Assessment of Hectorite/Spring Water Hydrogels as Wound Healing Products

Fátima García-Villén, Rita Sánchez-Espejo, Ana Borrego-Sánchez, Pilar Cerezo, Giuseppina Sandri, César Viseras

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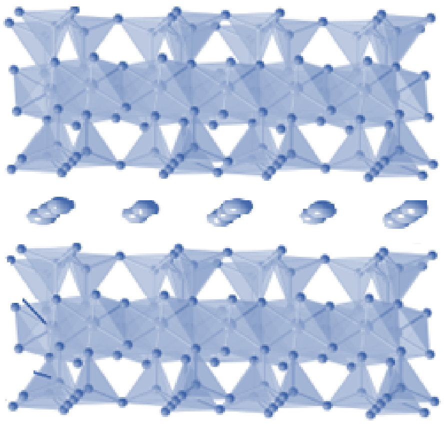
sciforum

Hectorite

Smectite clay mineral
with a layered structure



+

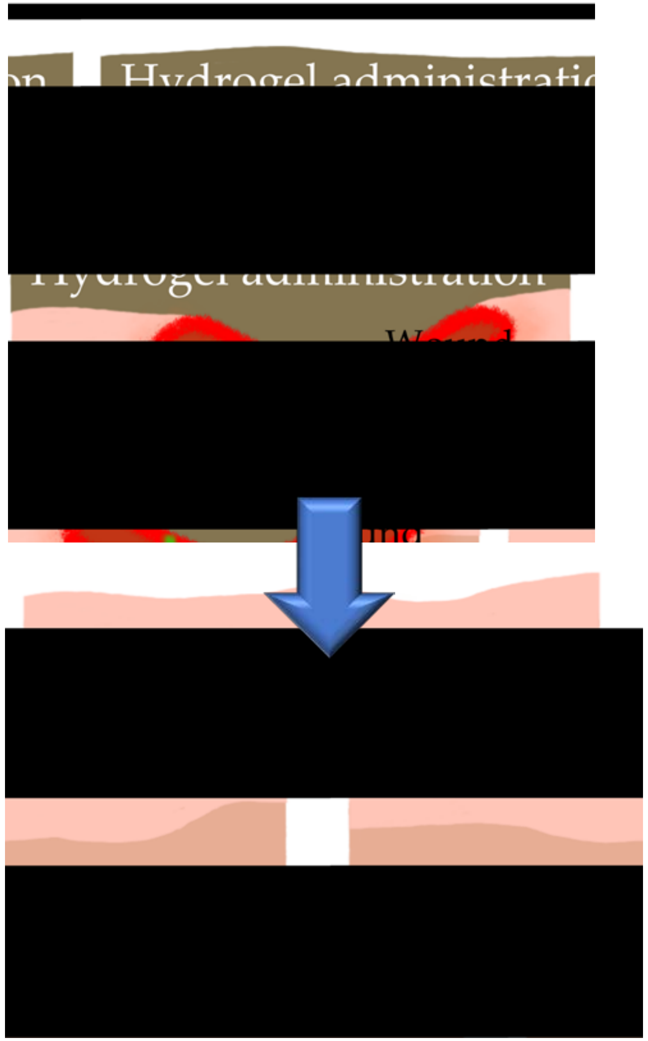
Spring water

Bioactive elements

Na^{+} Ca^{2+} K^{+} Mg^{2+}

Hectorite/spring water hydrogel

as a wound healing formulation



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Materials and Methods

Materials

- Hectorite (HT): Pangel HT-11 (Purified clay mineral from TOLSA)
- Spring water (ALI): Medicinal waters (from Alicún de las Torres)

Methods

- Solid State Characterization of Hectorite
- Hectorite Hydrogel Formulation

25g of HT in 225 mL of ALI   8000 rpm for 10 min   **Hydrogel**

- Rheology and pH Stability of Hydrogel
- Biocompatibility and Wound Healing Studies of Hydrogel

Solid State Characterization of Hectorite

Results

XRPD and XRF

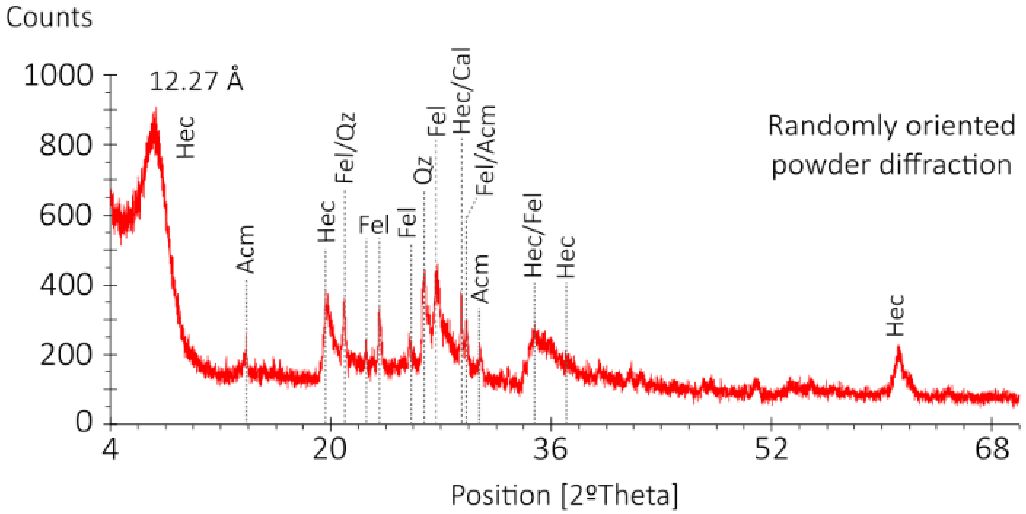


Figure 1. XRPD of HT. Mineral phases identified are included in the diffractogram. Hec: hectorite; Acm: acmite; Fel: potassium feldspar; Cal: calcite.

Table 1. XRF results of hectorite. The LOI value (Loss of Ignition) accounted for a 9.4% w/w.

Oxides	Amount (%)	Oxides	Amount (%)
SiO_2	53.19	CaO	3.09
Al_2O_3	8.39	Na_2O	5.60
Fe_2O_3	3.42	K_2O	2.83
MnO	0.05	TiO_2	0.37
MgO	13.38	P_2O_5	0.12

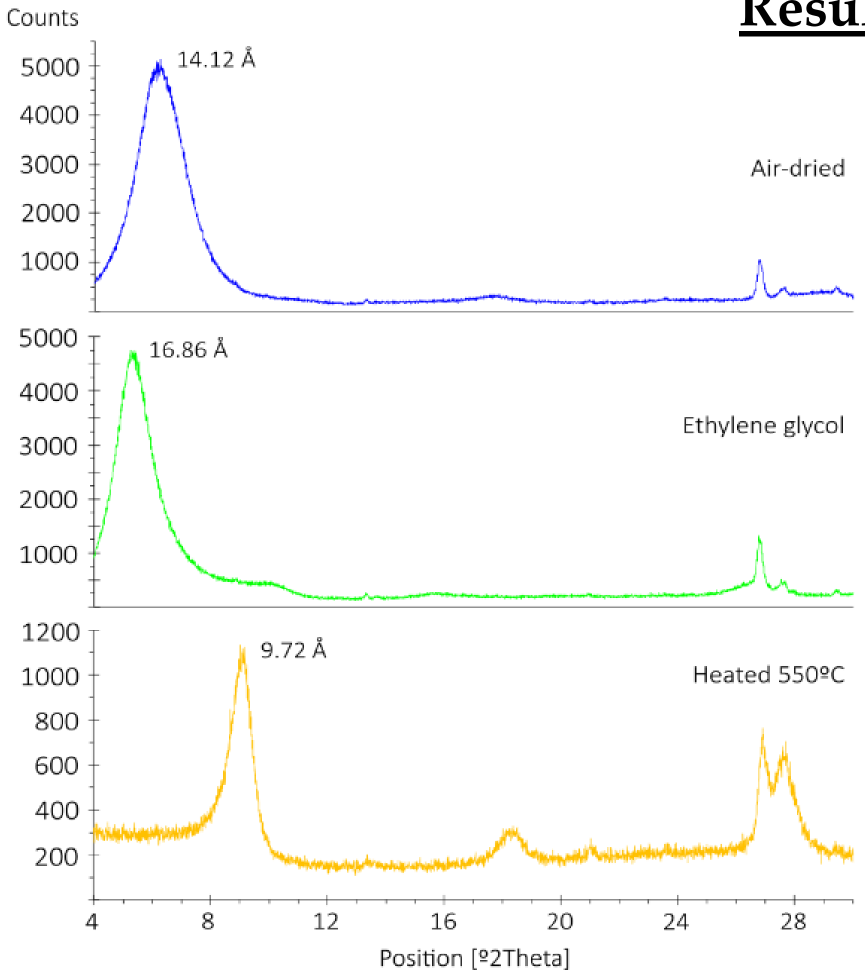


Figure 2. X-ray oriented mounts of HT (air-dried, ethylene glycol and sample heated at 550ºC).

Results confirmed that the main mineral phase was a smectite

Solid State Characterization of Hectorite

Results

TGA and DSC analysis

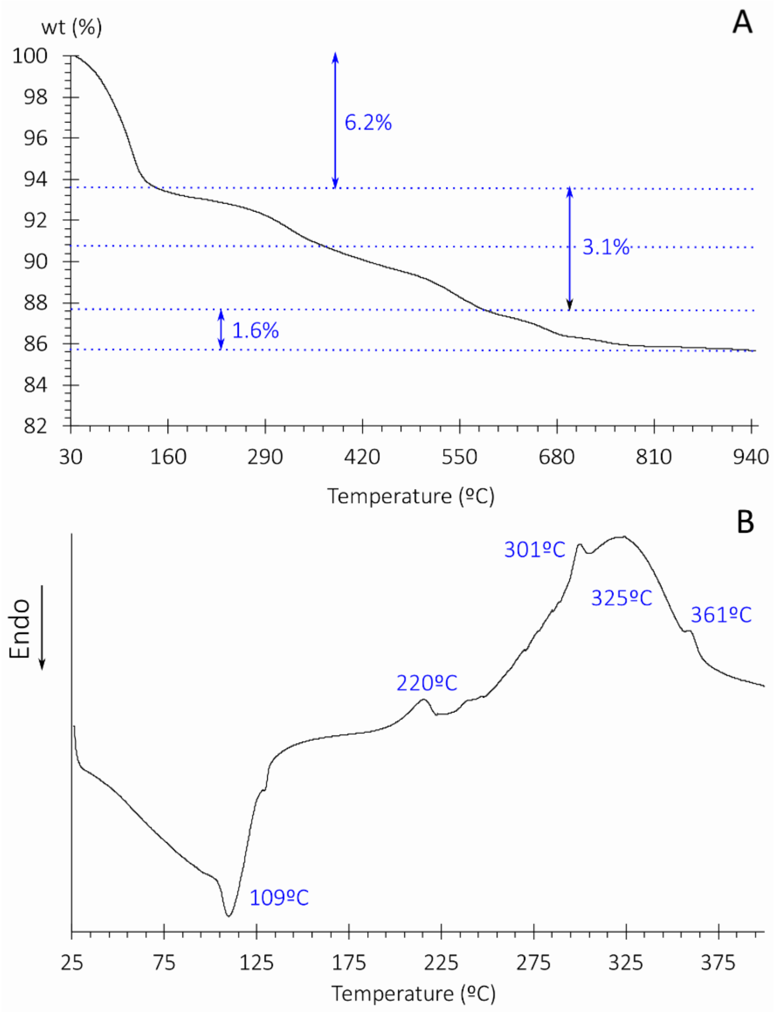


Figure 3. A) TGA analysis and B) DSC analysis of hectorite.

Dehydroxylation of hectorite happened between 580 to 687°C

Solid State Characterization of Hectorite

Results

HR-TEM

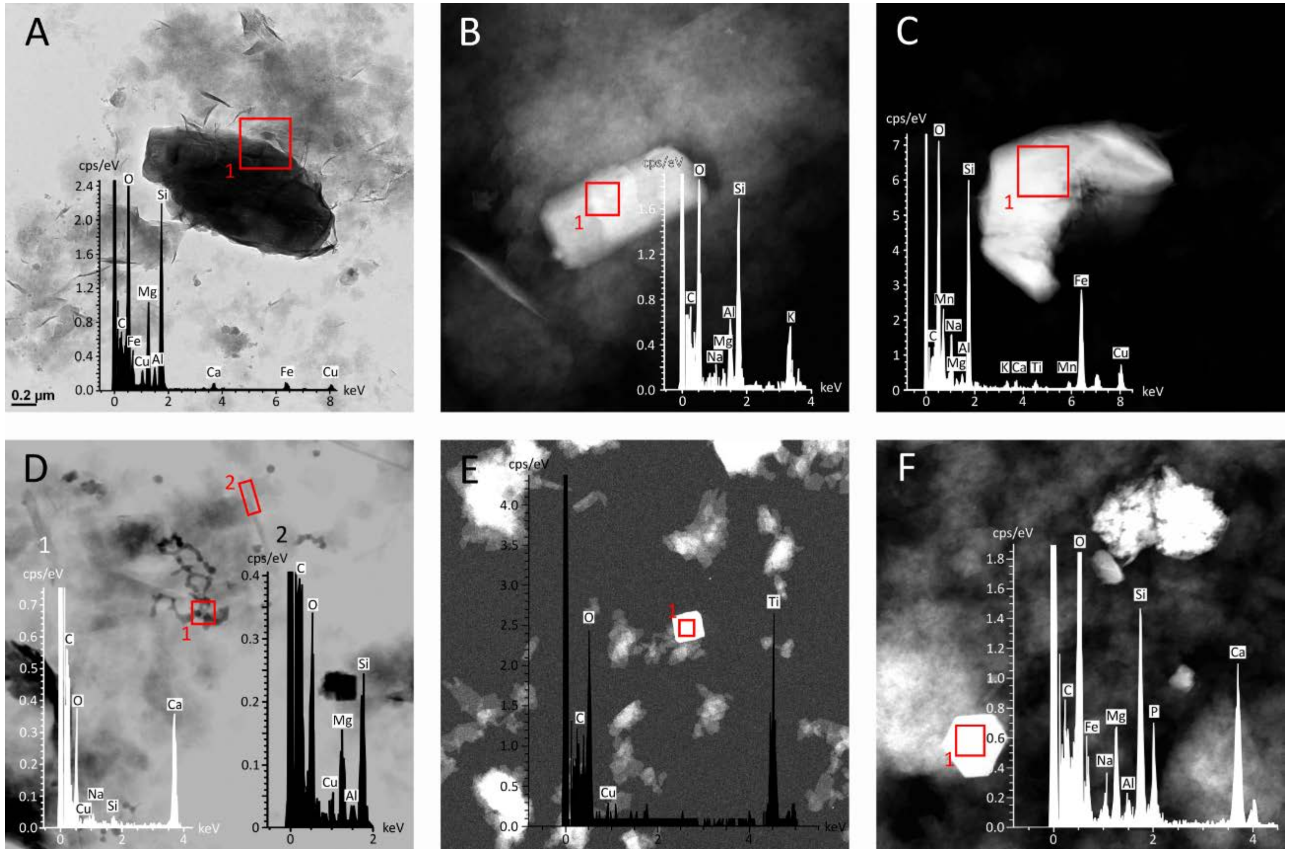


Figure 4. HR-TEM microphotographs of different mineral phases identified in HT sample together with their corresponding EDX analysis. A) hectorite smectite (major part of HT); B) potassium feldspar mixed with hectorite; C) acmite crystal; D) calcite and sepiolite mixed with hectorite; E) rutile crystal; F) apatite mixed with hectorite. Images B to F were obtained in STEM mode.

Typical smectite morphology and composition were detected

The solid state characterization showed that the hectorite posses a remarkable purity (84% w/w of hectorite), very similar to that of similar pharmaceutical excipients

Rheology and pH Stability of Hydrogel

Results

RHEOLOGY

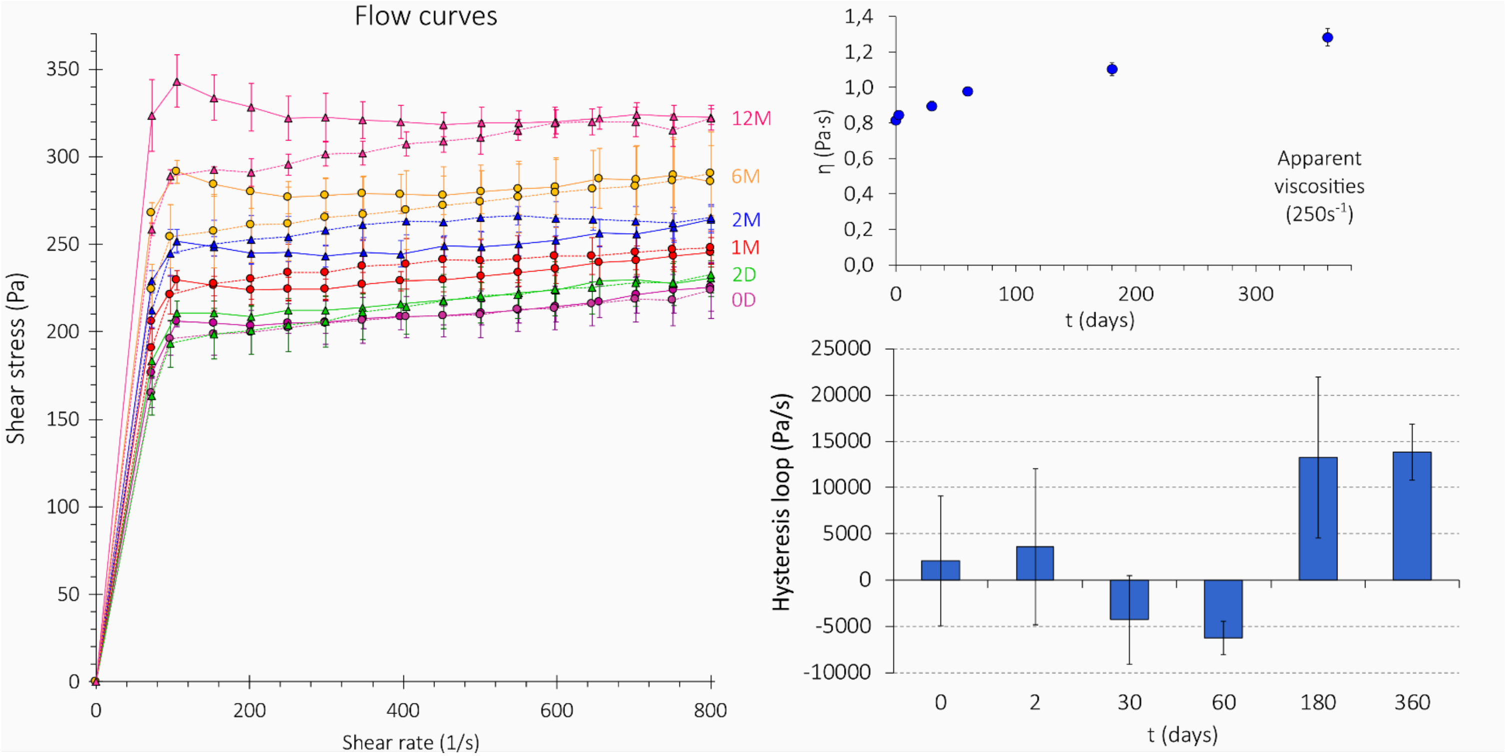


Figure 5. Flow curves, apparent viscositites and hyteresis loops of HTgel@10 (mean values ± s.d.; n=6 in all cases).

HTgel@10 showed a non-Newtonian, viscoplastic to pseudoplastic profile and a stable pH for 12 months

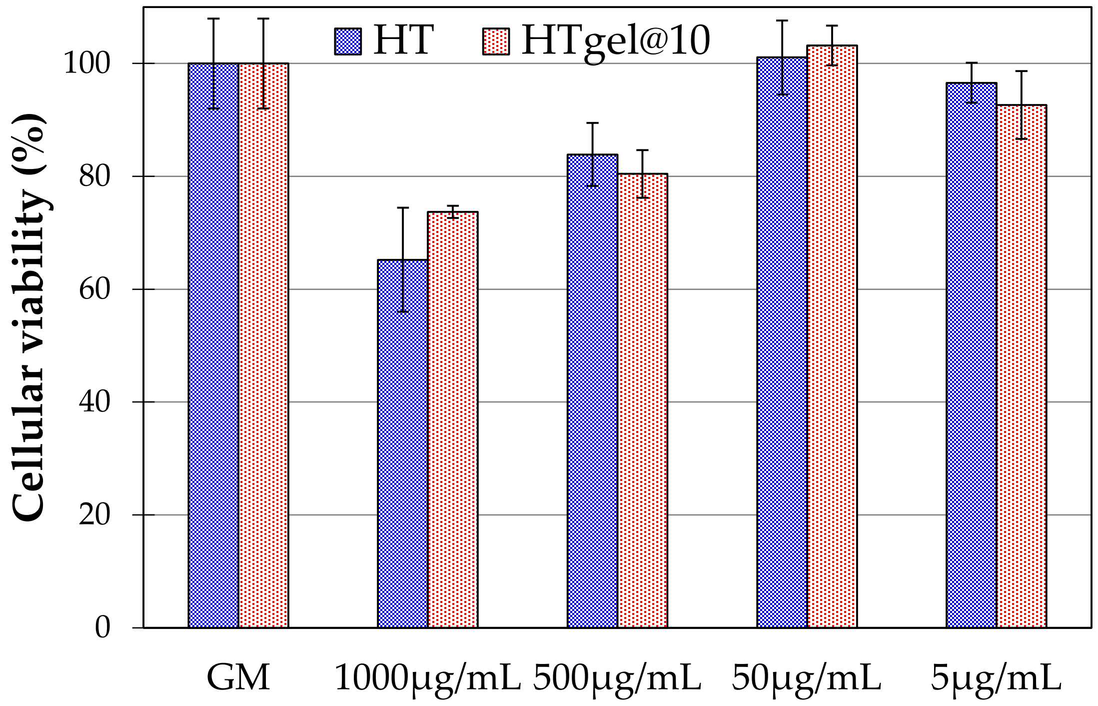
pH

Table 2. Monitoring of HTgel@10 hydrogel

	0D	2D	30D	2M	6M	12M
pH	10.25 ± 0.013	10.15 ± 0.039	9.96 ± 0.011	9.88 ± 0.013	9.66 ± 0.024	9.88 ± 0.039

Results

BIOCOMPATIBILITY



WOUND HEALING

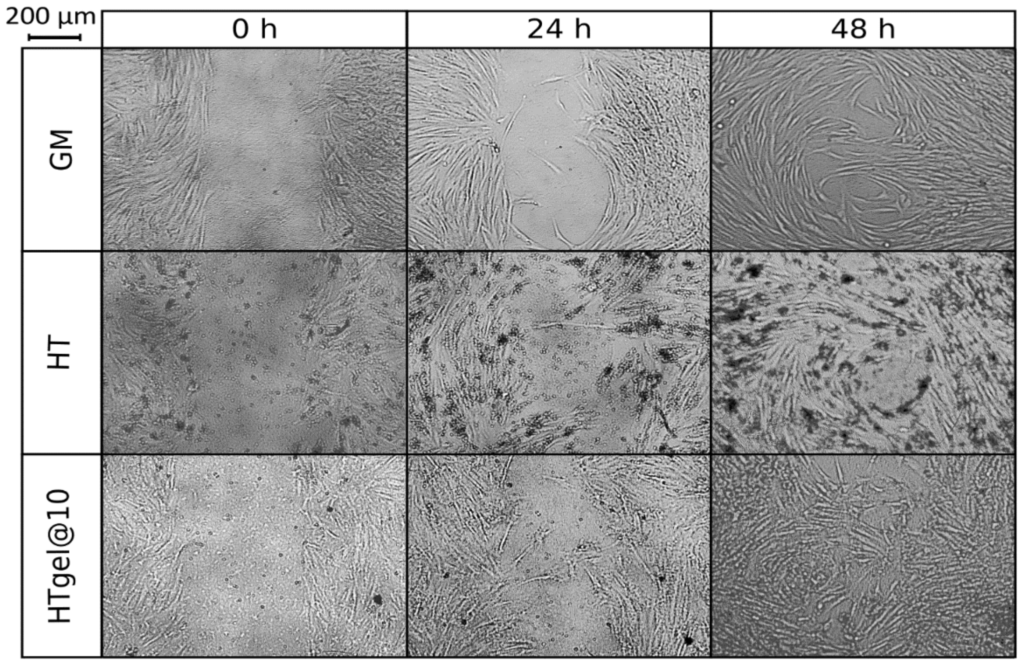


Figure 6. MTT test (left) (mean values ± s.e.; n=8) and wound healing results (right). The wound healing was evaluated by using samples at 50 µg/mL. Microphotographs were taken with an inverted optical microscope.

In vitro tests reported that the hectorite and the HTgel@10 were biocompatible (cellular viability ≥ 70%)

In vitro wound healing test revealed that HTgel@10 was able to favour the wound closure

Therefore, hectorite/spring water hydrogels could be considered as potential wound healing formulations with remarkable stability and safety

Conclusions

- The present study demonstrated that the hectorite used in this study could be considered as a pharmaceutical grade excipient in view of its purity, rheological properties and dermal biocompatibility.
- This clay is able to form stable hydrogels in a natural spring water with potential wound healing activity, according to the *in vitro* tests.

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