

Anti-infective Catheter Fabrication through Additive Manufacturing



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Background

- Catheter Associated Infections (CAIs) are the second major cause of death in haemodialysis patients and cause an increase in treatment cost.
- Conventional methods to tackle CAIs involve coated catheters, often coated with heparin, pyrogallol or silver nanoparticles. This creates additional manufacturing steps and requires a fine balance between coating thickness and sufficient release from the coating.
- 3D Printing is proposed as a method of creating patient specific catheters using drug loaded filaments with sustained release of drug.

Methods

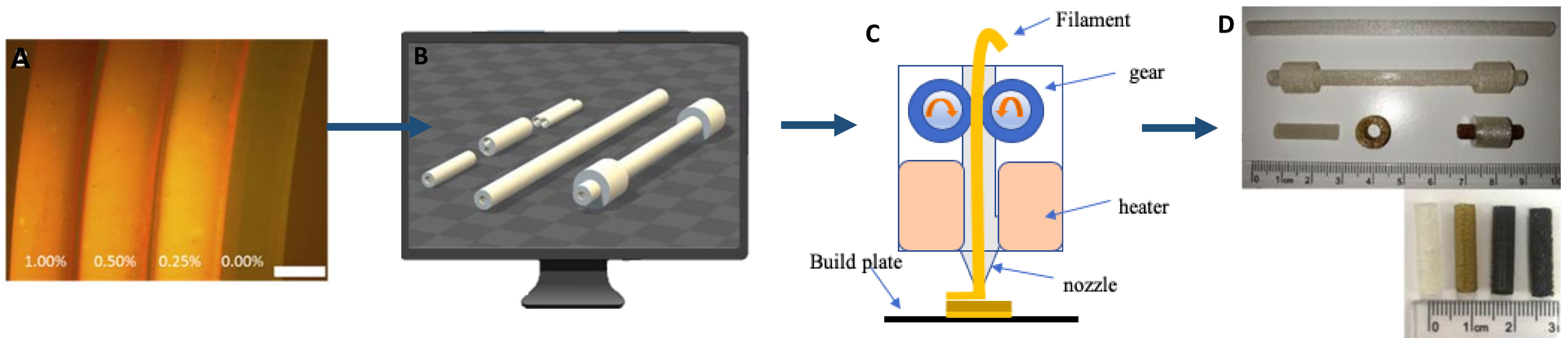


Fig. 1. Graphical summary of the methods of catheter fabrication. A) Extrusion of Tetracycline (TC) loaded filament B) Computer Aided design of catheters and cuffs C) Fused Deposition Modelling (FDM) Printing D) Printed Catheter constructs with increasing concentration of Tetracycline Drug

Release Studies

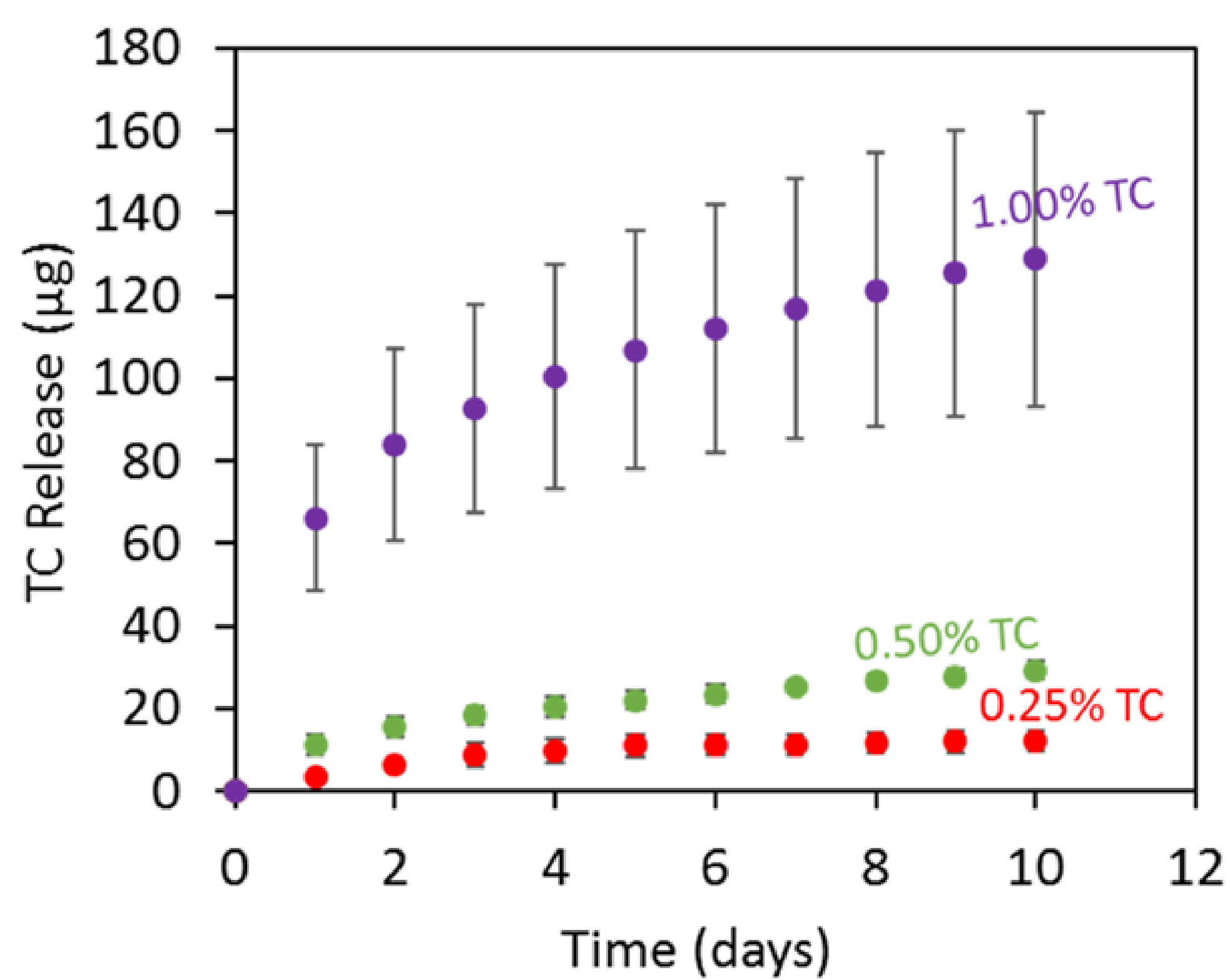


Fig. 2. Cumulative TC release from 3D-printed catheters containing 0.25, 0.5, and 1% of TC (means \pm S.D; n = 3).

Microbiology

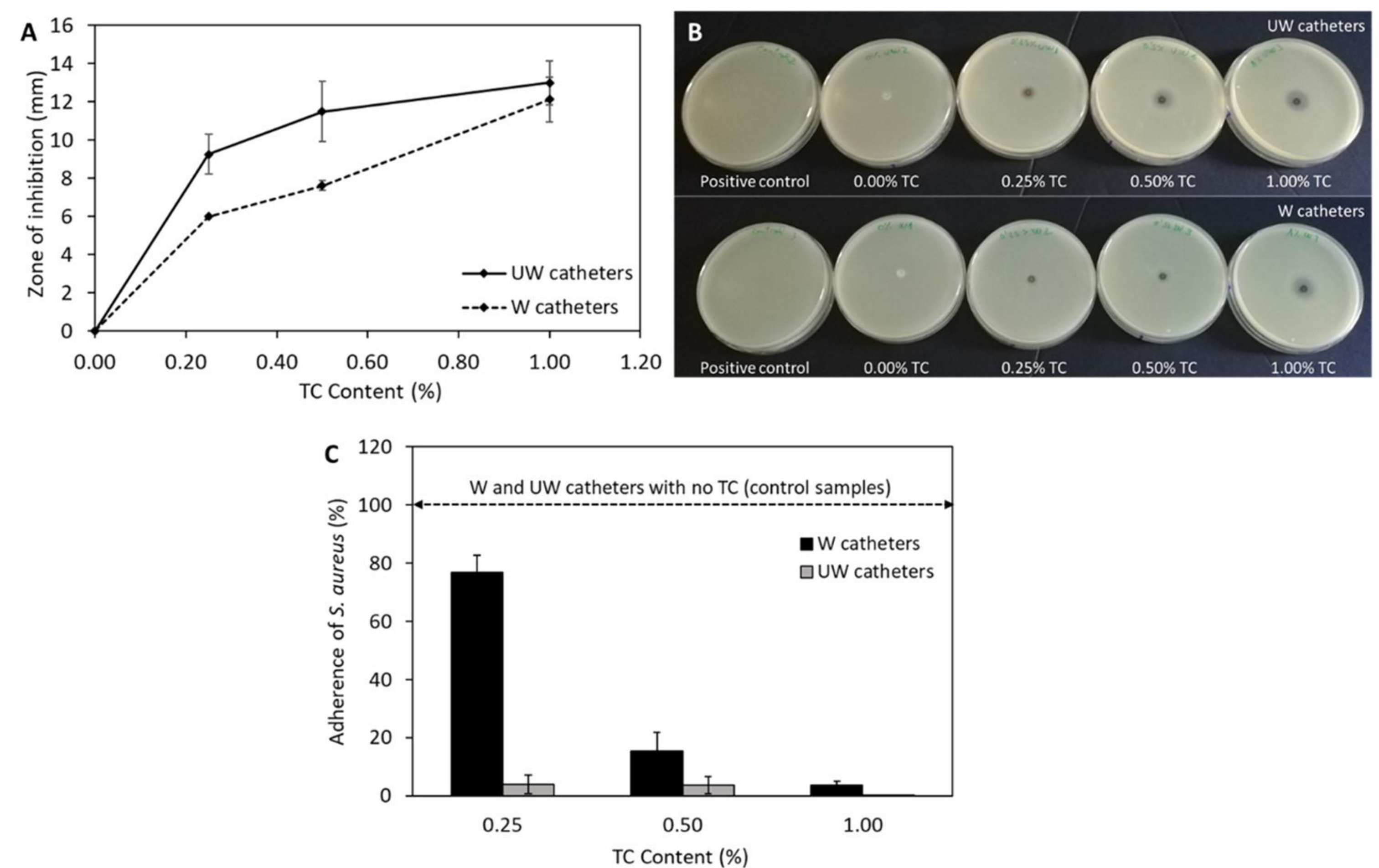


Fig. 3. A) Zones of inhibition created by washed (W) and unwashed (UW) catheter segments relative to TC concentration B) Positive *S. aureus* control and zones of inhibition created by W/UW catheter segments of varying concentrations of TC. C) Microbial adherence (%) of *S. aureus* to UW and W catheters after 24 h at 37 °C p(HEMA) and copolymers of 2-HEMA and conjugates 1–3 relative to the p(HEMA) homopolymer, denoted control, after 4 and 24 h incubations at 37 °C. Columns and error bars represent means \pm SD (n = 3).

Drug Distribution

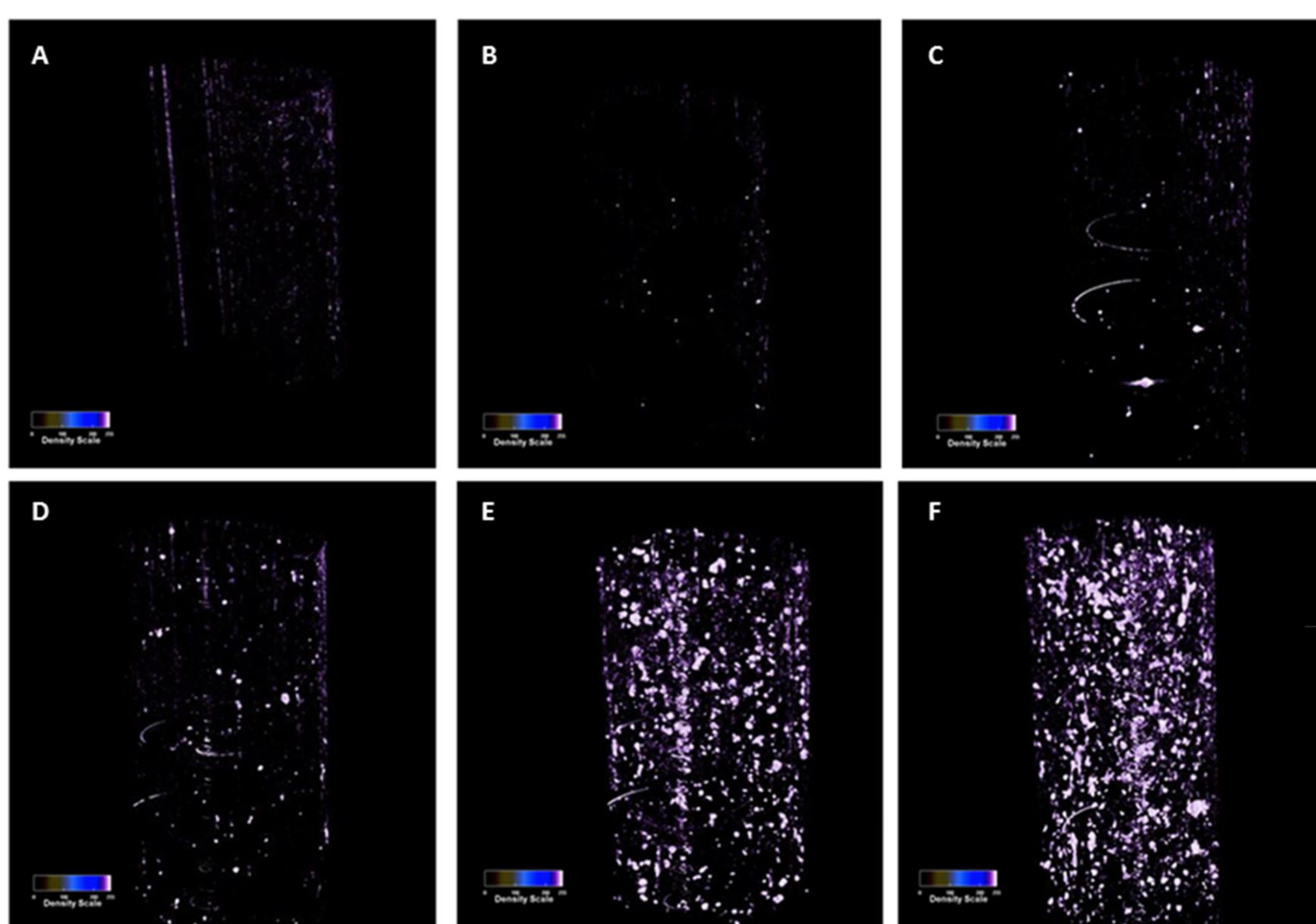


Fig. 4. 3D reconstruction of the drug distribution in the 3D-printed volume of the 0% TC W catheter (A), 0% TC UW catheter (B), 0.25% TC UW catheter (C), 0.5% TC UW catheter (D), 1% TC UW catheter (E), and 1% TC W catheter (F).

Conclusions

- TC can be effectively combined with TPU to create filaments for FDM Printing
- Catheter constructs could be 3D printed with inhibitory effect on *S. aureus* bacteria
- Catheters exhibited sustained release for a period of over 10 days

References

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