Data Article

Appraisal of the characteristic dataset of the synthesized nanobiocomposite hydrogel

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The survey on the characteristic data presented here, are related to the study entitled “Transparent chitosan based nanobiocomposite hydrogel: Synthesis, thermophysical characterization, cell adhesion and viability assay” [1]. Scanning electron microscopy images, evidence for structural confirmation and more description about biological assay are presented. The thermophysical characteristic including Differential scanning calorimetry and thermogravimetry analysis are described. Swelling kinetic parameters for the prepared hydrogel were calculated and showed that Schott’s equation is well suited for explaining the swelling behavior of this transparent hydrogel.

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1. Data

NMR spectrum including $^1$HNMR and $^{13}$CNMR spectrum of functionalized chitosan were recorded on a Bruker 400 MHz. Fig. 1 displays the previously reported clinoptilolite nanoparticle [2] which was imaged by SEM. FT-IR and $^1$H NMR of propargyl triethyl ammonium bromide were presented in Fig. 2. Also, $^{13}$CNMR which is so important in order to find the carbon structure of the compound was displayed as Fig. 3. To better understanding the chemical structure, chemical shifts of the $^1$H NMR and
$^{13}$C NMR as well as splitting of the mentioned peaks were inserted in Table 1. Preparation of the scaffold extracts and determination of the pH values of the 24, 48 and 72 hours extract and also gimsa staining was demonstrated in Figs. 4 and 5 respectively. Moreover thermophysical analyses (Figs. 6 and 7) were done on a Perkin-Elmer Pyris Diamond and Pyris 6 TGA Consumables. Difference in dimension of the same sized hydrogel in two temperatures and the transparency of the hydrogel were displayed in Fig. 8. The static water contact angle (WCA) was determined by Sessile drop measurements using a Contact Shape Analyzer, CA-500M (Sharifsolar, IRAN) (Fig. 9). Swelling kinetic parameters for the prepared chitosan based hydrogel were presented in Table 2.

Fig. 2. FT-IR and $^1$H NMR of propargyl triethyl ammonium bromide.
2. Experimental design, materials and methods

The clinoptilolite (CP) nanoparticles which were incorporated in this nanobiocomposite were prepared according to the previous published article [2]. The spherical structure and the size of nanoparticles were shown with SEM image in Fig. 1. To prepare modified chitosan with more applicable characteristics, functionalization of chitosan was done with triethyl amine and propargyl bromide. Through this process, quaternary ammonium moiety was inserted and the hydrophilicity of the chitosan was improved. The FTIR, $^1$H NMR (Fig. 2) and $^{13}$C NMR (Fig. 3) spectrum depicted the clear evidence of the modification. The characteristic peaks were demonstrated in details.

As can be seen in the Fig. 4, the pH values of the scaffold extracts were increased after 48 hours. This elevation from 7.5 up to 9 was not suitable for cell culture and was resulted in low cell proliferation.

To demonstrate the cell adhesion and proliferation on the scaffold surface after mentioned time, gimsa staining as well as MTT assay was performed. The purple fibroblast cells are evident in the microscopic image of the scaffold surface (Fig. 5).

Table 1
$^1$H NMR and $^{13}$C NMR dataset of propargyl triethyl ammonium bromide.

| Chemical shift (ppm)/splitting | $^1$H-NMR | $^{13}$C-NMR |
|------------------------------|-----------|--------------|
|                              | 1.23/triplet | 7.91       |
|                              | 3.33/quartet | 47.80      |
|                              | 4.04/triplet | 53.52      |
|                              | 4.35/doublet | 72.45      |
|                              | --         | 82.82      |
Thermal properties of modified chitosan were evaluated by DSC and TGA experiments. DSC of the prepared chitosan exhibited a broad exothermic peak at 315 °C (Fig. 6). Moreover, TGA experiments of the modified chitosan displayed that the start of degradation was occurred at around 230 °C and ended at 340 °C (Fig. 7). During this thermal process the sample lost about 42.97% of its weight. This step was mainly due to the decomposition and degradation of the functionalized moieties such as etheric and

![Fig. 6. DSC curve of modified chitosan.](image)
amine bonds and also polymeric chain [3]. According to the thermogram, the maximum weight loss is about 305 °C. This degradation and elimination step in TGA was displayed by exothermic peak in DSC thermogram too. The DSC is showing an endothermic peak at about 100 °C that may be correlated to removal of loosely bound water and existing solvent in the polymeric network.

Water absorption properties were assayed in two temperatures; in normal body temperature (37 °C) and room temperature (25 °C). The clear difference in size was occurred (Fig. 8a). The data obtained from this evaluation were presented in “Transparent chitosan based nanobiocomposite hydrogel: Synthesis, thermophysical characterization, cell adhesion and viability assay” [1] article. Also the transparency of the hydrogel was displayed in Fig. 8b. The static water contact angle (WCA) for the prepared chitosan based hydrogel was determined by (Krüss, Hamburg, Germany) (Fig. 9).

![Fig. 7. TGA curve of modified chitosan.](image)

**Fig. 7.** TGA curve of modified chitosan.

![Fig. 8. (a) difference in dimension of the same sized hydrogel after swelling for 24 hours. (b) Transparency of the hydrogel.](image)

**Fig. 8.** (a) difference in dimension of the same sized hydrogel after swelling for 24 hours. (b) Transparency of the hydrogel.
To survey on further experiments, some critical swelling kinetic parameters were calculated \[4,5\] and showed that Schott’s equation can explain this swelling behavior of the modified chitosan hydrogel (Table 2). The values obtained for $K_2$ illustrated the effect of temperatures on water absorption properties of hydrogels.

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### Conflict of Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

### References

[1] H. Tashakkorian, V. Hasantabar, A. Mostafazadeh, M. Golpour, Transparent chitosan based nanocomposite hydrogel: synthesis, thermophysical characterization, cell adhesion and viability assay, Int. J. Biol. Macromol. 144 (2020) 715–724.

[2] S.M. Baghbanian, N. Rezaei, H. Tashakkorian, Nanozeolite clinoptilolite as a highly efficient heterogeneous catalyst for the synthesis of various 2-amino-4H-chromene derivatives in aqueous media, Green Chem. 15 (2013) 3446–3458.

[3] S. Jana, M.K. Trivedi, R.M. Tallapragada, A. Branton, D. Trivedi, G. Nayak, R. Mishra, Characterization of physicochemical and thermal properties of chitosan and sodium alginate after biofield treatment, Pharm. Anal. Acta 6 (2015) 10.

[4] O.U. Akakuru, B.O. Isiuku, Chitosan hydrogels and their glutaraldehyde-crosslinked counterparts as potential drug release and tissue engineering systems - synthesis, characterization, swelling kinetics and mechanism, J. Phys. Chem. Biophys. 7 (2017) 3.

[5] M. Gierszewska-Drużyńska, J. Ostrowska-Czubenko, Structural and swelling properties of hydrogel membranes based on chitosan crosslinked with glutaraldehyde and sodium tripolyphosphate, Prog. Chem. Appl. Chitin Deriv. 20 (2015) 43–53.