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Functionalization of pectin hydrogels with *in situ* synthesized magnetite nanoparticles for hyperthermia treatments against cancer

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INTRODUCTION & AIM

Magnetite nanoparticles (Fe_3O_4) are attractive for MRI, drug delivery, and hyperthermia therapy thanks to their magnetic responsiveness, biocompatibility, and heat generation under alternating fields, though aggregation and limited stability remain challenges. Functionalizing pectin-based hydrogels with these nanoparticles creates a composite that retains the biocompatibility, tunable structure, and encapsulation ability of hydrogels while adding magnetic responsiveness. This project proposes the *in situ* synthesis of such hydrogels, combining the advantages of both materials.

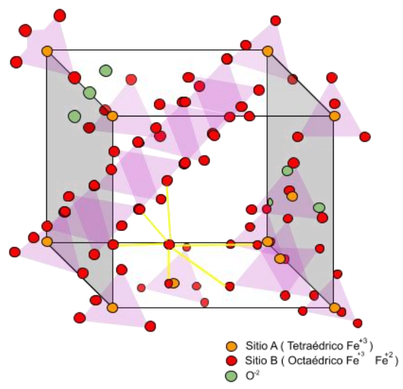

Figure 1. Magnetite unit cell

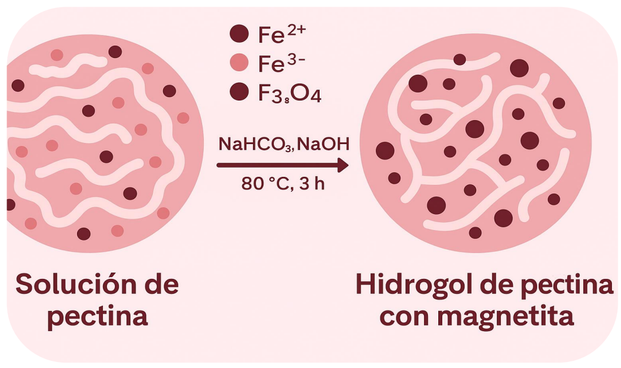

Figure 2. Pectin hydrogel with magnetite nanoparticles

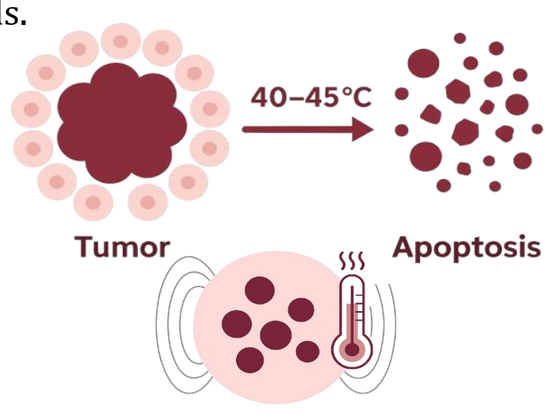

Figure 3. Hydrogel with magnetite nanoparticles for hyperthermia treatments against cancer

METHOD

In situ method

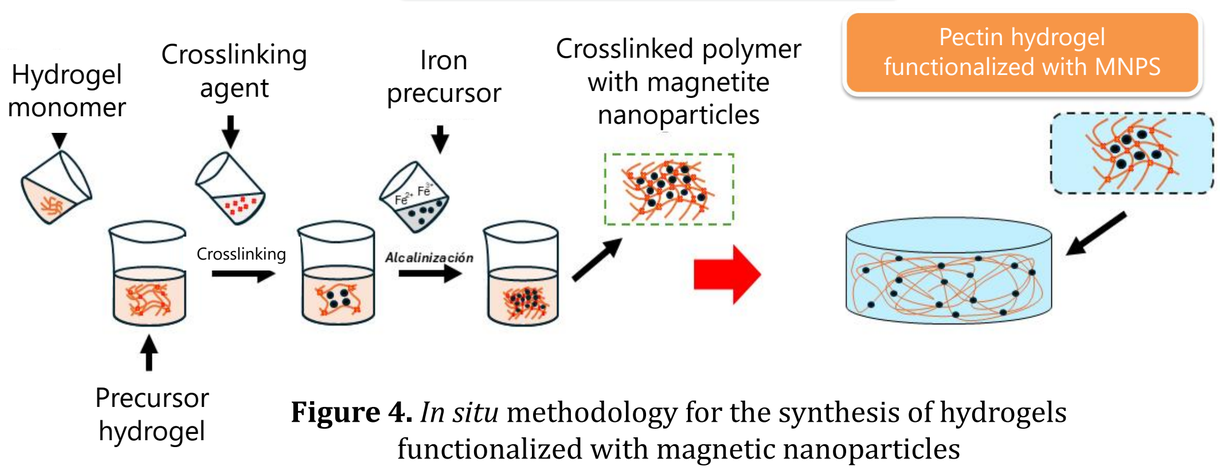

Figure 4. *In situ* methodology for the synthesis of hydrogels functionalized with magnetic nanoparticles

Figure 5. Hydrogels obtained after synthesis

CONCLUSION

*FTIR analysis confirmed the crosslinking of pectin and its interaction with magnetite thanks to the deformations of the functional groups present, as observed in the signals present at 1600 cm^{-1}, 1413 cm^{-1}, and 1400 cm^{-1}.
*XRD confirmed the production of magnetite in both hydrogels; however, the formation of impurities can also be observed.
*SEM images can confirm the functionalization of the hydrogel with magnetite nanoparticles and the spherical shape of the nanoparticles.
*The resulting material can enhance the stability of magnetite nanoparticles in the desired phase, enabling their use as a material for biomedical applications.

RESULTS & DISCUSSION

• FTIR

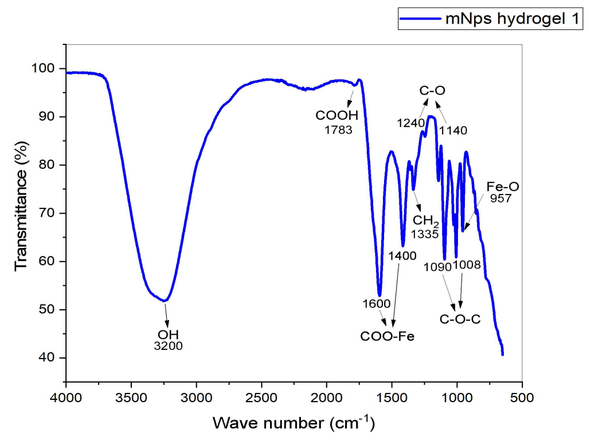

Figure 7. FTIR of the first synthesized hydrogel with magnetic nanoparticles

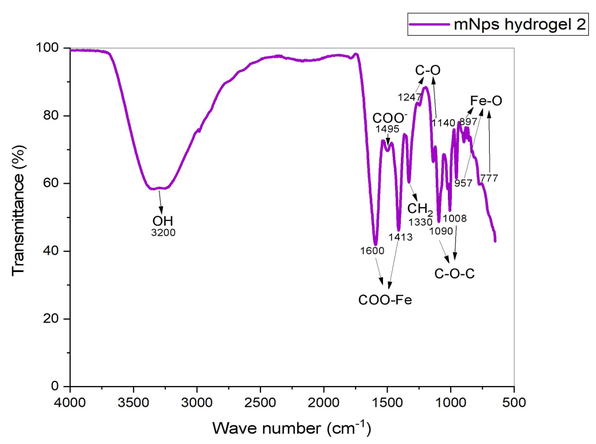

Figure 8. FTIR of the second synthesized hydrogel with magnetic nanoparticles

• XRD

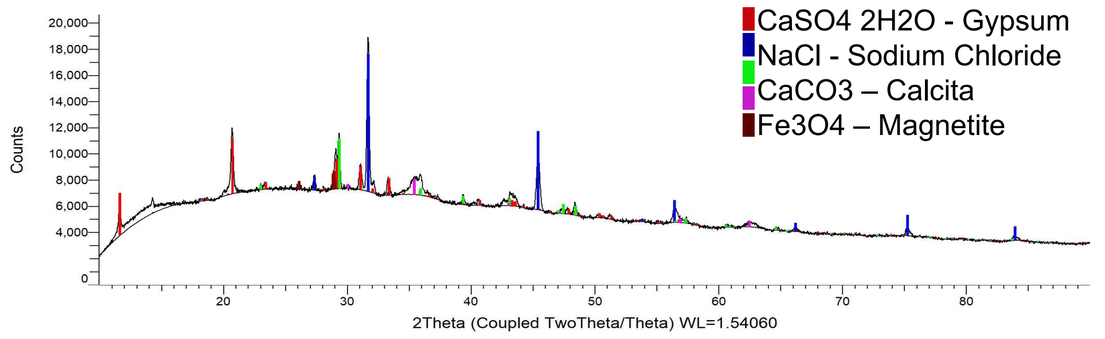

Figure 9. Diffractogram of the obtained hydrogel with magnetite nanoparticles

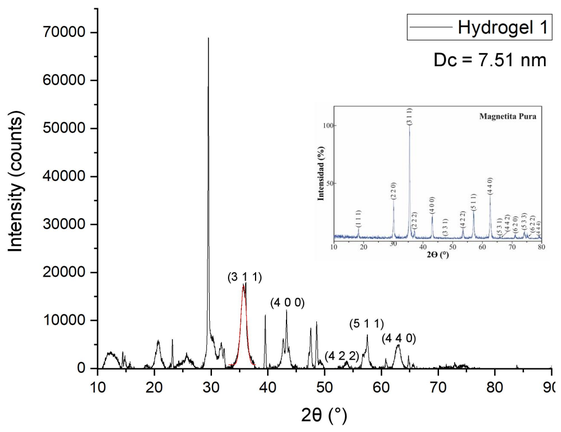

Figure 10. Diffractogram of hydrogel 1

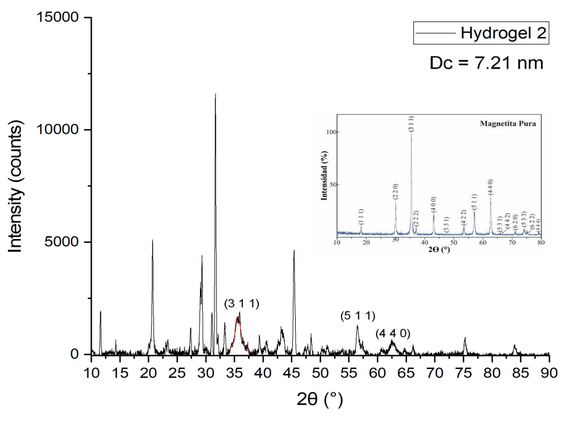

Figure 11. Diffractogram of hydrogel 2

• SEM

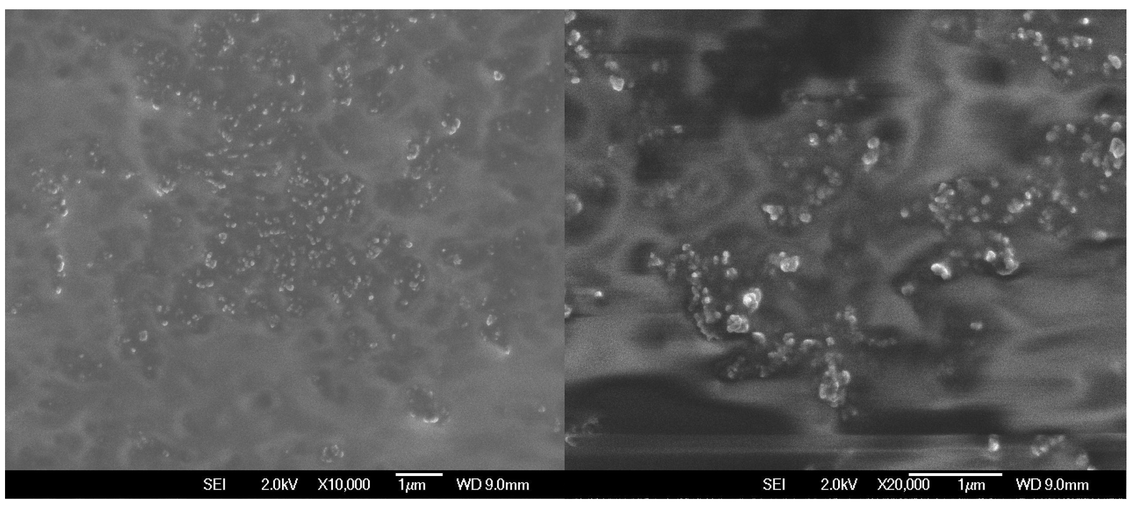

Figure 12. SEM images of the functionalized hydrogel with magnetite nanoparticles

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