materials proceedings

MDPI

Abstract

3D Printing for Affinity Chromatographic Support Production †

Joana F. A. Valente [1,*], Juliana R. Dias [1], Fani Sousa [2] and Nuno Alves [1,*]

[1] CDRSP-IPL—Centre for Rapid and Sustainable Product Development, Polytechnic of Leiria, Leiria, Rua de Portugal, 2430-028 Marinha Grande, Portugal; juliana.dias@ipleiria.pt
[2] CICS-UBI—Health Science Research Centre, University of Beira Interior, Av. Infante D. Henrique, 6200-506 Covilhã, Portugal; fani.sousa@fcsaude.ubi.pt
* Correspondence: joana.valente@ipleiria.pt (J.F.A.V.); nuno.alves@ipleiria.pt (N.A.)
† Presented at the Materiais 2022, Marinha Grande, Portugal, 10–13 April 2022.

Keywords: 3D printing; arginine; affinity chromatography; plasmid DNA

The development and growth of biopharmaceutical therapies lead to a demand for efficient chromatographic methods to purify desired biomolecules (e.g., nucleic acids, enzymes or monoclonal antibodies) which are presently under consideration or approved by the Food and Drug Administration. These molecules have distinct chemical and size properties which are critical cues for the development and production of chromatographic supports. The most common chromatographic supports are based on micro-particulate materials that have a randomly compacted configuration. Also, in the case of monolithic supports, it is not possible to fully control its internal structure [1,2].

Accordingly, this slightly different internal morphology and porous structure presented leads to be difficult to predict their chromatographic behaviour which requires careful testing and validation of the quality of the packed chromatographic supports before use. Moreover, bed consolidation is typically evaluated by empirical characterization methods. For these reasons, column packing is often treated as an inexact science, whilst the limited scope to control morphology and porosity with traditionally made monolithic materials can result in low levels of column-to-column reproducibility and often the need arises to individually prepare and validate each monolithic column [3].

Meanwhile, 3D printing technology is starting to be used in this field since it could provide full control of the geometry of the produced pieces. Therefore, on the chromatographic field, this technology allows a more defined and uniform convective flow path than the randomly interconnected pores observed on the conventional chromatographic support [4]. This is an extraordinary improvement since it will allow modulating the flow, the pressure and consequently the path of the molecules within the chromatographic support.

Although the aforementioned, 3DP methodologies *per si* will not lead to high-quality pharmaceutical products being needed the association with affinity ligands, such as amino acids to enable reaching high purity yields of the desired molecules. Beyond the most studied amino acids as chromatographic ligands, arginine has been successfully immobilized on different chromatographic supports (namely agarose bead matrices, macroporous matrices and monoliths) to achieve extra pure gene therapy products [5,6].

Regarding all the above mentioned, in this work, it was studied the immobilization of arginine on 3DP chromatographic supports.

Author Contributions: Conceptualization, F.S. and J.F.A.V.; methodology F.S. and J.F.A.V.; validation, F.S., J.R.D. and J.F.A.V.; formal analysis, F.S., J.R.D. and J.F.A.V.; investigation, J.F.A.V.; resources; writing—original draft preparation, J.F.A.V.; writing—review and editing, J.F.A.V. and F.S.; supervision, N.A. and F.S.; funding acquisition, N.A. All authors have read and agreed to the published version of the manuscript.

check for updates

Citation: Valente, J.F.A.; Dias, J.R.; Sousa, F.; Alves, N. 3D Printing for Affinity Chromatographic Support Production. *Mater. Proc.* **2022**, *8*, 82. https://doi.org/10.3390/materproc2022008082

Academic Editors: Geoffrey Mitchell, Carla Moura and Joana Coutinho

Published: 8 June 2022

Publisher's Note: MDPI stays neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Funding: This work was supported by the Fundação para a Ciência e a Tecnologia (FCT) and Centro2020 through the following Projects: UIDB/04044/2020, UIDP/04044/2020, UIDB/00709/2020, PAMI-ROTEIRO/0328/2013 (Nº 022158), MATIS (CEN-TRO-01-0145-FEDER-000014).

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Not applicable.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Valente, J.F.A.; Pereira, P.; Sousa, A.; Queiroz, J.A.; Sousa, F. Effect of plasmid DNA size on chitosan or polyethyleneimine polyplexes formulation. *Polymers* **2021**, *13*, 793. [CrossRef]
2. Valente, J.F.A.; Sousa, A.; Queiroz, J.A.; Sousa, F. DoE to improve supercoiled p53-pDNA purification by O-phospho-l-tyrosine chromatography. *J. Chromatogr. B* **2019**, *1105*, 184–192. [CrossRef]
3. Hearn, M.T. Trends in additive manufacturing of chromatographic and membrane materials. *Curr. Opin. Chem. Eng.* **2017**, *18*, 90–98. [CrossRef]
4. Valente, J.F.A.; Sousa, F.; Alves, N. Additive Manufacturing Tools to Improve the Performance of Chromatographic Approaches. *Trends Biotechnol.* **2021**, *39*, 970–973. [CrossRef]
5. Valente, J.F.A.; Sousa, A.; Azevedo, G.A.; Queiroz, J.A.; Sousa, F. Purification of supercoiled p53-encoding plasmid using an arginine-modified macroporous support. *J. Chromatogr. A* **2020**, *1618*, 460890. [CrossRef]
6. Azevedo, G.M.; Valente, J.F.A.; Sousa, A.; Pedro, A.Q.; Pereira, P.; Sousa, F.; Queiroz, J.A. Effect of chromatographic conditions on supercoiled plasmid DNA stability and bioactivity. *Appl. Sci.* **2019**, *9*, 5170. [CrossRef]