OptiPrep™ Mini-Review MC09

Hepatic non-parenchymal stellate cells – a bibliography

- This Mini-Review provides a complete bibliography of publications that report the use of OptiPrep™ for the purification of the non-parenchymal stellate cells. It complements **Mini-Review MC08** which provides a brief overview of the separation technology and **Mini-Review MC10** which is a bibliography of published papers primarily reporting the analysis of Kupffer and sinusoidal endothelial cells; this lists papers on non-parenchymal epithelial cells, NK cells, oval cells and progenitor cells.
- References are divided into sections and sub-sections alphabetically according research topic.. Within each section or sub-section references are listed alphabetically according to **first author** (multiple examples are listed chronologically).
- The letter in parenthesis at the end of each reference indicates the species source of the cells (H) = human, (M) = mouse, (R) = rat.

Note that the vast majority of papers address some aspect of liver fibrosis/fibrogenesis; thus "Fibrosis" or "Fibrogenesis" are not included in the following index headings

Adipogenesis

Jiang, Y., Wang, S., Zhao, Y., Lin, C., Zhong, F., Jin, L., He, F. and Wang, H. (2015) *Histone H3K9 demethylase JMJD1A modulates hepatic stellate cells activation and liver fibrosis by epigenetically regulating peroxisome proliferator-activated receptor γ* FASEB J. **29**, 1830–1841 (R)

Alcoholic liver injury

Byun, J-S., Suh, Y-G., Yi, H-S., Lee, Y-S. and Jeong, W-I. (2013) *Activation of toll-like receptor 3 attenuates alcoholic liver injury by stimulating Kupffer cells and stellate cells to produce interleukin-10 in mice* J, Hepatol., **58**, 342–349 (R)

Antigenic targeting

Wu, F., Wuensch, S.A., Azadniv, M., Ebrahimkhani, M.R. and Crispe, I.N. (2009) *Galactosylated LDL nanoparticles: a novel targeting delivery system to deliver antigen to macrophages and enhance antigen specific T cell responses* Mol. Pharmaceut., **6**, 1506-1517 (M)

Apoptosis

Duan, Y., Gu, X., Zhu, D., Sun, W., Chen, J., Feng, J., Song, K., Xu, F., He, X. and He, X. (2014) *Schistosoma japonicum soluble egg antigens induce apoptosis and inhibit activation of hepatic stellate cells: a possible molecular mechanism* Int. J. Parasitol., **44**, 217–224 (M)

Habens, F., Srinivasan, N., Oakley, F., Mann, D.A., Ganesan, A. and Packham, G. (2005) *Novel sulfasalazine analogues with enhanced NF-kB inhibitory and apoptosis promoting activity* Apoptosis, **10**, 481-491 (R)

Oakley, F., Meso, M., Iredale, J.P., Green, K., Marek, C.J., Zhou, X., May, M.J., Millward-Sadler, H., Wright, M.C. and Mann, D.A. (2005) *Inhibition of inhibitor of κB kinases stimulates hepatic stellate cell apoptosis and accelerated recovery from rat liver fibrosis* Gastroenterology, **128**, 108-120 (R)

Tao, Y-y., Yan, X-c., Zhou, T., Shen, L., Liu, Z-l. and Liu, C-h., (2014) *Fuzheng Huayu recipe alleviates hepatic fibrosis via inhibiting TNF-α induced hepatocyte apoptosis* BMC Complement. Altern. Med., **14**: 449 (M)

Atorvastatin effects

Klein, S., Klösel, J., Schierwagen, R., Körner, C., Granzow, M., Huss, S., Reza Mazar, I.G., Weber, S., van den Ven, P.F.M., Pieper-Fürst, U., Fürst, D.O., et al (2012) *Atorvastatin inhibits proliferation and apoptosis, but induces senescence in hepatic myofibroblasts and thereby attenuates hepatic fibrosis in rats* Lab. Invest., **92**, 1440–1450 (R)

Autoimmune hepatitis

Murthy, A., Shao, Y.W., Defamie, V., Wedeles, C., Smookler, D. and Khokha, R. (2012) *Stromal TIMP3 regulates liver lymphocyte populations and provides protection against Th1 T cell-driven autoimmune hepatitis* J. Immunol., **188**, 2876–2883 (M)

Autophagic cell death

Shaker, M.E., Ghani, A., Shiha, G.E., Ibrahim, T.M., Mehal, W.Z.(2013) *Nilotinib induces apoptosis and autophagic cell death of activated hepatic stellate cells via inhibition of histone deacetylases* Biochim. Biophys. Acta, **1833**, 1992–2003 (R)

B cell activity

Thapa, M., Chinnadurai, R., Velazquez, V.M., Tedesco, D., Elrod, E., Han, J-H., Sharma, P., et al (2015) *Liver fibrosis occurs through dysregulation of MyD88-dependent innate B-cell activity* Hepatology, **61**, 2067-2079 (M)

Bile duct ligation

Cui, W., Matsuno, K., Iwata, K., Ibi, M., Matsumoto, M., Zhang, J., Zhu, K., Katsuyama, M., Torok, N.J. and Yabe-Nishimura, C. (2011) *NOX1/Nicotinamide adenine dinucleotide phosphate, reduced form (NADPH) oxidase promotes proliferation of stellate cells and aggravates liver fibrosis induced by bile duct ligation* Hepatology, **54**, 949-958 (M)

Kageyama, Y., Ikeda, H., Watanabe, N., Nagamine, M., Kusumoto, Y., Yashiro, M., Satoh, Y., Shimosawa, T., Shinozaki, K., et al (2012) *Antagonism of sphingosine 1-phosphate receptor 2 causes a selective reduction of portal vein pressure in bile duct-ligated rodents* Hepatology, **56**, 1427-1438 (R)

Carcinogenesis

Seifert, L., Deutsch, M., Alothman, S., Alqunaibit, D., Werba, G., Pansari, M., Pergamo, M., Ochi, A. (2015) *Dectin-1 regulates hepatic fibrosis and hepatocarcinogenesis by suppressing TLR4 signaling pathways* Cell Rep., **13**, 1–13 (M)

Wright, J.H., Johnson, M.M., Shimizu-Albergine, M., Bauer, R.L., Hayes, B.J., Surapisitchat, J., Hudkins, K.L., Riehle, K.J., Johnson, S.C., et al (2014) *Paracrine activation of hepatic stellate cells in platelet-derived growth factor C transgenic mice: Evidence for stromal induction of hepatocellular carcinoma* Int. J. Cancer, **134**, 778–788 (M)

Wright, J.H., Johnson, M.M., Shimizu-Albergine, M., Bauer, R.L., Hayes, B.J., Surapisitchat, J., Hudkins, K.L., Riehle, K.J., Johnson, S.C., Yeh, M.M., Bammler, T.K., Beyer, R.P., Gilbertson, D.G., Alpers, C.E., Fausto, N. and Campbell, J.S. (2014) *Paracrine activation of hepatic stellate cells in platelet-derived growth factor C transgenic mice: Evidence for stromal induction of hepatocellular carcinoma* Int. J. Cancer, **134**, 778–788 (M)

Chemokine receptor

Lee, Y-S., Eun, H.S., Kim, S.Y., Jeong, J-M., Seo, W., Byun, J-S., Jeong, W-I. and Yi, H-S. (2106) *Hepatic immunophenotyping for streptozotocin-induced hyperglycemia in mice* Sci. Rep., **6**: 30656 (M)

Connective tissue/collagen

Huang, G. and Brigstock, D.R. (2011) *Integrin expression and function in the response of primary culture hepatic stellate cells to connective tissue growth factor (CCN2)* J. Cell. Mol. Med., **15**, 1087-1095 (M)

Jiroutova, A., Slavkovsky, R., Cermakova, M., Majdiakova, L., Hanovcova, I., Bolehovska, R., Hadjzlerova, M., Radilova, H., Ruszova, E. and Kanta, J. (2007) *Expression of mRNAs related to connective tissue metabolism in rat hepatic stellate cells and myofibroblasts* Exp. Toxicol. Pathol., **58**, 263-273 (R)

Mousavi, S.A., Fønhus, M.S. and Berg, T. (2009) *Up-regulation of uPARAP/Endo180 during culture activation of rat hepatic stellate cells and its presence in hepatic stellate cell lines from different species* BMC Cell Biol., **10**:39 (R)

Oben, J.A., Yang, S., Lin, H., Ono, M. and Diehl. A.M. (2003) *Acetylcholine promotes the proliferation and collagen gene expression of myofibroblastic hepatic stellate cells* Biochem. Biophys. Res. Commun., **300**, 172-177 (M)

Oben, J.A., Yang, S., Lin, H., Ono, M. and Diehl, A.M. (2003) *Norepinephrine and neuropeptide Y promote proliferation and collagen gene expression of hepatic myofibroblastic stellate cells* Biochem. Biophys. Res. Commun., **302**, 685-690 (M)

Contractile properties

Laleman W., Van Landeghem L, Severi T, Vander Elst I, Zeegers M, Bisschops R, Van Pelt J, Roskams T, Cassiman D, Fevery J, Nevens F. (2007) *Both Ca^{2+}-dependent and -independent pathways are involved in rat hepatic stellate cell contraction and intrahepatic hyperresponsiveness to methoxamine* Am. J. Physiol. Gastrointest. Liver Physiol., **292,** G556–G564 (R)

Laleman, W., van Landeghem, L., van der Elst, I., Zeegers, M., Fevery, J. and Nevens, F. (2007) *Nitroflurbiprofen, a nitric oxide-releasing cyclooxygenase inhibitor, improves cirrhotic portal hypertension in rats* Gastroenterology, **132**, 709-719 (R)

Cryopreservation

Nakamura, A., Ueno, T., Yagi, Y., Okuda, K., Ogata, T., Nakamura, T., Torimura, T., Iwamoto, H., Ramadoss, S., Sata, M., Tsutsumi, V., et al (2010) *Human primary cultured hepatic stellate cells can be cryopreserved* Med. Mol. Morphol., **43**, 107–115 (H)

Cytokines

Kandhi. R., Bobbala, D., Yeganeh. M., Mayhue, M., Menendez, A. and Ilangumaran, S. (2016) *Negative regulation of the hepatic fibrogenic response by suppressor of cytokine signaling 1* Cytokine, **82**, 58–69 (M)

Ogiso, H., Ito, H., Ando, T., Arioka, Y., Kanbe, A., Ando, K., Ishikawa, T., Saito, K., Hara, A., Moriwaki, H., Shimizu, M. and Seishima, M. (2016) *The deficiency of indoleamine 2,3-dioxygenase aggravates the CCl_4-induced liver fibrosis in mice* PLoS One, **11**: e0162183 (M)

DNA methylation

Page, A., Paoli, P., Salvador, E.M., White, S., French, J. and Mann, J. (2016) *Hepatic stellate cell transdifferentiation involves genome-wide remodeling of the DNA methylation landscape* J. Hepatol., **64**, 661–673 (R)

Drug effects

Habens, F., Srinivasan, N., Oakley, F., Mann, D.A., Ganesan, A. and Packham, G. (2005) *Novel sulfasalazine analogues with enhanced NF-kB inhibitory and apoptosis promoting activity* Apoptosis, **10**, 481-491 (R)

Khan, F., Peltekian, K.M. and Peterson, T.C. (2008) *Effect of interferon-alpha, Ribavirin, pentoxifylline, and interleukin-18 antibody on hepatitis C sera-stimulated hepatic stellate cell proliferation* J. Interferon Cytokine Res., **28**, 643-652 (R)

Laleman W., Van Landeghem L, Severi T, Vander Elst I, Zeegers M, Bisschops R, Van Pelt J, Roskams T, Cassiman D, Fevery J, Nevens F. (2007) *Both Ca^{2+}-dependent and -independent pathways are involved in rat hepatic stellate cell contraction and intrahepatic hyperresponsiveness to methoxamine* Am. J. Physiol. Gastrointest. Liver Physiol., **292,** G556–G564 (R)

Laleman, W., van Landeghem, L., van der Elst, I., Zeegers, M., Fevery, J. and Nevens, F. (2007) *Nitroflurbiprofen, a nitric oxide-releasing cyclooxygenase inhibitor, improves cirrhotic portal hypertension in rats* Gastroenterology, **132**, 709-719 (R)

Liang, Y-J., Luo, J., Yuan, Q., Zheng, D., Liu, Y-P., Shi, L., Zhou, Y., Chen, A-L., Ren, Y-Y., Sun, K-Y., Sun, Y., Wang, Y. and Zhang, Z-S. (2011) *New insight into the antifibrotic effects of praziquantel on mice in infection with Schistosoma japonicum* PLoS One **6**: e20247 (M)

Oakley, F., Meso, M., Iredale, J.P., Green, K., Marek, C.J., Zhou, X., May, M.J., Millward-Sadler, H., Wright, M.C. and Mann, D.A. (2005) *Inhibition of inhibitor of κB kinases stimulates hepatic stellate cell apoptosis and accelerated recovery from rat liver fibrosis* Gastroenterology, **128**, 108-120 (R)

Peterson, T.C. and Rowden, G. (1998) *Drug-metabolizing enzymes in rat liver myofibroblasts* Biochem. Pharmacol., **55**, 703-708 (R)

Dystroglycan

Kastanis, G.J., Hernandez-Nazara, Z., Nieto, N,, Rincón-Sanchez, A.R., Popratiloff, A., Dominguez-Rosales, J.A., Lechuga, C.G., Rojkind, M. (2011) *The role of dystroglycan in PDGF-BB-dependent migration of activated hepatic stellate cells/myofibroblasts* Am. J. Physiol. Gastrointest. Liver Physiol., **301**, G464–G474 (M)

Epigallocatechin

Fu, Y. and Chen, A. (2006) *The phyto-chemical (−)-epigallocatechin gallate suppresses gene expression of epidermal growth factor receptor in rat hepatic stellate cells in vitro by reducing the activity of Egr-1* Biochem. Pharmacol., **72**, 227-238 (R)

Fu, Y., Zheng, S., Lu, S.C. and Chen, A. (2008) *Epigallocatechin-3-gallate inhibits growth of activated hepatic stellate cells by enhancing the capacity of glutathione synthesis* Mol. Pharmacol., **73**, 1465-1473 (R)
Yumei, F., Zhou, Y., Zheng, S. and Chen, A. (2006) *The antifibrogenic effect of (-)-epigallocatechin gallate results from the induction of de novo synthesis of glutathione in passaged rat hepatic stellate cells* Lab. Invest., **86**, 697-709 (R)

Gene transfer

Gao, R., McCormick, C.J., Arthur, M.J.P., Ruddell, R., Oakley, F., Smart, D.E., Murphy, F.R., Garris, M.P.G. and Mann, D.A. (2002) *High efficiency gene transfer into cultured primary rat and human hepatic stellate cells using baculovirus vectors* Liver **22**, 15-22 (R)
Perugorria, M.J., Wilson, C.L., Zeybel, M., Walsh, M., Amin, S., Robinson, S., White, S.A., Burt, A.D., Oakley, F., Tsukamoto, H., Mann, D.A. and Mann, J. (2012) *Histone methyltransferase ASH1 orchestrates fibrogenic gene transcription during myofibroblast tansdifferentiation* Hepatology, **56**, 1129-1139 (H) (M)
Smith, P.G., Oakley, F., Fernandez, M., Mann, D.A., Lemoine, N.R. and Whitehouse, A. (2005) *Herpesvirus saimiri-based vector biodistribution using noninvasive optical imaging* Gene Ther., **12**, 1465-1476 (R)

Growth factors and growth factor receptors/signalling

Bahrami, A.J., Gunaje, J.J., Hayes, J., Riehle, K.J., Kenerson, H.L., Yeung, R.S., Stempien-Otero, A.S., Campbell, J.S. and Mahoney Jr, W.M. (2014) *Regulator of G-protein signaling-5 is a marker of hepatic stellate cells and expression mediates response to liver injury* PLoS One, **9**: e108505
Barnaeva, E., Nadezhda, A., Hannappel, E., Sjogren, M.H. and Rojkind, M. (2007) *Thymosin β_4 upregulates the expression of hepatocyte growth factor and downregulates the expression of PDGF-β receptor in human hepatic stellate cells* Ann. N.Y. Acad. Sci., **1112**, 154-160 (H)
Cassiman, D., Denef, C., Desmet, V.J. and Roskams, T. (2001) *Human and rat hepatic stellate cells express neurotrophins and neurotrophin receptors* Hepatology, **33**, 148-158 (R)
De Leve, L.D., Wang, X. and Wang, L. (2016) *VEGF-sdf1 recruitment of CXCR7$^+$ bone marrow progenitors of liver sinusoidal endothelial cells promotes rat liver regeneration* Am. J. Physiol. Gastrointest Liver Physiol., **310**, G739–G746 (R)
Fu, Y. and Chen, A. (2006) *The phyto-chemical (−)-epigallocatechin gallate suppresses gene expression of epidermal growth factor receptor in rat hepatic stellate cells in vitro by reducing the activity of Egr-1* Biochem. Pharmacol., **72**, 227-238 (R)
Huang, G., Besner, G.E. and Brigstock, D.R. (2012) *Heparin-binding epidermal growth factor-like growth factor suppresses experimental liver fibrosis in mice* Lab. Invest., **92**, 703–712 (M)
Jiroutova, A., Slavkovsky, R., Cermakova, M., Majdiakova, L., Hanovcova, I., Bolehovska, R., Hadjzlerova, M., Radilova, H., Ruszova, E. and Kanta, J. (2007) *Expression of mRNAs related to connective tissue metabolism in rat hepatic stellate cells and myofibroblasts* Exp. Toxicol. Pathol., **58**, 263-273 (R)
Kastanis, G.J., Hernandez-Nazara, Z., Nieto, N,, Rincón-Sanchez, A.R., Popratiloff, A., Dominguez-Rosales, J.A., Lechuga, C.G., Rojkind, M. (2011) *The role of dystroglycan in PDGF-BB-dependent migration of activated hepatic stellate cells/myofibroblasts* Am. J. Physiol. Gastrointest. Liver Physiol., **301**, G464–G474 (M)
Lin, J. and Chen, A. (2008) *Activation of peroxisome proliferator-activated receptor-g by curcumin blocks the signaling pathways for PDGF and EGF in hepatic stellate cells* Lab. Invest., **88**, 529-540 (R)
Reyes-Gordillo, K., Shah, R., Popratiloff, A., Fu, S., Hindle, A., Brody, F. and Rojkind, M. (2011) *Thymosin-β4 (Tβ4) blunts PDGF-dependent phosphorylation and binding of AKT to actin in hepatic stellate cells* Am. J. Pathol., **178**, 2100–2108 (H)
Tao, Y-Y., Wang, Q-L., Shen, L., Fu, W-W, and Liu, C-H. (2013) *Salvianolic acid B inhibits hepatic stellate cell activation through transforming growth factor beta-1 signal transduction pathway in vivo and in vitro* Exp. Biol. Med., **238**, 1284–1296 (R)
Tsai, S-M. and Wang, W-P. (2011) *Expression and function of fibroblast growth factor (FGF) 7 during liver regeneration* Cell. Physiol. Biochem., **27**, 641-652 (M)
Verma-Gandhu, M., Peterson, M.R. and Peterson, T.C. (2007) *Effect of fetuin, a TGFβ antagonist and pentoxifylline, a cyrokine antagonist on hepatic stellate cell function and fibrotic parameters in fibrosis* Eur. J. Pharmacol., **572**, 220-227 (R)
Yumei, F., Zhou, Y., Zheng, S. and Chen, A. (2006) *The antifibrogenic effect of (-)-epigallocatechin gallate results from the induction of de novo synthesis of glutathione in passaged rat hepatic stellate cells* Lab. Invest., **86**, 697-709 (R)
Zhang, Z., Zha, Y., Hu, W., Huang, Z., Gao, Z., Zang, Y., Chen, J., Dong, L. and Zhang, J. (2013) The *Autoregulatory feedback loopof microRNA-21/programmed cell death protein 4/activation protein-1 (MiR-21/PDCD4/AP-1) as a driving force for hepatic fibrosis development* J. Biol. Chem., **288**, 37082-37093 (R)

Gut microbiota

Bigorgne, A.E., John, B., Ebrahimkhani, M.R., Shimizu-Albergine, M., Campbell, J.S. and Crispe, I.N. (2016) *TLR4-dependent secretion by hepatic stellate cells of the neutrophil-chemoattractant CXCL1 mediates liver response to gut microbiota* PLoS One, **11**: e0151063 (M)

Hepatitis B

Pallett, L.J., Gill, U.S., Quaglia, A., Sinclair, L.V., Jover-Cobos, M., Schurich, A., Singh, K.P., Thomas, N. et al. (2015) *Metabolic regulation of hepatitis B immunopathology by myeloid-derived suppressor cells* Nat. Med., 21, 591-600 (H)

Hypertension

Jalan, R., De Chiara, F., Balasubramaniyan, V., Andreola, F., Khetan, V., Malago, M., Pinzani, M., Mookerjee, R.P. and Rombouts, K. (2016) *Ammonia produces pathological changes in human hepatic stellate cells and is a target for therapy of portal hypertension* J. Hepatol., **64**, 823–833 (H)

Integrin expression

Huang, G. and Brigstock, D.R. (2011) *Integrin expression and function in the response of primary culture hepatic stellate cells to connective tissue growth factor (CCN2)* J. Cell. Mol. Med., **15**, 1087-1095 (M)
Martin, K., Pritchett, J., Llewellyn, J., Mullan, A.F., Athwal, V.S., Dobie, R., Harvey, E., Zeef, L. et al (2016) *PAK proteins and YAP-1 signalling downstream of integrin beta-1 in myofibroblasts promote liver fibrosis* Nat. Comm., **7**: 12502 (M)

Interleukin expression

Byun, J-S., Suh, Y-G., Yi, H-S., Lee, Y-S. and Jeong, W-I. (2013) *Activation of toll-like receptor 3 attenuates alcoholic liver injury by stimulating Kupffer cells and stellate cells to produce interleukin-10 in mice* J, Hepatol., **58**, 342–349 (R)
Mchedlidze, T., Waldner, M., Zopf, S., Walker, J., Rankin, A.L., Schuchmann, M., Voehringer, D., McKenzie, A.N.J., Neurath, M.F., Pflanz, S. and Wirtz, S. (2013) *Interleukin-33-dependent innate lymphoid cells mediate hepatic fibrosis* Immunity, **39**, 357–371 (M)
Seo, W., Eun, H.S., Kim, S.Y., Yi, H-S., Lee, Y-S., Park, S-H., Jang, M-J., Jo, E., Kim, S.C. et al (2016) *Exosome-mediated activation of toll-like receptor 3 in stellate cells stimulates interleukin-17 production by γδ T cells in liver fibrosis* Hepatology **64**, 616-631 (M)
Tan, Z., Qian, X., Jiang, R., Liu, Q., Wang, Y., Chen, C., Wang, X., Ryffe, B. and Sun, B. (2013) *IL-17A plays a critical role in the pathogenesis of liver fibrosis through hepatic stellate cell activation* J. Immunol., **191**, 1835–1844 (M)

Lipid metabolism

Jeong, W-I., Osei-Hyiaman, D., Park, O., Liu, J., Batkai, S., Mukhopadhyay, P., Horiguchi, N., Harvey-White, J., Marsicano, G., Lutz, B., Gao, B. and Kunos, G. (2008) *Paracrine activation of hepatic CB_1 receptors by stellate cell-derived endocannabinoids mediates alcoholic fatty liver* Cell Metab., **7**, 227-235 (M)

Mesenchymal/mesothelial cells

Hyun, J., Wang, S., Kim, J., Kim, G.J. and Jung, Y. (2015) *MicroRNA125b-mediated Hedgehog signaling influences liver regeneration by chorionic plate-derived mesenchymal stem cells* Sci. Rep., **5**: 14135 (R)
Li, Y., Wang, J. and Asahina, K. (2013) *Mesothelial cells give rise to hepatic stellate cells and myofibroblasts via mesothelial–mesenchymal transition in liver injury* Proc. Natl. Acad. Sci. USA, **110**, 2324-2329 (M)
Lua, I., James, D., Wang, J., Wang, K.S. and Asahina, K. (2014) *Mesodermal mesenchymal cells give rise to myofibroblasts, but not epithelial cells, in mouse liver injury* Hepatology, **60**, 311-322 (M)
Li, Y., Lua, I., French, S.W. and Asahina, K. (2016) *Role of TGF-β signaling in differentiation of mesothelial cells to vitamin A-poor hepatic stellate cells in liver fibrosis* Am. J. Physiol. Gastrointest. Liver Physiol., **310**, G262–G272 (M)
Sicklick, J.K., Choi, S.S., Bustamente, M., McCall, S.J., Hernández-Pérez, E., Huang, J., Li, Y-X., Rojkind, M. and Diehl, A.M. (2006) *Evidence for epithelial-mesenchymal transitions in adult liver cells* Am. J. Physiol. Liver Physiol., **291**, G575-G583 (M)
Tang, W-P., Akahoshi, T., Piao, J-S., Narahara, S., Murata, M., Kawano, T., Hamano, N., Ikeda, T. and Hashizume, M. (2015) *Basic fibroblast growth factor-treated adipose tissue-derived mesenchymal stem cell infusion to ameliorate liver cirrhosis via paracrine hepatocyte growth factor* J. Gastroenterol. Hepatol., **20**, 1065–1074 (R)

Tang, W-P., Akahoshi, T., Piao, J-S., Narahara, S., Murata, M., Kawano, T., Hamano, N., Ikeda, T. and Hashizume, M. (2016) *Splenectomy enhances the therapeutic effect of adipose tissue-derived mesenchymal stem cell infusion on cirrhosis rats* Liver Int.,**36**, 1151–1159 (R)

Methodology

Liu, W., Hou, Y., Chen, H., Wei, H., Lin, W., Li, J., Zhang, M., He, F. and Jiang, Y. (2011) *Sample preparation method for isolation of single-cell types from mouse liver for proteomic studies* Proteomics **11**, 3556–3564 (M)
Chang, W., Yang, M., Song, L., Shen, K., Wang, H., Gao, X., Li, M., Niu, W. and Qin, X. (2014) *Isolation and culture of hepatic stellate cells from mouse liver*Acta Biochim. Biophys. Sin., **46**, 291–298 (M)

Myeloperoxidase

Pulli, B., Ali, M., Iwamoto, Y., Zeller, M.W.G., Schob, S., Linnoila, J.J. and Chen, J.W. (2015) *Myeloperoxidase–hepatocyte–stellate cell cross talk promotes hepatocyte injury and fibrosis in experimental nonalcoholic steatohepatitis* Antioxid. Redox Signal., **23**, 1255–1269 (M)

Myofibroblast (proliferation/migration/senescence)

Klein, S., Klösel, J., Schierwagen, R., Körner, C., Granzow, M., Huss, S., Reza Mazar, I.G., Weber, S., van den Ven, P.F.M., Pieper-Fürst, U., et al (2012) *Atorvastatin inhibits proliferation and apoptosis, but induces senescence in hepatic myofibroblasts and thereby attenuates hepatic fibrosis in rats* Lab. Invest., **92**, 1440–1450 (R)

Myofibroblast transdifferentiation – see “Transcription factors - Methylation”

NADPH oxidase – NOX1 isoform

Cui, W., Matsuno, K., Iwata, K., Ibi, M., Matsumoto, M., Zhang, J., Zhu, K., Katsuyama, M., Torok, N.J. and Yabe-Nishimura, C. (2011) *NOX1/Nicotinamide adenine dinucleotide phosphate, reduced form (NADPH) oxidase promotes proliferation of stellate cells and aggravates liver fibrosis induced by bile duct ligation* Hepatology, **54**, 949-958 (M)

Neurotransmitters

Cassiman, D., van Pelt, J., de Vos, R., van Lommel, F., Desmet, V., Yap, S-H. and Roskams, T. (1999) *Synaptophysin: a novel marker for human and rat hepatic stellate cells* Am. J. Pathol., **155**, 1831-1839 (R)

NK cell killing

Jeong, W-I., Park, O. and Gao, B. (2008) *Abrogation of the antifibrotic effect of natural killer cells/interferon-γ contributes to alcohol acceleration of liver fibrosis* Gastroenterology **134**, 248-258 (M)
Radaeva, S., Sun, R., Jaruga, B., Nguyen, V.T., Tian, Z. and Gao, B. (2006) *Natural killer cells ameliorate liver fibrosis by killing activated stellate cells in NKG2D-dependent and tumor necrosis factor-related apoptosis-inducing ligand-dependent manners* Gastroenterology, **130**, 434-452 (M)
Radaeva. S., Wang, L., Radaeva, S., Jeong, W-I., Park, O. and Gao, B. (2007) *Retinoic acid signaling sensitizes hepatic stellate cells to NK cell killing via upregulation of NK cell activating ligand RAE1* Am. J. Physiol. Gastrointest. Liver Physiol., **293**, G809-G816 (M)

Notch signalling

He, F., Guo, F-C., Li, Z., Yu, H-C., Ma, P-F., Zhao, J-L., Feng, L., Li, W-N. et al (2015) *Myeloid-specific disruption of recombination signal binding protein Jj ameliorates hepatic fibrosis by attenuating inflammation through cylindromatosis in mice* Hepatology, **61**, 303-314 (M)

Opioid system

Ebrahimkhani, M.R., Kiani, S., Oakley, F., Kendall, T., Shariftabrizi, A., Tavangar, S.M., Moezi, L., Payabvash, S., Karoon, A., Hoseininik, H., Mann, D.A., Moore, K.P., Mani, A.R. and Dehpour, A.R. (2006) *Naltrexone, an opioid receptor antagonist, attentuates liver fibrosis in bile duct ligated rats* Gut, **55**, 1606-1616 (R)

Oxidases/oxygen species

Ping, J., Li, J-T., Liao, Z-X., Shang, L. and Wang, H. (2011) *Indole-3-carbinol inhibits hepatic stellate cells proliferation by blocking NADPH oxidase/reactive oxygen species/p38 MAPK pathway* Eur. J. Pharmacol., **650**, 656–662 (R)

PDGF signalling

Zhang, X., Tan, Z., Wang, Y., Tang, J., Jiang, R., Hou, J., Zhuo, H., Wang, X., Ji, J., Qin, X. and Sun, B. (2015) *PTPRO-associated hepatic stellate cell activation plays a critical role in liver fibrosis* Cell. Physiol. Biochem., **35**, 885-898 (M)

Phosphoinositides

Rombouts, K. and Carloni, V. (2016) *Determination and characterization of tetraspanin-associated phosphoinositide-4 kinases in primary and neoplastic liver cells* In Methods Mol. Biol., **1376**, Astrocytes: Methods and Protocols (ed. Waugh, M.G.) Springer Science+Business Media, LLC pp 203-212 (H)

Peroxisome proliferators-activated receptor-γ

Lin, J. and Chen, A. (2008) *Activation of peroxisome proliferator-activated receptor-g by curcumin blocks the signaling pathways for PDGF and EGF in hepatic stellate cells* Lab. Invest., **88**, 529-540 (R)
Mann, J., Chu, D.C.K., Maxwell, A., Oakley, F., Zhu, N.L., Tsukamoto, H. and Mann, D.A. (2010) *MeCP2 controls an epigenetic pathway that promotes myofibroblast transdifferentiation and fibrosis* Gastroenterology, **138**, 705–714 (R)

Portal hypertension

Bockx, I., Verdrengh, K., Vander Elst, I., van Pelt, J., Nevens, F., Laleman, W. and Cassiman, D. (2012) *High-frequency vagus nerve stimulation improves portal hypertension in cirrhotic rats* Gut, **61**, 604-612 (R)
Kageyama, Y., Ikeda, H., Watanabe, N., Nagamine, M., Kusumoto, Y., Yashiro, M., Satoh, Y., Shimosawa, T., Shinozaki, K., Tomiya, T., et al (2012) *Antagonism of sphingosine 1-phosphate receptor 2 causes a selective reduction of portal vein pressure in bile duct-ligated rodents* Hepatology, **56**, 1427-1438 (R)

Proteoglycans

Bukong, T.N., Maurice, S.B., Chahal, B., Schaeffer, D.F. and Winwood, P.J. (2016) *Versican: a novel modulator of hepatic fibrosis* Lab. Invest., **96**, 361–374 (M)

Proteomics

Liu, W., Hou, Y., Chen, H., Wei, H., Lin, W., Li, J., Zhang, M., He, F. and Jiang, Y. (2011) *Sample preparation method for isolation of single-cell types from mouse liver for proteomic studies* Proteomics **11**, 3556–3564 (M)

Retinoic acid/ester

Dunham, R.M., Thapa, M., Velazquez, V.M., Elrod, E.J., Denning, T.L., Pulendran, B. and Grakoui, A. (2013) *Hepatic stellate cells preferentially induce Foxp3^{+} regulatory T cells by production of retinoic acid* J. Immunol., **190**, 2009–2016 (M)
Radaeva, S., Sun, R., Jaruga, B., Nguyen, V.T., Tian, Z. and Gao, B. (2006) *Natural killer cells ameliorate liver fibrosis by killing activated stellate cells in NKG2D-dependent and tumor necrosis factor-related apoptosis-inducing ligand-dependent manners* Gastroenterology, **130**, 434-452 (M)
Radaeva. S., Wang, L., Radaeva, S., Jeong, W-I., Park, O. and Gao, B. (2007) *Retinoic acid signaling sensitizes hepatic stellate cells to NK cell killing via upregulation of NK cell activating ligand RAE1* Am. J. Physiol. Gastrointest. Liver Physiol., **293**, G809-G816 (M)
Schreiber, R., Taschler, U., Wolinski, H., Seper, A., Tamegger, S.N., Graf, M., Kohlwein, S.D., Haemmerle, G., Zimmermann, R., Zechner, R. and Lass, A. (2009) *Esterase 22 and beta-glucuronidase hydrolyze retinoids in mouse liver* J. Lipid Res., **50**, 2514–2523 (M)
Taschler, U., Schreiber, R., Chitraju, C., Grabner, G.F., Romauch, M., Wolinski, H., Haemmerle, G. et al (2015) *Adipose triglyceride lipase is involved in the mobilization of triglyceride and retinoid stores of hepatic stellate cells* Biochim. Biophys. Acta, **1851**, 937–945 (M)

RNA (various types)

Hyun, J., Wang, S., Kim, J., Rao, K.M., Park, S.Y., 2, Chung, I., Ha, C-S., Kim, S-W., Yun, Y.H. and Jung, Y. (2016) *MicroRNA-378 limits activation of hepatic stellate cells and liver fibrosis by suppressing Gli3 expression* Nat. Comm., **7**: 10993 (M)
Jiroutova, A., Slavkovsky, R., Cermakova, M., Majdiakova, L., Hanovcova, I., Bolehovska, R., Hadjzlerova, M., Radilova, H., Ruszova, E. and Kanta, J. (2007) *Expression of mRNAs related to connective tissue metabolism in rat hepatic stellate cells and myofibroblasts* Exp. Toxicol. Pathol., **58**, 263-273 (R)
Leask, A., Chen, S., Pala, D., Brigstock, D.R. (2008) *Regulation of CCN2 mRNA expression and promoter activity in activated hepatic stellate cells* J. Cell. Commun. Signal., **2**, 49-56 (M)

Yu, F., Zheng, J., Mao, Y., Dong, P., Lu, Z., Li, G., Guo, C., Liu, Z. and Fan, X. (2015) *Long non-coding RNA growth arrest-specific transcript 5 (GAS5) inhibits liver fibrogenesis through a mechanism of competing endogenous RNA* J. Biol. Chem., **290**, 28286–28298 (M)
Zhang, Z., Gao, Z., Hu, W., Yin, S., Wang, C., Zang, Y., Chen, J., Zhang, J. and Dong, L. (2013) 3,3'-*Diindolylmethane ameliorates experimental hepatic fibrosis via inhibiting miR-21 expression* Br. J. Pharmacol., **170**, 649–660 (R)
Zhang, Z., Zha, Y., Hu, W., Huang, Z., Gao, Z., Zang, Y., Chen, J., Dong, L. and Zhang, J. (2013) The *Autoregulatory feedback loopof microRNA-21/programmed cell death protein 4/activation protein-1 (MiR-21/PDCD4/AP-1) as a driving force for hepatic fibrosis development* J. Biol. Chem., **288**, 37082-37093 (R)
Zheng, J., Wu, c., Lin, Z., Guo, Y., Shi, L., Dong, P., Lu, Z., Gao, S., Liao, Y., Chen, B. and Yu, F. (2014) *Curcumin up-regulates phosphatase and tensin homologue deleted on chromosome 10 through microRNA-mediated control of DNA methylation – a novel mechanism suppressing liver fibrosis* FEBS J., **281**, 88–103 (R)
Zheng, J., Dong, P., Mao, Y., Chen, S., Wu, X., Li, G., Lu, Z. and Yu, F. (2015) *lincRNA-p21 inhibits hepatic stellate cell activation and liver fibrogenesis via p21* FEBS J., **282**, 4810–4821 (M)
Zhou, C., York, S.R., Chen, J.Y., Pondick, J.V., Motola, D.L., Chung, R.T. and Mullen, A.C. (2016) *Long noncoding RNAs expressed in human hepatic stellate cells form networks with extracellular matrix proteins* Genome Med., **8**: 31 (H)

Schistosome infection

Duan, Y., Gu, X., Zhu, D., Sun, W., Chen, J., Feng, J., Song, K., Xu, F., He, X. and He, X. (2014) *Schistosoma japonicum soluble egg antigens induce apoptosis and inhibit activation of hepatic stellate cells: a possible molecular mechanism* Int. J. Parasitol., **44**, 217–224 (M)
He, X., Pu, G., Tang, R., Zhang, D. and Pan, W. (2014) *Activation of nuclear factor kappa B in the hepatic stellate cells of mice with Schistosomiasis japonica* PloS One **9**: e104323 (M)
Liang, Y-J., Luo, J., Lu, Q., Zhou, Y., Wu, H-W., Zheng, D., Ren, Y-Y., Sun, K-Y., Wang, Y. and Zhang, Z-S. (2012) *Gene profile of chemokines on hepatic stellate cells of schistosome-infected mice and antifibrotic roles of CXCL9/10 on liver non-parenchymal cells* PLoS One, **7**: e42490 (M)
Wang, M., Abais, J.M., Meng, N., Zhang, Y., Ritter, J.K., Li, P-L. and Tang, W-X. (2014) *Upregulation of cannabinoid receptor-1 and fibrotic activation of mouse hepatic stellate cells during Schistosoma J.. infection: Role of NADPH oxidase* Free Radic. Biol. Med., **71**, 109–120 (M)

S100A4

Chen, L., Li, J., Zhang, J., Dai, C., Liu, X., Wang, J. et al (2015) *S100A4 promotes liver fibrosis via activation of hepatic stellate cells* J. Hepatol., **62**, 156-164 (M)

T-cells

Chinnadurai, R. and Grakoui, A. (2010) *B7-H4 mediates inhibition of T cell responses by activated murine hepatic stellate cells* Hepatology, **52**, 2177-2185 (M)
Dunham, R.M., Thapa, M., Velazquez, V.M., Elrod, E.J., Denning, T.L., Pulendran, B. and Grakoui, A. (2013) *Hepatic stellate cells preferentially induce Foxp3^{+} regulatory T cells by production of retinoic acid* J. Immunol., **190**, 2009–2016 (M)
Feng, M., Wang, Q., Jiang, Z., Ding, J., Wang, H., Wang, M., Lu, L. and Guan, W. (2016) *Adoptive transferred hepatic stellate cells attenuated drug-induced liver injury by modulating the rate of regulatory T cells/T helper 17 cells* Clin. Immunol., **165**, 12–18 (M)
Feng, M., Wang, Q., Jiang, Z., Ding, J., Wang, H., Wang, M., Lu, L. and Guan, W. (2016) *Adoptive transferred hepatic stellate cells attenuated drug-induced liver injury by modulating the rate of regulatory T cells/T helper 17 cells* Clin. Immunol., **165**, 12–18 (M)
Ichikawa, S., Mucida, D., Tyznik, A.J., Kronenberg, M. and Cheroutre, H. (2011) *Hepatic stellate cells function as regulatory bystanders* J. Immunol., **186**, 5549-5555 (M)
Khadem, F., Gao, X., Mou, Z., Jia, P., Movassagh, H., Onyilagha, C., Gounni, A.S., Wright, M.C. and Uzonna, J.E. (2016) *Hepatic stellate cells regulate liver immunity to visceral Leishmaniasis through P110δ-dependent induction and expansion of regulatory T cells in mice* Hepatology, **63**, 620-632 (M)

Toll-like receptor signalling

Byun, J-S., Suh, Y-G., Yi, H-S., Lee, Y-S. and Jeong, W-I. (2013) *Activation of toll-like receptor 3 attenuates alcoholic liver injury by stimulating Kupffer cells and stellate cells to produce interleukin-10 in mice* J, Hepatol., **58**, 342–349 (R)

Seifert, L., Deutsch, M., Alothman, S., Alqunaibit, D., Werba, G., Pansari, M., Pergamo, M., Ochi, A. (2015) *Dectin-1 regulates hepatic fibrosis and hepatocarcinogenesis by suppressing TLR4 signaling pathways* Cell Rep., **13**, 1–13 (M)
Seo, W., Eun, H.S., Kim, S.Y., Yi, H-S., Lee, Y-S., Park, S-H., Jang, M-J., Jo, E., Kim, S.C. et al (2016) *Exosome-mediated activation of toll-like receptor 3 in stellate cells stimulates interleukin-17 production by γδ T cells in liver fibrosis* Hepatology **64**, 616-631 (M)
Wilson, C.L., Mann, J., Walsh, M., Perugoria, M.J., Oakley, F., Wright, M.C., Brignole, C., Di Paolo, D., Perri, P., Ponzoni, M., Karin, M. and Mann, D.A. (2014) *Quiescent hepatic stellate cells functionally contribute to the hepatic innate immune response via TLR3* PLoS One, **9**: e83391 (R)

Transcription factors

E-box DNA

Vincent, K.J., Jones, E., Arthur, M.J.P., Smart, D.E., Trim, J., Wright, M.C. and Mann, D.A. (2001) *Regulation of E-box DNA binding during in vivo and in vitro activation of rat and human hepatic stellate cells* Gut, **49**, 713-719 (H) (R)

Inflammatory response

Elsharkawy, A.M., Oakley, F., Lin, F., Packham, G., Mann, D.A, and Mann, J. (2010) *The NF-κB p50:p50:HDAC-1 repressor complex orchestrates transcriptional inhibition of multiple pro-inflammatory genes* J. Hepatol., **53**, 519-527 (M)
Oakley, F., Mann, J., Nailard, S., Smart, D.E., Mungalasingh, N., Constandinou, C., Ali, S., Wilson, S.J., Millward-Sadler, H., Iredale, J.P. and Mann, D.A. (2005) *Nuclear factor-κB1 (p50) limits the inflammatory and fibrogenic responses to chronic injury* Am. J. Pathol., **166**, 695-708 (M)

Metalloproteinases

Bertrand-Philippe, M., Ruddell, R.G., Arthur, M.J.P., Thomas, J., Mungalsingh, N. and Mann, D.A. (2004) *Regulation of tissue inhibitor of metalloproteinase 1 gene transcription by RUNX1 and RUNX2* J. Biol. Chem., **279**, 24530-24539 (H) (R)
Fowell, A.J., Collins, J.E., Duncombe, D.R., Pickering, J.A., Rosenberg, W.M.C. and Benyon, R.C. (2011) *Silencing tissue inhibitors of metalloproteinases (TIMPs) with short interfering RNA reveals a role for TIMP-1 in hepatic stellate cell proliferation* Biochem. Biophys. Res. Comm., **407**, 277–282 (R)
Jiroutova, A., Slavkovsky, R., Cermakova, M., Majdiakova, L., Hanovcova, I., Bolehovska, R., Hadjzlerova, M., Radilova, H., Ruszova, E. and Kanta, J. (2007) *Expression of mRNAs related to connective tissue metabolism in rat hepatic stellate cells and myofibroblasts* Exp. Toxicol. Pathol., **58**, 263-273 (R)
Murthy, A., Shao, Y.W., Defamie, V., Wedeles, C., Smookler, D. and Khokha, R. (2012) *Stromal TIMP3 regulates liver lymphocyte populations and provides protection against Th1 T cell-driven autoimmune hepatitis* J. Immunol., **188**, 2876–2883 (M)
Perugorria, M.J., Wilson, C.L., Zeybel, M., Walsh, M., Amin, S., Robinson, S., White, S.A., Burt, A.D., Oakley, F., Tsukamoto, H., Mann, D.A. and Mann, J. (2012) *Histone methyltransferase ASH1 orchestrates fibrogenic gene transcription during myofibroblast tansdifferentiation* Hepatology, **56**, 1129-1139 (H) (M)
Smart, D.E., Vincent, K.J., Arthur, M.J.P., Eickelberg, O., Castellazzi, M., Mann, J. and Mann, D.A. (2001) *JunD regulates transcription of the tissue inhibitor of metalloproteinases-1 and interleukin-6 genes in activated hepatic stellate cells* J. Biol. Chem., **276**, 24414-24421 (R)
Trim, J.E., Samra, S.K., Arthur, M.J.P., Wright, M.C., McAulay, M., Beri, R. and Mann, D.A. (2000) *Upstream tissue inhibitor of metalloproteinases-1 (TIMP-1) element-1, a novel and essential regulatory DNA motif in the human TIMP-1 gene promoter, directly interacts with a 30-kDa nuclear protein* J. Biol. Chem., **275**, 6657-6663 (R)

Methylation

Mann, J., Oakley, F., Akiboye, F., Elsharkawy, A., Thorne, A.W. and Mann, D.A. (2007) *Regulation of myofibroblast transdifferentiation by DNA methylation and MeCP2: Implications for wound healing and fibrogenesis* Cell Death Different., **14**, 275-285 (R)
Mann, J., Chu, D.C.K., Maxwell, A., Oakley, F., Zhu, N.L., Tsukamoto, H. and Mann, D.A. (2010) *MeCP2 controls an epigenetic pathway that promotes myofibroblast transdifferentiation and fibrosis* Gastroenterology, **138**, 705–714 (R)
Perugorria, M.J., Wilson, C.L., Zeybel, M., Walsh, M., Amin, S., Robinson, S., White, S.A., Burt, A.D., Oakley, F., Tsukamoto, H., Mann, D.A. and Mann, J. (2012) *Histone methyltransferase ASH1 orchestrates fibrogenic gene transcription during myofibroblast tansdifferentiation* Hepatology, **56**, 1129-1139 (H) (M)

Zheng, J., Wu, c., Lin, Z., Guo, Y., Shi, L., Dong, P., Lu, Z., Gao, S., Liao, Y., Chen, B. and Yu, F. (2014) *Curcumin up-regulates phosphatase and tensin homologue deleted on chromosome 10 through microRNA-mediated control of DNA methylation – a novel mechanism suppressing liver fibrosis* FEBS J., **281**, 88–103 (R)

NF-κB

Elsharkawy, A.M., Wright, M.C., Hay, R.T., Arthur, M.J.P., Hughes, T., Bahr, M.J., Degitz, K. and Mann, D.A. (1999) *Persistent activation of nuclear factor - κB in cultured rat hepatic stellate cells involves the induction of potentially novel Rel-like factors and prolonged changes in the expression of IκB family proteins* Hepatology, **30**, 761-769 (R)
Habens, F., Srinivasan, N., Oakley, F., Mann, D.A., Ganesan, A. and Packham, G. (2005) *Novel sulfasalazine analogues with enhanced NF-kB inhibitory and apoptosis promoting activity* Apoptosis, **10**, 481-491 (R)
Oakley F., Mann, J., Ruddell, R.G., Pickford, J., Weinmaster, G. and Mann, D.A. (2003) *Basal expression of IκBα is controlled by the mammalian transcriptional repressor RBP-J (CBF1) and its activator Notch1* J. Biol. Chem., **278**, 24359-24370 (R)

Transdifferentiation

Page, A., Paoli, P.P., Hill, S.J., Howarth, R., Wu, R., Kweon, S-M., French, J., White, S. et al (2015) *Alcohol directly stimulates epigenetic modifications in hepatic stellate cells* J. Hepatol., **62**, 388−397 (R)

Ubiquitin

Wilson, C.L., Murphy, L.B., Leslie, J., Kendrick, S., French, J., Fox, C.R., Sheerin, N.S., Fisher, A. Robinson, J.H., Tiniakos, D.G., Gray, D.A., Oakley, F. and Mann, D.A. (2015) *Ubiquitin C-terminal hydrolase 1: A novel functional marker for liver myofibroblasts and a therapeutic target in chronic liver disease* J. Hepatol., **63**, 1421–1428 (R)

Vagus nerve stimulation

Bockx, I., Vander Elst, I., Roskams, T. and Cassiman, D. (2010) *The hepatic vagus nerve stimulates hepatic stellate cell proliferation in rat acute hepatitis via muscarinic receptor type 2* Liver Int., **30**, 693-702 (R)
Bockx, I., Verdrengh, K., Vander Elst, I., van Pelt, J., Nevens, F., Laleman, W. and Cassiman, D. (2012) *High-frequency vagus nerve stimulation improves portal hypertension in cirrhotic rats* Gut, **61**, 604-612 (R)

Vitamin D

Beilfuss, A., Sowa, J-P., Sydor, S., Beste, M., Bechmann, L.P., Schlattjan, M., Syn, W-K., Wedemeyer, I. et al (2015) *Vitamin D counteracts fibrogenic TGF-β signaling in human hepatic stellate cells both receptor-dependently and independently* Gut, **64**, 791–799 (H)

Wnt system

Corbett, L., Mann, J. and Mann, D.A. (2015) *Non-canonical Wnt predominates in activated rat hepatic stellate cells, influencing HSC survival and paracrine stimulation of Kupffer cells* PLoS One, **10**: e0142794 (M)
He, L., Gubbins, J., Peng, Z., Medina, V., Fei, F., Asahina, K., Wang, J., Kahn, M., Rountree, C.B. and Stiles, B.L. (2016) *Activation of hepatic stellate cell in Pten null liver injury model* Fibrogenesis Tissue Repair **9**: 8 (R)

Mini-Review MC09: 2nd edition, November 2016

Alere Technologies AS

Axis-Shield Density Gradient Media
is a brand of Alere Technologies AS