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Designing and Fabrication of Heterojunctions of Thiosemicarbazones and Nanoparticles in search of their Medicinal Activity

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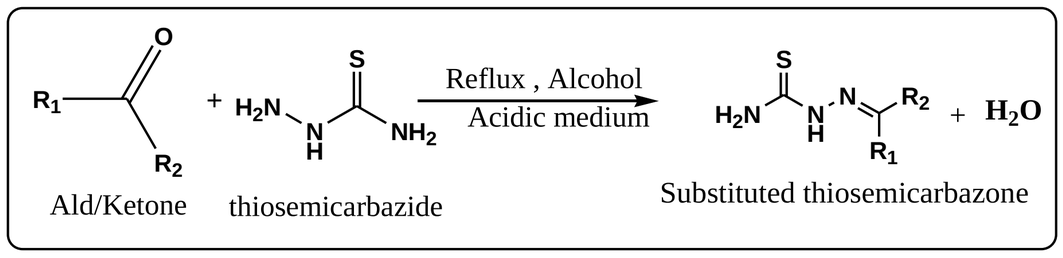
INTRODUCTION

- Thiosemicarbazone (TSC) derivatives and their complexes have emerged as versatile medicinal agents [1]. However the use of large-sized compounds in drug delivery poses major challenges, including *in vivo* instability, poor bioavailability, poor solubility, poor absorption in the body, issues with target-specific delivery and probable adverse effects of drugs [2].
- Metallic nanoparticles when conjugated with TSCs can enhance the medicinal properties due to change in their morphological characteristics [3].



Where R_1,R_2 = H/Aryl/Alkyl Substituent

Fig. 1 Preparatory scheme of Schiff bases

METHODOLOGY

- The studies included in the paper were taken from leading databases like PubMed, Web of Science and Scopus.
- Keywords like fabrication of nanoparticles, functionalized nanoparticles, thiosemicarbazone, and conjugated nanomaterials were used to find out the relevant studies.

Functionalization of Nanoparticles

- Functionalization is the process of using various methods to modify the surface of nanoparticles (NPs) in order to increase target selectivity and decrease potential nanotoxicity. A number of methods, such as covalent or non-covalent conjugation and the use of linker molecules, are used to join the molecules together [4].
- The NPs can be coated with different species for functionalization like glutamic acid, and chitosan for conjugation with TSCs [5].

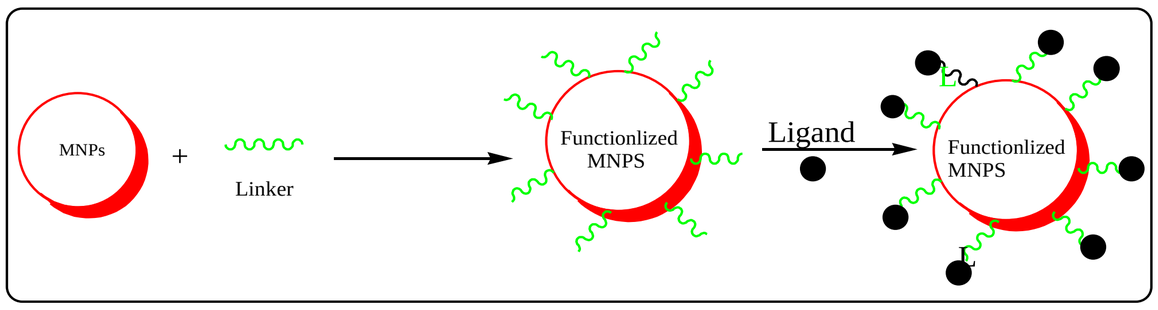


Fig. 2 Functionalization of NPs

Nano functionalized TSCs and their anticancer activity

S. No.	MNPs	Functionalized MNPs	Cell line	IC_{50} value (µg/ml)	Reference
1	CuO	CuO@Glu/TSC	MCF-7	133.97	DOI: 10.1007/s10876-021-02187-1
2	NiO	NiO@Glu/TSC	MCF-7	298.33	DOI: 10.1007/s10876-021-01995-9
3	Fe_3O_4	Fe_3O_4@Glu/BTSC	A549	189.15	DOI: 10.34172/aim.2022.126
4	Ag	Ag@Gln/TSC	Colon cancer cells	88	DOI: 10.1038/s41598-024-54344-x
5	Co_3O_4	Co_3O_4@Glu/TSC	AGS	107.5	DOI: 10.1007/s13205-020-02230-4

Some Recent MNPs Drug Carriers

S. No.	Drug	Therapeutic activity	Nanocarrier (core@shell)
1	Ciprofloxacin	Anti-infective agents (antibiotic)	FeO @poly(vinyl alcohol)-g-poly(methylmethacrylate)
2	Doxorubicin	Antineoplastic agent	FeO @gelatin
3	5-Fluorouracil	Antimetabolites, anticancer drug	FeO @ethylcellulose
4	Gemcitabine	Antimetabolites, cancer chemotherapy	FeO @poly(ethylene glycol)
5	Dopamine	Catecholamine neurotransmitter, Parkinson's disease	FeO @silica (diatom)

Characterization of TSC functionalized NPs

S. No.	Parameter	Characterisation Technique
1	Shape and size	UV–Visible spectroscopy, Dynamic light scattering, Atomic force microscopy, Scanning electron microscopy, Transmission electron microscopy
2	Charge and Surface Chemistry	Zeta Potential, Fourier Transform Infrared Spectroscopy, X-ray photoelectron spectroscopy
3	Composition	Energy dispersive X-ray, X-ray diffraction, Electron dispersive X-ray spectroscopy
4	Crystal structure	High-resolution transmission electron microscopy, Electron diffraction, X-ray diffraction
5	Thermal stability	Thermo gravimetric analysis, Differential thermal analysis

CONCLUSION

- The challenge of NPs in biomedicine is their potential for immune recognition and clearance through a variety of mechanisms, such as phagocytosis by macrophages .
- Strategies to minimize immune recognition and clearance of nanoparticles, such as surface modification and targeting, are necessary for effective biomedical applications.

REFERENCES

1. Siddiqui, E. J., Azad, I., Khan, A. R., & Khan, T. (2019). Thiosemicarbazone complexes as versatile medicinal chemistry agents: a review. *Journal of drug delivery and therapeutics*, *9*(3), 689-703.
2. Patra, J. K., Das, G., Fraceto, L. F., Campos, E. V. R., Rodriguez-Torres, M. D. P., Acosta-Torres, L. S., ... & Shin, H. S. (2018). Nano based drug delivery systems: recent developments and future prospects. *Journal of nanobiotechnology*, *16*, 1-33.
3 Asif, M., Yasmin, R., Asif, R., Ambreen, A., Mustafa, M., & Umbreen, S. (2022). Green synthesis of silver nanoparticles (AgNPs), structural characterization, and their antibacterial potential. *Dose-Response*, *20*(2), 15593258221088709
4,Oak, U., & Khare, T. (2022). Nanoparticle Functionalization: Approaches and Applications. In *Nano-Strategies for Addressing Antimicrobial Resistance: Nano-Diagnostics, Nano-Carriers, and Nano-Antimicrobials* (pp. 157-181). Cham: Springer International Publishing.
5.Bhattarai, S. R., Kc, R. B., Kim, S. Y., Sharma, M., Khil, M. S., Hwang, P. H. & Kim, H. Y. (2008). N-hexanoyl chitosan stabilized magnetic nanoparticles: implication for cellular labeling and magnetic resonance imaging. *Journal of nanobiotechnology*, *6*(1), 1-9.