# Hydrogels with Tunable Bactericidal Activities



Recently, researchers at the **Indian Association for the Cultivation of Science (IACS), Kolkata** has fabricated Hydrogels which can be tuned with different bacteria-killing properties.

- These hydrogels were fabricated when the naturally occurring nucleoside molecule cytidine was self-assemble into a hydrogel in the presence of **silver acetate and phenylboronic acid.**

  This hydrogel was found to exhibit antibacterial activity against Gram-negative bacterial strains such as E.coli.
- **Silver Acetate**
  - Silver is known to have **antibacterial property** but it may not be used due to its **toxicity.**
  - However, when silver acetate was incorporated in the hydrogel the toxicity was reduced and thus suitable for treating bacterial infections.
  - The hydrogel with the presence of silver reduces the cell size of the E.coli and disrupts its cell membrane, leading to leakage of cellular contents.
  - The **hydrogel containing silver acetate** was found to be **non-toxic** to normal kidney epithelial cells and red blood cells.
- **Boronic Acid**

  By changing the Boronic Acid component in Hydrogel, a large number of hydrogels with different bacteria-killing properties can be created.

## Unique Physical Properties of the Hydrogel

**Thixotropic property**

- It is an ability to **change a gel to a sol phase** when subjected to **mechanical shaking or stirring.** When allowed to stand, it returns to its original gel phase.
- The property of certain gels or fluids that are thick or viscous under static conditions and becomes fluid (become thin, less viscous) over time when shaken, agitated, sheared or otherwise stressed is **termed as Thixotropy.** E.g. Paint, the fluidity vanishes quickly and the surface sets permanent as water (or oil) evaporates.

**Sol**

- Sol is a **colloid** (aggregate of very fine particles dispersed in a continuous medium) in which the particles are solid and the dispersion medium is fluid.
- If the dispersion medium is water, the colloid may be called a hydrosol and if air, an aerosol.
- They do **not settle** or separate over time
- They display the **Tyndall effect.**
    - Tyndall effect is a phenomenon of scattering of a beam of light by a medium containing small suspended particles—e.g., smoke or dust in a room, which makes visible a light beam entering a window.
    - This effect is exhibited by all colloidal solutions and some very fine suspensions. Therefore, it can be used to **verify if a given solution is a colloid.**

**pH-Responsive**

- The hydrogel is stable between pH 3 and 6, whereas it becomes unstable at more acidic or alkaline pH.
- The low pH helps to increase intrinsic antibacterial activities as well as changing the pH would act as an external stimulus for drug delivery through hydrogels.

## Uses of Hydrogel

- It can be used for drug delivery applications.
- Intrinsic antibacterial activities.
- Cancer drug chemotherapy

**Indian Association for the Cultivation of Science (IACS)**

- Indian Association for the Cultivation of Science (ICAS) is the **oldest institute** in India devoted for research in frontier **areas of basic sciences.**
- It was founded in 1876.

- It is here that Professor **C V Raman discovered the celebrated Raman Effect for which he was awarded the Nobel Prize in Physics in 1930.**

  **The Raman Effect** is a **change in the wavelength** of light that occurs when a light beam is **deflected by molecules.**

**E.Coli Bacteria:**

- It is a **Gram-negative, anaerobic, rod-shaped bacteria**.
- It is commonly found in the lower intestine of warm-blooded organisms.
- Most E. coli strains are harmless, but some serotypes can cause serious food poisoning in their hosts.

**Source: TH**