Good Food Institute

Scaffold material

Synthetic polymers

ECM & animal-based proteins

Plant or fungus-based

Self-assembling peptides

Scaffold type

Microcarriers

Polystyrene with Synthemax (proprietary peptide-based) or CellBIND (negative charge) coating: Verbruggen et al. 2018

Dissolvable PGA with Synthemax (proprietary peptide-based) coating, polystyrene: Rodrigues et al. 2019

PCL/PNIPAAm thermoresponsive macrocarriers: Nguyen et al. 2019

Polystyrene with laminin or vitronectin coating: Heng et al. 2012, Lam et al. 2014 (with addition of pLL)

PGA with Matrigel or vitronectin coating: Rodrigues et al. 2019

PEGDA with collagen coating: Wu et al. 2018

Cultispher S (gelatin), Spherecol (collagen): Park et al. 2014

Gelatin microspheres for nutrient and growth factor delivery: Park et al. 2021

Spherical or grooved gelatin microcarriers: Norris et al. 2022

Cytodex 3 (collagen-coated dextran) Hewitt et al. 2011

Park et al. 2014

Cytodex 1 (dextran substituted with N, N-diethylaminoethyl groups) with collagen coating: Yang et al. 2022

Alginate microcarriers with gelatin coating: Kong et al. 2022

Cellulose with Matrigel coating: Oh et al. 2009

Commercial dextran-based:
- van Wezel et al. 1967
- Park et al. 2014, Lam et al. 2014
- Verbruggen et al. 2018

Alginate:
- Lucena-Thomas et al. 2020
- Ansari et al. 2016 (cells encapsulated in microspheres)

Pectin & cardosin A: Marga et al. 2017 (patent)

Decellularized broccoli florets as microcarriers: Thyden et al. 2022

Heat-inactivated fungal pellets as microcarriers: Ogawa et al. 2022

Decellularized plants & algae:
- *Ficus hispida, Pachira aquatica, Garcinia*: Adamski et al. 2018
- Parsley stems (and others): Fontana et al. 2017
- Green onion bulb: Cheng et al. 2020
- Grass: Allan et al. 2021
- *Ulva*: Bar-Shai et al. 2021
- Carrots: Contessi Negrini et al. 2020

Celery
- Campuzano et al. 2020
- Contessi Negrini et al. 2020

Apple
- Lee et al. 2019
- Modulevsky et al. 2014
- Contessi Negrini et al. 2020

Spinach
- Gershlak et al. 2017
- Robbins et al. 2020
- Jones et al. 2021

Porous scaffolds

Highly porous PLGA microcarriers: Kankala et al. 2019

Porous PLA scaffolds: Zeltinger et al. 2001

PLGA hollow fiber membranes: Ellis & Chaudhuri 2007

Porous PLLA/PLGA scaffolds: Levy-Mishali et al. 2009

PCL rolled porous sheets: Fakhar et al. 2019

Porous gelatin microcarriers: Liu et al. 2022

Porous silk fibroin scaffolds treated with Scl2-silk chimeric protein: An et al. 2013

Collagen sponges complexed with bFGF: Kanematsu et al. 2004

Collagen sponges: Nikolovski & Mooney 2000

Gelatin & hyaluronic acid cryogel sponges: Chang et al. 2013

Porous silk fibroin scaffolds: Chaturvedi et al. 2017

Freeze dried gelatin-alginate-agarose scaffolds: Enrione et al. 2017

Freeze dried chitosan-alginate-collagen or gelatin scaffolds: Li et al. 2022

Textured soy protein with gelatin-agar coating: Lee et al. 2022

Bacterial cellulose sponges: Lai et al. 2015

Decellularized plants & algae

Chitosan sponges: Jana et al. 2013, Rubio et al. 2019

Textured soy protein: Ben-Arye et al. 2020

Soda bread: Holmes et al. 2020

Hydrogels (excluding hydrogel-based microcarriers and bioinks)

Limited utility unless edible or fully biodegradable

GelMA hydrogels:
- Yoon et al. 2016
- Costantini et al. 2017

Cell alignment on patterned PIPAAm/PAAm substrates followed by transfer to fibrin gel: Takahashi et al. 2022

PEG-PLGA-PEG hydrogels: Lee et al. 2007

PEG hydrogels: Hume et al. 2012

PMEDSAH hydrogel coatings: Villa-Diaz et al. 2010

Stacked fibrin & Matrigel hydrogels: Furuhashi et al. 2021

Stacked collagen or collagen & Matrigel hydrogels: Nie et al. 2021

Collagen & Matrigel-based hydrogels: Langelaan et al. 2011

Cell accumulation induced by fibronectin & gelatin coating:
- Nishiguchi et al. 2011
- Gribova et al. 2016

Collagen hydrogels (Tissue in a Tube): Shahin-Shamsabadi & Selvaganapathy 2020

Fibrin hydrogels: Simsa et al. 2019

Collagen & fibrin-based hydrogels: Beier et al. 2009

Collagen & fibrin-based hydrogels: Beier et al. 2009

Decellularized apple + collagen or gelatin hydrogel: Hickey et al. 2018

Gelatin-alginate-agarose microstructured films: Orellana et al. 2020

Hyaluronate & alginate-based hydrogels: Oerther et al. 1999

Pectin-chitosan membranes: Martins et al. 2018

Gelatin hydrogels with sacrificial alginate: Contessi Negrini et al. 2019

Fibrin or Matrigel hydrogels with printed sacrificial carbohydrate-based channels: Miller et al. 2012

PEG hydrogels with printed sacrificial carbohydrate-based channels: Miller et al. 2012

Alginate-capped chitosan-CMC nanofilms for nutrient delivery: Park et al. 2021

Tyramine-functionalized dextran: Kamperman et al. 2021

Glutenin, zein, soy, cellulose, alginate, konjac, and chitosan films: Xiang et al. 2022

Alginate hydrogel tubes:
- Lin et al. 2018
- Li et al. 2018
- Mehta et al 2019

Alginate or agarose hydrogels with printed sacrificial carbohydrate-based channels: Miller et al. 2012

Alginate bioink printed into κ-carrageenan microgel support: Machour et al. 2022)

Mold-cast alginate-RGD scaffolds: Zagury et al. 2022

RADA16:
- Zhou et al. 2016
- Kishimoto et al. 2011

RADA16 with osteopontin motif: Gao et al. 2017

VEVK9 and VEVK12 nanofibrous matrices: Kumada et al. 2010

3D printing and other additive techniques

Selective laser sintering of PCL: Kinstlinger et al. 2016

PLGA bioink: Chen et al. 2019

Gelatin, hyaluronic acid, and fibrinogen bioink with PCL supports: Kim et al. 2018, 2020

GelMA-silk fibroin bioink: Li et al. 2021

DLP bioprinting of gelMA with tartrazine: Jeong et al. 2022

Garrett et al. 2021, 2022

Tendon-gel integrated printing using fibrinogen, Matrigel, gelatin: Kang et al. 2020

Hyaluronic acid bioink: Ouyang et al. 2016, 2017

Collagen bioink: Osidak et al. 2019

Collagen & Matrigel scaffold, sacrificial gelatin SWIFT printed channels: Skylar-Scott et al. 2019

Gelatin-fibrinogen bioink with pre-aligned organ building blocks in collagen: Ahrens et al. 2022

GelMA-alginate bioink for continuous multimaterial extrusion printing: (Liu et al. 2016)

GelMA-alginate bioink for continuous chaotic bioprinting: Bolívar-Monsalve et al. 2021

GelMA, fibrinogen, or collagen bioink printed into κ-carrageenan microgel support: Machour et al. 2022)

ExCeL: alginate or collagen bioinks printed on crosslinker-treated paper: Shahin-Shamsabadi & Selvaganapathy 2019

Alginate-gelatin-plant (soy, pigeon pea, wheat) hydrolysate-based bioink: Dutta et al. 2022

Whey protein isolate & gellan gum-based bioink: Oliveira et al. 2020

Gelatin-alginate bioink: Zanderigo et al. 2022

Fish gelatin-alginate bioink: Liu et al. 2022

Soybean oil-based resin for UV crosslinking: Sealy et al. 2022

3D printed alginate-RGD/pea protein scaffolds: Zagury et al. 2022

3D printed alginate-RGD/pea protein/soy protein scaffolds: Ianovici et al. 2022

Alginate-based bioink:
- Freeman & Kelly 2017
- Zanderigo 2022

(κ-)-carrageenan bioink: Marques et al. 2022

(κ-)-carrageenan bioink with electrospun fibers: Algae2Fish (in progress)

CH-01/CH-02 bioink: Arab et al. 2018

IVFK and IVZK bioink: Rauf et al. 2021

RADA16/ methylcellulose bioink: Cofiño et al. 2019

Fiber scaffolds

PCL/ PNIPAAm fibers: Allen et al. 2017

Hydrospun PCL fibers: Tzezana et al. 2008

Electrospun PLA fibers: Luo et al. 2018

Electrospun PLGA fibers: Aviss et al. 2010, Shin et al. 2015

Rotary jet spun PLA fibers: Badrossamay et al. 2010

PGA fibers: Nikolovski & Mooney 2000

Gravity fiber drawing of PCL:
- Yadavalli et al. 2020
- Ongoing project at Cytonest and UGA

PCL nanofiber sheets coated with poly-D-lysine, laminin: Das et al. 2020

GelMA fibers: Ebrahimi et al. 2018

PCL/gelatin or collagen fibers: Choi et al. 2008, Perez-Puyana et al. 2021

Deravi et al. 2017

Electrospun collagen: Beier et al. 2009

Rotary jet spun fibronectin: Chantre et al. 2018

Electrospun albumin: Nseir et al. 2013

Electrospun alginate/PCL sheets: Apsite et al. 2019

Rotary jet spun gelatin: MacQueen et al. 2019

Rotary jet spun soy protein hydrolysate + cellulose acetate: Ahn et al. 2018

Decellularized *Cladophora*: Bar-Shai et al. 2021

Aspergillus mycelial mats: Narayanan et al. 2020

Mycelial mats: Bayer et al. 2020 (patent)

Cellulose nanofibers functionalized with CBD-RGD: Cohen 2022

Legend

- Skeletal muscle
- Smooth/ cardiac muscle
- Fibroblast
- Adipogenic
- Endothelial
- Osteogenic
- ESC/iPSC
- MSC
- Bovine
- Porcine
- Chicken
- Rabbit
- Fish
- Shrimp

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