Development of thiabendazole-loaded mesoporous silica nanoparticles for the enhanced delivery of the target drug

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Introduction

Thiabendazole (TBZ) is an anthelmintic compound that is currently being researched for cancer treatment [1]. Its biomedical use, however, has been constrained due to its poor solubility. The use of mesoporous silica nanoparticles (MSNPs), such as Mobil Composition of Matter Number 41 (MCM-41), is a promising way to enhance the solubility of low water-soluble drugs [2].

Research objectives

Considering the potency of MCM-41 MSNPs to improve the therapeutic effects of the drugs, the study aimed to load TBZ into the NPs to improve its therapeutic effects.

Methods

In this study, various instruments, including scanning electron microscope (SEM), transmission electron microscopy (TEM), and Zetasizer, were used. The 3-(4,5-dimethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide (MTT) assay was also used to evaluate the toxicity of their toxicity on cancer cells. Cell migration and reactive oxygen species (ROS) assays were also assessed.

Results & discussion

The results showed that the drug loading capacity of 19.1% was achieved with a particle size of 215.9 ± 0.07 nm and spherical shape (Figure 1).

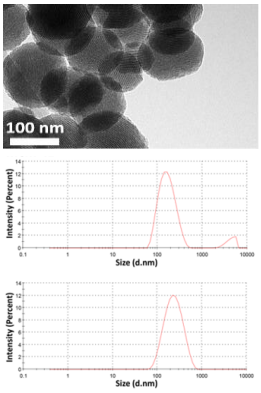
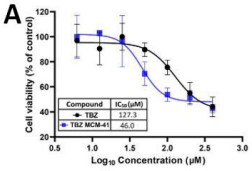


Figure 1: DLS and TEM results of MCM-41 and TBZ MCM-41

According to cell viability measurements (Figure 2A), TBZ MCM-41 nanoparticles induced a 2.8-fold increase in TBZ cytotoxicity. The results of the proliferation assay (Figure 2B) demonstrated that using MCM-41 as a carrier could improve the toxicity of TBZ in a concentration-dependent manner that was in agreement with the results of the cell viability assay. Furthermore, the ROS assay (Figure 2C) revealed that TBZ MCM-41 nanoparticles were approximately 15% more effective at producing ROS than TBZ.



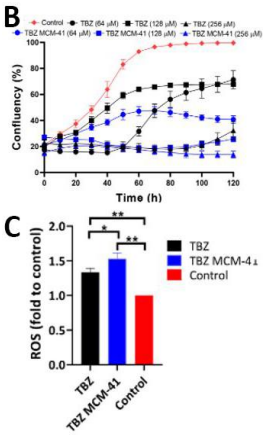


Figure 2: A) Cell viability, B) proliferation, and C) ROS assays

Limitations

Due to COVID-19 pandemic-related quarantine and situation, access to the labs has been limited.

Conclusion

In conclusion, the findings indicate that MCM-41 nanoparticles are a viable carrier for improving the therapeutic efficacy of TBZ against PC-3 cells and that the formulation should be tested in vivo.

Selected references

Alavi, S. E., & Shahmabadi, H. E. (2021). Anthelmintics for drug repurposing: opportunities and challenges. Saudi Pharmaceutical Journal.

Ghaferi, M., Koohi Moftakhari Esfahani, M., Raza, A., Al Harthi, S., Ebrahimi Shahmabadi, H., & Alavi, S. E. (2021). Mesoporous silica nanoparticles: synthesis methods and their therapeutic use-recent advances. Journal of Drug Targeting, 29(2), 131-154.