

# ELECTROSPUN NANOFIBRES FROM PAN AND BIOBASED POLYMER BLEND FOR POTENTIAL BIOMEDICAL APPLICATIONS

Lilia Sabantina<sup>1,2</sup>, Katharina Becker<sup>3</sup>, Nonsikelelo Sheron Mpofu<sup>1</sup>

<sup>1</sup> Department of Apparel Engineering and Textile Processing, Berlin University of Applied Sciences - HTW-Berlin, 12459 Berlin, Germany

<sup>2</sup> Department of Textile and Paper Engineering, Universitat Politècnica de València, Pza Ferrandiz y Carbonell s/n, 03801 Alcoy, Spain

<sup>3</sup> Department of Materials Engineering, Berlin University of Applied Sciences - HTW-Berlin, 12459 Berlin, Germany

## INTRODUCTION & AIM

Electrospinning enables the fabrication of continuous polymeric nanofibers with controllable diameters, high surface-to-volume ratios, and tunable porosity—properties that make them highly suitable for biomedical applications such as wound healing, tissue scaffolds, and drug delivery [1,2]. Polyacrylonitrile (PAN) is widely used as a base polymer for electrospinning because of its chemical resistance, mechanical strength, and excellent spinnability. Although PAN itself is biologically inert, its nitrile groups enable post-functionalization or blending with bioactive components to improve hydrophilicity and biological performance [3,4]. In a recent study by Mpofu et al. (2025), electrospun PAN nanofiber mats incorporating mushroom mycelium powder demonstrated that bio-based fillers can be successfully embedded into PAN nanofibers without losing fiber integrity, offering new prospects for hybrid biomedical materials [5]. Curcumin, a natural polyphenolic compound from *Curcuma longa*, exhibits antioxidant, antimicrobial, and anti-inflammatory activity [6,7]. However, its poor water solubility and bioavailability limit its direct application. Embedding curcumin within electrospun fibers allows controlled release and improved stability [8]. The present study investigates the fabrication of PAN/curcumin nanofibers with 1, 2, 3, 4, and 5 wt% curcumin and evaluates how increasing curcumin concentration influences solution behavior, fiber morphology, and jet stability, with the goal of developing functional nanofiber mats for biomedical applications.

## MATERIALS AND METHODS

### Electrospinning

Electrospinning solutions were prepared using 14–16 wt% PAN (X-PAN copolymer, Dralon, Dormagen, Germany) dissolved in dimethyl sulfoxide (DMSO, ≥99.9%, S3 Chemicals, Bad Oeynhausen, Germany). Curcumin powder (Nural Inh. S.Ural e.G., Langgöns, Germany) was added at 1, 2, 3, 4, and 5 wt% relative to the polymer mass. The solutions were magnetically stirred at room temperature until homogeneous. Electrospinning was conducted on a wire-based Nanospider Lab (Elmarco Ltd., Liberec, Czech Republic). The applied voltage was 60–70 kV, resulting in currents of 0.04–0.06 mA. The carriage speed was set to 100 mm/s and the distance between the wire electrode and the polypropylene collector substrate was 210 mm. The nozzle diameter was 0.9 mm, the ambient temperature 23–24 °C, and the relative humidity 32%. Each spinning run lasted 1 h.

### Characterization

The obtained nanofiber mats were analyzed via scanning electron microscopy (SEM) (JCM-IT 100, JEOL Ltd, Japan). Fiber diameter, bead formation, and surface uniformity were evaluated.

## RESULTS & DISCUSSION

At 1 wt% curcumin, smooth and uniform nanofibers were obtained with a morphology with some beads. As curcumin concentration increased, the viscosity of the spinning solution rose, leading to thicker fibers and occasional bead formation. Beyond 3 wt%, phase separation and electrostatic disturbances during spinning produced cotton-candy-like fiber agglomerates, an observation consistent with unstable jet formation caused by excessive viscosity and conductivity changes. At 5 wt%, continuous nanofiber production was no longer possible; instead, loose fibrous clusters and uneven deposits were formed. Color intensity of the mats shifted progressively from white (pure PAN) to deeper yellow with increasing curcumin loading, confirming successful incorporation. The overall trend aligns with prior studies showing that bio-additives in PAN systems (e.g., mycelium powder [5]) can alter solution behavior and morphology at high loadings. These findings indicate that up to 3 wt% curcumin can be successfully integrated into PAN nanofibers while maintaining structural integrity, making this composition promising for further biomedical evaluation.

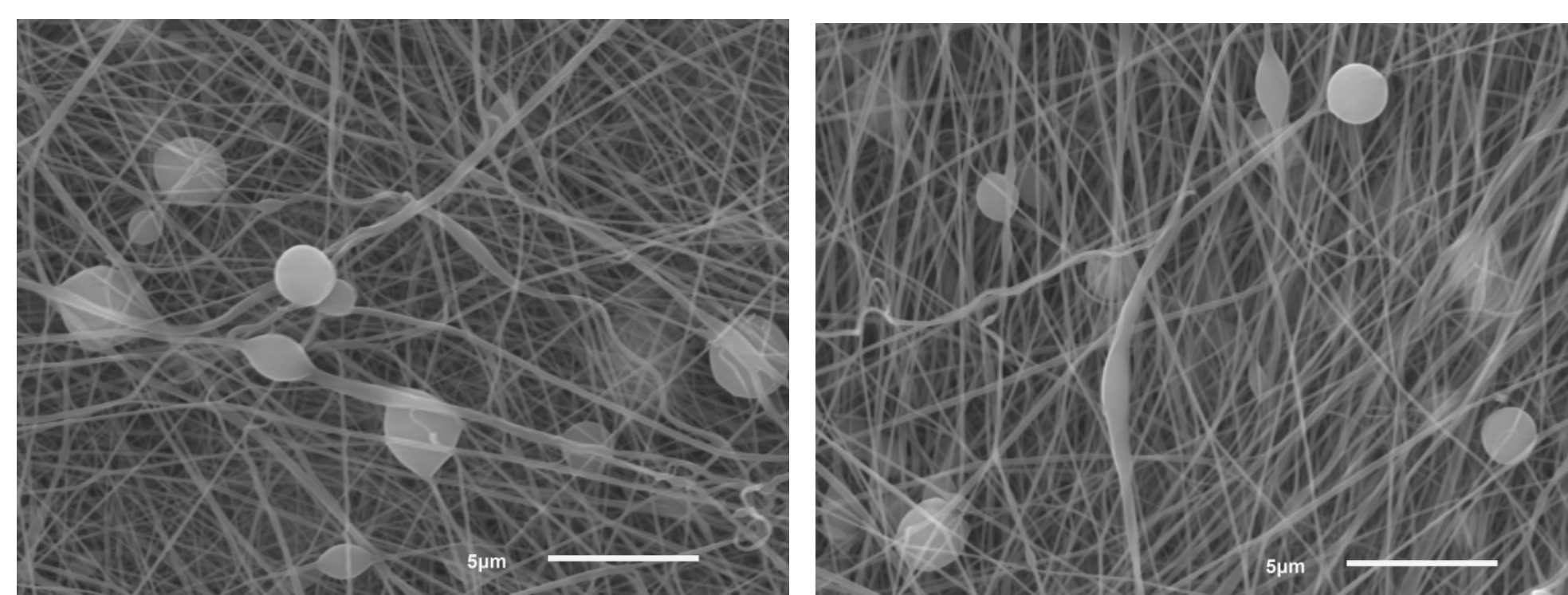


Fig. 1. SEM images of samples with 1 wt% curcumin and 4 wt% curcumin powder.

## CONCLUSION

Electrospun PAN/curcumin nanofiber mats were fabricated. Increasing curcumin concentration led to higher viscosity, larger fiber diameters, and bead formation, with severe instability observed above 3 wt%. The combination of PAN's mechanical robustness and curcumin's bioactivity offers potential for biomedical materials with controlled release or antimicrobial properties. Future work will include mechanical and thermal testing, curcumin release kinetics, and in-vitro biocompatibility assays.

## REFERENCES

1. Li, D.; Xia, Y. *Adv. Mater.* **2004**, *16*, 1151–1170.
2. Bhattarai, N. et al. *J. Control. Release* **2006**, *117*, 147–158.
3. Nataraj, S.K. et al. *Prog. Polym. Sci.* **2012**, *37*, 487–513.
4. Sabantina, L. et al. *J. Nanomater.* **2018**, *2018*, 6131085.
5. Mpofu, N.S. et al. *Eng. Proc.* **2025**, *87*, 45.
6. Anand, P. et al. *Mol. Pharm.* **2007**, *4*, 807–818.
7. Hewlings, S.J.; Kalman, D.S. *Foods* **2017**, *6*(10), 92.
8. Mitra, S. et al. *Polymers* **2022**, *14*, 881.