The development of doxorubicin delivery systems specifically designed to target cancer cells using magnetic Fe3O4 nanoparticles

Anastasia Gershtein[1], Elizaveta Permyakova[1], Saida Karshieva[2],Dmitry Shtansky[1]
m1903055@edu.misis.ru
1 Research Laboratory "Inorganic Nanomaterials", NUST "MISIS",Moscow 119049, Russia
2 Institute of Biomedical Engineering, NUST "MISIS",119049 Moscow, Russia

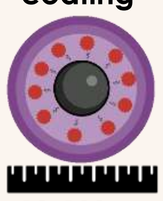
INTRODUCTION

Chemotherapy is one of the common methods of cancer treatment. However, insufficient selectivity of anticancer drugs leads to the use of high concentrations of drugs. In turn, this causes severe side effects and adversely affects healthy cells. Nanoparticle-based delivery systems are used to increase the efficiency of drugs.

Drug carriers made of magnetic iron oxide nanoparticles (Fe3O4) have become increasingly popular.

- magnetic properties
- biocompatibility
- high surface area
- simple synthesis
- availability
- tendency to agglomeration
- rapid excretion through the reticuloendothelial system

Biopolymer coating



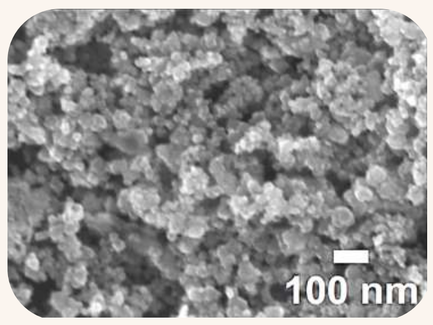
10-100 nm

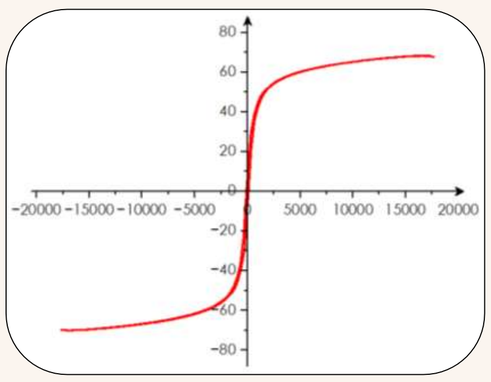
Fe3O4 NANOPARTICLES

EG
$FeCl_3$
CH_3COONa

60 min
250 °C

Sealed autoclave





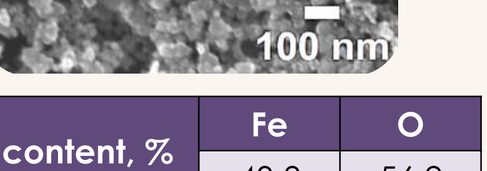
Superparamagnetic particles

Atomic content, %	Fe	O
	43,8	56,2
Size, nm	20 - 30	
Zeta potential, mV	-15,2	
Specific surface area, m^2/g	62,22	
Saturation magnetization, $(A \cdot m^2)/kg$	68,4	

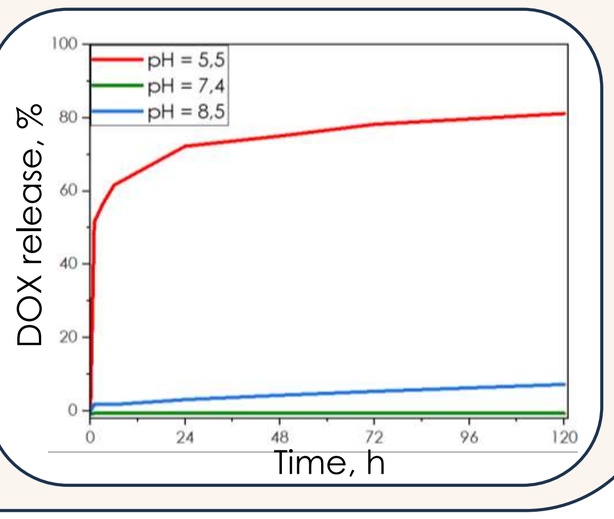
DOX LOADING AND RELEASE

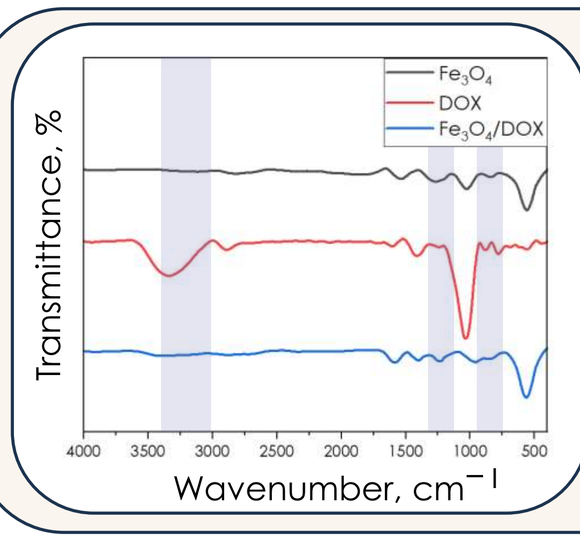
The anti-cancer drug is doxorubicin (DOX), which is used to treat different types of tumors.

The nanoparticles showed high loading capacity to DOX (15,1%) and also exhibited rapid drug release at pH 5,5.



Fe3O4 **DOX** **Fe3O4/DOX**





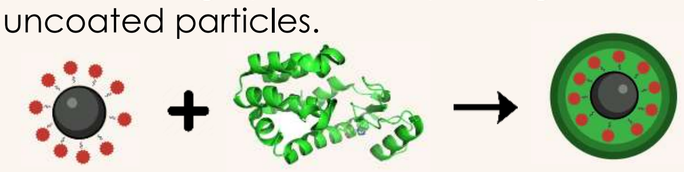
The conjugation of DOX with nanoparticles is confirmed by the obtained FTIR spectra.

Doxorubicin structure

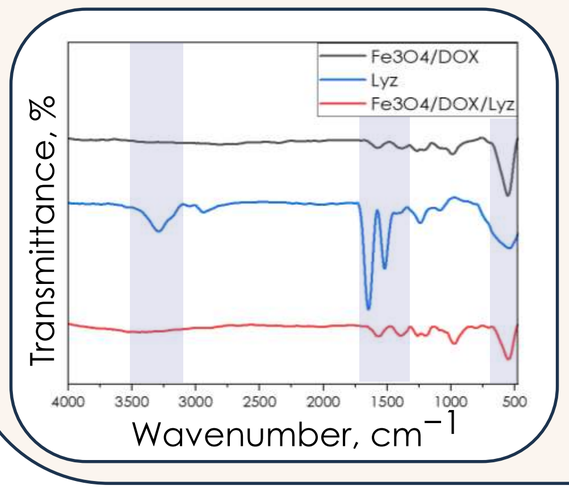
LYSOZYME COATING

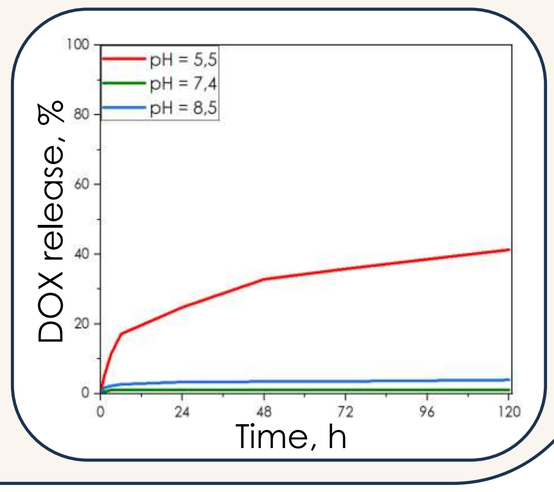
The lysozyme-coating reaction was carried out at pH 8,2, since there is very little DOX release at this pH.

The lysozyme coating provided prolonged drug release compared to uncoated particles.



Fe3O4/DOX **Lysozyme** **Fe3O4/DOX/Lys**

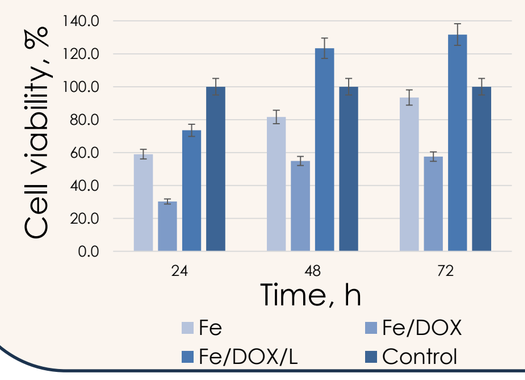




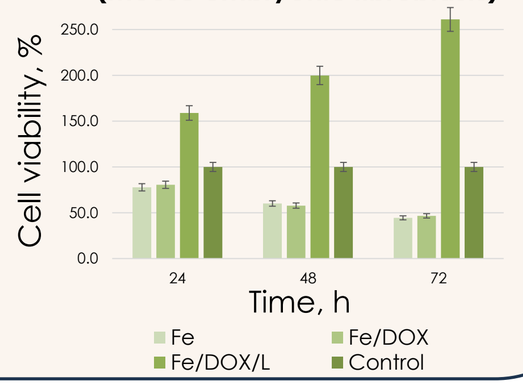
CELL VIABILITY

DOX-loaded Fe3O4 nanoparticles had a cytotoxic effect against both cell lines, but lysozyme coating reduced the cytotoxic effect against healthy cells and promoted significant growth.

Emt 6 cell line (murine mammary carcinoma)



NIH 3T3 cell line (mouse embryonic fibroblasts)



CONCLUSIONS

Work in progress: particle stability studies, biological tests (in vitro tests and in vivo tests);

The obtained results demonstrate the potential use of iron oxide nanoparticles as drug carriers in delivery systems.

References:
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2. Al-Obaidy, R., Haider, A. J., Al-Musawi, S., & Arsad, N. Scientific reports.13(1), 3180 **(2023)**.
3. Qian, G., Zhang, L., Li, X., Shuai, C., & Wang, X. ACS applied bio materials. 4(6), 5304–5311 **(2021)**.

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