NANOZYMES – SCIENCE & TECHNOLOGY

News: The CSIR-Central Leather Research Institute in Chennai has made significant advancements in the field of nanozymes.
They have shown how nanozymes can revamp collagen-based biomaterials.

What's in the news?

What is collagen

Collagen is a primary structural protein in the body. it provides support and elasticity to skin, bones, tendons, and other connective tissues. It plays a crucial role in maintaining the strength and integrity of these tissues.

It **is crucial for medical applications such as wound healing and tissue engineering**.

What is Collagen Crosslinking?

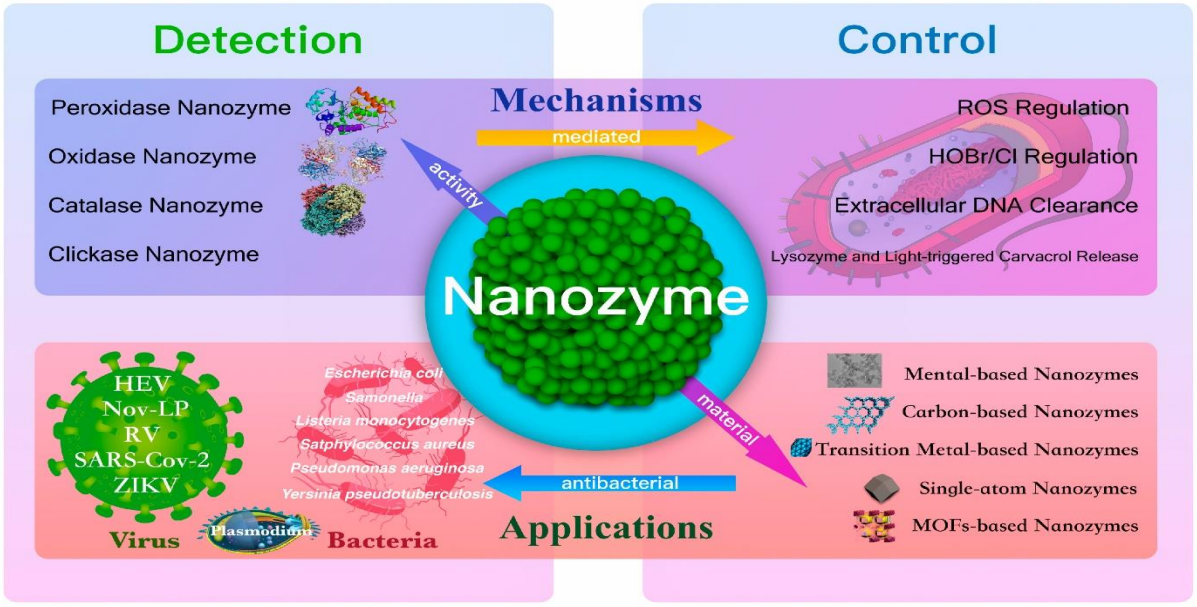
Collagen cross-linking involves **chemically bonding collagen fibers to enhance their strength and stability.** This technique is often used in medical treatments, such as in the cornea for treating keratoconus.

Traditional methods of crosslinking collagen often involve harsh chemicals or extreme conditions. These can degrade the protein's natural structure and lead to toxicity.

Recent advancement

The CSIR-CLRI team has demonstrated that a manganese-based oxidase nanozyme (MnN) can crosslink collagen under mild conditions. This requires a trace amount of tannic acid. This process preserves the collagen's natural triple-helical structure (essential in medical applications).

One of the major challenges with collagen-based biomaterials is their susceptibility to degradation by enzymes like collagenase. The MnN nanozyme has been shown to significantly enhance the material's resistance to enzymatic degradation.



About Nanozymes

Nanozymes are **nanomaterials that mimic the function of natural enzymes. They offer several benefits over traditional chemical processes**, such as enhanced specificity, efficiency, and biocompatibility.

Enzymes are proteins that act as biological catalysts by accelerating chemical reactions. The molecules upon which enzymes may act are called substrates. Enzyme converts the substrates into different molecules known as products.

Their activity can be influenced by several factors, such as pH, temperature, the concentration of substrates, and even external stimuli like magnetic fields or light. This adaptability makes them highly versatile for various applications.

Types of Nanozymes

- **Metal-based Nanozymes**: These include nanoparticles made from metals like gold, silver, and platinum.
- **Metal Oxides**: Compounds like iron oxide have been widely used for their peroxidase-like activity and potential in biomedical applications.
- **Metal-Organic Frameworks (MOFs)**: These are composed of metal ions coordinated to organic ligands.
- **Carbon-based Nanozymes**: Including graphene oxide and carbon nanotubes.
- **Polymer and Peptide Nanozymes**: These are less common but have potential due to their biocompatibility and specific functionalities.

Applications

- Nanozymes are **used in biosensors** for detecting glucose, cholesterol, and other biomolecules.
- They are **being explored for cancer therapy** to kill cancer cells or as drug delivery vehicles with targeted activation.
- **Theranostics** is a combination of diagnostic and therapeutic applications where nanozymes are used for disease detection and treatment simultaneously.
- Nanozymes are **effective in breaking down pollutants such as dyes and pesticides in water.**
- They can be used in the **catalytic breakdown of hazardous substances in industrial waste, making them environmentally friendly alternatives.**
- Nanozymes are **used in various industrial processes for catalysis**, including chemical synthesis and fuel cells, due to their ability to catalyze reactions under mild conditions.

Source: https://www.thehindubusinessline.com/business-tech/how-nanozymes-are-revamping-collagen-based-biomaterials/article68670047.ece