# SIKSHA 'O' ANUSANDHAN

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Ref.No.:SPS/SOADU/649/2024
Date: 09/08/2024

## Citation (Brief summary) on the research work

## Synthesis, characterization, and evaluation of Superparamagnetic Iron oxide nanoparticles for theranostic application

Cancer is considered as a significant cause of death worldwide.Triple-Negative Breast Cancer (TNBC) is a type of breast cancer that is aggressive and prone to rapid multiplication at the lymph nodes and has a higher chance of recurrence. As the three prominent women's hormonal receptors (Progesterone, Estrogen and Human epidermal growth factor) are not present in TNBC, hormone therapy or immunotherapy are excluded from the list of treatments for TNBC. Unfortunately, inherited cytotoxic activity, non-targeted delivery, and higher doses of these chemotherapeutic drugs result in severe systemic side effects and poor prognosis and the destruction of a large number of healthy cells compared to the TNBC cells. Therefore, it is the high time to implement advanced and novel strategies like nanotechnology in the treatment and control of TNBC.Among various nanoparticles, superparamagnetic- Iron oxide nanoparticles (IONPs) is considered as the most efficient in cancer diagnosis and treatment due to some specific physical and chemical properties like superparamagnetism, good tissular diffusion, and better bioavailability with low toxicity.

The main objective of this present proposal is to develop superparamagnetic IONPs to be applicable for breast cancer treatment and reduce the side effects of chemotherapeutic drugs. As per our first protocol, the superparamagneticIONPs were prepared using green synthesis method from Triphala churna extract (TIONPs) to evaluate its anticancer efficacy in treating TNBC with enhanced antioxidant and cytotoxic activity. The TIONPs showed promising cytotoxic activity against TNBC cells and associated skin cancer cell (A431), in comparison to the normal human cells. These TIONPs can be rapidly localized directly into the target organ utilizing their inherent paramagnetic property to reduce the side effects of current chemotherapeutic drugs. The green synthesized TIONPs can come up as a future anticancer drug for TNBC treatment.

In the second approach I have developed superparamagnetic IONPs using chemical co-precipitation method and coated with four different polymers including PEG, PVA, HPMC, and chitosan. All the synthesized samples were structurally and magnetically evaluated by FTIR, SEM, DLS-Zeta, and VSM, Mossbauer spectroscopy, and AC/DC magnetization. The outcomes demonstrated that the formulations were superparamagnetic in nature and had spherical shapes ranging from 30-80 nm and maximum % of magnetite than disordered magnetite. It can be used for both diagnosis (contrast agent in MRI) and cancer treatment section in future.

In the next approach superparamagnetic IONPs will be used for tumor detection by MRI and it will be loaded withdoxorubicin for targeted drug delivery at the breast cancer site using external magnet.Our developed superparamagnetic IONPs will attempt to minimize the treatment limitations through external magnetic field guided accumulation of drug selectively at the targeted breast cancer cell site and thereby reducing its administered daily dose for improved safety and efficacy. After the establishment of successful pre-clinical and clinical trials, our developed superparamagnetic IONPs can be sold as a parenteral product for the external magnet therapy of breast cancer. This kind of medicine should be launched as quickly as possible to help many people overcome this difficulty, as breast cancer is a serious concern now across the globe. Although the marketability of this sort of product (superparamagnetic IONPs) is enormous, no product for the treatment of breast cancer has yet been commercialised.

**Citation on the research work published**

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4. Sharma V, Sharma JK, Kansay V, Dutta A, Raj M, Singh M, Kapoor A, Pahwa C, Sharma A, Kumar S, Sharma AK. Green synthesis, characterization and drug-loaded iron oxide nanoparticles derived from Nerium oleander flower extract as a nanocarrier for in vitro antibacterial efficacy. Nano Express. 2024 Feb 29;5(1):015014.
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DEAN 09/08/24
DEAN
Faculty of Pharmaceutical Sciences
Siksha 'O' Anusandhan
(Deemed to be University)