

# Antimicrobial activity of bacterial nanocellulose modified with chestnut extract

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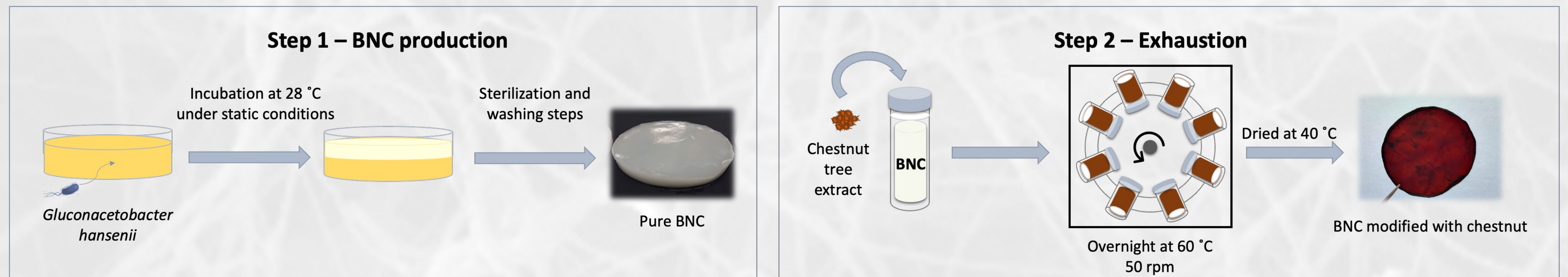
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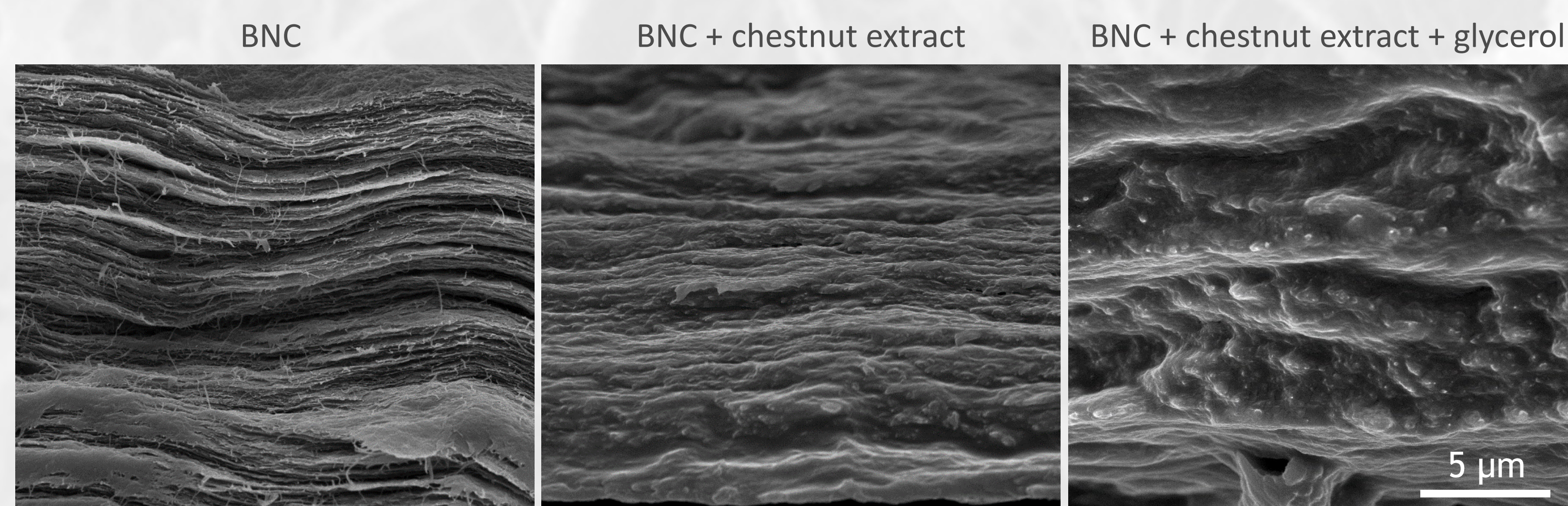
## Abstract

Chestnut wood extracts are rich in tannins that exhibit numerous health-promoting properties. The incorporation of 5% (w/v) chestnut extract within the nanofibrous structure of bacterial nanocellulose (BNC) produced by *Gluconacetobacter hansenii* ATCC 53582 was obtained through exhaustion. This simple processing methodology resulted in a flexible (upon addition of 2% (w/v) glycerol), biodegradable, biocompatible nanocomposite for potential application in medical appliances.

## Methodology



## Results



- The incorporation of the chestnut extract proved to be uniform.
- SEM micrographs showed a good incorporation of the extract within the BNC. The presence of chestnut together with glycerol is even more evident within the fibrous structure of the BNC.

Figure 1. Scanning electron micrographs cross-section (magnification 15000 x).

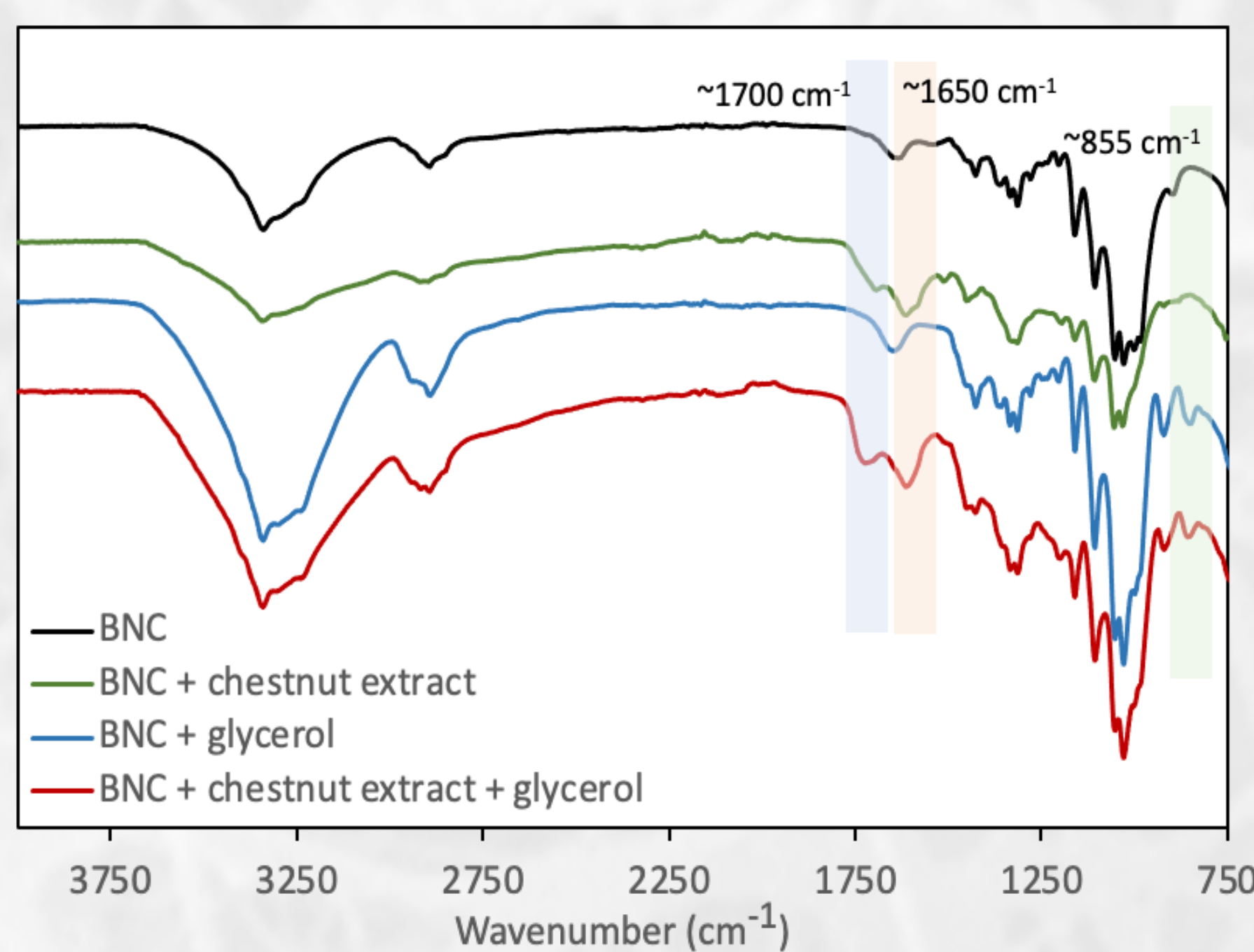


Figure 2. FTIR spectra.

- The incorporation of the extract is supported by FTIR spectra, showing a peak at ~1650 cm<sup>-1</sup> and ~855 cm<sup>-1</sup> corresponding to chestnut extract and glycerol, respectively.

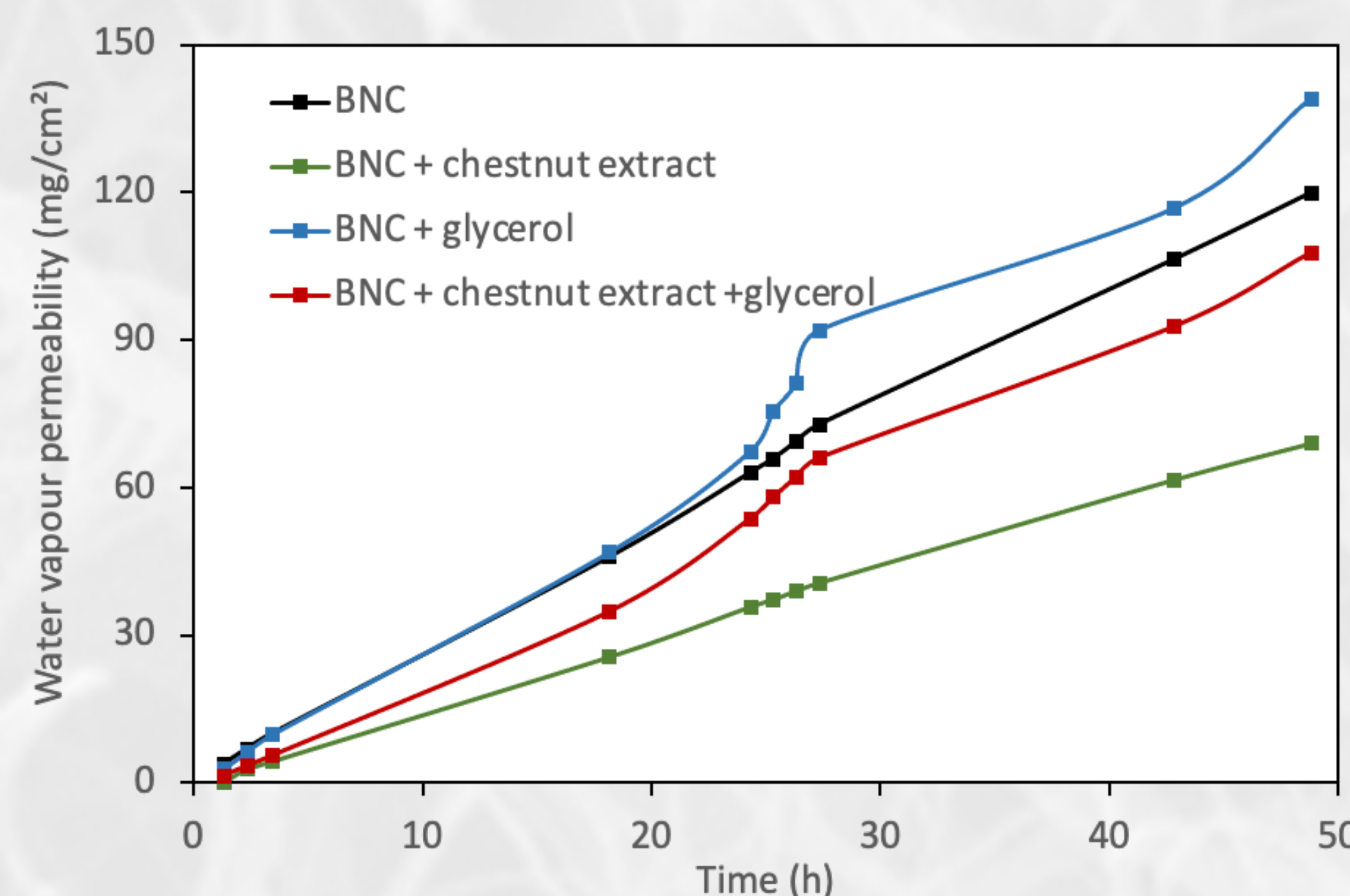


Figure 3. Water vapour permeability (WVP).

- The WVP of BNC + chestnut extract decreased when compared to the original BNC, which can be due to the increased thickness.
- The WVP of BNC + chestnut extract + glycerol, increased due to the hydrophilic character of glycerol.

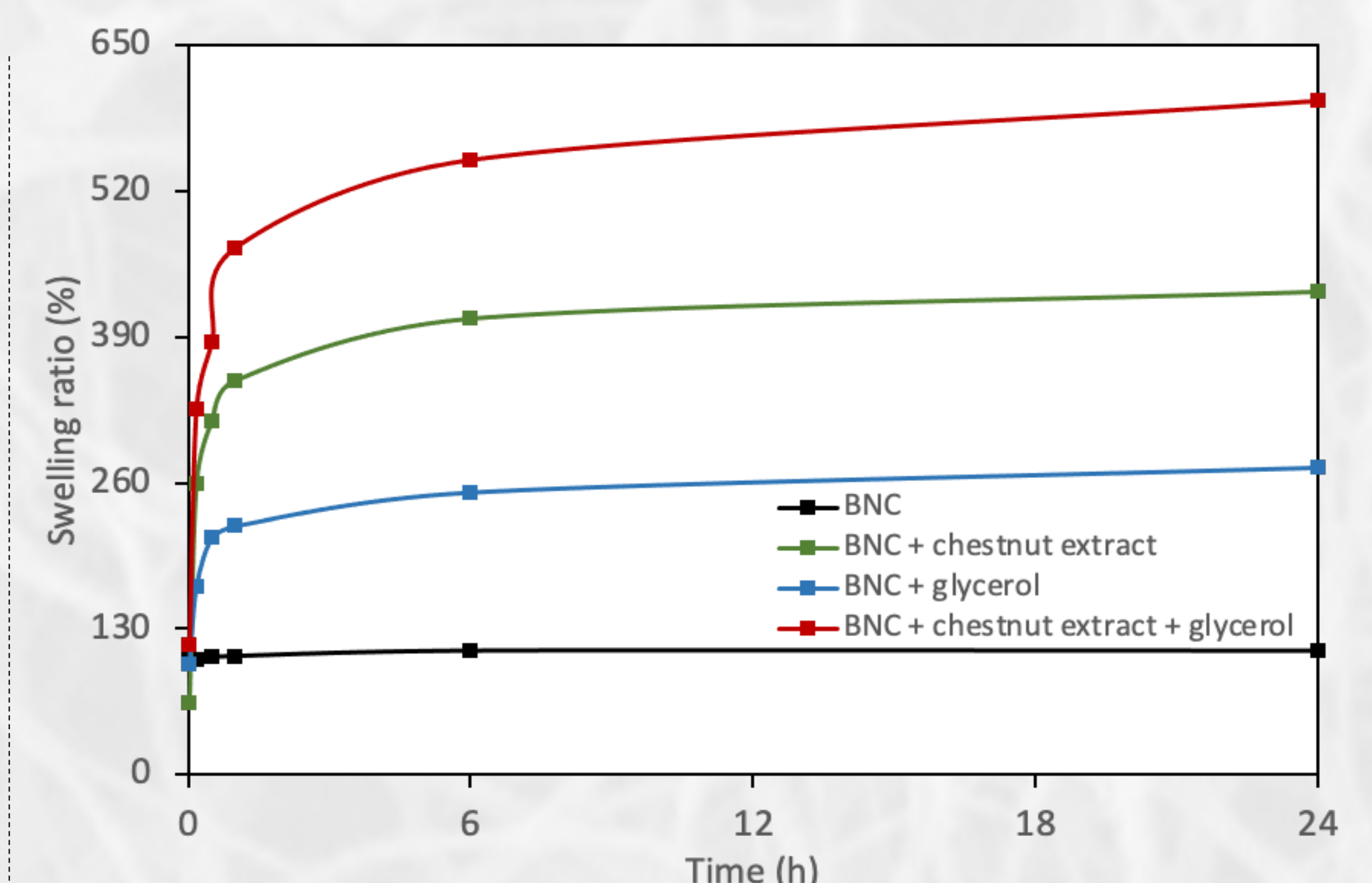


Figure 4. Swelling behaviour over 24 hours.

- The compact structure of dried BNC resultant of the strong hydrogen bonds, hinders the water uptake. With the incorporation of chestnut extract and/or glycerol the dynamic water uptake increased significantly.

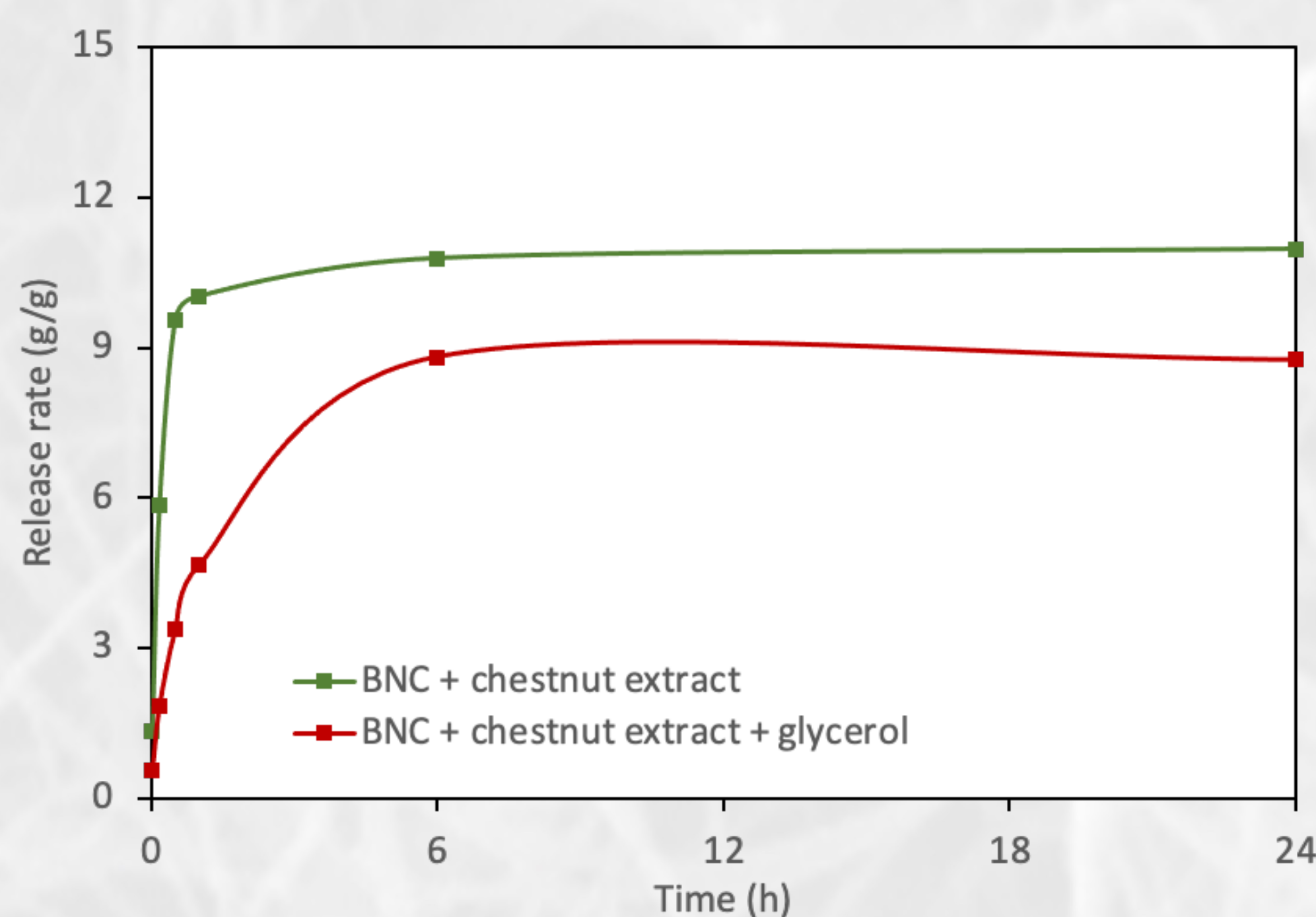


Figure 5. Release profile.

- The release profile of the chestnut from the BNC evidenced a burst release within the first hour.
- When glycerol is present in the formulation the chestnut extract release is prolonged, stabilizing after 6 hours.

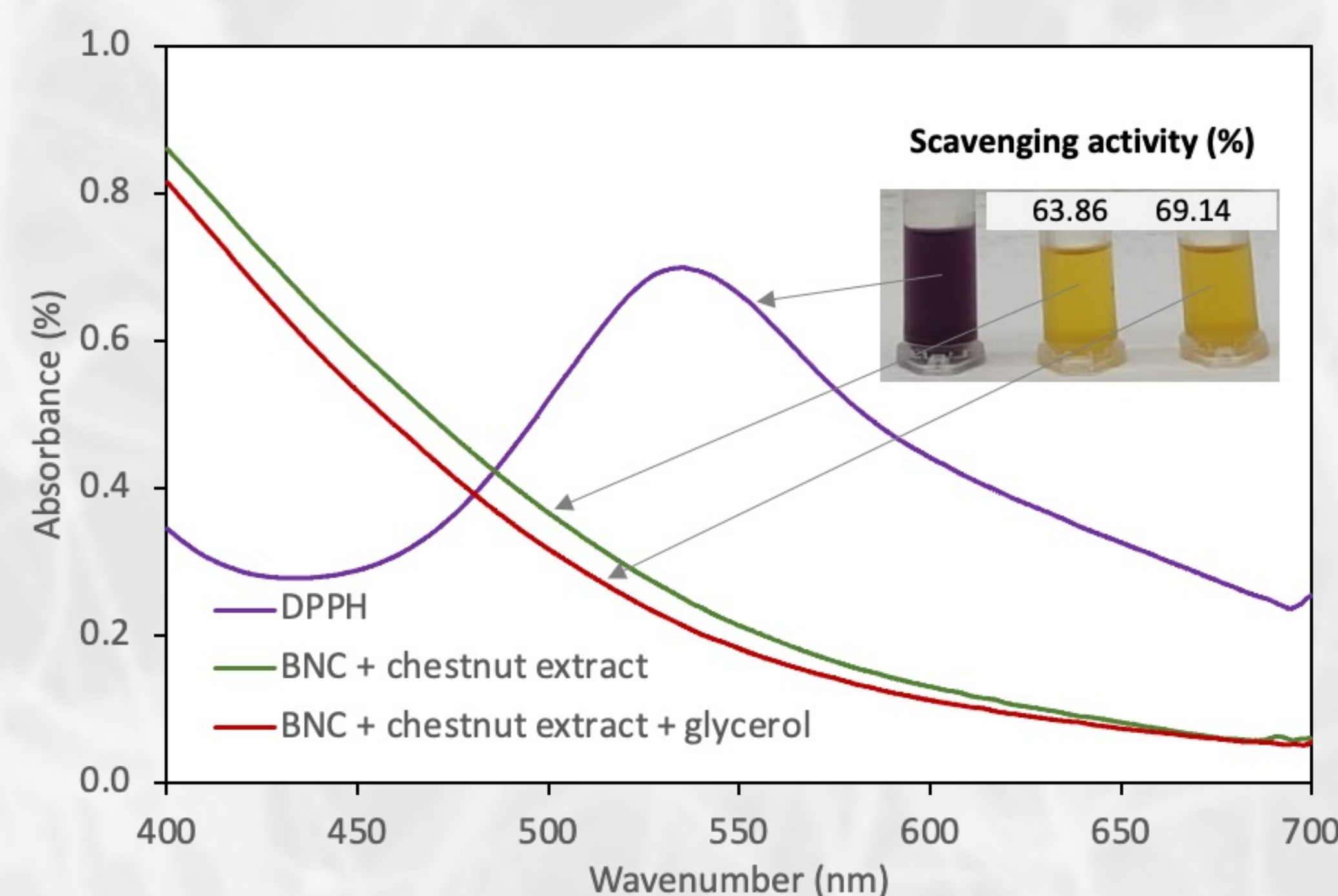


Figure 6. Antioxidant properties after 30 minutes.

- There is evident antioxidant activity displayed by the chestnut extract when incorporated within the BNC (with and without glycerol).

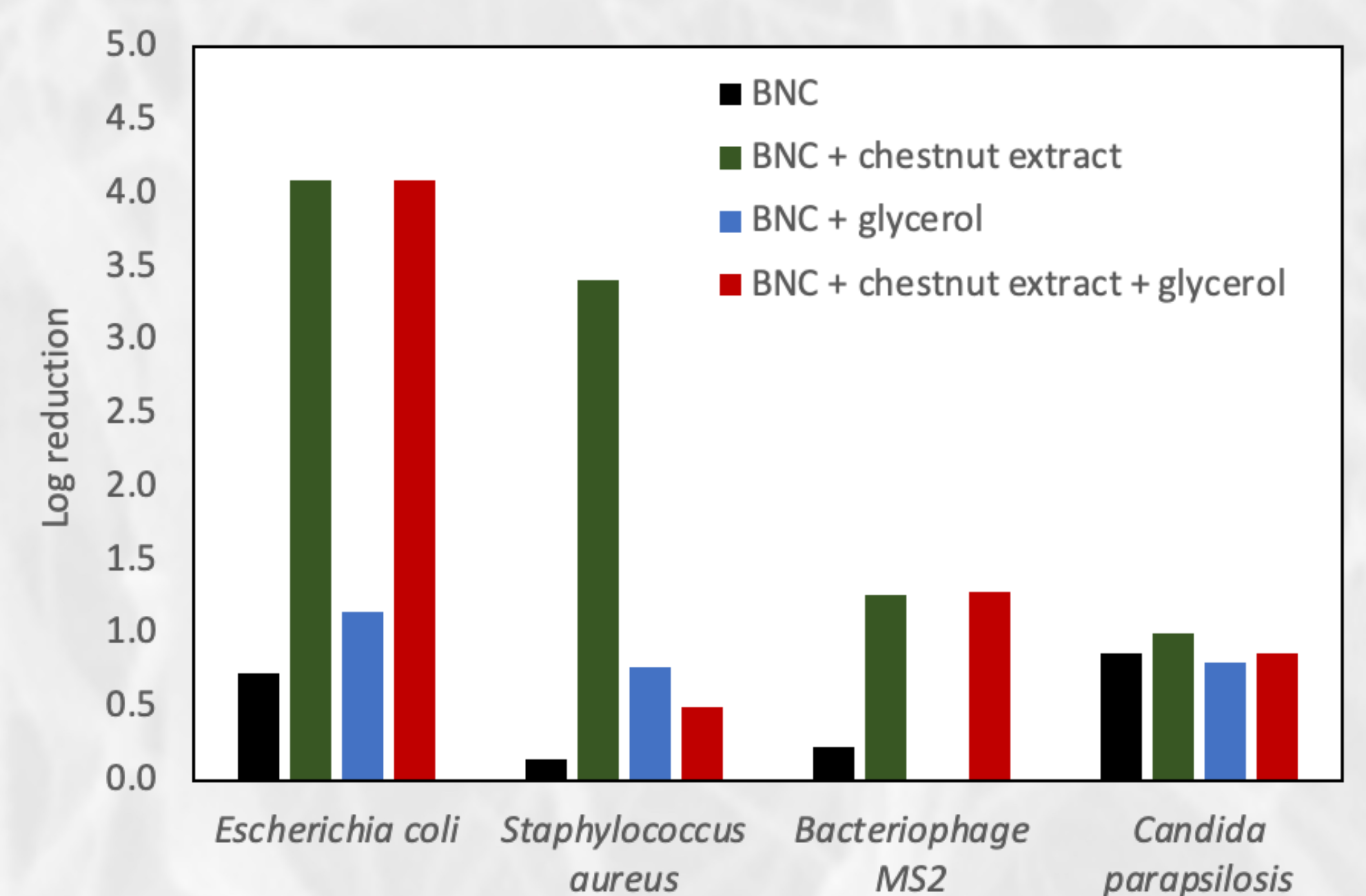


Figure 7. Antimicrobial activity.

- Excellent antibacterial activity against *E. coli* of the BNC incorporating chestnut extract with and without glycerol.
- In the absence of glycerol, the BNC with chestnut extract also presented interesting activity against *S. aureus*.
- No evident activity against the tested virus and fungi.

## Conclusions

- The incorporation of the extract proved to be uniform. SEM and FTIR showed the presence of chestnut extract and glycerol within BNC.
- WVP and swelling denoted a continuous increase over a period of 24 h.
- Despite the higher swelling of BNC incorporating chestnut extract and glycerol, the chestnut extract release was prolonged and slightly lower.
- The chestnut extract proved to have excellent antibacterial activity with 99.99% of *E. coli* reduction and antioxidant properties close to 70 %.

## Acknowledgements

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