

PRESS RELEASE

Team at BRIC-inStem uncovers redox-controlled mechanism that actively regulates mitochondrial network shapes

A team of researchers from Dr. Sunil Laxman's lab at BRIC-inStem, Bengaluru has discovered a crucial link between cellular redox states and the shape of mitochondria — the tiny powerhouses of our cells. The findings, published in PNAS, reveal that shifts in intracellular redox levels can actively reshape mitochondrial networks through redox signaling, giving greater insights about how mitochondria respond to cellular stress.

Mitochondria constantly undergo dynamic changes — fusing into interconnected networks or fragmenting into smaller units — but the underlying mechanisms driving these changes have remained elusive. The new study, with Dr. Gaurav Singh and Dr. Vineeth Vengayil as co-first authors, Aayushee Khanna and Swagata Adhikary as co-authors and Dr. Sunil Laxman as corresponding author, shows that changes in the redox state, driven by metabolic electron flow and reactive oxygen species (ROS), regulate mitochondrial morphology. This control is fast and reversible.

Using advanced imaging and metabolic assays in yeast as a model system, the team have uncovered how increased electron flux into the mitochondrial respiratory chain — which raises cellular ROS levels — leads to a more oxidized environment and rapid mitochondrial fragmentation. This process is not a sign of dysfunction but a regulated response involving the mitochondrial fission machinery effected by the Dnm1 GTPase enzyme.

Understanding this redox-dependent remodeling of mitochondria opens new avenues for research into diseases where mitochondrial dysfunction plays a key role, such as neurodegenerative and metabolic conditions.

The discovery provides fresh insight into the fundamental biology of cells and could inform future therapeutic strategies aimed at modulating mitochondrial dynamics in disease.

Media Contact:

Dr. Sunil Laxman

Principal Investigator

BRIC-Institute of Stem Cell Science and Regenerative Medicine (inStem)

Email: sunil@instem.res.in

Phone: +91-80-23666580

Website: <https://sunillaxmanlab.weebly.com/>

Reference:

Singh G, Vengayil V, Khanna A, Adhikary S, Laxman S. Active control of mitochondrial network morphology by metabolism-driven redox state. Proceedings of the National Academy of Sciences. 2025 Apr 22;122(16):e2421953122.

Link to publication: <https://www.pnas.org/doi/10.1073/pnas.2421953122>