POLYSACCHARIDE HYDROGELS, CONTAINING OLIVE MILL WASTEWATER (OMW), TO PRODUCE ANTIBACTERIAL FILMS FOR WOUND HEALING

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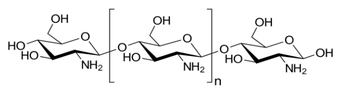
INTRODUCTION

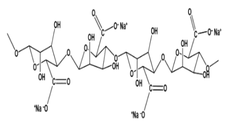
Wound dressings traditionally used such as bandages, gauze, or cotton wool do not play an active role in the wound healing process and do not maintain the right amount of water in the injured area. Hydrogel is a potential candidate for advanced dressings because, being a polymeric formulation with a three-dimensional network, it retains the right amount of water and at the same time cools the wound reducing pains. The polysaccharides represented an indispensable source of versatile materials and were chosen due to their beneficial properties such as: homogeneity, bio-adhesion, and bio-activity. Chitosan, sodium alginate, sodium hyaluronate have an intrinsic antimicrobial activity and they are also active in wound healing. The goal of this research was to exploit the polymeric films, as carrier of olive mill wastewater (OMW) as antibacterial agent, for the treatment of skin injures and wound healing.

MATERIALS

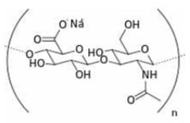
Chitosan (CHI)



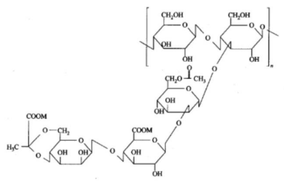
Sodium alginate (ALGI)



Sodium ialuronate(HA)



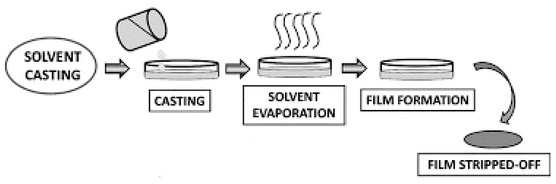
Xanthan gum(GX)

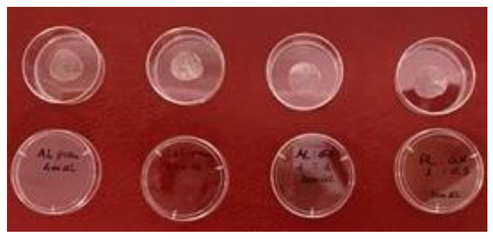


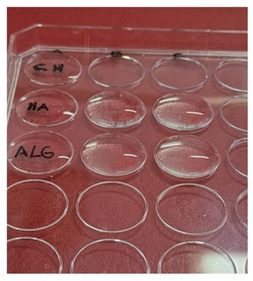
METHODS

Gels preparation

Hydrogels containing 0.5 to 2.5% (w/w) of gelling polymer were prepared at room temperature by dispersing sodium alginate, sodium hyaluronate and xanthan gum in 100 ml deionised water while chitosan was dispersed in 100 ml of water after treatment with 1 g of acetic acid (1% w/V) under constant stirring to prevent the solid particles aggregation.
Then, hydrogels containing OMW [1] were also prepared, after complete dissolution of the gelling polymer a quantity of OMW equal to 10% (w/w) of the total was added.



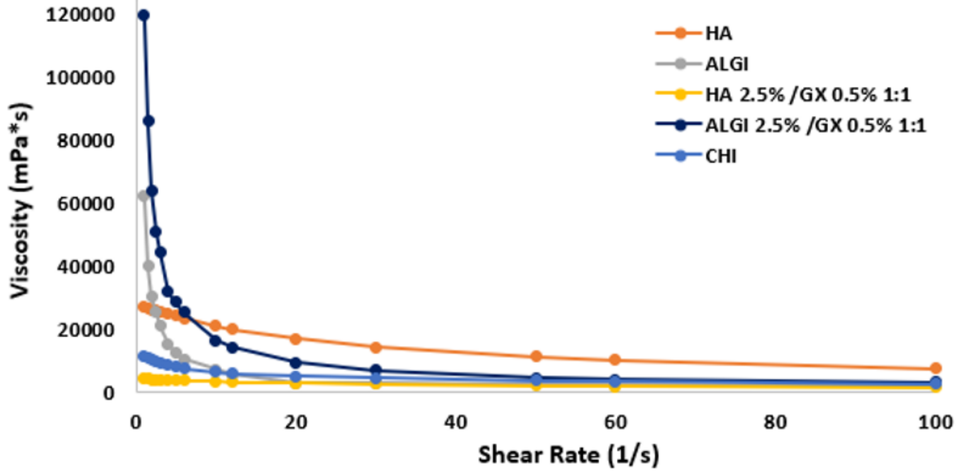




Films preparation

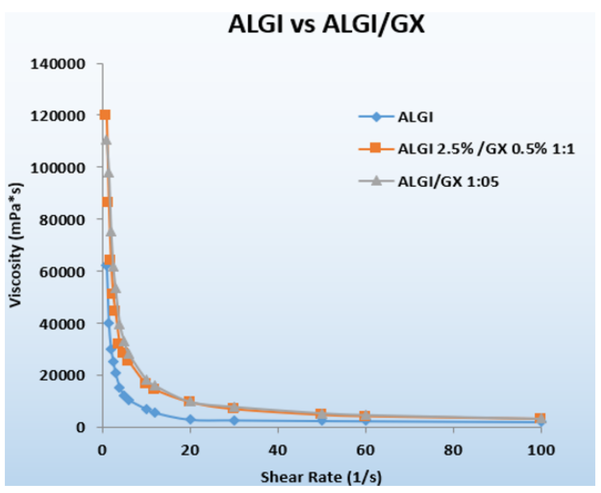
Previously hydrogels, obtained by dispersion in water of chitosan 2.5% (w/w) [2], sodium alginate 2.5% (w/w), sodium hyaluronate 2.5% (w/w) and xanthan gum 0.5% (w/w), were exploited for film preparation by solvent casting method [3].
Except for chitosan (CHI), which was used pure, binary mixtures of hydrogels (w/w) based on sodium alginate (ALGI)/xanthan gum (GX), the latter used as a plasticizing agent, and sodium hyaluronate (HA)/xanthan gum (GX) in 1:1 and 1:0.5 ratio, were prepared.

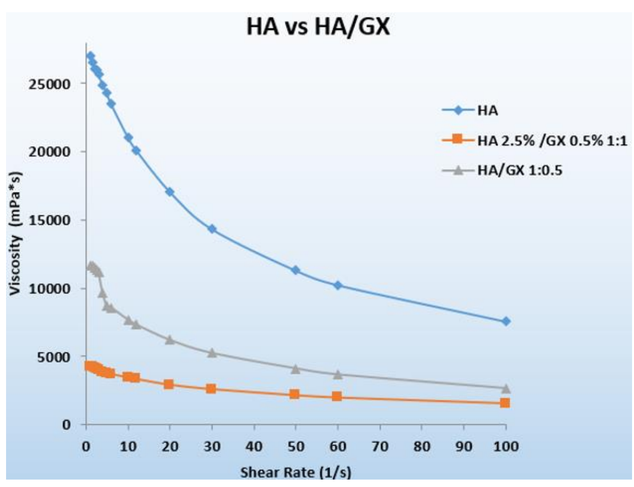
RESULTS



Film	Condition	% Water loss
CHI 2.5%	KOH	8
	$CaCl_2$	6
HA 2.5%	KOH	8
	$CaCl_2$	5
ALGI 2.5%	KOH	7
	$CaCl_2$	5
HA 2.5%/GX 0.5%	KOH	7
	$CaCl_2$	3
ALGI 2.5 %/GX 0.5%	KOH	5
	$CaCl_2$	6

Hydrogels	pH
CHI 2.5%	4.80 ± 0.02
HA 2.5%	7.05 ± 0.02
ALGI 2.5%	7.02 ± 0.01
HA 2.5% /GX 0.5%	6.13 ± 0.02
ALGI 2.5%/GX 0.5%	6.19 ± 0.01





Sample	Hydrogel (g)	Abs	DPPH (% ± SD)	AA (% ± SD)
CHI 2.5%	0.6	0.525	54.24 ± 0.2	45.76 ± 0.2
ALGI 2.5%	0.6	0.650	67.15 ± 0.2	32.85 ± 0.2
HA 2.5%	0.6	0.720	74.38 ± 0.1	25.62 ± 0.1
ALGI 2.5%/GX 0.5%	0.6	0.660	68.18 ± 0.2	31.82 ± 0.2
HA 2.5%/GX 0.5%	0.6	0.730	75.41 ± 0.1	24.59 ± 0.1

Hydrogel for film solvent casting	Ratio of polymers	Thickness (mm± SD)
CHI 2.5%	-	0.015 ± 0.020
HA 2.5%	-	0.020 ± 0.015
ALGI 2.5%	-	0.015 ± 0.020
HA 2.5%/GX 0.5%	1:1	0.010 ± 0.010
ALGI 2.5 %/GX 0.5%	1:1	0.010 ± 0.010

- ✓ Films had a homogeneous surface and good moldability even after ***water loss***.
- ✓ Hydrogels with a ***pH*** ≤ 6 may be useful for inhibiting bacterial growth and thus improving and accelerating the healing of infected wounds.
- ✓ From the preliminary data obtained, all the hydrogels showed a good ***antioxidant activity***, ranging between 40% and 25%, where the OMW extract in the chitosan gel would seem to have greater efficacy.

CONCLUSIONS

All tested formulations showed excellent rheological properties, their pH was optimal for topical applications and all hydrogel showed an excellent film-forming capacity. The hydrogel added with OMW have shown good antioxidant activity. Based on the data obtained, highlighted that the studied hydrogels carrying OMW may be excellent candidates for topical dressings in wound healing.

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Associazione Farmaceutici Industria Società Scientifica

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3) Pagano, C.; Puglia, D.; Luzi, F.; Michele, A.D.; Scuota, S.; Primavilla, S.; Ceccarini, M.R.; Beccari, T.; Iborra, C.A.V.; Ramella, D.; et al. Development and Characterization of Xanthan Gum and Alginate Based Bioadhesive Film for Pycnogenol Topical Use in Wound Treatment. *Pharmaceutics* **2021**, 13, 324.