based biomaterial inks for three-dimensional bioprinting

## Supplementary File

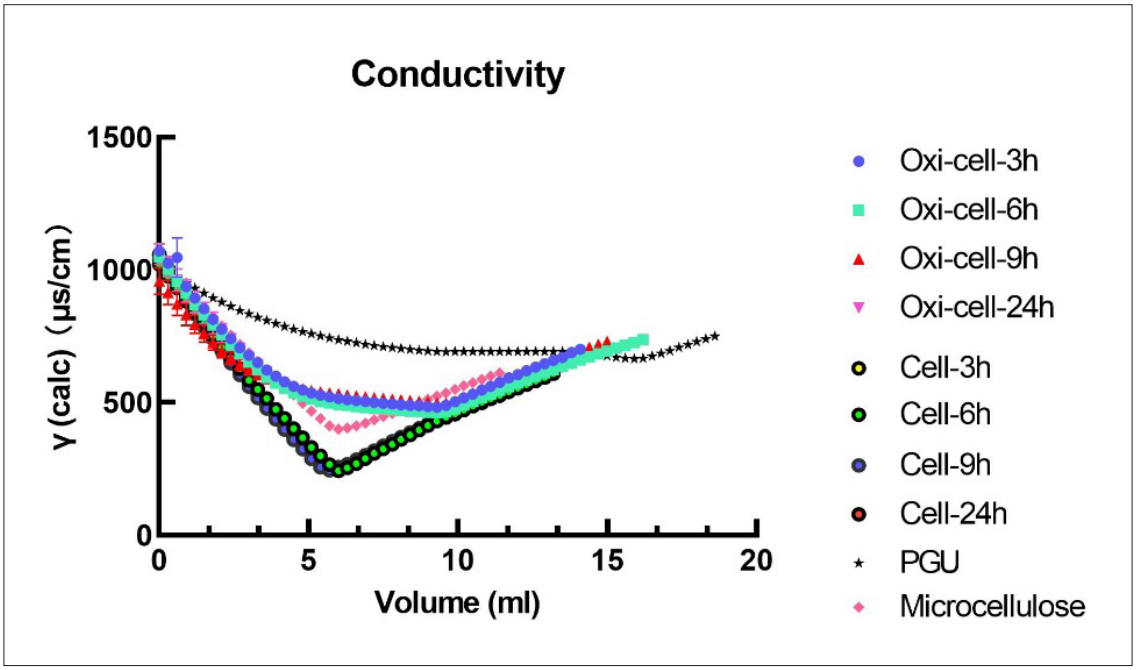


**Figure S1.** Conductivity analysis of microcellulose with and without 2,2,6,6-tetramethylpiperidine-1-oxyl radical oxidation, high pH control, and polyglucuronic acid (PGU). Abbreviation: Oxi-cell, oxidized microcellulose.

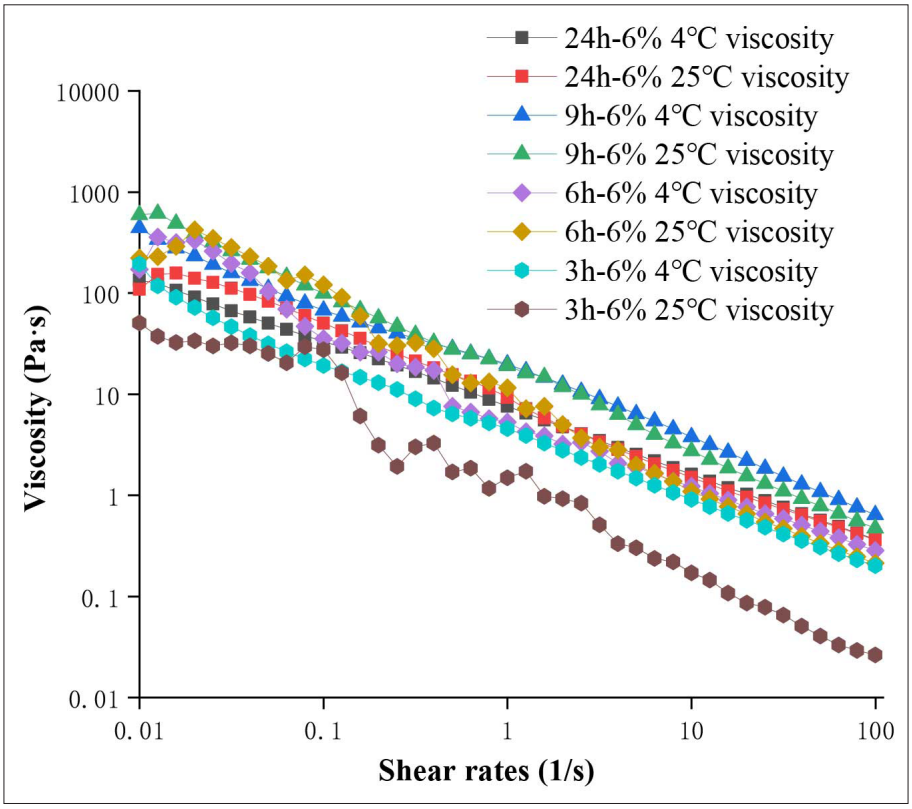


**Figure S2.** Flow behavior of cellulose aqueous solutions at a concentration of 6% (w/w) at different oxidation durations of 3, 6, 9, and 24 h at 4 and 25°C.

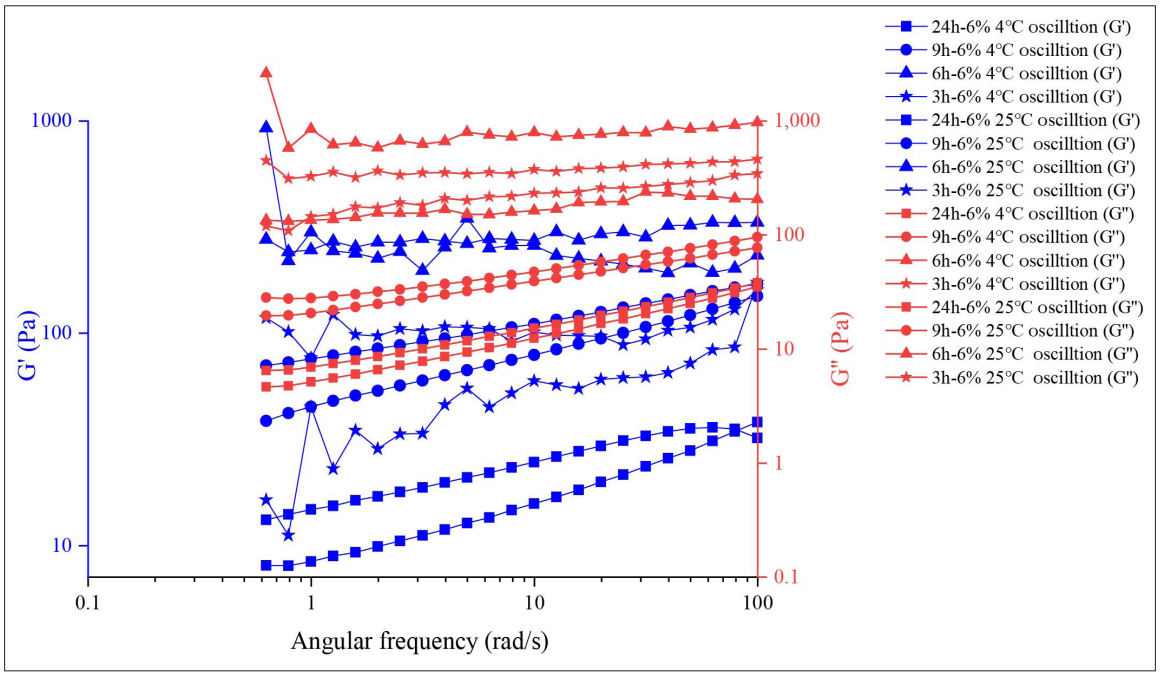


**Figure S3.** Storage modulus (*G*'), loss modulus (*G*") versus angular frequency (rad/s) of cellulose aqueous solutions at a concentration of 6% (w/w) with oxidation times of 3, 6, 9, and 24 h at 4 and 25°C.

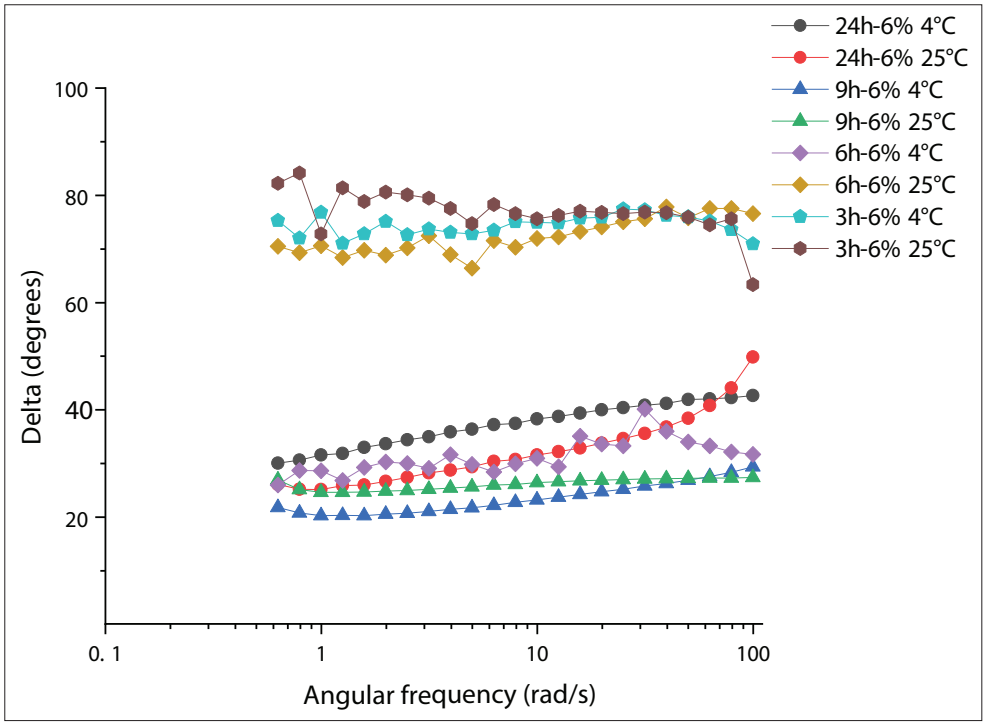


**Figure S4.** Tan delta (°) versus angular frequency (rad/s) of cellulose aqueous solutions at a concentration of 6% (w/w) with oxidation times of 3, 6, 9, and 24 h at 25°C.

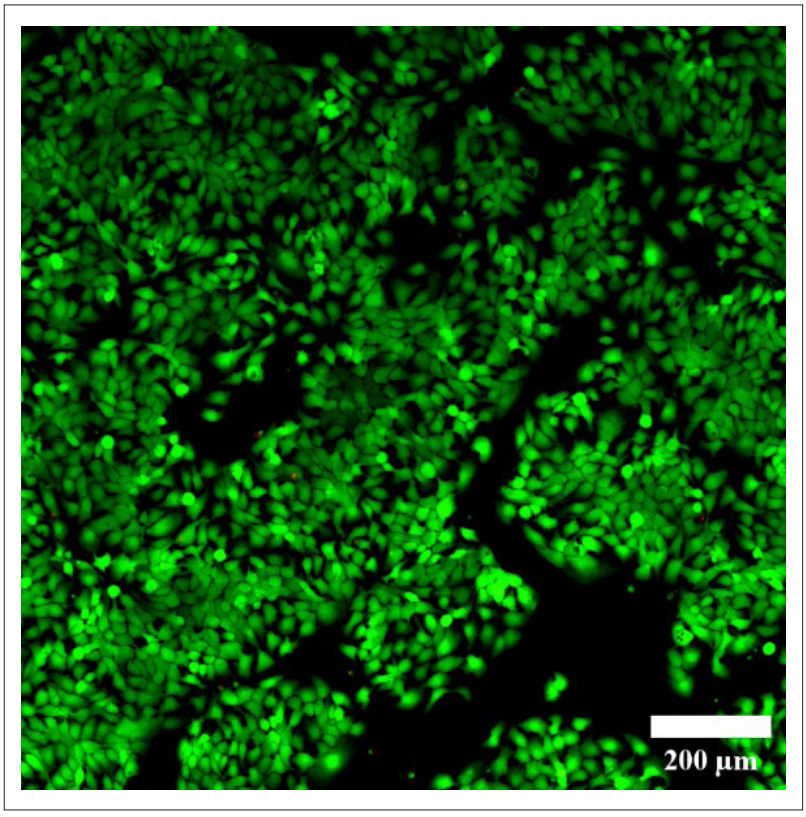


**Figure S5.** Confocal microscopy image of human keratinocytes exhibiting spindle morphology on a tissue culture plate. Magnification = 10×.

**Table S1. Degree of oxidation of microcellulose at different time points**

| Sample name | In vitro bioactive oxidized cellulose bioink | Degree of oxidation |
|---|---|---|
| Oxi-cell 3 h | 0.000900 | 62% |
| Oxi-cell 6 h | 0.000975 | 67% |
| Oxi-cell 9 h | 0.000975 | 67% |
| Oxi-cell 24 h | 0.000975 | 67% |
| PGU | 0.001425 | 100% |
| Cell 3 h | 0 | 0% |
| Cell 6 h | 0 | 0% |
| Cell 9 h | 0 | 0% |
| Cell 24 h | 0 | 0% |

Abbreviations: Oxi-cell, oxidized microcellulose; PGU, polyglucuronic acid.

**Table S2. Ostwald-de Waele model fitting parameters of 6% oxidized cellulose aqueous solutions at 4 and 25°C for oxidation durations of 3, 6, 9, and 24 h**

| Sample name (viscosity) | n | K | $R^2$ |
|---|---|---|---|
| 24 h-6% 4°C | 0.349 ± 0.004 | 7.350_±_0.086 | 1.000 |
| 24 h-6% 25°C | 0.289_±_0.018 | 8.574_±_0.427 | 0.994 |
| 9 h-6% 4°C | 0.196 ± 0.032 | 10.161_±_0.1648 | 0.997 |
| 9 h-6% 25°C | 0.167_±_0.023 | 14.72_±_0.443 | 0.997 |
| 6 h-6% 4°C | 0.204_±_0.037 | 7.617_±_0.777 | 0.979 |
| 6 h-6% 25°C | 0.117_±_0.033 | 9.965_±_0.900 | 0.987 |
| 3 h-6% 4°C | 0.306_±_0.014 | 4.466_±_0.175 | 0.996 |
| 3 h-6% 25°C | 0.123_±_0.042 | 1.344_±_0.153 | 0.979 |

Notes: *K* denotes the consistency index; *n* is the flow behavior index.

**Video S1.** Three-dimensional printability of oxidized microcellulose (5.7% w/w).