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IIT Kanpur develops novel sensor to study how medicines activate vital receptors

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Opens up new possibilities for advanced drug discovery and therapeutic innovation



Researchers at the Indian Institute of Technology Kanpur (IIT-K) have developed a novel antibody-based biosensor that can monitor the activation of G protein-coupled receptors (GPCRs) in live cells. GPCRs are the largest family of receptor proteins in human cells and are targeted by more than one-third of all clinically prescribed medicines.

Led by Prof. Arun K. Shukla, the research team has been investigating GPCR biology for over a decade. GPCRs, because of their central role, are considered some of the most important gateways for developing new drugs and therapies. The new biosensor represents a significant milestone in overcoming the technical challenges of monitoring receptor activation inside living cells.

GPCRs typically remain inactive until they receive a signal, such as light, hormones, or small molecules, that activates them to transmit signals across the cell membrane. This process, known as signal transduction, is central to human physiology. However, studying these activations in real-time within live cells has been difficult.

To address this, the IIT Kanpur team developed an engineered antibody (nanobody) sensor that binds to GPCRs only upon activation and in association with arrestins. When the receptors are activated by their ligands, the nanobody comes into close proximity, triggering an enzymatic reaction that produces a measurable luminescence signal.

“The beauty of this biosensor is that it does not require any modification of GPCRs, and still, it can report their activation by ligands. This opens up possibilities for imaging these receptors in disease contexts,” said Prof. Arun K. Shukla, Professor, IIT Kanpur who led the study.

The project was carried out in collaboration with Prof. Josef Lazar’s laboratory at the Institute of Organic Chemistry and Biochemistry, Czech Academy of Sciences, Prague. It was supported by an Indo-Czech joint research initiative funded by the Department of Science and Technology (DST), Government of India.