

Patent landscape analysis of hydrogel-based bioinks for 3D bioprinting

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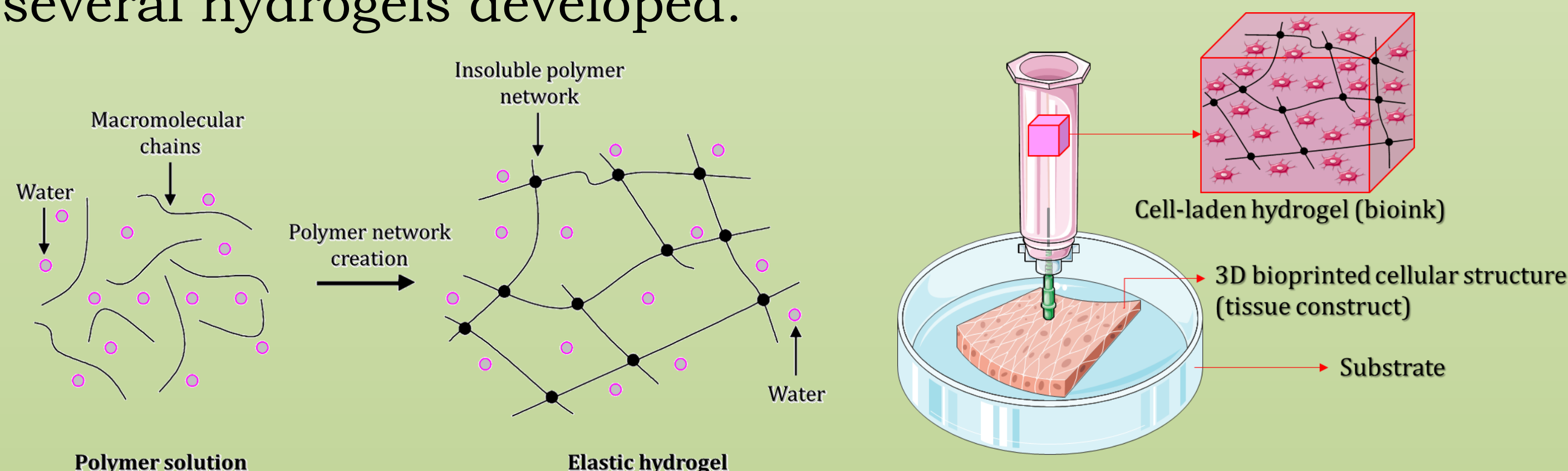
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INTRODUCTION

There are a variety of hydrogels commonly used in three-dimensional (3D) bioprinting, which is the process involving the deposition of cell-laden hydrogels (or bioinks) on a substrate.

Hydrogels are synthetic matrices made up of a network of hydrophilic polymers that absorb water and/or biological fluids. They can be created from a large number of water-soluble materials including synthetic and natural polymers. The 3D structure of these hydrogels is due to crosslinking which forms an insoluble macromolecular network in the environmental fluid. The resemblance to different biological tissues, due to the elasticity and the presence of a large amount of water, allows the use of hydrogels in the regeneration of several types of damaged tissues (e.g., fibrin hydrogel is seeded with neural cells to regenerate brain tissue, keratinocytes are seeded in collagen hydrogel to regenerate skin tissue, etc.)

To promote the sufficiency of bioinks in 3D bioprinting, several researchers have investigated pathways to enhance ink properties to meet bioprinting requirements, with several hydrogels developed.



AIM

This work in the form of patent landscape analysis describes the state of the art by introducing what has been patented in relation to hydrogel-based bioinks, by determining **publication years, classifications, inventors, applicants, owners, and jurisdictions.**

RESOURCES AND RESEARCH METHODS

- The supported field codes used in this study was based on the Patentscope search service of the World Intellectual Property Organization (WIPO).
- Different keywords and related terms were used and patents were searched according to **title, abstract and claims.**
- The search was then filtered to include only documents with the application date until 2020.

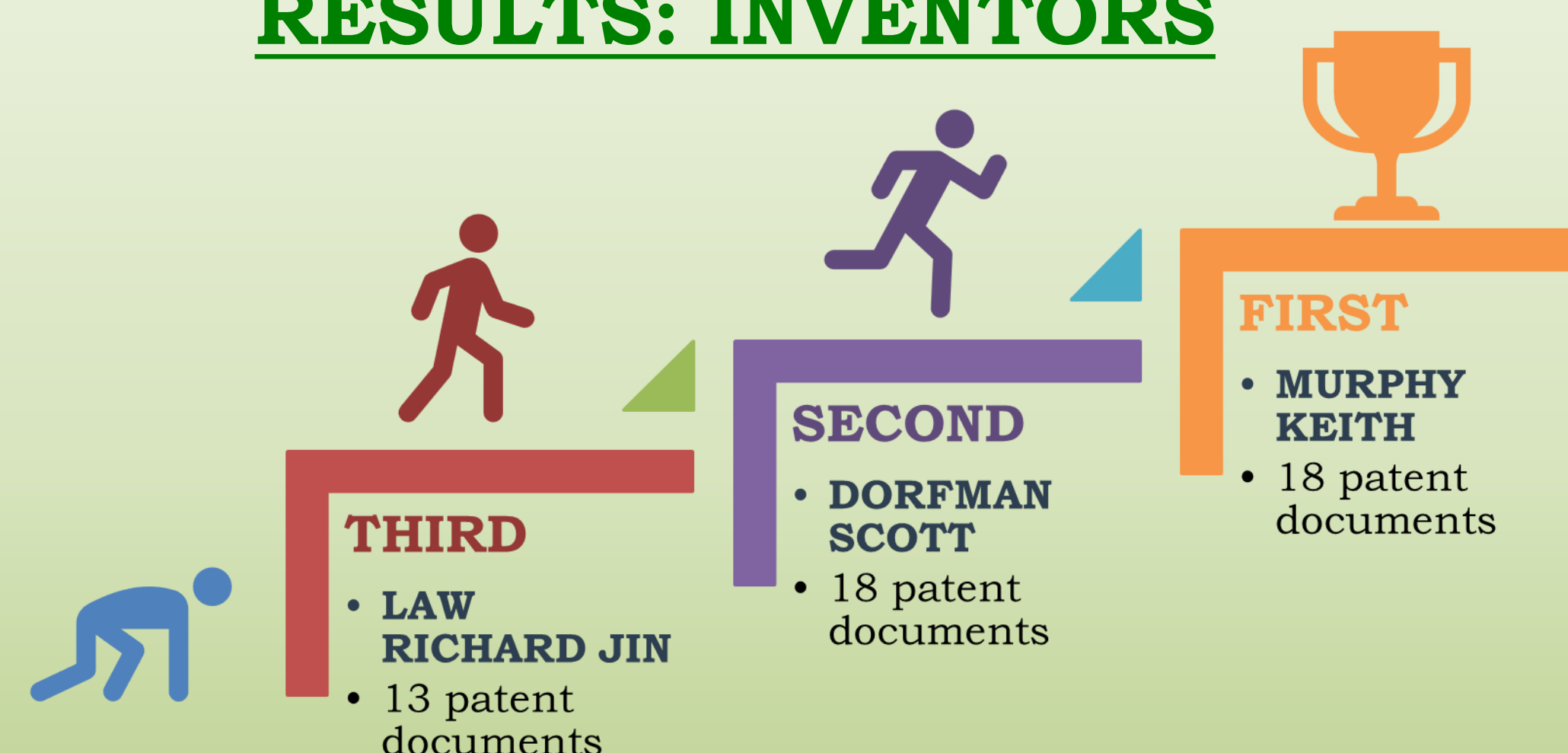
RESULTS: PUBLICATION YEARS



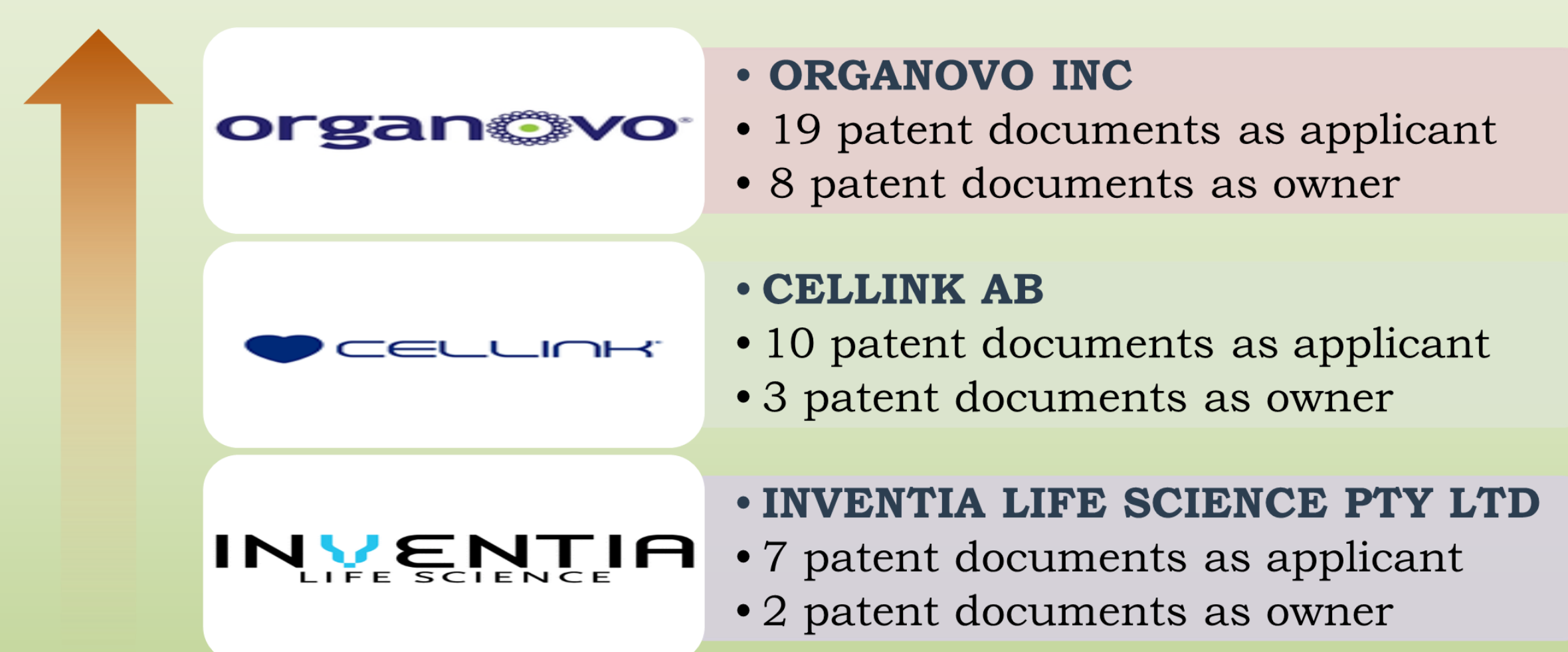
RESULTS: PATENT CLASSIFICATIONS

Classification	Patents documents
Materials for prostheses or for coating prostheses characterized by their function or physical properties: hydrogels or hydrocolloids.	38
Materials for prostheses or for coating prostheses containing ingredients of undetermined constitution or reaction products thereof: animal cells.	34
Products made by additive manufacturing.	32
Processes of additive manufacturing.	30
Materials specially adapted for additive manufacturing.	26
Materials for prostheses or for coating prostheses in the form of macromolecular materials: polysaccharides.	20
Apparatus for enzymology or microbiology.	18
Undifferentiated human, animal or plant cells: cell lines; tissues; cultivation or maintenance thereof; culture media therefor.	18
Apparatus for additive manufacturing; details thereof or accessories therefor.	18
Tissue, human, animal or plant cell, or virus culture apparatus.	17

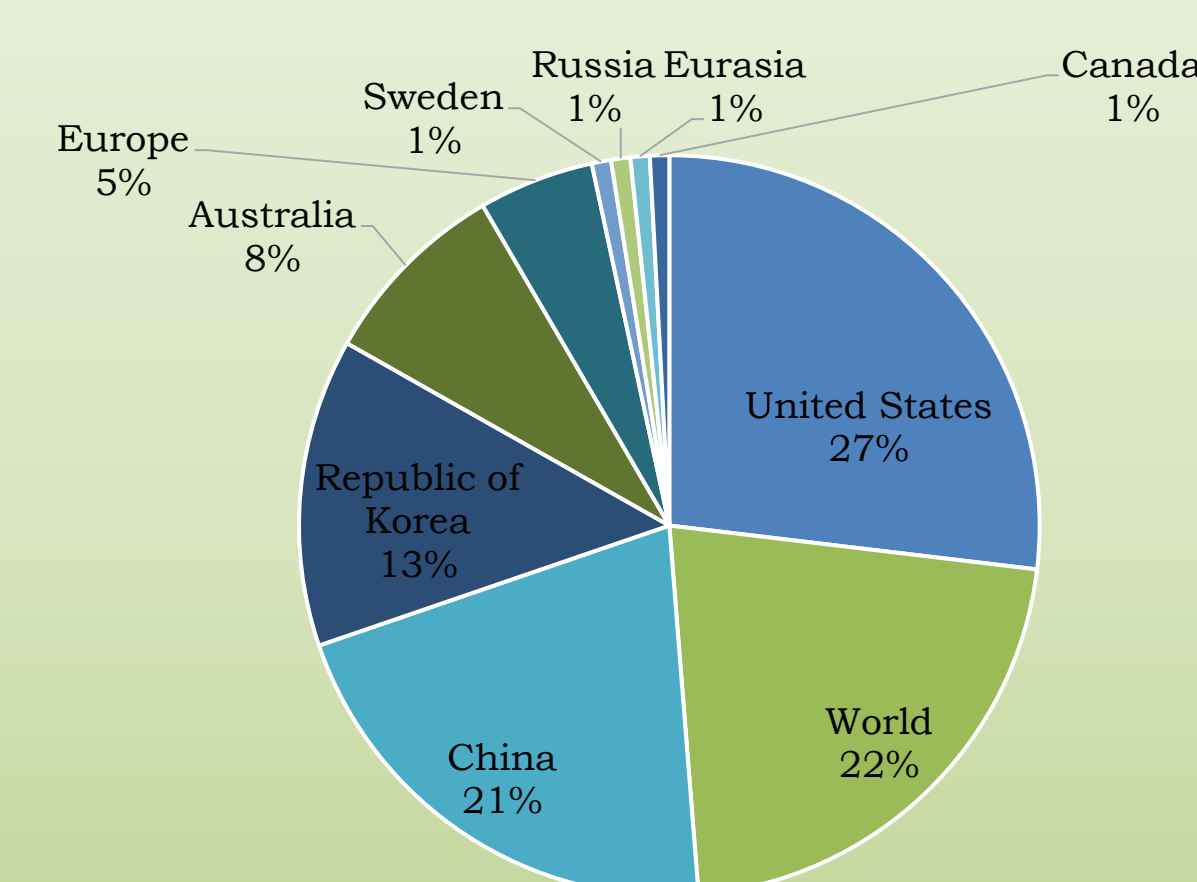
RESULTS: INVENTORS



RESULTS: APPLICANTS AND OWNERS



RESULTS: JURISDICTION



CONCLUSIONS

In this study, 119 patent documents have been found for hydrogel-based bioinks. United States was ranked first with 32 patent documents. 2020 was the year with the maximum number of patent documents (31). The innovation and improvement of hydrogel-based bioinks concerned: raw materials, formulations, methods and process. All filled patents in this area concerned types of hydrogels, methods of preparation of hydrogel-based bioinks, 3D bioprinting of hydrogel scaffolds and application in tissue engineering, as well as scaffold design and biofabrication.