Taylor & Francis
Taylor & Francis Group

Annals of Medicine

ISSN: (Print) (Online) Journal homepage: https://www.tandfonline.com/loi/iann20

Physically crosslinked polyvinyl alcohol hydrogels as synthetic cartilage materials

S. Schweizer, I. Monteiro, A.S Oliveira, P. Nolasco, R. Colaço & A.P Serro

To cite this article: S. Schweizer, I. Monteiro, A.S Oliveira, P. Nolasco, R. Colaço & A.P Serro (2021) Physically crosslinked polyvinyl alcohol hydrogels as synthetic cartilage materials, Annals of Medicine, 53:sup1, S25-S26, DOI: 10.1080/07853890.2021.1896904

To link to this article: https://doi.org/10.1080/07853890.2021.1896904

Published online: 28 Sep 2021.

authors failed to replicate a modulatory effect applying tsDCS [3]. Modelling studies predicted EF magnitudes sufficient for neuromodulation in the montages previously applied in the spinal segments to be modulated when these are located between the electrodes [2].
Discussion and conclusions: Literature review indicates that experimental findings mainly depend on electrode polarity and position over the SC. tsDCS is a tool amenable to modulate motor circuits excitability in the spinal cord. This intervention can have clinical implications in the treatment of conditions like spasticity. However, future studies should consider EF magnitude and its orientation relative to spinal neurons. We propose that future clinical protocols should be guided by computational modelling to increase the chances of consistent positive results [4].

CONTACT Mariana Pereira mariana.fapereira@gmail.com

Acknowledgements

The authors acknowledge funding from the Fundação para a Ciência e Tecnologia (FCT) in the scope of the FCT-IBEB Strategic Project UID/BIO/00645/2013. S. R. Fernandes was supported by a FCT grant, reference SFRH/BD/100254/2014.

References

[1] Cogiamanian F, Ardolino G, Vergari M, et al. Transcutaneous spinal direct current stimulation. Front Psychiatry. 2012;3:1–5.
[2] Fernandes SR, Salvador R, Wenger C, et al. Transcutaneous spinal direct current stimulation of the lumbar and sacral spinal cord: a modelling study. J Neural Eng. 2018;15(3):036008.
[3] Kuck A, Stegeman DF, van der Kooij H, et al. Changes in H-reflex recruitment after trans-spinal direct current stimulation with multiple electrode configurations. Front Neurosci. 2018;12:151.
[4] Fernandes SR, and Pereira M, Salvador R, et al. Cervical transspinal direct current stimulation: a modelling-experimental approach. J Neuroeng Rehab. 2019;16:123.

DOI: 10.1080/07853890.2021.1896902

Physically crosslinked polyvinyl alcohol hydrogels as synthetic cartilage materials

S. Schweizer[a], I. Monteiro[b], A.S Oliveira[b,c,d], P. Nolasco[b,d], R. Colaço[c] and A.P Serro[b,d]

[a]Chemical Engineering Department, University of Reutlingen, Reutlingen, Germany; [b]CQE, Instituto Superior Técnico – University of Lisbon, Lisbon, Portugal; [c]IDMEC, Instituto Superior Técnico – University of Lisbon, Lisbon, Portugal; [d]Centro de Investigação Interdisciplinar Egas Moniz (CiiEM), Egas Moniz Cooperativa de Ensino Superior, Caparica, Portugal

ABSTRACT
Introduction: Polyvinyl alcohol (PVA) hydrogels have been considered very promising materials for the replacement of cartilage tissues due to their biocompatibility, chemical resistance, swelling capacity, and tribological behaviour [1,2]. However, their mechanical properties are still far from those of articular cartilage. In the present work, some PVA hydrogels are prepared with different compositions and under different conditions, to obtain materials with superior physical and mechanical properties.
Materials and methods: A 13.5% w/w PVA solution, prepared by dissolving the polymer (Mw 145,000 Da) in pure water for 20 h at 95 °C, was poured into Petri dishes and cooled to room temperature (8 h). Cast-drying (CD) (60 °C, 80% RH, 7 days) method was used to produce CD_{PVA} gels. Some of these were subsequently annealed for 30 min at 100 °C, giving rise to $CD_{PVA+A100}$ samples. The freeze-thawing (FT) procedure (6 cycles of 16 h of freezing at −20 °C and 8 h of thawing at room temperature) was chosen to prepare FT_{PVA} and $FT_{PVA+PAA}$ samples. For the latter case, polyacrylic acid (PAA, MW 100,000 Da) was added to the PVA solution in the ratio of 3:10 (w/w) in relation to the PVA. The materials were characterised in terms of water content, wettability (captive bubble method), microstructure (SEM) and mechanical performance (compression tests).
Results: The CD gels presented lower water content and contact angles, a non-porous microstructure (see Figure 1), and higher rigidity than the FT samples. The annealing procedure slightly affected the studied properties of CD_{PVA}, while the addition of PAA improved the water absorption of FT gels.
Discussion and conclusions: The characteristics of PVA-based hydrogels can be easily tailored by adjusting the production method or combining PVA with other compounds in order to produce materials that best resemble human cartilage, and that can be used as substitutes for joint cartilage tissue.

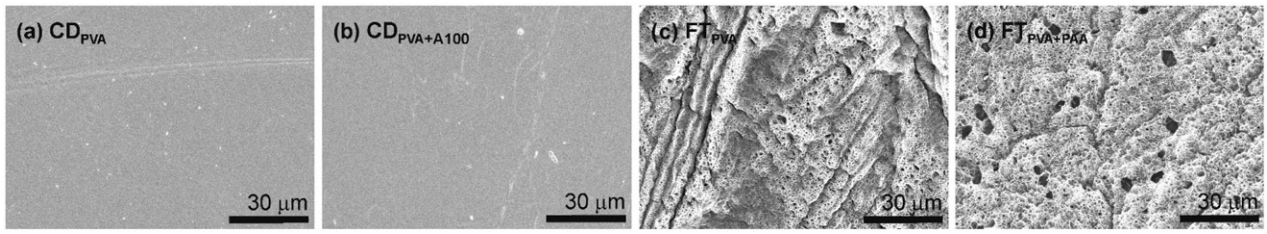

Figure 1. Microstructure of (a) CD_{PVA}, (b) $CD_{PVA+A100}$, (c) FT_{PVA}, and (d) $FT_{PVA+PAA}$.

CONTACT S. Schweizer sara.schweizer80@gmail.com

Acknowledgements

To Fundação para a Ciência e a Tecnologia for funding through the research project PTDC/CTM-CTM/29593/2017 and the unit projects UID/EMS/50022/2019 (LAETA - IDMEC), UID/QUI/00100/2019 (CQE), and UID/BIM/04585/2019 (CiiEM). To Kuraray for providing the PVA powder.

References

[1] Baker MI, Walsh SP, Schwartz Z, et al. A review of polyvinyl alcohol and its uses in cartilage and orthopedic applications. J Biomed Mater Res B Appl Biomater. 2012;100(5):1451–1457.
[2] Oliveira AS, Seidi O, Ribeiro N, et al. Tribomechanical comparison between PVA hydrogels obtained using different processing conditions and human cartilage. Materials. 2019;12(20):3413.

DOI: 10.1080/07853890.2021.1896904

Profiles of elemental concentrations in human: contribution of X-ray fluorescence to discrimination between healthy and diseased tissues and prediction of alterations in tongue carcinoma

Luísa Zagalo[a], Pedro Oliveira[a], Maria João Oliveira[b], Luísa Gonçalves[a], Carlos Zagalo[a] and José Brito[a]

[a]Centro de Investigação Interdisciplinar Egas Moniz (CiiEM), Egas Moniz Cooperativa de Ensino Superior, Caparica, Portugal; [b]Instituto de Ciências Biomédicas Abel Salazar, Porto, Portugal

ABSTRACT

Introduction: It has been shown that the concentrations of some elements, for example K, Ca, Cu, Fe, and Zn, may differ significantly between the healthy area and the tumour area in the same human tissue [1]. Most studies conducted so far are focussed on specific elements which are a priori known to be involved in physiological or pathological processes, and thus risk neglecting the potential role of the excluded elements in those processes [2]. The role of elements considered in isolation has been questioned because it ignores the important interactions amongst the various elements [3]. However, even when concentrations of various elements are obtained in the same study, comparisons between healthy and diseased tissues, or correlations between the various elements, both intrinsically multivariate, are often implemented with univariate methods, which may result in observed effects or the inability to detect such effects [4]. The methodologies in this study, which complement multielement determinations by X-ray fluorescence spectroscopy (XRF) and X-ray diffraction (XRD) in several types of biological samples, with multivariate data analysis methodologies, provide an important contribute to fill existing gaps in current knowledge of the role elements in such metabolic pathways.
Materials and methods: Samples consisted of five matched pairs (10 samples) of normal and tumour human tongue tissue. In the developing work, the XRF and XRD techniques are applied in the determination of the concentration profile of several elements of interest, in samples of healthy tissue and tongue carcinoma, with the objective of developing a classification system based on the profile of elemental concentrations which allows to discriminate between healthy tissue and carcinoma, and thus clarify the role of these elements in the aetiology of the disease.
Results: Potential differences in Ca, Fe and S were observed. Intrasampling tests determined that samples were inhomogeneous which may affect the ability to discriminate between normal and tumour tissues.
Discussion and conclusions: It is highlighted that the limited number of samples prevents any conclusive findings for now nevertheless results provide areas of focus for upcoming study.

CONTACT Luísa Zagalo analuisazagalo@gmail.com