Qkine

Growth factors for enhanced

Organoid

culture protocols

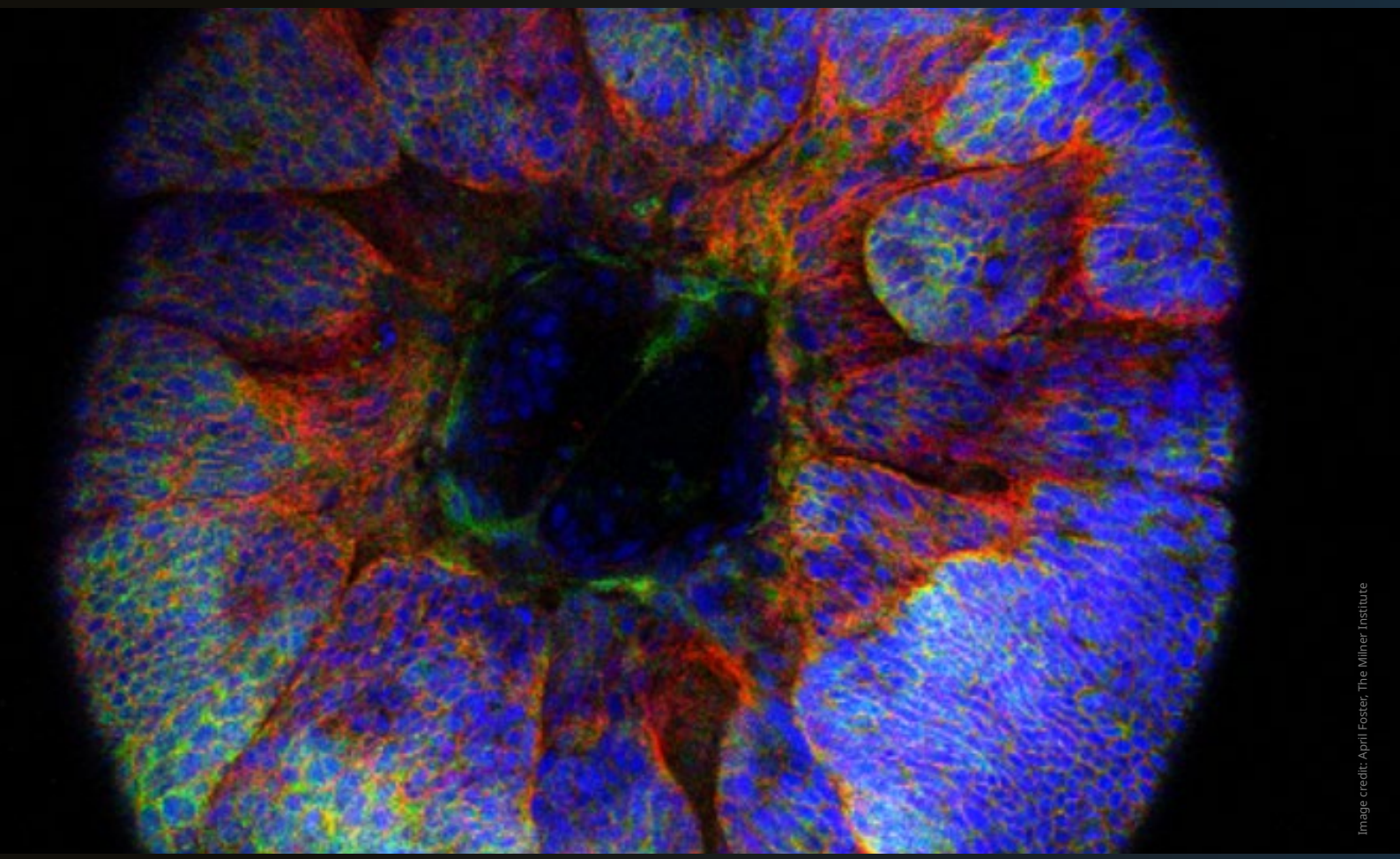


Image credit: April Foster, The Milner Institute

Enhanced reproducibility

Protein innovation

Bioactivity. Guaranteed.

Manufactured in Cambridge, UK

More reliable growth factors for your organoid cultures

High-quality growth factors are essential for the development and maintenance of robust, reproducible, and physiologically relevant organoid cultures. Therefore, it is crucial to use growth factors from reliable sources with stringent quality control measures ensuring the purity, stability, and bioactivity of the growth factors. Choosing an animal-free supplier guarantees that there are no contaminating endogenous growth factors, allowing scientists to have confidence in their cell culture.

Qkine manufactures bioactive animal-free recombinant proteins at an ISO9001:2015 certified facility based in Cambridge, UK. Qkine combines proprietary production processes with protein engineering technology to tackle fundamental biological, quality, and scale-up challenges to provide more reliable tools for research and bio-manufacturing.

As leaders in protein innovation, approximately 30% of our catalogue is made of unique products. We have developed a portfolio of stable and protein tag-free growth factors aimed at increasing reproducibility and scaling-up your organoid research.

Raising the standard in bioactive protein manufacturing and innovation

- Manufactured in Cambridge, UK
- Animal-free and carrier-protein free
- In stock for fast worldwide delivery
- Bulk quantities available for large scale applications
- High purity and protein tag-free
- ISO 9001:2015 accredited facility
- Highly bioactive
- Innovative engineered protein forms available

An organoid is a three-dimensional (3D) structure derived from stem cells which mimics the key function, structure, and biology of an organ or a tissue. In contrast to traditional 2D cell culture models, Organoid models can replicate the intricate spatial architecture and the physiological responses of in vivo differentiated tissue enabling the investigation of the biologically relevant cell-to-cell and cell-matrix interactions.

Organoids are derived from induced pluripotent stem cells (iPSCs), embryonic stem cells (ESCs) or tissue-derived cells in conditions that promote their self-organization and differentiation into specific cell types. By creating the cellular microenvironments using matrices, and providing appropriate growth factors, organoids can develop into complex structures that resemble miniaturized organs.

The ability of organoids to replicate tissue architecture enables the investigation of complex physiological systems. Applications of organoid technologies encompass drug sensitivity testing for precision oncology, studying host-parasite interactions, enhancing infectious disease models, and facilitating disease modelling for drug discovery and basic research.

The recent FDA Modernization Act 2.0, which removed the mandate for animal testing to assess the safety and efficacy of new drugs, along with rapid advancements in the field, have highlighted the tremendous potential of organoid models to impact human health and well-being.

> "Our lab has been using FGF2 and activin A from Qkine in stem cell cultures for many months now. Our Epiblast Stem Cell and Trophoblast Stem Cells never looked better. Qkine has provided us with exceptional customer service and most importantly top-quality, affordable growth factors. We will be definitely be using their products in the future."
>
> Prof Jan Zylicz, Novo Nordisk Foundation, University of Copenhagen

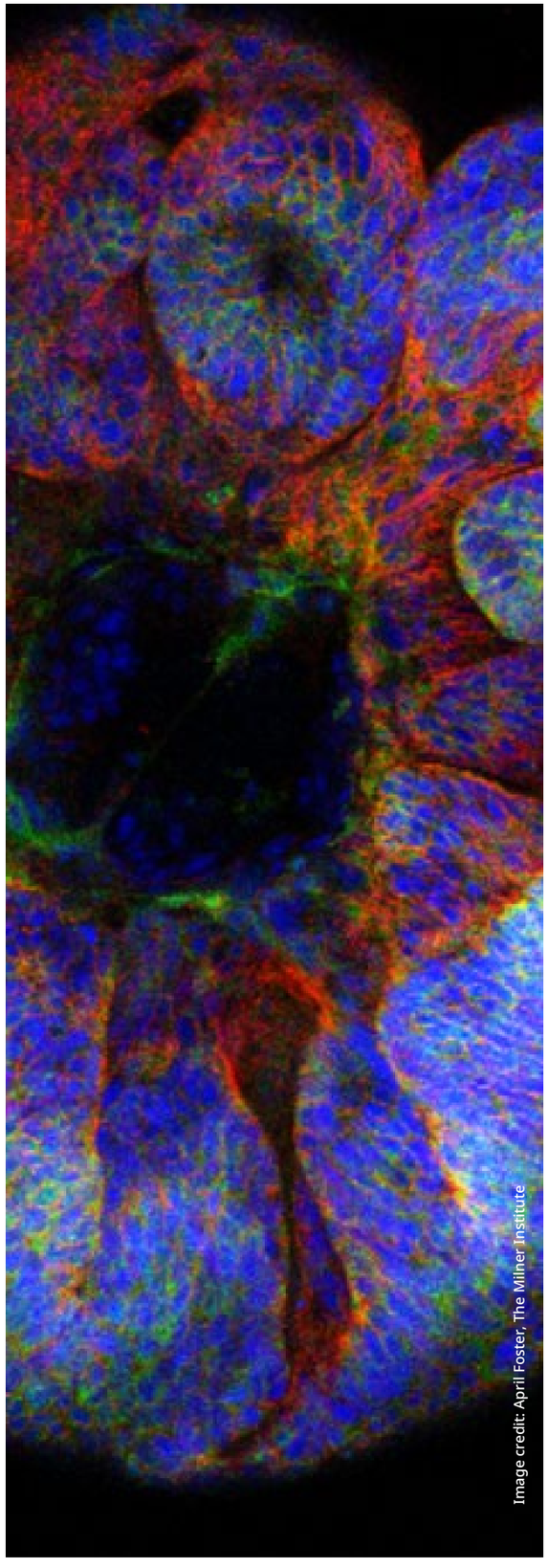
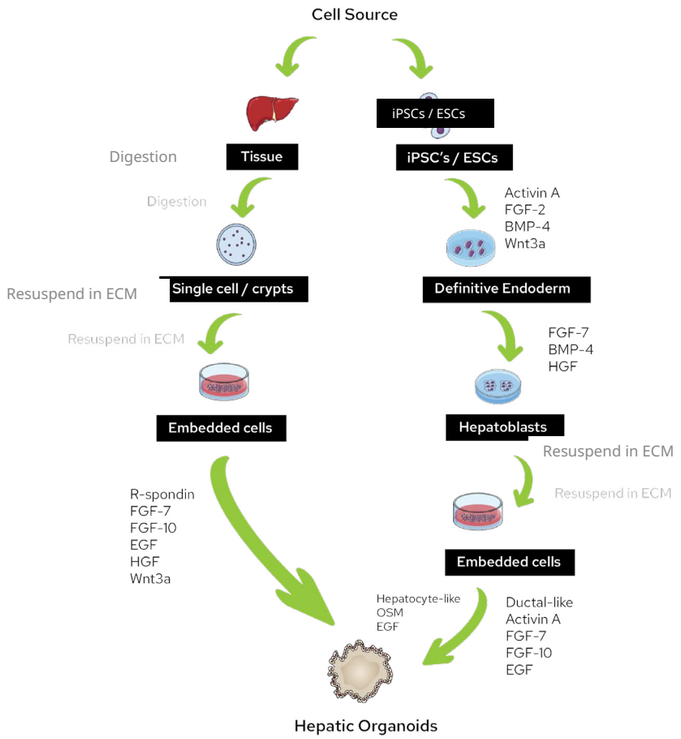


Image credit: April Foster, The Milner Institute

Hepatic organoids

The utilization and implementation of hepatic organoids hold immense potential in advancing the field of hepatic research. These organoids have transformed the culture and maintenance of liver cells, particularly hepatocytes, which tend to exhibit significant dedifferentiation in conventional cultures. Hepatic organoids are typically cultured within an extracellular matrix supplemented with a combination of growth factors, facilitating the formation and differentiation of hepatic organoids. The expression of albumin (ALB) is assessed to confirm successful hepatic differentiation.
The establishment of hepatic organoids has enabled the disease modeling and the investigation of gene and cell therapy in liver cancer and alcohol-associated liver disease.



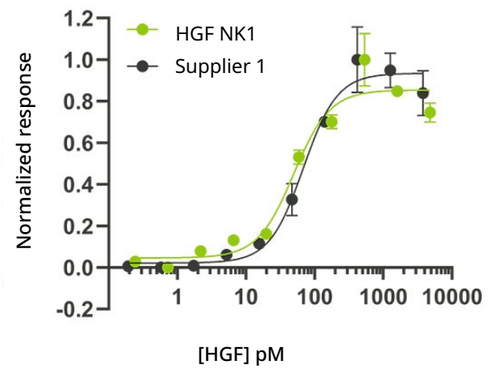
Product code	Description	Product code	Description
Qk001	Human/mouse Activin A	Qk053	Thermostable FGF2-G3 154 aa
Qk005	Human/mouse Activin A PLUS	Qk046	Human KGF (FGF-7)
Qk035	Follistatin-resistant Activin A	Qk003	Human/rat/bovine/porcine FGF-10
Qk038	Human BMP-4	Qk013	Human HGF (NK1)
Qk011	Human EGF protein	Qk049	Human Oncostatin M (OSM) protein
Qk025	Human FGF-2 (bFGF) 145 aa	Qk031	Human R-spondin 1 LR5
Qk027	Human FGF-2 (bFGF) 154 aa	Qk006	Human R-spondin 1
Qk052	Thermostable FGF2-G3 145 aa	Qk032	Human R-spondin 3

Further reading

Broutier L, Andersson-Rolf A, Hindley CJ, et al. Culture and establishment of self-renewing human and mouse adult liver and pancreas 3D organoids and their genetic manipulation. Nat Protoc. 2016;11(9):1724-1743.
Caiazza C, Parisi S, Caiazzo M. Liver Organoids: Updates on Disease Modeling and Biomedical Applications. Biology (Basel). 2021;10(9):835.
Nuciforo S, Heim MH. Organoids to model liver disease. JHEP Rep. 2020;3(1):100198. Published 2020 Oct 22.

Recombinant HGF (NK1) protein

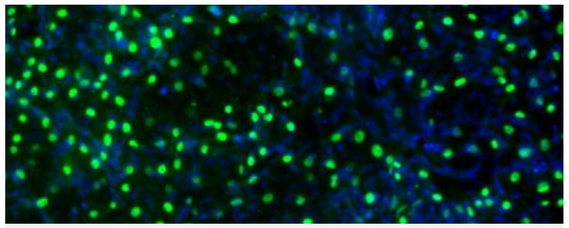
Recombinant human HGF protein is a potent, high-purity NK1 isoform of human hepatocyte growth factor (HGF). This protein promotes efficient differentiation of human iPSCs to hepatocyte-like cells at just 10 ng/ml with homogeneous expression of the hepatic marker, HNF4α. This animal-free 20 kDa naturally occurring isoform of HGF is suitable for chemically defined media and reproducible scale-up.



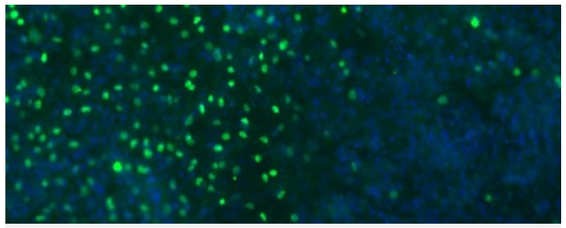
Full-length HGF protein domains

NK1 isoform

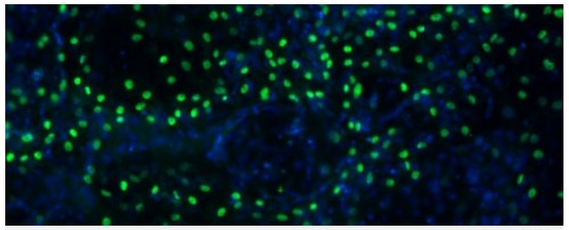
Highly pure, animal-free, protein with extensive biochemical and quantitative bioactivity data to ensure reproducible and scalable stem cell differentiation. Luciferase assay shows HGF (NK1) (Qk013) has equivalent bioactivity to full-length HGF (mammalian expression system) from other suppliers.



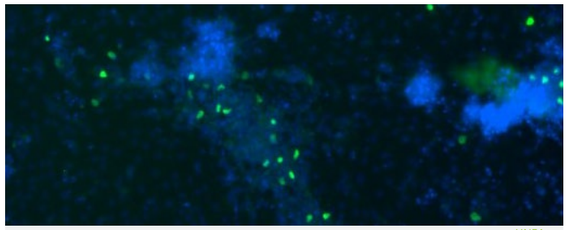
Qk013 HGF (NK1) 10ng/ HNF4α DAPI 10 x



Qk013 HGF (NK1) 40ng/ml HNF4α DAPI 10 x



Supplier B HGF 10 ng/ml HNF4α DAPI 10 x



Supplier B HGF 40 ng/ml HNF4α DAPI 10 x

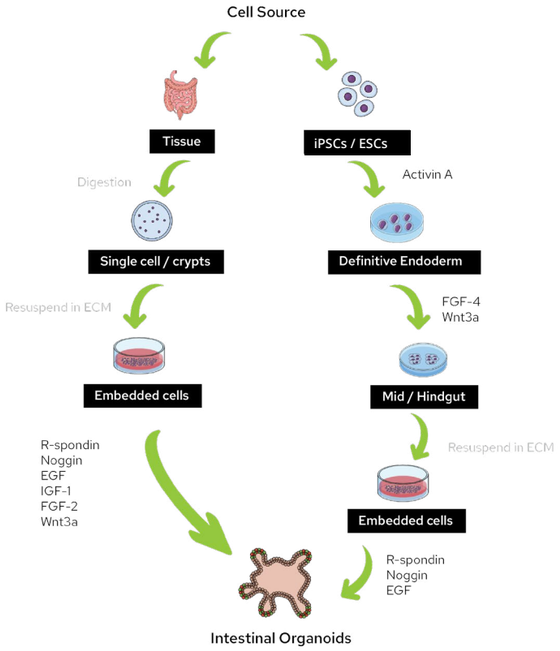
HGF (NK1) promotes efficient differentiation of human iPSCs to hepatocyte-like cells at just 10 ng/ml with highly homogeneous expression of the hepatic marker, HNF4α.

Learn more about our human HGF (NK1) for more reproducible hepatocyte differentiation.

Product code	Description
Qk013	Human HGF (NK1)
Qk060	Bovine HGF (NK1)
Qk061	Porcine HGF (NK1)

Intestinal organoids

Intestinal organoids are one of the first organoids to have been successfully established in vitro. Intestinal organoids comprise of several intestinal cell types, including enterocytes, goblet cells, Paneth cells, enteroendocrine cells, and intestinal stem cells. These cells self-organize themselves to form a crypt-villus architecture that closely resembles that of the intestine. The intestinal crypts express markers such as the intestinal stem cell marker, Lgr5, and the enterocyte marker, villin. They have been shown to perform many of the key functions such as secretion of mucus and gut hormonal regulation and have been widely used for intestinal disease modeling, including inflammatory bowel disease and colorectal cancer. The development of intestinal organoids has made a significant contribution to organoid research and has formed the foundation for other tissue-specific organoid discoveries such as liver organoids.



Product code	Description
Qk001	Human/mouse Activin A
Qk005	Human/mouse Activin A PLUS
Qk035	Follistatin-resistant Activin A
Qk011	Human EGF protein
Qk025	Human FGF-2 (bFGF) 145 aa
Qk027	Human FGF-2 (bFGF) 154 aa
Qk052	Thermostable FGF2-G3 145 aa
Qk053	Thermostable FGF2-G3 154 aa

Product code	Description
Qk004	Human FGF-4
Qk041	Human/bovine/porcine IGF-1 LR3
Qk047	Human/bovine/porcine IGF-1
Qk034	Human noggin
Qk033	Mouse/rat noggin
Qk031	Human R-spondin 1 LR5
Qk006	Human R-spondin 1
Qk032	Human R-spondin 3

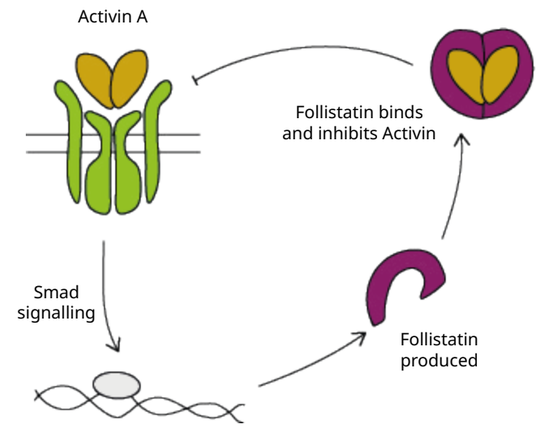
Further reading

Sato T, Vries RG, Snippert HJ, et al. Single Lgr5 stem cells build crypt-villus structures in vitro without a mesenchymal niche. Nature. 2009;459(7244):262-265.
Fujii M, Matano M, Toshimitsu K, et al. Human Intestinal Organoids Maintain Self-Renewal Capacity and Cellular Diversity in Niche-Inspired Culture Condition. Cell Stem Cell. 2018;23(6):787-793.
Günther C, Winner B, Neurath MF, Stappenbeck TS. Organoids in gastrointestinal diseases: from experimental models to clinical translation. Gut. 2022;71(9):1892-1908

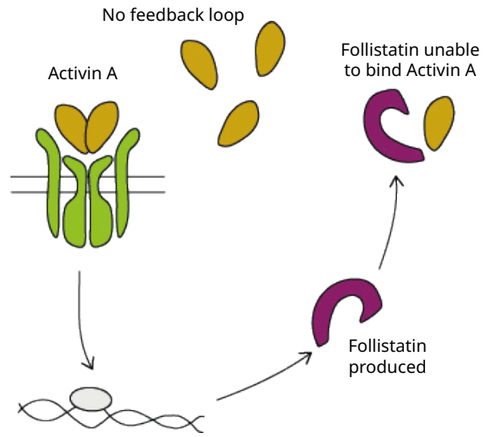
Follistatin-resistant activin A (FRACTA) for organoid culture

Activin A, used widely in iPSC and organoid culture, is inhibited by a natural protein inhibitor follistatin that accumulates during cell culture. This leads to fluctuations in the level of Activin A activity between media feeds. Follistatin-resistant Activin A (FRACTA) has the same bioactivity as wild-type activin A (Qk001) but is not subject to the natural feedback inhibition by follistatin allowing you to fine-tune and control Activin A signalling. This specialized activin A was developed in Prof Marko Hyvönen's lab (University of Cambridge).

Follistatin inhibits Activin



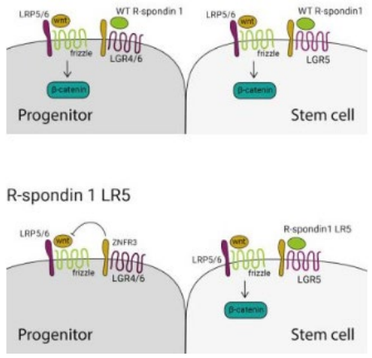
Removing inhibition by



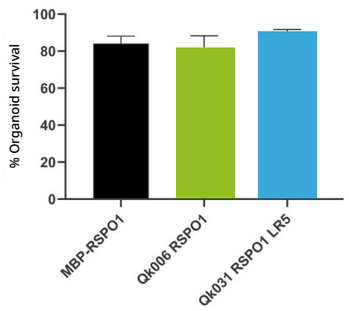
R-spondin 1 LR5 protein for intestinal organoids

Recombinant human R-spondin 1 LR5 protein is engineered to bind to the LGR5 receptor on intestinal stem cells with high affinity. As LGR5 is specifically expressed by the stem cell population of the lower intestinal crypt in organoid cultures and not the transit amplifying cells, the engineered R-spondin 1 LR5 activates Wnt signalling only in LGR5+ stem cell population in comparison to the wild-type version. R-spondin 1 LR5 has been tested in intestinal organoid culture and supports organoid survival and growth.

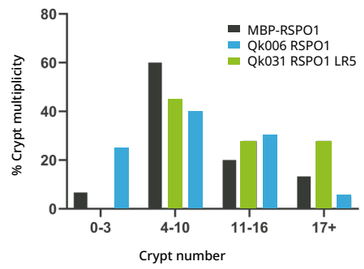
Specificity to LGR5+ stem cells



Organoid survival is



Crypt multiplicity is



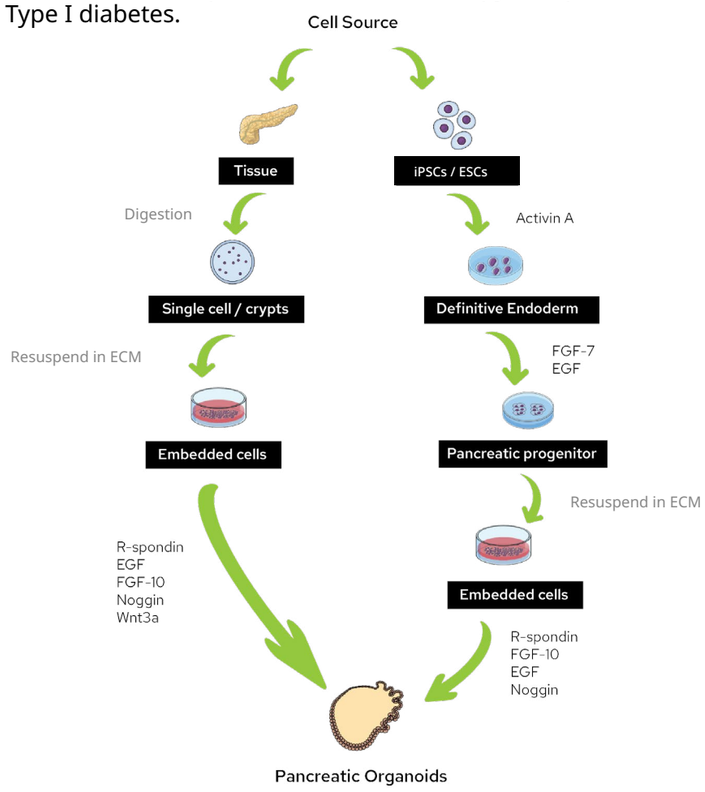
All organoid data from the laboratory of Marc de la Roche and reproduced with permission (© Marc de la Roche,

Learn more about our pioneering proteins by visiting our website.

Product code	Description
Qk035	Follistatin-resistant Activin A
Qk031	R-spondin 1 LR5

Pancreatic organoids

Pancreatic organoids are generated to mimic the pancreatic ductal system. They are composed of tissue-specific cell types including pancreatic ductal cells, acinar cells, and endocrine cells that are organized to form complex pancreatic structures. Cells within pancreatic organoids express key markers such as ductal marker, KRT19, and pancreatic progenitor marker, PDX1. The establishment of pancreatic organoids has great potential to study pancreatic regeneration, repair mechanisms, and the development of targeted therapies for pancreatic disorders. For example, multiple studies are investigating pancreatic stem cell transplantation and cell therapy to replace the insulin-producing beta cells in patients with Type I diabetes.



Product code	Description
Qk001	Human/mouse Activin A
Qk005	Human/mouse Activin A PLUS
Qk035	Follistatin-resistant Activin A
Qk011	Human EGF protein
Qk046	Human KGF (FGF-7)
Qk003	Human/rat/bovine/porcine FGF-10

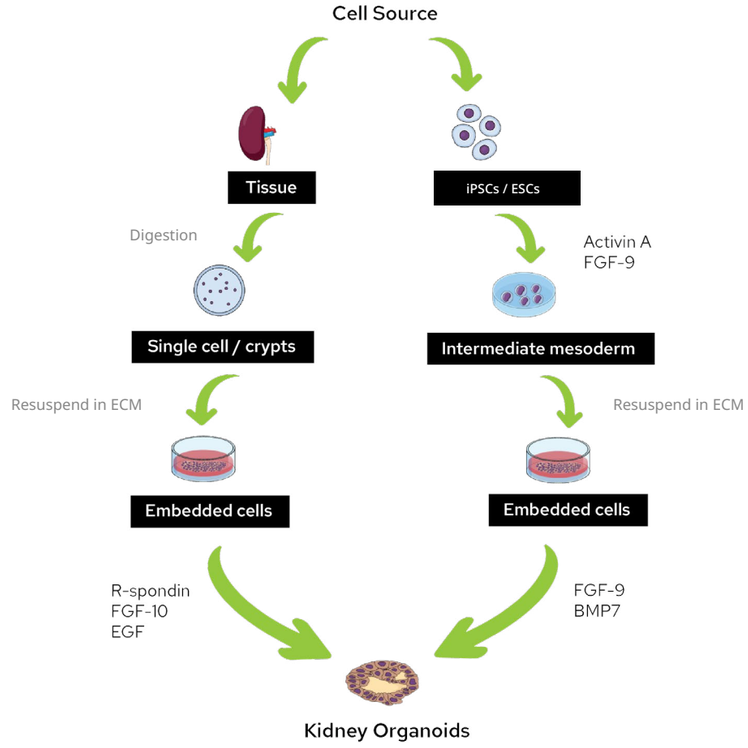
Product code	Description
Qk034	Human noggin
Qk033	Mouse/rat noggin
Qk031	Human R-spondin 1 LR5
Qk006	Human R-spondin 1
Qk032	Human R-spondin 3

Further reading

Driehuis E, Gracanin A, Vries RGJ, Clevers H, Boj SF. Establishment of Pancreatic Organoids from Normal Tissue and Tumors. STAR Protoc. 2020;1(3):100192.
Huang L, Holtzinger A, Jagan I, et al. Ductal pancreatic cancer modeling and drug screening using human pluripotent stem cell- and patient-derived tumor organoids. Nat Med. 2015;21(11):1364-1371.
Shi X, Li Y, Yuan Q, et al. Integrated profiling of human pancreatic cancer organoids reveals chromatin accessibility features associated with drug sensitivity. Nat Commun. 2022;13(1):2169.

Kidney organoids

The recent progress in organoid technology has facilitated the generation of kidney organoids to mimic the structure and function of the kidney, a vital organ responsible for waste regulation. These developed kidney organoids consist of tissue-specific cell types that are arranged to form the intricate cellular architecture of tubules, nephrons, and associated mesenchyme networks. Kidney organoids demonstrate the expression of key markers such as E-cadherin (ECAD) and podocalyxin (PODXL) in the distal tubules and podocytes, respectively. Previous studies focusing on kidney-related research have proved challenging due to limited physiologically relevant kidney models. However, kidney organoids present a promising solution to overcome these challenges for kidney-related investigations and applications.



Product code	Description
Qk001	Human/mouse Activin A
Qk005	Human/mouse Activin A PLUS
Qk035	Follistatin-resistant Activin A
Qk011	Human EGF protein
Qk039	Human FGF-9

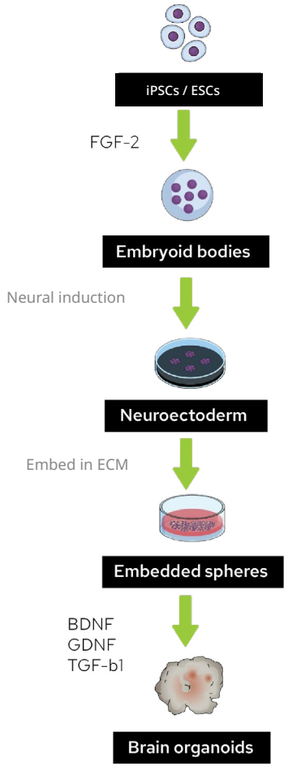
Product code	Description
Qk003	Human/rat/bovine/porcine FGF-10
Qk031	Human R-spondin 1 LR5
Qk006	Human R-spondin 1
Qk032	Human R-spondin 3

Further reading

Takasato M, Er PX, Chiu HS, Little MH. Generation of kidney organoids from human pluripotent stem cells. Nat Protoc. 2016;11(9):1681-92
Chambers BE, Weaver NE, Wingert RA. The “3Ds” of Growing Kidney Organoids: Advances in Nephron Development, Disease Modeling, and Drug Screening. Cells. 2023;12(4):549.
Sander V, Przepiorski A, Crunk AE, Hukriede NA, Holm TM, Davidson AJ. Protocol for Large-Scale Production of Kidney Organoids from Human Pluripotent Stem Cells. STAR Protoc. 2020;1(3):100150. Published 2020 Oct 29. doi:10.1016/j.xpro.2020.100150

Neural organoids

Neural organoids, also known as cerebral organoids, are composed of tissue-specific cell types including glial cells, neurons, and other brain cells, that are arranged to form complex neural networks that mimic the developmental processes and structural organization of the brain. Cells within neural organoids have been shown to express key markers such as the neuronal marker class III beta-tubulin (Tuj1) or the apical progenitor marker, PAX6. The capacity of neural organoids to model neurodegenerative disorders such as Alzheimer's and Parkinson's diseases has facilitated the investigation of regenerative medicine of injured neurons and the development of potential stem cell treatments.



Product code	Description
Qk050	Human BDNF
Qk025	Human FGF-2 (bFGF) 145 aa
Qk027	Human FGF-2 (bFGF) 154 aa
Qk052	Thermostable FGF2-G3 145 aa

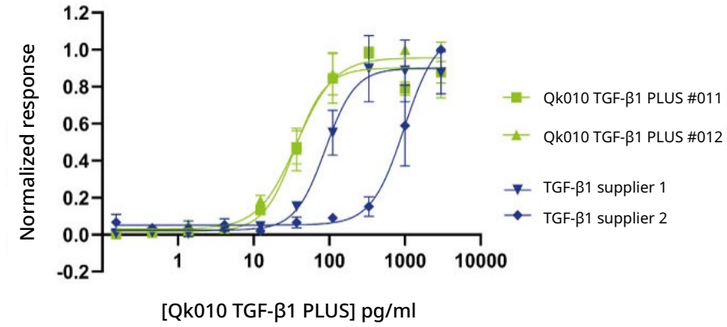
Product code	Description
Qk053	Thermostable FGF2-G3 154 aa
Qk051	Human GDNF
Qk010	Human/bovine/porcine TGF-β1 PLUS

Further reading

Monzel AS, Smits LM, Hemmer K, et al. Derivation of Human Midbrain-Specific Organoids from Neuroepithelial Stem Cells. Stem Cell Reports. 2017;8(5):1144-1154.
Lancaster MA, Renner M, Martin CA, Wenzel D, Bicknell LS, Hurles ME, Homfray T, Penninger JM, Jackson AP, Knoblich JA. Cerebral organoids model human brain development and microcephaly. Nature. 2013 Sep 19;501(7467):373-9.
Matsui TK, Matsubayashi M, Sakaguchi YM, et al. Six-month cultured cerebral organoids from human ES cells contain matured neural cells. Neurosci Lett. 2018;670:75-82.

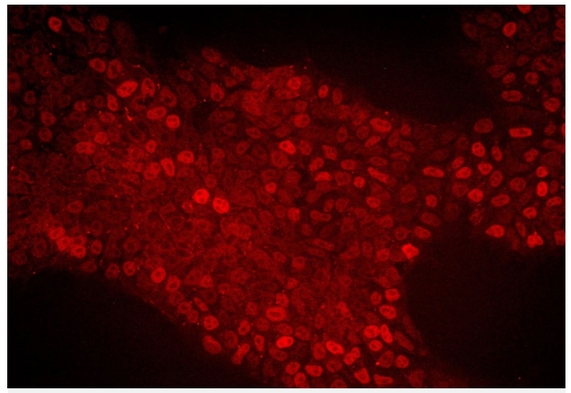
Animal origin-free recombinant TGF-β1 protein

Qkine TGF-β1 PLUS protein is the first entirely animal-free recombinant human transforming growth factor beta 1 (TGF-β1) protein for highly reproducible results and compatible with chemically defined stem cell media and organoid cultures. TGF-β1 is used extensively in the E8 media for induced pluripotent stem cell (iPSC), embryonic stem cell (ESC), and organoid cultures. This protein is a high-purity, animal-free, and carrier-protein free 24 kDa dimer comprising an optimized mature domain of TGF-β1 protein.

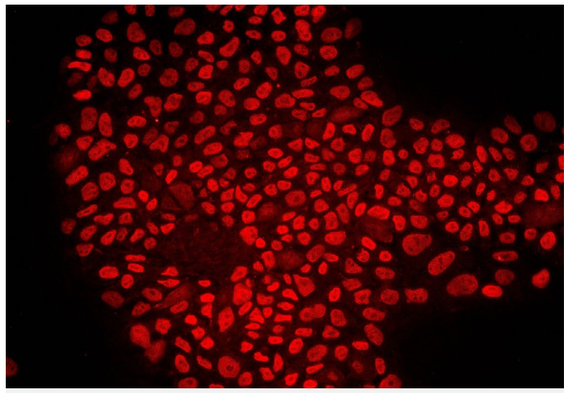


- Suitable for chemically defined stem cell media
- Animal origin-free manufacturing process
- High-purity protein with exceptional bioactivity and lot-to-lot consistency

Highly pure, animal-free, protein with extensive biochemical and quantitative bioactivity data to ensure reproducible and scalable stem cell maintenance. Quantitative luciferase reporter assays show TGF-β1 PLUS (Qk010) has consistently high bioactivity when compared directly to TGF-β1 produced in mammalian expression systems from two other suppliers.



Supplier B (mammalian expressed) NANOG



Qkine TGF-β1 PLUS (Qk010) NANOG

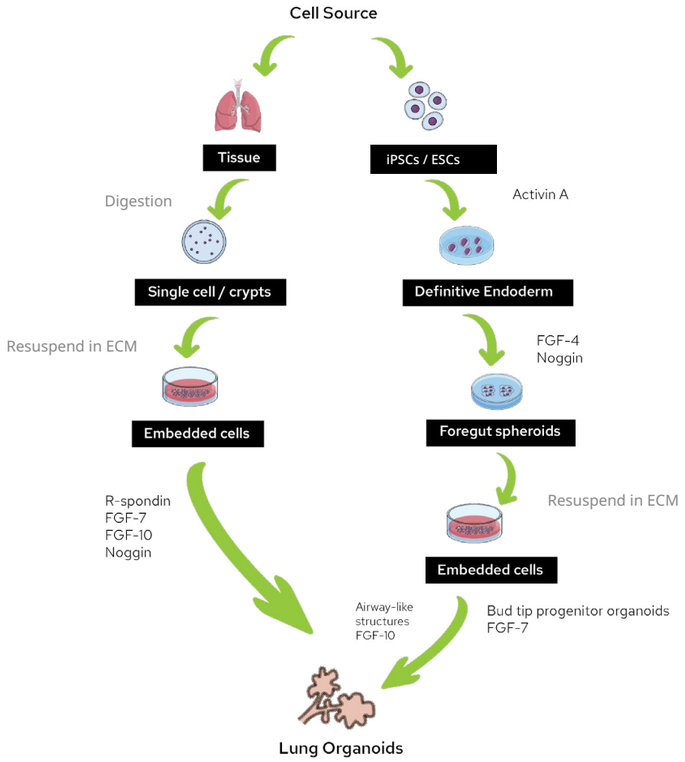
Comparison between Qkine TGF-β1 PLUS (animal-free) and mammalian expressed TGF-β1 sourced from another supplier. TGF-β1 PLUS promotes efficient maintenance of iPSCs at 1 ng/ml, with highly homogeneous expression of the pluripotency marker Nanog.

Learn more about ultra high-purity, animal origin-free TGF-β1 protein for enhanced iPSC and ESC culture.

Product code	Description
Qk010	Human TGF-β1 PLUS
Qk072	Human TGF-β2
Qk054	Human TGF-β

Lung organoids

Lung organoids have the potential to be used as a powerful tool for high-throughput drug screening and development as they provide the capacity to study complex respiratory-related processes and diseases. Lung organoids have been shown to contain several tissue-specific cell types including lung epithelial cells, endothelial cells, and mesenchymal cells. These organoids structurally resemble the branching architecture of the alveolar and airway regions within the lung. By employing lung organoids, researchers gain access to robust 3D model systems that closely resemble lung tissue, facilitating the study of airway-related conditions such as chronic obstructive pulmonary disease (COPD).



Product code	Description
Qk001	Human/mouse Activin A
Qk005	Human/mouse Activin A PLUS
Qk035	Follistatin-resistant Activin A
Qk004	Human FGF-4
Qk046	Human KGF (FGF-7)
Qk003	Human/rat/bovine/porcine FGF-10

Product code	Description
Qk034	Human noggin
Qk033	Mouse/rat noggin
Qk031	Human R-spondin 1 LR5
Qk006	Human R-spondin 1
Qk032	Human R-spondin 3

Further reading

Miller AJ, Dye BR, Ferrer-Torres D, et al. Generation of lung organoids from human pluripotent stem cells in vitro. Nat Protoc. 2019;14(2):518-540.
Li Z, Yu L, Chen D, Meng Z, Chen W, Huang W. Protocol for generation of lung adenocarcinoma organoids from clinical samples. STAR Protoc. 2020;2(1):100239.
Paolicelli G, Luca A, Jose SS, et al. Using Lung Organoids to Investigate Epithelial Barrier Complexity and IL-17 Signaling During Respiratory Infection. Front Immunol. 2019;10:323.

More resources at qkine.com

Qkine

Pluripotent stem-cell derived organoids

Growth factors for organoid culture media

qkine.com/organoids

Cortical
BDNF, FGF-8 a, FGF-8b, GDNF, TGF-β1
Qk050, Qk059, Qk057, Qk051, Qk010
Jacob et al 2020
Retina
IGF-1
Qk047
Regent et al 2020

Lung
Activin A, FGF-4, FGF-10, Noggin
Qk001, Qk004, Qk003, QK034
Dye et al 2015

Mammary
FGF-10, HGF
Qk003, Qk013
Qu et al 2017

Stomach
Activin A, EGF, FGF-4, Noggin, Wnt3a
Qk001, Qk011, Qk004, Qk034
McCracken et al 2014

Pancreas
Activin A, BMP-4, FGF-4, Noggin
Qk001, Qk038, Qk004, Qk034
Koike et al 2021

Skin
FGF-2, BMP-4
Qk027, Qk038
Lee et al 2020

Esophagus
Activin A, BMP-4, EGF, FGF-2, FGF-10, KGF, Noggin
Qk001, Qk038, Qk011, Qk027, Qk003, Qk046, Qk034
Zhang al 2018
Retina
Activin A, BMP-4, EGF, FGF-4, FGF-10, Noggin,
Qk001, Qk038, Qk011, Qk004, Qk003, Qk034
Wnt3a

Heart
FGF-2, TGF-β1
Qk027, Qk010
Drakhlis et al 2021

Blood vessels
BMP-4, FGF-2, VEGF-A
Qk038, Qk027, Qk048
Wimmer et al 2019

Liver
Activin A, OSM, (Wnt3a)
Qk001, Qk049
Sekine et al 2017
Activin A, BMP-4, BMP-7, EGF, FGF-2,
Qk001, Qk038, Qk011, Qk027
FGF-7, HGF
Qk046, Qk013
Ramli et al 2020

Kidney
FGF-9
Qk039
Takasato et al 2015

Intestine
Activin A, EGF, FGF-4, Noggin, R-spondin 1, Wnt3a
Qk001,Qk011Qk004, Qk034, Qk006
McCracken et al 2014

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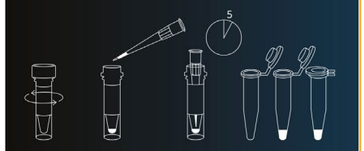
Reconstituting lyophilized proteins

Qkine growth factors are lyophilized to maintain biochemical quality, improve stability, and allow shipping at ambient temperatures to enhance sustainability.



Quick calculator

The optimum reconstitution solution for each protein is determined experimentally.

Reconstitute to a concentration of >50-1000 µg/ml, dilute in sterile physiological buffer as required, prepare single-use aliquots and store frozen.

Reconstitution calculator

Mass in vial (µg) ÷ Desired concentration (µg/ml) X 1000 = Volume to add (µl)

We're happy to help, please email support@qkine.com, or visit qkine.com/your-proteins

We're here to help you achieve successful and stress-free science
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Bioactivity. Guaranteed.

Stringent quality control at every step

All our growth factors are manufactured within a stringent quality framework and adhere to our Nine-point Quality Commitment. As part of our Bioactivity Guarantee, we conduct comparative quantitative bioactivity studies with dominant suppliers to ensure the bioactivity of all our proteins is equivalent or greater. Higher compliance protein documentation, including detailed lot-specific CoO, CoA, and animal-free (AOF) certification are available. Please email customerservice@qkine.com to request these.

Raising the standard in bioactive protein manufacturing and innovation

To find out more about more about
our high purity bioactive proteins,
please visit www.qkine.com
or email customerservice@qkine.com

Qkine products are for research use and ex vivo cell manufacturing use only

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