Films-based hydrogel designed as functional biomaterials for treatment of skin wound

Mariana Chelu [1, *], Jose Calderon Moreno [1], Irina Atkinson [1], Adriana Rusu [1], Emma Adriana Ozon [2], Ana-Maria Seciu-Grama [3] and Adina Magdalena Musuc [1, *]

[1] "Ilie Murgulescu" Institute of Physical Chemistry, Romanian Academy, 202, Spl. Independentei, 060021 Bucharest, Romania; mchelu@icf.ro; amusuc@icf.ro
[2] "Carol Davila" University of Medicine and Pharmacy, Faculty of Pharmacy, Department of Pharmaceutical Technology and Biopharmacy, 6 Traian Vuia Street, 020945 Bucharest, Romania
[3] National Institute of Research and Development for Biological Sciences, 296 Spl. Independentei, 060031 Bucharest, Romania

INTRODUCTION

The development of high-performance dressings for the treatment of infected skin wounds represents a necessary requirement. In this paper it was designed and synthesized adhesive hydrogel films containing active agents such as hyaluronic acid (HA) and lidocaine as local anesthetic. HA is an extremely effective and long-lasting moisturizer, biocompatible, with a regenerating effect, promoting the regeneration of damaged skin. Lidocaine has been incorporated to relieve acute pain and improve patient comfort and endurance. Films without HA and lidocaine were also produced as control sample.

OBJECTIVES

1. Development of new hydrogels based on films designed as functional biomaterials for the treatment of skin wounds.
2. Preparation of hydrogel matrices containing hyaluronic acid and lidocaine
3. Applications of these new hydrogels as a patches for painless treatment and healing of skin wounds.

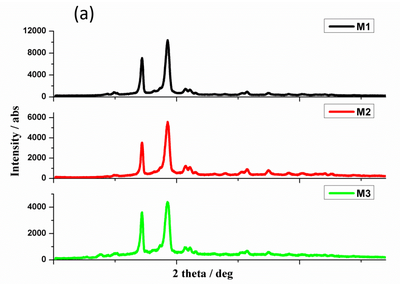
The new obtained film-based hydrogels can be used as promising materials capable of restoring the structural and functional properties of the skin.

MATERIALS AND METHODS

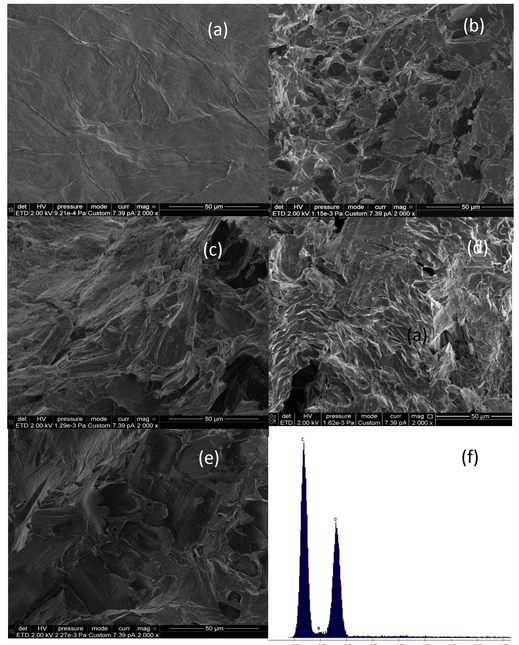
The hydrogels were prepared by the one pot method, by adding to the matrix based on PEG, Xanthan and arginine, in this order, hyaluronic acid with different molecular weights and lidocaine (S1, S2, S3). The materials were synthesized by dissolving in deionized water at room temperature and stirring continuously for one hour. For characterization, the hydrogels were poured into Petri dishes and dried at room temperature for several days. Films without HA and lidocaine were also produced as control sample (M1, M2, M3).

The successful synthesis of films, obtained at room temperature from aqueous solutions, was also confirmed by Fourier transform infrared analysis, X-ray diffraction and scanning electron microscopy. Water absorption, adhesion and mechanical strength of the films-based hydrogel are improved with the introduction of HA and Li, leading to the rapid skin wound healing process.

Results

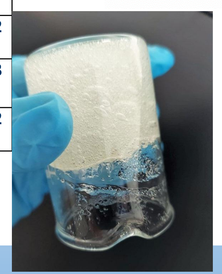


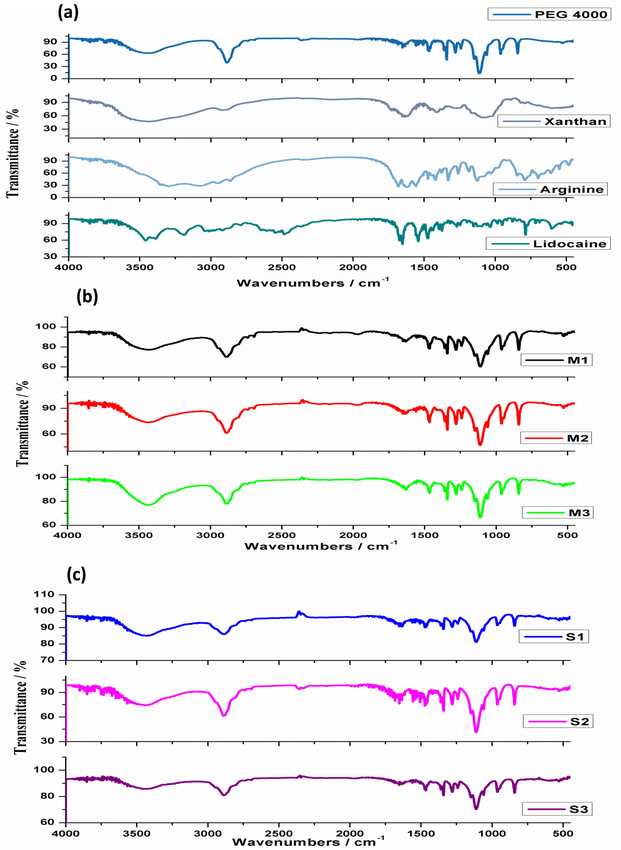
XRD diffractograms of (a) M1, M2, M3; (b) S1, S2, S3



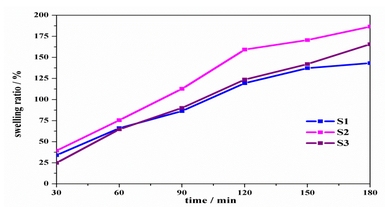
SEM micrographs of (a) M1, (b) M3, (c) S1, (d) S2, (e) S3 and (f) EDX for S3

Patch type	Wi (g)	30 minute		1 hour		1,5 hours		2 hours		2,5 hours		3 hours	
		Wt	Sr%	Wt	Sr%	Wt	Sr%	Wt	Sr%	Wt	Sr%	Wt	Sr%
S1	2.140	2.868	34.02	3.553	66.03	3.988	86.35	4.695	119.39	5.078	137.28	5.205	143.22
S2	2.263	3.154	39.37	3.972	75.52	4.814	112.72	5.868	159.30	6.123	170.57	6.484	186.53
S3	2.219	2.773	24.96	3.653	64.62	4.218	90.08	4.964	123.70	5.372	142.09	5.894	165.62





FTIR spectra of (a) precursors; (b) M1, M2, M3; (c) S1, S2, S3



Swelling ratio assessment

The swelling ratio is the parameter that has the highest influence on the adhesive and release properties of the patches.

CONCLUSIONS

- Wet adhesive backing films with good adhesion to skin, encapsulating HA with different molecular weights and Li were developed to explore their potential to be used as a patch for painless treatment and healing of skin wounds.
- FTIR and XRD analyses proved the incorporation of HA and Li in the films-hydrogel matrix.
- As expected, considering the use of the same matrix, the swelling ability is not significantly different between the three patch formulations. The formulation's hydration is higher during the first two hours. After 3 hours, the registered swelling ratios were: 143.22% for S1, 186.53% for S2 and 165.62% for S3. The swelling ratio decreased in the following order: S2>S3>S1. The results are proving that the swelling behavior is influenced by the properties of the active ingredients.
- The present research suggest that the films-based hydrogel incorporated hyaluronic acid and lidocaine with their inherent properties are good choice of materials for skin wound healing process.

IECBM 2022 — The 2nd International Electronic Conference on Biomolecules: BIOMACROMOLECULES AND THE MODERN WORLD CHALLENGES
01–15 NOVEMBER 2022 | ONLINE
biomolecules MDPI