

Hydrogel-based wound dressings containing ZnO nanoparticles and honey for diabetic wound treatment

Ekoh, E.^{a,b}; Silva, D.C.^{a,b}; Amaral, R^c, Alvarez S.^c; Matos C.^c; Gomes, J^c; Barroso, H.^b; Salema-Oom, M.^b; Santos, C. ^{a,d}; Alves, M.M.^a; Serro, A.P.^{a,b*}

^a Centro de Química Estrutural, Institute of Molecular Sciences, Departamento de Engenharia Química, Instituto Superior Técnico, Universidade de Lisboa, Lisboa, Portugal.
^b Egas Moniz Center for Interdisciplinary Research (CiiEM), Egas Moniz School of Health and Science, Caparica, Portugal.
^c Colégio Valsassina, Lisboa, Portugal.
^d Instituto Politécnico de Setúbal, EST Setúbal, Setúbal, Portugal.
* E-mail: anapaula.serro@tecnico.ulisboa.pt

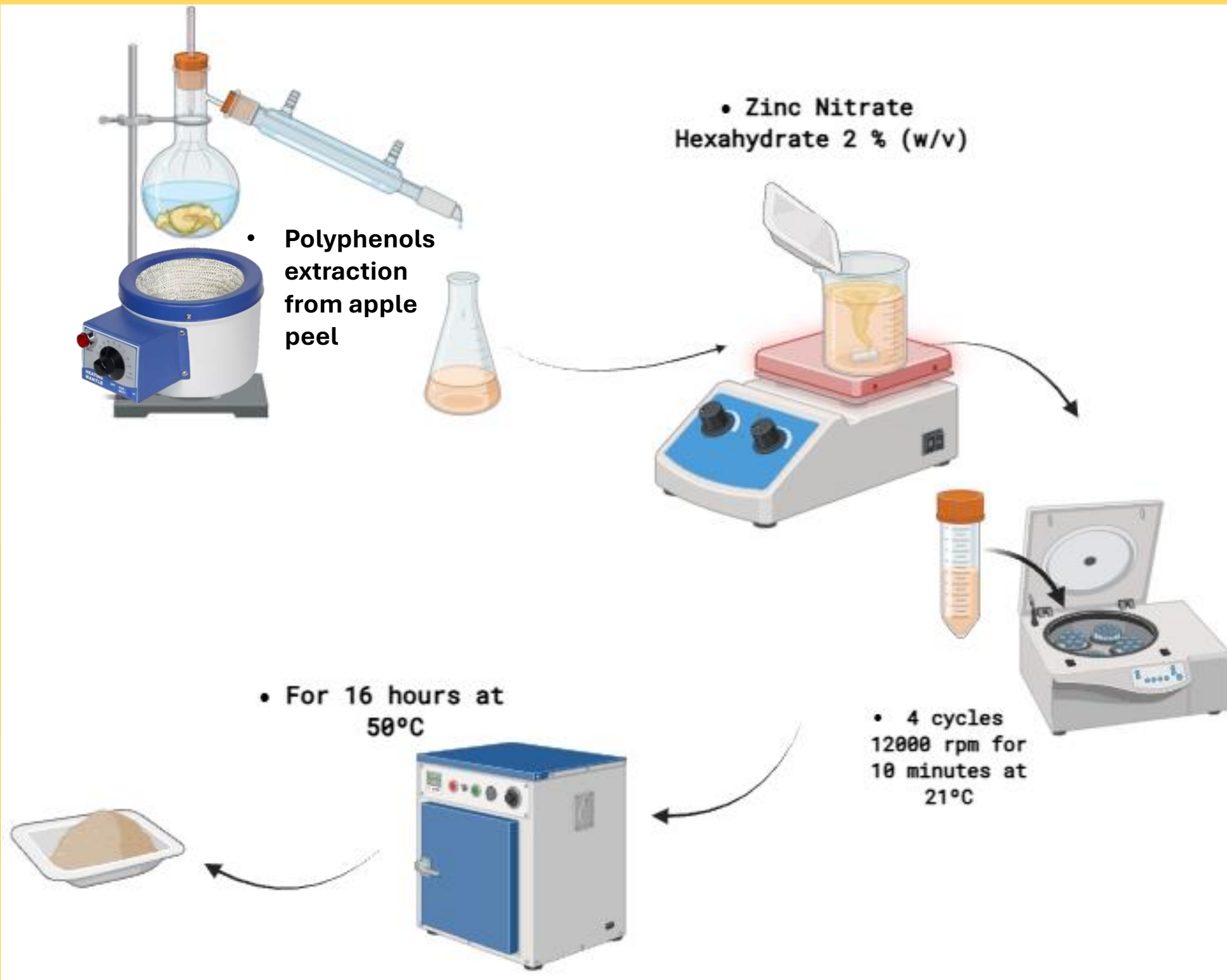
Introduction

The rising global prevalence of **diabetes**, largely due to aging and obesity, has intensified public health concerns, especially regarding **diabetic wounds**. Many of these wounds are chronic, which turns them prone to infection, and can lead to severe outcomes like necrosis, amputation, or death. Existing treatments often fall short, since healing is impaired by high levels of reactive oxygen species (ROS), ongoing inflammation, and recurrent infections. This highlights the urgent need for more effective, multifunctional wound dressings.

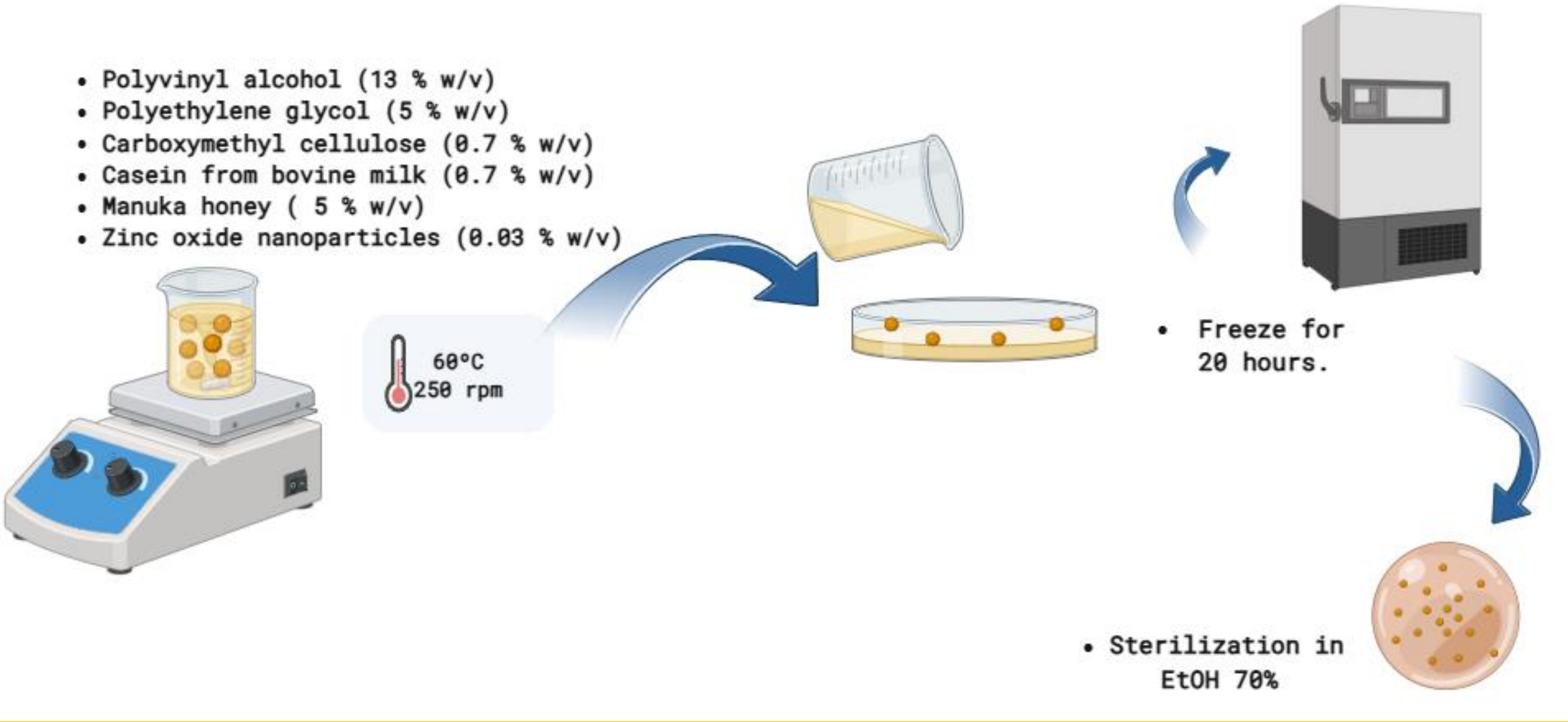
Goal

This study focuses on creating a novel hydrogel-based wound dressing that incorporates natural bioactive agents - **manuka honey** and **zinc oxide nanoparticles (ZnO)** - leveraging their well-known antimicrobial and tissue-regenerative properties.

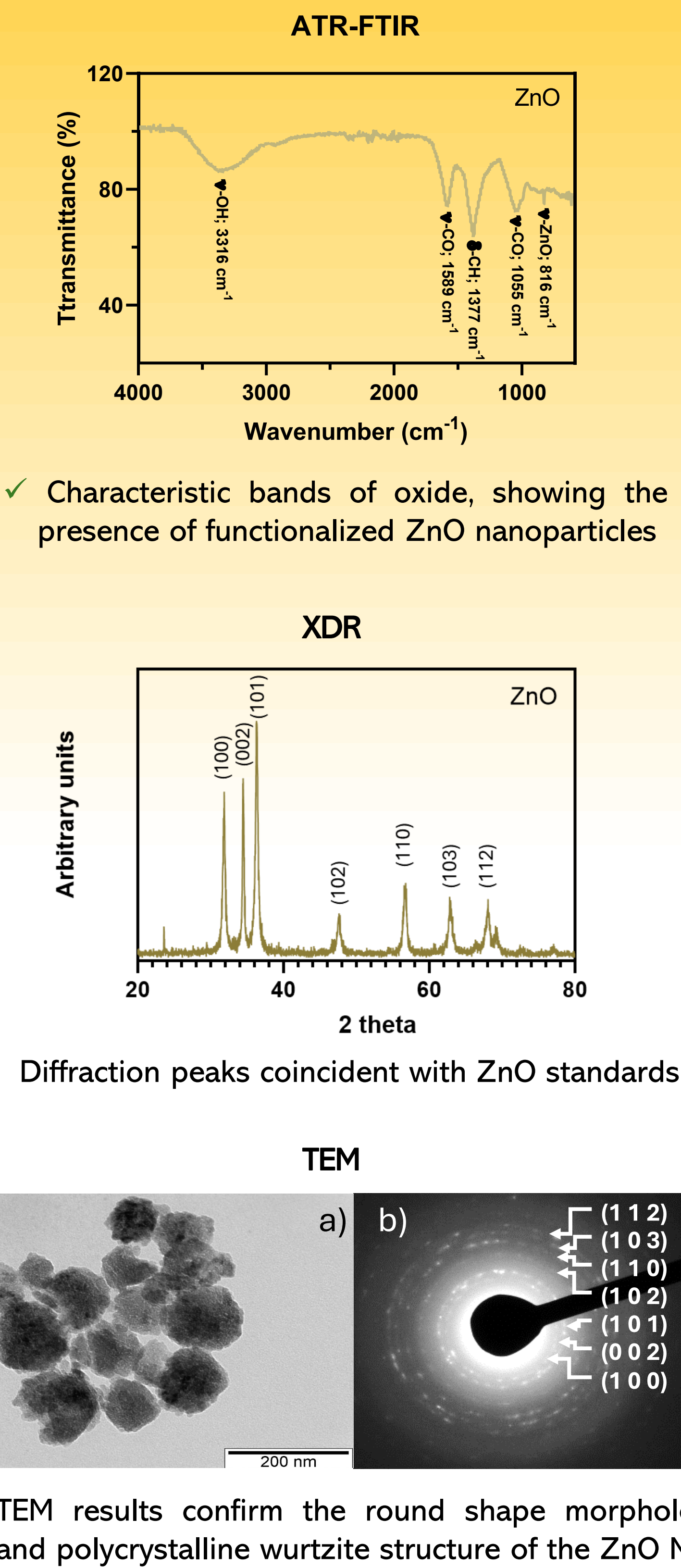
ZnO nanoparticles synthesis



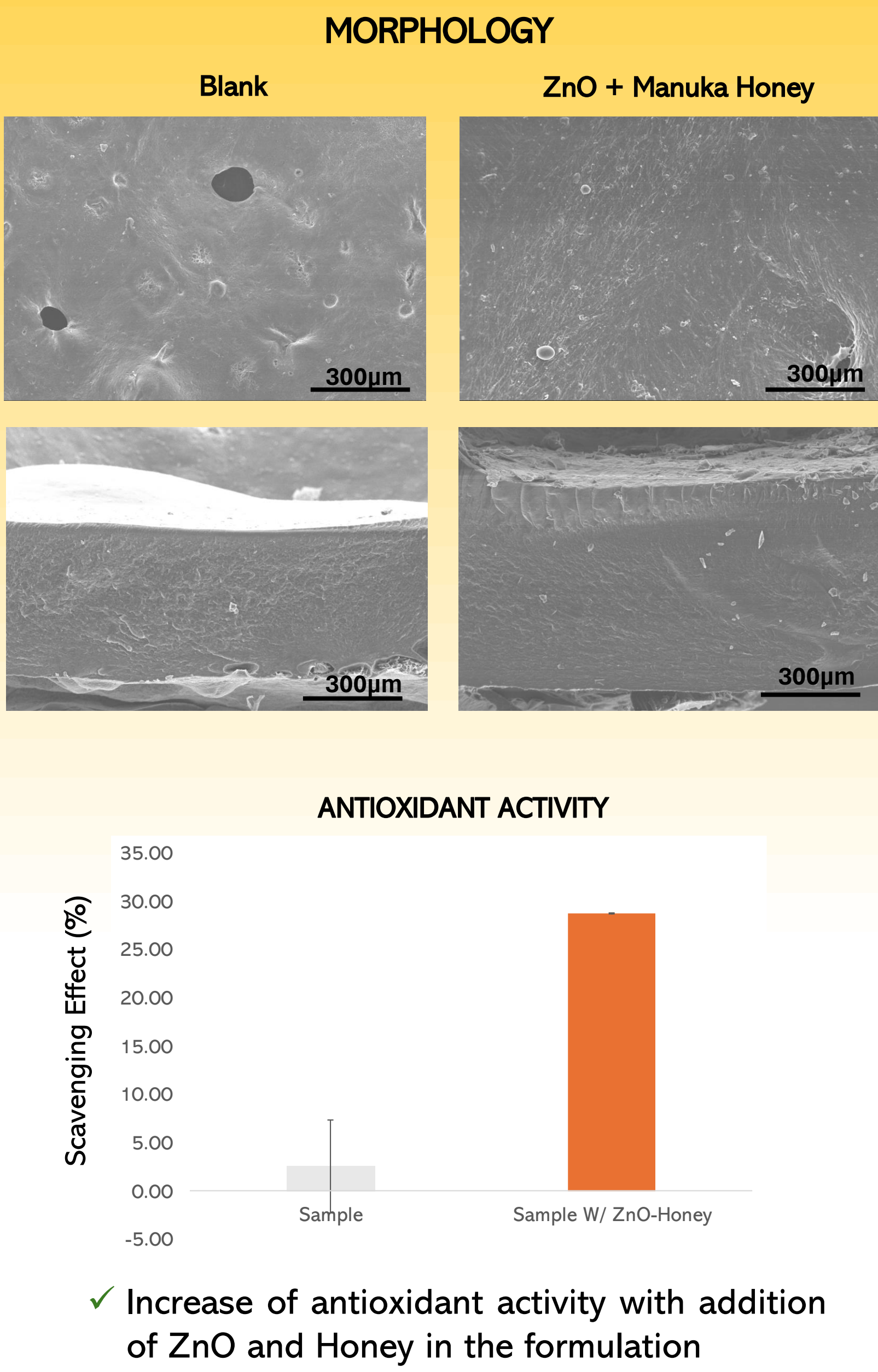
Sample Preparation



ZnO nanoparticles characterization



Hydrogels characterization



PHYSICAL PROPERTIES		
	Blank	ZnO + Manuka honey
Swelling Ratio (%)	279.6 ± 22	235.6 ± 39.7
Equilibrium water Content (%)	79.8 ± 1.1	73.3 ± 3.0
Tensile Strength (kPa)	66 ± 4.2	40 ± 4.5
Contact Angle (°)	46.1 ± 1.4	45.8 ± 2.3
Max mucoadhesion force (N)	2.98 ± 0.04	41.3 ± 3.8

✓ Suitable physical properties for wound dressing application.

Conclusion

The hydrogels showed suitable properties. ZnO+Honey formulation fulfilled the required physical characteristics for wound dressings and exhibited antibacterial activity, alongside with a significant antioxidant activity (29 % scavenging effect). This highlights its potential as a multifunctional dressing for diabetic wound care.