**Highlights:**

* Gold nanoparticles (Au NPs) have been synthesized using a facile, fast and single step advanced hydrothermal method.
* In the synthesis part, we used biomaterial: *Elaeocarpus ganitrus* seeds extract as reducing and stabilizing agent.
* Au NPs were non-toxic to *Elaeocarpus ganitrus* and are environmentally safe.
* The synthesized nanoparticles showed promising antibacterial, antioxidant and anticancer activity against PC-3 cell lines.