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# Recent advances in Nano biotechnology: A review

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**Abstract**
In the modern era of industrialization and pollution, as new diseases outbreaks day by day, it is important to find novel treatment system. Nanobiotechnology has been proved for its better application in biology and medicine. This paper reviews three recent works on Nanobiotechnology that has been illustrated the successful application of Nanomaterials and Nanotools against current biological problems. Yang Yue *et al*. tested the biological effect of toxic nanoparticle in fish cell and algal cell. And it is proved that the action of certain protein in the algal cell membrane prevents its action in the algal cell, while the fish cell gets affected. Savita Bisht has illustrated the successful application of nanoparticle encapsulated curcumin or "Nanocurcumin" against cancer. Sangeetha and Kumaraguru have synthesized metal nanoparticle from seaweeds. All these findings support the same fact that Nanobiotechnology has become a vital field in modern biology and medicine.

**Keywords:** Levonorgestrel; Kromasil; ACN; Methanol``; Stability-indicating; Related substances; ICH guidelines; HPLC

## Introduction
Nanobiotechnology, Bionanotechnology, and Nanobiology are terms that refer to the intersection of Nanotechnology and Biology. Nanobiotechnology has only emerged very recently, Bionanotechnology and Nanobiotechnology serve as blanket terms for various related technologies [Ehud 2007] [1].
Nanobiology includes Nanodevices (such as biological machines), Nanoparticles, and Nanoscale Phenomena that occurs within the discipline of Nanotechnology. This technical approach to biology allows scientists to imagine and create systems that can be used for biological research. Biologically inspired Nanotechnology uses biological systems as the inspirations for technologies not yet created. However, as with Nanotechnology and Biotechnology, Bionanotechnology does have many potential ethical issues associated with it.
The twin fields Nanotechnology and Biotechnology have got certain common platforms of working in the arena of applications which has revolutionized the biological investigations. Structural and surface properties of nanostructures can be modified systematically. This results in modification of the properties of nanostructures at a Nanoscale level. This makes them in very useful in biological contexts, from fundamental scientific studies to commercially viable technologies. Nanostructures with highly controlled properties in the nanometre size range are available in a progressive manner now. This has created interest in their use in biotechnological systems [Shanmugam 2010] [5].
The most important objectives that are frequently found in Nanobiology involve applying Nanotools to relevant medical or biological problems and refining these applications. Developing new tools for medical and biological purposes is another primary objective in Nanotechnology. New Nanotools are often made by refining the applications of the Nanotools that are already being used. The imaging of native biomolecules, biological membranes, and tissues is also a major topic for the Nanobiology researchers. Other topics concerning Nanobiology include the use of cantilever array sensors and the application of nanophotonics for manipulating molecular processes in living cells.
Recently, the use of microorganisms to synthesize functional Nanoparticles has been of great interest. The microbial processes have opened up new opportunities for us to explore novel applications, for example, the biosynthesis of metal Nanomaterials (as microbes can change the oxidation state of metals). In contrast to chemical and physical methods, microbial processes for synthesizing Nanomaterials can be achieved in aqueous phase under gentle and environmentally stable conditions. This approach has become an attractive focus in current green Bionanotechnology research towards sustainable development [Sivakumar *et al.* 2013]. The highlighting objectives of this paper includes, the illustration of Nanobiotechnology as the recent advance in the field of Biotechnology, to create awareness on the advancement in Nanotechnology, application of Nanotools to relevant medical and biological problems and to suggest the betterment of biological researches using nanotechniques.

## Review of Literature
**Interaction of Silver nanoparticles with algae and fish cells; a side by side comparison (Yang Yue *et al*. 2017) [9].**
Silver nanoparticles (AgNP) can be released into aquatic environment. This raises concerns about potential impact of AgNP on aquatic organisms. Yang Yue *et al.* (2017) [9] experimented a comparative analysis of interaction of silver nanoparticles with two types of cells; algal cell (*Euglena gracilis*) and fish cell (*Oncorhynchus mykiss*). The comparison was based on the AgNP (silver nanoparticles) behavior in exposure media, toxicity, uptake and interaction with proteins. As a result, they have been observed that, the composition of exposure media affected the AgNP behavior and toxicity to the cells. Toxicity of AgNP to algal cell was mediated by the dissolved silver, but the toxicity of AgNP was increased in fish cell due to the activity of both nanoparticle and the dissolved silver. These results indicated that, AgNP did not enter into algal cell because of the barrier

surrounding the cell membrane, but adsorbed onto the surface. While the fish cells fully taken up the AgNP. This is how they proved that the algal cell membrane bound proteins have a special characteristic feature, that it selectively limit the entry of certain toxic substances. The conclusion made was, mineral uptake in algae and fish cell was totally different. For algae, extracellular proteins secreted from cells were affected by AgNP exposure, but for fish cells, intracellular or membrane bound proteins are susceptible to AgNP binding and functional impairment.

In the recent era of industrialization and pollution, as the established nutrient food sources become scarcely available, the biological impact of toxic substances especially in the aquatic environment should get more attention from the scientific researchers, and there lies the importance of this work too.

**Polymeric nanoparticle-encapsulated Curcumin ("Nanocurcumin"): A novel strategy for Human Cancer Therapy**

**(Savita Bisht *et al.* 2017)** Among various diseases, cancer has become a big threat to human beings globally. As per Indian population census data, the rate of mortality due to cancer in India was high and alarming with about 806000 existing cases by the end of the last century (Imran *et al*. 2011) [3]. As this present scenario of increased susceptibility to cancer in human beings, modern medicine and biological sciences are forced to invent more experiments on cancer treatment. Among the various anticancerous phyto compounds, Curcumin, a yellow polyphenol extracted from rhizome of turmeric (*Curcuma longa*) has been proved to bear potent anticancer properties.

Savita Bisht *et al.* in 2007 [7] has been experimentally proven that, the nanoparticle based drug delivery approaches have the potential for rendering hydrophobic agents like curcumin, which is dispersible in aqueous media. They have been reported the synthesis, physicochemical characterization and cancer related application of a nanoparticle encapsulated Cucurmin, ie, Nanocurcumin. They have used cross linked polymeric nanoparticle with a hydrophobic core and a hydrophilic shell for the encapsulation of Curcumin, generating drug encapsulated nanoparticle. Nanocurcumin was synthesized by utilizing the micellar aggregates of cross-linked and random copolymers of N-isopropylacrylamide (NIPAAM), with N-vinyl-2-pyrrolidone (VP) and poly (ethyleneglycol) monoacrylate (PEG-A). Physico-chemical characterization of the polymeric nanoparticles was done by dynamic laser light scattering and transmission electron microscopy. Nanocurcumin, unlike free curcumin, is readily dispersed in aqueous media. Nanocurcumin demonstrates comparable in vitro therapeutic efficacy to free curcumin against a panel of human pancreatic cancer cell lines, as assessed by cell viability and clonogenicity assays in soft agar. Further, nanocurcumin's mechanisms of action on pancreatic cancer cells mirror that of free curcumin, including induction of cellular apoptosis (degeneration of cancerous cells), blockade of nuclear factor kappa B (NFκB) activation, and down regulation of steady state levels of multiple pro-inflammatory cytokines (IL-6, IL-8, and TNFα). From the results, it is proven that the use of nanocurcumin avails the appropriate application of suitable drug for cancer treatment.

As the recent case studies of cancer indicates that the human mortality due to this disease is increasing in an alarming rate, the most effective medicine and its proper application should be ensured. Curcumin is the effective drug for cancer treatment, but it was successful for the treatment only when it is applied as Nanocurcumin. As this nanoparticle can be directly applied into the cell and as it can readily be solved in the aqueous phase of cytoplasm, the degeneration of cancer cell takes place with no proliferation and spreading of those cells, ultimately destroying the cancer cells from the area where it has been originated. This work meets its relevancy in the modern medicine and research, as it is the best solution for a question of decades long.

**Extracellular synthesis of Zinc Oxide Nanoparticle using Seaweeds of Gulf of Mannar, India**

**(Sangeetha Nagarajan and Kumaraguru Arumugam Kuppusamy, 2013)** Recently, the importance of metal ions to the vital functions of the living organisms, hence their health and well-being, has become increasingly apparent (Helmut 1983) [2]. Metal oxide nanoparticles are versatile platform for biomedical application and therapeutic intervention (John *et al*. 2010) [4].

Even if the application of metal nanoparticle has been brought the great advance in medicine and research, the synthesis and its expenses become a great challenge. Owing to this problem, in 2013, Sangeetha and Kumaraguru has been experimented a new approach for the extracellular synthesis of Zinc Oxide nanoparticle using seaweeds. According to them, biosynthesis of metal nanoparticles by marine resources is thought to be clean, nontoxic, and environmentally acceptable. Marine ecosystems are very important for the overall health of both marine and terrestrial environments. The use of natural sources like Marine biological resources are essential for nanotechnology. Seaweeds constitute one of the commercially important marine living renewable resources. They have used seaweeds such as green *Caulerpa peltata*, red *Hypnea Valencia* and brown *Sargassum myriocystum* (Plate 1) for synthesis of Zinc oxide nanoparticles. The preliminary screening of physico-chemical parameters such as concentration of metals, concentration of seaweed extract, temperature, pH and reaction time revealed that only one of these selected seaweeds, *S. myriocystum* were able to synthesize zinc oxide nanoparticles. It was confirmed through the initial color change of the reaction mixture observed under UV visible spectrophotometer. The extracellular biosynthesized clear zinc oxide nanoparticles were 36 nm in size. From the results they have concluded that, the seaweed, *Sargassum myriocystum* contain water soluble Fucoidan pigmants, which were responsible for the reduction and stabilization of the zinc oxide nanoparticles.

The biosynthesized ZnO nanoparticles are effective antibacterial agents against Gram-positive than the Gram-negative bacteria. It exhibited moderate activity against *Streptococcus mutans,* gram positive bacteria. The nanoparticles of exhibited weak activity against *Micrococcus luteus.* The metal nanoparticle of zinc exhibited moderate activity against *Vibrio cholera,* the negative bacteria, but *Klebsiella pneumonia* had weak activity, and *Neisseria gonorrohea* showed strong activity. The significant antimicrobial activity of the metal nanoparticles was

comparable to the standard antibiotics Penicillin and Amphotericin.

As the established medical system fails to meet the patient convenience, the invention of new and appropriate drugs are important in recent world scenario, where, the Nanobiotechnology became a powerful tool for all this issues.

## Conclusion

A particle will become more precise in action when its size is reduced to a minimum; as the powder pepper tastes spicier than the pepper seeds. This concepts leads to the principal concept of Nanobiotechnology that, the use of nanomaterials for the accurate and precise application of drugs.

Yang Yue *et al.* tested the biological effect of toxic nanoparticle in fish cell and algal cell. And it is proved that the action of certain protein in the algal cell membrane prevents its action in the algal cell, while the fish cell gets affected. Savita Bisht has been illustrated the successful application of nanoparticle encapsulated curcumin or "Nanocurcumin" against cancer. Sangeetha and Kumaraguru have been synthesized metal nanoparticle from seaweeds and it can be considered as an important goal in field of Nanobiotechnology. The reviews of all three studies has been proven that the emerging field of Nanobiotechnology will be the only tool for the future medicine.

**Plate 1 showing morphology of the selected seaweeds**


**Fig 1:** Morphology of *Caulerpa peltata*

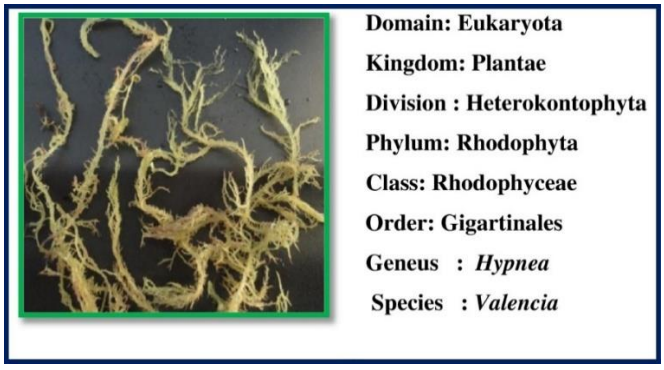


**Fig 2:** Morphology of *Hypnea Valencia*

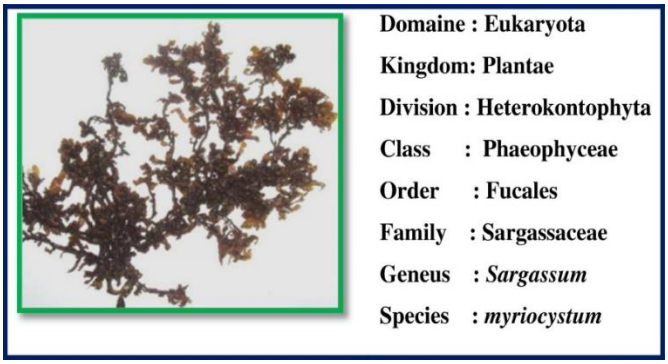


**Fig 3:** Morphology of *Sargassum myriocystem*

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