

## ABSTRACT

*Cynanchum tunicatum* (Retz.) Alston is a rare medicinal plant known for its therapeutic potential, has significant attention due to its biologically active compounds with various pharmacological properties. In this present study, macroscopic character feature and internal structure of leaf, stem and root were analysed. Optimization of sterilization techniques used for to overcome the low germination percentage. Hence, optimization enhanced the *in vitro* seed germination of *C. tunicatum* with different concentration of sodium hypochlorite (NaHClO<sub>3</sub>) and mercuric chloride (HgCl<sub>2</sub>). Abiotic factors were also standardized using Response Surface Methodology (RSM). The seeds of *C. tunicatum* were inoculated on MS medium absence of PGRs. With the help of abiotic factors, the maximum germination rate (96%) was achieved. *In vitro* explants such as leaves, nodes, internodes and root were produced friable and organogenic calli, these calli were used for micro-propagation. Somatic embryos were obtained and different stages were analysed with the help of microtome sectioning. The *in vitro* seed germination and micropropagation studies have been proven capable of promoting disease free plants.

This study explored the phytochemical profiling, biological activities, and potential applications of *C. tunicatum* extracts in pharmaceutical and biotechnological fields. Qualitative and quantitative phytochemical analysis revealed the presence of alkaloids, flavonoids, terpenoids and phenolic compounds in both wild plant and *in vitro* calli, which contribute to its antioxidant, anti-microbial, anti-inflammatory and anti-cancer properties. Molecular docking revealed the discovery of new drug from *C. tunicatum*. Bioactive compounds were obtained from GCMS analysis of *C. tunicatum* associated with the primary drug pathway for human colorectal cancer. The highest affinity score was achieved between chromone and 6GUE protein responsible for cancer. The findings underscored the potential of *C. tunicatum* as a promising candidate for future drug formulation for cancer.