

6 Literatur

- Ahmad, K. F., Engel, C. K. & Prive, G. G. Crystal structure of the BTB domain from PLZF. *Proc Natl Acad Sci U S A.* **95**, 12123-12128. (1998).
- Ahrens, P. B. & Ankel, H. The role of asparagine-linked carbohydrate in natural killer cell-mediated cytolysis. *J Biol Chem.* **262**, 7575-7579. (1987).
- Angata, T. & Varki, A. Cloning, characterization, and phylogenetic analysis of siglec-9, a new member of the CD33-related group of siglecs. Evidence for co-evolution with sialic acid synthesis pathways. *J Biol Chem.* **275**, 22127-22135. (2000).
- Angata, T. & Varki, A. Siglec-7: a sialic acid-binding lectin of the immunoglobulin superfamily. *Glycobiology.* **10**, 431-438. (2000).
- Angata, T., Hingorani, R., Varki, N. M. & Varki, A. Cloning and characterization of a novel mouse Siglec, mSiglec-F: differential evolution of the mouse and human (CD33) Siglec-3-related gene clusters. *J Biol Chem.* **276**, 45128-45136. Epub 42001 Sep 45128. (2001).
- Angata, T. & Varki, A. Chemical diversity in the sialic acids and related alpha-keto acids: an evolutionary perspective. *Chem Rev.* **102**, 439-469. (2002).
- Anisimov, S. V., Tarasov, K. V., Riordon, D., Wobus, A. M. & Boheler, K. R. SAGE identification of differentiation responsive genes in P19 embryonic cells induced to form cardiomyocytes in vitro. *Mech Dev.* **117**, 25-74. (2002).
- Ashwell, G. & Harford, J. Carbohydrate-specific receptors of the liver. *Annu Rev Biochem.* **51**, 531-554. (1982).
- Askanas, V. et al. Light and electron microscopic immunolocalization of presenilin 1 in abnormal muscle fibers of patients with sporadic inclusion-body myositis and autosomal-recessive inclusion-body myopathy. *Am J Pathol.* **152**, 889-895. (1998).
- Barna, M., Hawe, N., Niswander, L. & Pandolfi, P. P. Plzf regulates limb and axial skeletal patterning. *Nat Genet.* **25**, 166-172. (2000).
- Barna, M. et al. Plzf mediates transcriptional repression of HoxD gene expression through chromatin remodeling. *Dev Cell.* **3**, 499-510. (2002).
- Berg, E. L., Robinson, M. K., Mansson, O., Butcher, E. C. & Magnani, J. L. A carbohydrate domain common to both sialyl Le(a) and sialyl Le(X) is recognized by the endothelial cell leukocyte adhesion molecule ELAM-1. *J Biol Chem.* **266**, 14869-14872. (1991).
- Bevilacqua, M. et al. Selectins: a family of adhesion receptors. *Cell.* **67**, 233. (1991).
- Bevilacqua, M. P. & Nelson, R. M. Selectins. *J Clin Invest.* **91**, 379-387. (1993).

- Bhaskar, K. R. *et al.* Viscous fingering of HCl through gastric mucin. *Nature*. **360**, 458-461. (1992).
- Bhavanandan, V. P. Cancer-associated mucins and mucin-type glycoproteins. *Glycobiology*. **1**, 493-503. (1991).
- Bird, J. M. & Kimber, S. J. Oligosaccharides containing fucose linked alpha(1-3) and alpha(1-4) to N-acetylglucosamine cause decompaction of mouse morulae. *Dev Biol*. **104**, 449-460. (1984).
- Birnboim, H. C. & Doly, J. A rapid alkaline extraction procedure for screening recombinant plasmid DNA. *Nucleic Acids Res*. **7**, 1513-1523. (1979).
- Bitter-Suermann, D. & Roth, J. Monoclonal antibodies to polysialic acid reveal epitope sharing between invasive pathogenic bacteria, differentiating cells and tumor cells. *Immunol Res*. **6**, 225-237. (1987).
- Blume, A. *et al.* Domain-specific characteristics of the bifunctional key enzyme of sialic acid biosynthesis, UDP-N-acetylglucosamine 2-epimerase/N-acetylmannosamine kinase. *Biochem J*. **384**, 599-607. (2004).
- Bouvier, J. D. & Seyfried, T. N. Ganglioside composition of normal and mutant mouse embryos. *J Neurochem*. **52**, 460-466. (1989).
- Bradford, M. M. A rapid and sensitive method for the quantitation of microgram quantities of protein utilizing the principle of protein-dye binding. *Anal Biochem*. **72**, 248-254. (1976).
- Bremer, E. G., Schlessinger, J. & Hakomori, S. Ganglioside-mediated modulation of cell growth. Specific effects of GM3 on tyrosine phosphorylation of the epidermal growth factor receptor. *J Biol Chem*. **261**, 2434-2440. (1986).
- Bresalier, R. S., Rockwell, R. W., Dahiya, R., Duh, Q. Y. & Kim, Y. S. Cell surface sialoprotein alterations in metastatic murine colon cancer cell lines selected in an animal model for colon cancer metastasis. *Cancer Res*. **50**, 1299-1307. (1990).
- Bretin, S. *et al.* Differential expression of CRMP1, CRMP2A, CRMP2B, and CRMP5 in axons or dendrites of distinct neurons in the mouse brain. *J Comp Neurol*. **486**, 1-17. (2005).
- Bridges, K., Harford, J., Ashwell, G. & Klausner, R. D. Fate of receptor and ligand during endocytosis of asialoglycoproteins by isolated hepatocytes. *Proc Natl Acad Sci U S A*. **79**, 350-354. (1982).
- Brooks, J. E. Properties and uses of restriction endonucleases. *Methods Enzymol*. **152**, 113-129. (1987).
- Brooks, C. L., Li, M. & Gu, W. Monoubiquitination: the signal for p53 nuclear export? *Cell Cycle*. **3**, 436-438. Epub 2004 Apr 2001. (2004).

- Bruses, J. L. & Rutishauser, U. Roles, regulation, and mechanism of polysialic acid function during neural development. *Biochimie*. **83**, 635-643. (2001).
- Buaas, F. W. *et al.* Plzf is required in adult male germ cells for stem cell self-renewal. *Nat Genet*. **36**, 647-652. Epub 2004 May 2023. (2004).
- Burdon, T., Chambers, I., Stracey, C., Niwa, H. & Smith, A. Signaling mechanisms regulating self-renewal and differentiation of pluripotent embryonic stem cells. *Cells Tissues Organs*. **165**, 131-143. (1999).
- Burnette, W. N. "Western blotting": electrophoretic transfer of proteins from sodium dodecyl sulfate--polyacrylamide gels to unmodified nitrocellulose and radiographic detection with antibody and radioiodinated protein A. *Anal Biochem*. **112**, 195-203. (1981).
- Buttner, B. *et al.* Biochemical engineering of cell surface sialic acids stimulates axonal growth. *J Neurosci*. **22**, 8869-8875. (2002).
- Campbell, R. E., Mosimann, S. C., Tanner, M. E. & Strynadka, N. C. The structure of UDP-N-acetylglucosamine 2-epimerase reveals homology to phosphoglycosyl transferases. *Biochemistry*. **39**, 14993-15001. (2000).
- Carter, R. S., Pennington, K. N., Arrate, P., Oltz, E. M. & Ballard, D. W. Site-specific monoubiquitination of IkappaB kinase IKKbeta regulates its phosphorylation and persistent activation. *J Biol Chem*. **280**, 43272-43279. Epub 42005 Nov 43271. (2005).
- Chen, Z. *et al.* Fusion between a novel Kruppel-like zinc finger gene and the retinoic acid receptor-alpha locus due to a variant t(11;17) translocation associated with acute promyelocytic leukaemia. *Embo J*. **12**, 1161-1167. (1993).
- Chigorno, V., Tettamanti, G. & Sonnino, S. Metabolic processing of gangliosides by normal and Salla human fibroblasts in culture. A study performed by administering radioactive GM3 ganglioside. *J Biol Chem*. **271**, 21738-21744. (1996).
- Close, B. E. *et al.* The polysialyltransferase ST8Sia II/STX: posttranslational processing and role of autopolsialylation in the polysialylation of neural cell adhesion molecule. *Glycobiology*. **11**, 997-1008. (2001).
- Colli, W. Trans-sialidase: a unique enzyme activity discovered in the protozoan Trypanosoma cruzi. *Faseb J*. **7**, 1257-1264. (1993).
- Collins, S. J., Gallo, R. C. & Gallagher, R. E. Continuous growth and differentiation of human myeloid leukaemic cells in suspension culture. *Nature*. **270**, 347-349. (1977).
- Collins, S. J., Ruscetti, F. W., Gallagher, R. E. & Gallo, R. C. Terminal differentiation of human promyelocytic leukemia cells induced by dimethyl sulfoxide and other polar compounds. *Proc Natl Acad Sci U S A*. **75**, 2458-2462. (1978).

- Collins, S. J., Ruscetti, F. W., Gallagher, R. E. & Gallo, R. C. Normal functional characteristics of cultured human promyelocytic leukemia cells (HL-60) after induction of differentiation by dimethylsulfoxide. *J Exp Med.* **149**, 969-974. (1979).
- Comb, D. G. & Roseman, S. Enzymic synthesis of N-acetyl-D-mannosamine. *Biochim Biophys Acta.* **29**, 653-654. (1958).
- Cook, M. et al. Expression of the zinc-finger gene PLZF at rhombomere boundaries in the vertebrate hindbrain. *Proc Natl Acad Sci U S A.* **92**, 2249-2253. (1995).
- Crocker, P. R., Hartnell, A., Munday, J. & Nath, D. The potential role of sialoadhesin as a macrophage recognition molecule in health and disease. *Glycoconj J.* **14**, 601-609. (1997).
- Crocker, P. R. et al. Siglecs: a family of sialic-acid binding lectins. *Glycobiology.* **8**, v. (1998).
- Crocker, P. R., Vinson, M., Kelm, S. & Drickamer, K. Molecular analysis of sialoside binding to sialoadhesin by NMR and site-directed mutagenesis. *Biochem J.* **341**, 355-361. (1999).
- Crocker, P. R. & Varki, A. Siglecs in the immune system. *Immunology.* **103**, 137-145. (2001).
- Crocker, P. R. Siglecs: sialic-acid-binding immunoglobulin-like lectins in cell-cell interactions and signalling. *Curr Opin Struct Biol.* **12**, 609-615. (2002).
- Dennis, J. W. & Laferte, S. Recognition of asparagine-linked oligosaccharides on murine tumor cells by natural killer cells. *Cancer Res.* **45**, 6034-6040. (1985).
- Deo, R. C. et al. Structural bases for CRMP function in plexin-dependent semaphorin3A signaling. *Embo J.* **23**, 9-22. Epub 2003 Dec 2018. (2004).
- Eckhardt, M. et al. Mice deficient in the polysialyltransferase ST8SiaIV/PST-1 allow discrimination of the roles of neural cell adhesion molecule protein and polysialic acid in neural development and synaptic plasticity. *J Neurosci.* **20**, 5234-5244. (2000).
- Effertz, K., Hinderlich, S. & Reutter, W. Selective loss of either the epimerase or kinase activity of UDP-N-acetylglucosamine 2-epimerase/N-acetylmannosamine kinase due to site-directed mutagenesis based on sequence alignments. *J Biol Chem.* **274**, 28771-28778. (1999).
- Eggens, I. et al. Specific interaction between Lex and Lex determinants. A possible basis for cell recognition in preimplantation embryos and in embryonal carcinoma cells. *J Biol Chem.* **264**, 9476-9484. (1989).
- Eisenberg, I. et al. The UDP-N-acetylglucosamine 2-epimerase/N-acetylmannosamine kinase gene is mutated in recessive hereditary inclusion body myopathy. *Nat Genet.* **29**, 83-87. (2001).

- Emig, S., Schmalz, D., Shakibaei, M. & Buchner, K. The nuclear pore complex protein p62 is one of several sialic acid-containing proteins of the nuclear envelope. *J Biol Chem.* **270**, 13787-13793. (1995).
- Enns, G. M. *et al.* Clinical course and biochemistry of sialuria. *J Inherit Metab Dis.* **24**, 328-336. (2001).
- Evans, M. J. & Kaufman, M. H. Establishment in culture of pluripotential cells from mouse embryos. *Nature.* **292**, 154-156. (1981).
- Fenderson, B. A., Hahnel, A. C. & Eddy, E. M. Immunohistochemical localization of two monoclonal antibody-defined carbohydrate antigens during early murine embryogenesis. *Dev Biol.* **100**, 318-327. (1983).
- Fenderson, B. A., Holmes, E. H., Fukushi, Y. & Hakomori, S. Coordinate expression of X and Y haptens during murine embryogenesis. *Dev Biol.* **114**, 12-21. (1986).
- Fenderson, B. A., Eddy, E. M. & Hakomori, S. Glycoconjugate expression during embryogenesis and its biological significance. *Bioessays.* **12**, 173-179. (1990).
- Fenderson, B. A. & Andrews, P. W. Carbohydrate antigens of embryonal carcinoma cells: changes upon differentiation. *APMIS Suppl.* **27**, 109-118. (1992).
- Ferreira, H. *et al.* Sialuria in a Portuguese girl: clinical, biochemical, and molecular characteristics. *Mol Genet Metab.* **67**, 131-137. (1999).
- Ferwerda, W., Blok, C. M. & Heijlman, J. Turnover of free sialic acid, CMP-sialic acid, and bound sialic acid in rat brain. *J Neurochem.* **36**, 1492-1499. (1981).
- Fogel, M., Altevogt, P. & Schirrmacher, V. Metastatic potential severely altered by changes in tumor cell adhesiveness and cell-surface sialylation. *J Exp Med.* **157**, 371-376. (1983).
- Fukuda, M.N., Sasaki, H., Lopez, L., Fukuda M. Survival of recombinant erythropoietin in the circulation: the role of carbohydrates. *Blood.* **73**, 84-89. (1989)
- Fukada, M. *et al.* Molecular characterization of CRMP5, a novel member of the collapsin response mediator protein family. *J Biol Chem.* **275**, 37957-37965. (2000).
- Furukawa, M., He, Y. J., Borchers, C. & Xiong, Y. Targeting of protein ubiquitination by BTB-Cullin 3-Roc1 ubiquitin ligases. *Nat Cell Biol.* **5**, 1001-1007. Epub 2003 Oct 1005. (2003).
- Geyer, R., Wee, S., Anderson, S., Yates, J. & Wolf, D. A. BTB/POZ domain proteins are putative substrate adaptors for cullin 3 ubiquitin ligases. *Mol Cell.* **12**, 783-790. (2003).
- Ginsburg, M., Snow, M. H. & McLaren, A. Primordial germ cells in the mouse embryo during gastrulation. *Development.* **110**, 521-528. (1990).

- Giordanengo, V. *et al.* Epigenetic reprogramming of UDP-N-acetylglucosamine 2-epimerase/N-acetylmannosamine kinase (GNE) in HIV-1-infected CEM T cells. *Faseb J.* **18**, 1961-1963. Epub 2004 Oct 1966. (2004).
- Goldwasser, E., Kung, C.K-H., Eliason, J., On the mechanism of erythropoietin-induced Differentiation. *J Biol. Chem.* **249**, 420 2-4206. (1973).
- Gonzalez, F., Delahodde, A., Kodadek, T. & Johnston, S. A. Recruitment of a 19S proteasome subcomplex to an activated promoter. *Science.* **296**, 548-550. (2002).
- Goshima, Y., Nakamura, F., Strittmatter, P. & Strittmatter, S. M. Collapsin-induced growth cone collapse mediated by an intracellular protein related to UNC-33. *Nature.* **376**, 509-514. (1995).
- Greene, L. A. & Tischler, A. S. Establishment of a Noradrenergic Clonal Line of Rat Adrenal Pheochromocytoma Cells which Respond to Nerve Growth Factor 10.1073/pnas.73.7.2424. *PNAS* **73**, 2424-2428 (1976).
- Hahnel, A. C. *et al.* Two alkaline phosphatase genes are expressed during early development in the mouse embryo. *Development.* **110**, 555-564. (1990).
- Hakomori, S. Biochemical basis and clinical application of tumor-associated carbohydrate antigens: current trends and future perspectives. *Gan To Kagaku Ryoho.* **16**, 715-731. (1989).
- Hakomori, S. Aberrant glycosylation in tumors and tumor-associated carbohydrate antigens. *Adv Cancer Res.* **52**, 257-331. (1989).
- Hamajima, N. *et al.* A novel gene family defined by human dihydropyrimidinase and three related proteins with differential tissue distribution. *Gene.* **180**, 157-163. (1996).
- Hanai, N., Dohi, T., Nores, G. A. & Hakomori, S. A novel ganglioside, de-N-acetyl-GM3 (II3NeuNH2LacCer), acting as a strong promoter for epidermal growth factor receptor kinase and as a stimulator for cell growth. *J Biol Chem.* **263**, 6296-6301. (1988).
- Hartnell, A. *et al.* Characterization of human sialoadhesin, a sialic acid binding receptor expressed by resident and inflammatory macrophage populations. *Blood.* **97**, 288-296. (2001).
- Herrler, G. *et al.* The receptor-destroying enzyme of influenza C virus is neuraminate-O-acetylesterase. *Embo J.* **4**, 1503-1506. (1985).
- Hershko, A. & Ciechanover, A. The ubiquitin system. *Annu Rev Biochem.* **67**, 425-479. (1998).
- Hinderlich, S., Stasche, R., Zeitler, R. & Reutter, W. A bifunctional enzyme catalyzes the first two steps in N-acetylneuraminic acid biosynthesis of rat liver. Purification and characterization of UDP-N-acetylglucosamine 2-epimerase/N-acetylmannosamine kinase. *J Biol Chem.* **272**, 24313-24318. (1997).

- Hinderlich, S. *et al.* The homozygous M712T mutation of UDP-N-acetylglucosamine 2-epimerase/N-acetylmannosamine kinase results in reduced enzyme activities but not in altered overall cellular sialylation in hereditary inclusion body myopathy. *FEBS Lett.* **566**, 105-109. (2004).
- Hirmo, S., Kelm, S., Schauer, R., Nilsson, B. & Wadstrom, T. Adhesion of Helicobacter pylori strains to alpha-2,3-linked sialic acids. *Glycoconj J.* **13**, 1005-1011. (1996).
- Hirmo, S. *et al.* Inhibition of Helicobacter pylori sialic acid-specific haemagglutination by human gastrointestinal mucins and milk glycoproteins. *FEMS Immunol Med Microbiol.* **20**, 275-281. (1998).
- Honorat, J. *et al.* Ulip/CRMP proteins are recognized by autoantibodies in paraneoplastic neurological syndromes. *Eur J Neurosci.* **11**, 4226-4232. (1999).
- Horstkorte, R. *et al.* Tissue expression and amino acid sequence of murine UDP-N-acetylglucosamine-2-epimerase/N-acetylmannosamine kinase. *Eur J Biochem.* **260**, 923-927. (1999).
- Horstkorte, R. *et al.* Protein kinase C phosphorylates and regulates UDP-N-acetylglucosamine-2-epimerase/N-acetylmannosamine kinase. *FEBS Lett.* **470**, 315-318. (2000).
- Huizing, M. *et al.* Hypoglycosylation of alpha-dystroglycan in patients with hereditary IBM due to GNE mutations. *Mol Genet Metab.* **81**, 196-202. (2004).
- Hyman, J., Chen, H., Di Fiore, P. P., De Camilli, P. & Brunger, A. T. Epsin 1 undergoes nucleocytosolic shuttling and its eps15 interactor NH(2)-terminal homology (ENTH) domain, structurally similar to Armadillo and HEAT repeats, interacts with the transcription factor promyelocytic leukemia Zn(2)+ finger protein (PLZF). *J Cell Biol.* **149**, 537-546. (2000).
- Ikeuchi, T. & Tsuji, S. [Distal myopathy with rimmed vacuoles(DMRV)]. *Nippon Rinsho.* **55**, 3195-3199. (1997).
- Inagaki, H. *et al.* Differential expression of dihydropyrimidinase-related protein genes in developing and adult enteric nervous system. *Histochem Cell Biol.* **113**, 37-41. (2000).
- Ivatt, R. J. Transient expression of sialylated glycans during glycoprotein processing by embryonal carcinomas. *Biochem Biophys Res Commun.* **142**, 489-495. (1987).
- Izquierdo, L., Lopez, T. & Marticorena, P. Cell membrane regions in preimplantation mouse embryos. *J Embryol Exp Morphol.* **59**, 89-102. (1980).
- Ji, M. Y. *et al.* Developmental patterns of GalBeta1,3(4)GlcNAc alpha2,3-sialyltransferase (ST3Gal III) expression in the mouse: in situ hybridization using DIG-labeled RNA probes. *Arch Pharm Res.* **22**, 243-248. (1999).

- Ji, M. Y. *et al.* Developmental patterns of mST3GalV mRNA expression in the mouse: *in situ* hybridization using DIG-labeled RNA probes. *Arch Pharm Res.* **23**, 525-530. (2000).
- Johnson, L. V., Calarco, P. G. & Siebert, M. L. Alkaline phosphatase activity in the preimplantation mouse embryo. *J Embryol Exp Morphol.* **40**, 83-89. (1977).
- Jourdian, G. W., Dean, L. & Roseman, S. The sialic acids. XI. A periodate-resorcinol method for the quantitative estimation of free sialic acids and their glycosides. *J Biol Chem.* **246**, 430-435. (1971).
- Ju, E. J. *et al.* Pathophysiological implication of ganglioside GM3 in early mouse embryonic development through apoptosis. *Arch Pharm Res.* **28**, 1057-1064. (2005).
- Kageshita, T. *et al.* Association between sialyl Lewis(a) expression and tumor progression in melanoma. *Cancer Res.* **55**, 1748-1751. (1995).
- Katsumata, T., Noguchi, S., Yonezawa, N., Tanokura, M. & Nakano, M. Structural characterization of the N-linked carbohydrate chains of the zona pellucida glycoproteins from bovine ovarian and fertilized eggs. *Eur J Biochem.* **240**, 448-453. (1996).
- Kawai, H., Sango, K., Mullin, K. A. & Proia, R. L. Embryonic stem cells with a disrupted GD3 synthase gene undergo neuronal differentiation in the absence of b-series gangliosides. *J Biol Chem.* **273**, 19634-19638. (1998).
- Kean, E. L. Nuclear cytidine 5'-monophosphosialic acid synthetase. *J Biol Chem.* **245**, 2301-2308. (1970).
- Kelm, S. *et al.* Sialoadhesin, myelin-associated glycoprotein and CD22 define a new family of sialic acid-dependent adhesion molecules of the immunoglobulin superfamily. *Curr Biol.* **4**, 965-972. (1994).
- Kelm, S. & Schauer, R. Sialic acids in molecular and cellular interactions. *Int Rev Cytol.* **175**, 137-240. (1997).
- Keppler, O. T. *et al.* Elongation of the N-acyl side chain of sialic acids in MDCK II cells inhibits influenza A virus infection. *Biochem Biophys Res Commun.* **253**, 437-442. (1998).
- Keppler, O. T. *et al.* UDP-GlcNAc 2-epimerase: a regulator of cell surface sialylation. *Science.* **284**, 1372-1376. (1999).
- Kikuchi, K. & Tsuiki, S. Purification and properties of UDP-N-acetylglucosamine 2'-epimerase from rat liver. *Biochim Biophys Acta.* **327**, 193-206. (1973).
- Kircheis, R. *et al.* Early embryonic cells activate the alternative complement system. *In Vivo.* **9**, 85-98. (1995).

- Kircheis, R. *et al.* Selective lysis of early embryonic cells by the alternative pathway of complement--a possible mechanism for programmed cell death in embryogenesis. *In Vivo*. **10**, 389-403. (1996).
- Knowles, B. B. *et al.* Expression of H-2, laminin and SV40T and TASA on differentiation of transformed murine teratocarcinoma cells. (1980).
- Kojima, N. *et al.* Further studies on cell adhesion based on Le(x)-Le(x) interaction, with new approaches: embryoglycan aggregation of F9 teratocarcinoma cells, and adhesion of various tumour cells based on Le(x) expression. *Glycoconj J*. **11**, 238-248. (1994).
- Kornfeld, S., Kornfeld, R., Neufeld, E. F. & O'Brien, P. J. The Feedback Control of Sugar Nucleotide Biosynthesis in Liver. *Proc Natl Acad Sci U S A*. **52**, 371-379. (1964).
- Krause, S. *et al.* Localization of UDP-GlcNAc 2-epimerase/ManAc kinase (GNE) in the Golgi complex and the nucleus of mammalian cells. *Exp Cell Res*. **304**, 365-379. Epub 2004 Dec 2019. (2005).
- Kudo, T. *et al.* Normal embryonic and germ cell development in mice lacking alpha 1,3-fucosyltransferase IX (Fut9) which show disappearance of stage-specific embryonic antigen 1. *Mol Cell Biol*. **24**, 4221-4228. (2004).
- Lackie, P. M., Zuber, C. & Roth, J. Polysialic acid of the neural cell adhesion molecule (N-CAM) is widely expressed during organogenesis in mesodermal and endodermal derivatives. *Differentiation*. **57**, 119-131. (1994).
- Laemmli, U. K. Cleavage of structural proteins during the assembly of the head of bacteriophage T4. *Nature*. **227**, 680-685. (1970).
- Lasky, L. A. Selectin-carbohydrate interactions and the initiation of the inflammatory response. *Annu Rev Biochem*. **64**, 113-139. (1995).
- Leung, T. *et al.* p80 ROKalpha binding protein is a novel splice variant of CRMP-1 which associates with CRMP-2 and modulates RhoA-induced neuronal morphology. *FEBS Lett*. **532**, 445-449. (2002).
- Litscher, E. S. & Wassarman, P. M. Characterization of mouse ZP3-derived glycopeptide, gp55, that exhibits sperm receptor and acrosome reaction-inducing activity in vitro. *Biochemistry*. **35**, 3980-3985. (1996).
- Little, C. C. & Cloudman, A. M. The Occurrence of a Dominant Spotting Mutation in the House Mouse. *Proc Natl Acad Sci U S A*. **23**, 535-537. (1937).
- Liu, C. *et al.* Targeted disruption of the mZP3 gene results in production of eggs lacking a zona pellucida and infertility in female mice. *Proc Natl Acad Sci U S A*. **93**, 5431-5436. (1996).

- Liu, C., Litscher, E. S. & Wassarman, P. M. Zona pellucida glycoprotein mZP3 bioactivity is not dependent on the extent of glycosylation of its polypeptide or on sulfation and sialylation of its oligosaccharides. *J Cell Sci.* **110**, 745-752. (1997).
- Livingston, B. D., Jacobs, J. L., Glick, M. C. & Troy, F. A. Extended polysialic acid chains (n greater than 55) in glycoproteins from human neuroblastoma cells. *J Biol Chem.* **263**, 9443-9448. (1988).
- Lucka, L., Krause, M., Danker, K., Reutter, W. & Horstkorte, R. Primary structure and expression analysis of human UDP-N-acetyl-glucosamine-2-epimerase/N-acetylmannosamine kinase, the bifunctional enzyme in neuraminic acid biosynthesis. *FEBS Lett.* **454**, 341-344. (1999).
- Luckow, V. A. Baculovirus systems for the expression of human gene products. *Curr Opin Biotechnol.* **4**, 564-572. (1993).
- MacGregor, G. R., Zambrowicz, B. P. & Soriano, P. Tissue non-specific alkaline phosphatase is expressed in both embryonic and extraembryonic lineages during mouse embryogenesis but is not required for migration of primordial germ cells. *Development.* **121**, 1487-1496. (1995).
- Marticorena, P., Hogan, B., DiMeo, A., Artzt, K. & Bennett, D. Carbohydrate changes in pre- and peri-implantation mouse embryos as detected by a monoclonal antibody. *Cell Differ.* **12**, 1-10. (1983).
- Martin, G. R. Isolation of a pluripotent cell line from early mouse embryos cultured in medium conditioned by teratocarcinoma stem cells. *Proc Natl Acad Sci U S A.* **78**, 7634-7638. (1981).
- Matsuda, T. et al. STAT3 activation is sufficient to maintain an undifferentiated state of mouse embryonic stem cells. *Embo J.* **18**, 4261-4269. (1999).
- Mendla, K., Baumkotter, J., Rosenau, C., Ulrich-Bott, B. & Cantz, M. Defective lysosomal release of glycoprotein-derived sialic acid in fibroblasts from patients with sialic acid storage disease. *Biochem J.* **250**, 261-267. (1988).
- Miyamoto, C. et al. Production of human c-myc protein in insect cells infected with a baculovirus expression vector. *Mol Cell Biol.* **5**, 2860-2865. (1985).
- Moolenaar, C. E. et al. Expression of neural cell adhesion molecule-related sialoglycoprotein in small cell lung cancer and neuroblastoma cell lines H69 and CHP-212. *Cancer Res.* **50**, 1102-1106. (1990).
- Muhlenhoff, M., Eckhardt, M. & Gerardy-Schahn, R. Polysialic acid: three-dimensional structure, biosynthesis and function. *Curr Opin Struct Biol.* **8**, 558-564. (1998).
- Mullis, K. et al. Specific enzymatic amplification of DNA in vitro: the polymerase chain reaction. *Cold Spring Harb Symp Quant Biol.* **51**, 263-273. (1986).

- Mulnard, J. & Huygens, R. Ultrastructural localization of non-specific alkaline phosphatase during cleavage and blastocyst formation in the mouse. *J Embryol Exp Morphol.* **44**, 121-131. (1978).
- Munster-Kuhnel, A. K. *et al.* Structure and function of vertebrate CMP-sialic acid synthetases. *Glycobiology.* **14**, 43R-51R. Epub 2004 Jun 2016. (2004).
- Nichols, J. *et al.* Formation of pluripotent stem cells in the mammalian embryo depends on the POU transcription factor Oct4. *Cell.* **95**, 379-391. (1998).
- Niwa, H., Burdon, T., Chambers, I. & Smith, A. Self-renewal of pluripotent embryonic stem cells is mediated via activation of STAT3. *Genes Dev.* **12**, 2048-2060. (1998).
- Niwa, H., Miyazaki, J. & Smith, A. G. Quantitative expression of Oct-3/4 defines differentiation, dedifferentiation or self-renewal of ES cells. *Nat Genet.* **24**, 372-376. (2000).
- Noguchi, S. & Nakano, M. Structure of the acidic N-linked carbohydrate chains of the 55-kDa glycoprotein family (PZP3) from porcine zona pellucida. *Eur J Biochem.* **209**, 883-894. (1992).
- Noguchi, S. *et al.* Reduction of UDP-N-acetylglucosamine 2-epimerase/N-acetylmannosamine kinase activity and sialylation in distal myopathy with rimmed vacuoles. *J Biol Chem.* **279**, 11402-11407. Epub 12004 Jan 11405. (2004).
- Nonaka, I., Sunohara, N., Ishiura, S. & Satoyoshi, E. Familial distal myopathy with rimmed vacuole and lamellar (myeloid) body formation. *J Neurol Sci.* **51**, 141-155. (1981).
- Oetke, C. *et al.* Evidence for efficient uptake and incorporation of sialic acid by eukaryotic cells. *Eur J Biochem.* **268**, 4553-4561. (2001).
- Oetke, C., Hinderlich, S., Reutter, W. & Pawlita, M. Epigenetically mediated loss of UDP-GlcNAc 2-epimerase/ManNAc kinase expression in hyposialylated cell lines. *Biochem Biophys Res Commun.* **308**, 892-898. (2003).
- Okamoto, K. *et al.* A novel octamer binding transcription factor is differentially expressed in mouse embryonic cells. *Cell.* **60**, 461-472. (1990).
- Ong, E. *et al.* Developmental regulation of polysialic acid synthesis in mouse directed by two polysialyltransferases, PST and STX. *Glycobiology.* **8**, 415-424. (1998).
- Osanai, T. *et al.* Expression of glycoconjugates bearing the Lewis X epitope during neural differentiation of P19 EC cells. *FEBS Lett.* **488**, 23-28. (2001).
- Parillo, F., Fagioli, O., Dall'Aglio, C. & Verini-Supplizi, A. Lectin histochemical detection of sulfoglycans in the zona pellucida of mammalian antral oocytes. *Acta Histochem.* **102**, 193-202. (2000).

- Pease, S. & Williams, R. L. Formation of germ-line chimeras from embryonic stem cells maintained with recombinant leukemia inhibitory factor. *Exp Cell Res.* **190**, 209-211. (1990).
- Phillips, M. L. *et al.* ELAM-1 mediates cell adhesion by recognition of a carbohydrate ligand, sialyl-Lex. *Science.* **250**, 1130-1132. (1990).
- Pincet, F. *et al.* Ultraweak sugar-sugar interactions for transient cell adhesion. *Biophys J.* **80**, 1354-1358. (2001).
- Pintard, L., Willems, A. & Peter, M. Cullin-based ubiquitin ligases: Cul3-BTB complexes join the family. *Embo J.* **23**, 1681-1687. Epub 2004 Apr 1688. (2004).
- Polley, M. J. *et al.* CD62 and endothelial cell-leukocyte adhesion molecule 1 (ELAM-1) recognize the same carbohydrate ligand, sialyl-Lewis x. *Proc Natl Acad Sci U S A.* **88**, 6224-6228. (1991).
- Prives, J. M. & Olden, K. Carbohydrate requirement for expression and stability of acetylcholine receptor on the surface of embryonic muscle cells in culture. *Proc Natl Acad Sci U S A.* **77**, 5263-5267. (1980).
- Rathjen, P. D., Toth, S., Willis, A., Heath, J. K. & Smith, A. G. Differentiation inhibiting activity is produced in matrix-associated and diffusible forms that are generated by alternate promoter usage. *Cell.* **62**, 1105-1114. (1990).
- Reid, A. *et al.* Leukemia translocation gene, PLZF, is expressed with a speckled nuclear pattern in early hematopoietic progenitors. *Blood.* **86**, 4544-4552. (1995).
- Rens-Domiano, S. & Reisine, T. Biochemical and functional properties of somatostatin receptors. *J Neurochem.* **58**, 1987-1996. (1992).
- Resnick, J. L., Bixler, L. S., Cheng, L. & Donovan, P. J. Long-term proliferation of mouse primordial germ cells in culture. *Nature.* **359**, 550-551. (1992).
- Richards, R. L., Moss, J., Alving, C. R., Fishman, P. H. & Brady, R. O. Choleragen (cholera toxin): a bacterial lectin. *Proc Natl Acad Sci U S A.* **76**, 1673-1676. (1979).
- Richardson, C. C. *et al.* Studies on the joining of DNA by polynucleotide ligase of phage T4. *Cold Spring Harb Symp Quant Biol.* **33**, 151-164. (1968).
- Rosner, M. H. *et al.* A POU-domain transcription factor in early stem cells and germ cells of the mammalian embryo. *Nature.* **345**, 686-692. (1990).
- Roth, J., Taatjes, D. J., Bitter-Suermann, D. & Finne, J. Polysialic acid units are spatially and temporally expressed in developing postnatal rat kidney. *Proc Natl Acad Sci U S A.* **84**, 1969-1973. (1987).
- Roth, J. *et al.* Reexpression of poly(sialic acid) units of the neural cell adhesion molecule in Wilms tumor. *Proc Natl Acad Sci U S A.* **85**, 2999-3003. (1988).

- Ryan, A. K. & Rosenfeld, M. G. POU domain family values: flexibility, partnerships, and developmental codes. *Genes Dev.* **11**, 1207-1225. (1997).
- Saiki, R. K., Bugawan, T. L., Horn, G. T., Mullis, K. B. & Erlich, H. A. Analysis of enzymatically amplified beta-globin and HLA-DQ alpha DNA with allele-specific oligonucleotide probes. *Nature*. **324**, 163-166. (1986).
- Sambrook, J. F., E.D. and Maniatis, T (ed.) *Molecular Cloning: A Laboratory Manual* (T. Cold Spring Harbor: Cold Spring Harbor Laboratory Press, Plainview, NY,, 1989).
- Sanger, F. & Coulson, A. R. A rapid method for determining sequences in DNA by primed synthesis with DNA polymerase. *J Mol Biol.* **94**, 441-448. (1975).
- Sanger, F., Nicklen, S. & Coulson, A. R. DNA sequencing with chain-terminating inhibitors. *Proc Natl Acad Sci U S A*. **74**, 5463-5467. (1977).
- Sawada, T., Ho, J. J., Chung, Y. S., Sowa, M. & Kim, Y. S. E-selectin binding by pancreatic tumor cells is inhibited by cancer sera. *Int J Cancer*. **57**, 901-907. (1994).
- Schachner, M. & Bartsch, U. Multiple functions of the myelin-associated glycoprotein MAG (siglec-4a) in formation and maintenance of myelin. *Glia*. **29**, 154-165. (2000).
- Schauer, R. Chemistry, metabolism, and biological functions of sialic acids. *Adv Carbohydr Chem Biochem*. **40**, 131-234. (1982).
- Schauer, R. Sialic acids as antigenic determinants of complex carbohydrates. *Adv Exp Med Biol.* **228**, 47-72. (1988).
- Schauer, R. Achievements and challenges of sialic acid research. *Glycoconj J.* **17**, 485-499. (2000).
- Schenkman, S., Jiang, M. S., Hart, G. W. & Nussenzweig, V. A novel cell surface trans-sialidase of Trypanosoma cruzi generates a stage-specific epitope required for invasion of mammalian cells. *Cell*. **65**, 1117-1125. (1991).
- Scholer, H. R., Ruppert, S., Suzuki, N., Chowdhury, K. & Gruss, P. New type of POU domain in germ line-specific protein Oct-4. *Nature*. **344**, 435-439. (1990).
- Schwarzkopf, M. *et al.* Sialylation is essential for early development in mice. *Proc Natl Acad Sci U S A*. **99**, 5267-5270. Epub 2002 Apr 5262. (2002).
- Senbonmatsu, T. *et al.* A novel angiotensin II type 2 receptor signaling pathway: possible role in cardiac hypertrophy. *Embo J.* **22**, 6471-6482. (2003).
- Seppala, R., Lehto, V. P. & Gahl, W. A. Mutations in the human UDP-N-acetylglucosamine 2-epimerase gene define the disease sialuria and the allosteric site of the enzyme. *Am J Hum Genet.* **64**, 1563-1569. (1999).

- Seyfried, T. N. Ganglioside abnormalities associated with failed neural differentiation in a T-locus mutant mouse embryo. *Dev Biol.* **123**, 286-291. (1987).
- Shih, J. Y. *et al.* Collapsin response mediator protein-1 and the invasion and metastasis of cancer cells. *J Natl Cancer Inst.* **93**, 1392-1400. (2001).
- Shih, J. Y. *et al.* Collapsin response mediator protein-1: a novel invasion-suppressor gene. *Clin Exp Metastasis.* **20**, 69-76. (2003).
- Smith, H. O. & Wilcox, K. W. A restriction enzyme from *Hemophilus influenzae*. I. Purification and general properties. *J Mol Biol.* **51**, 379-391. (1970).
- Smith, G. E. *et al.* Modification and secretion of human interleukin 2 produced in insect cells by a baculovirus expression vector. *Proc Natl Acad Sci U S A.* **82**, 8404-8408. (1985).
- Solter, D. & Knowles, B. B. Monoclonal antibody defining a stage-specific mouse embryonic antigen (SSEA-1). *Proc Natl Acad Sci U S A.* **75**, 5565-5569. (1978).
- Sommar, K. M. & Ellis, D. B. Uridine diphosphate N-acetyl-D-glucosamine-2-epimerase from rat liver. II. Studies on the mechanism of action. *Biochim Biophys Acta.* **268**, 590-595. (1972).
- Sommar, K. M. & Ellis, D. B. Uridine diphosphate N-acetyl-D-glucosamine-2-epimerase from rat liver. I. Catalytic and regulatory properties. *Biochim Biophys Acta.* **268**, 581-589. (1972).
- Stasche, R. *et al.* A bifunctional enzyme catalyzes the first two steps in N-acetylneuraminate acid biosynthesis of rat liver. Molecular cloning and functional expression of UDP-N-acetyl-glucosamine 2-epimerase/N-acetylmannosamine kinase. *J Biol Chem.* **272**, 24319-24324. (1997).
- Stelzl, U. *et al.* A human protein-protein interaction network: a resource for annotating the proteome. *Cell.* **122**, 957-968. (2005).
- Takeda, A. Sialylation patterns of lymphocyte function-associated antigen 1 (LFA-1) differ between T and B lymphocytes. *Eur J Immunol.* **17**, 281-286. (1987).
- Tang, S. *et al.* Myelin-associated glycoprotein interacts with neurons via a sialic acid binding site at ARG118 and a distinct neurite inhibition site. *J Cell Biol.* **138**, 1355-1366. (1997).
- Tedder, T. F., Steeber, D. A., Chen, A. & Engel, P. The selectins: vascular adhesion molecules. *Faseb J.* **9**, 866-873. (1995).
- Tedder, T. F., Steeber, D. A. & Pizcueta, P. L-selectin-deficient mice have impaired leukocyte recruitment into inflammatory sites. *J Exp Med.* **181**, 2259-2264. (1995).

- Tedder, T. F., Tuscano, J., Sato, S. & Kehrl, J. H. CD22, a B lymphocyte-specific adhesion molecule that regulates antigen receptor signaling. *Annu Rev Immunol.* **15**, 481-504. (1997).
- Tomimitsu, H. *et al.* Distal myopathy with rimmed vacuoles (DMRV): new GNE mutations and splice variant. *Neurology.* **62**, 1607-1610. (2004).
- Tomlinson, S., Pontes de Carvalho, L. C., Vandekerckhove, F. & Nussenzweig, V. Role of sialic acid in the resistance of *Trypanosoma cruzi* trypomastigotes to complement. *J Immunol.* **153**, 3141-3147. (1994).
- Towbin, H., Staehelin, T. & Gordon, J. Electrophoretic transfer of proteins from polyacrylamide gels to nitrocellulose sheets: procedure and some applications. *Proc Natl Acad Sci U S A.* **76**, 4350-4354. (1979).
- Van Rinsum, J., Van Dijk, W., Hooghwinkel, G. J. & Ferwerda, W. Subcellular localization and tissue distribution of sialic acid precursor-forming enzymes. *Biochem J.* **210**, 21-28. (1983).
- Varki, A. Diversity in the sialic acids. *Glycobiology.* **2**, 25-40. (1992).
- Varki, A. & Angata, T. Siglecs--the major subfamily of I-type lectins. *Glycobiology.* **16**, 1R-27R. Epub 2005 Jul 2013. (2006).
- Vernay, M., De Weduwe, A. & Aubery, M. Age-related changes induced by tunicamycin in wheat germ agglutinin binding to chick embryo fibroblasts. *Mech Ageing Dev.* **21**, 385-393. (1983).
- Wang, F. F., Kung, C. K. & Goldwasser, E. Some chemical properties of human erythropoietin. *Endocrinology.* **116**, 2286-2292. (1985).
- Wang, L. H. & Strittmatter, S. M. A family of rat CRMP genes is differentially expressed in the nervous system. *J Neurosci.* **16**, 6197-6207. (1996).
- Wang, L. H. & Strittmatter, S. M. Brain CRMP forms heterotetramers similar to liver dihydropyrimidinase. *J Neurochem.* **69**, 2261-2269. (1997).
- Wang, Z., Sun, Z., Li, A. V. & Yarema, K. J. Roles for UDP-GlcNAc 2-epimerase/ManNAc 6-kinase outside of sialic acid biosynthesis: modulation of sialyltransferase and BiP expression, GM3 and GD3 biosynthesis, proliferation, and apoptosis, and ERK1/2 phosphorylation. *J Biol Chem.* **281**, 27016-27028. Epub 22006 Jul 27017. (2006).
- Watts, G. D., Thorne, M., Kovach, M. J., Pestronk, A. & Kimonis, V. E. Clinical and genetic heterogeneity in chromosome 9p associated hereditary inclusion body myopathy: exclusion of GNE and three other candidate genes. *Neuromuscul Disord.* **13**, 559-567. (2003).
- Weiss, B., Jacquemin-Sablon, A., Live, T. R., Fareed, G. C. & Richardson, C. C. Enzymatic breakage and joining of deoxyribonucleic acid. VI. Further purification

and properties of polynucleotide ligase from *Escherichia coli* infected with bacteriophage T4. *J Biol Chem.* **243**, 4543-4555. (1968).

Williams, R. L. *et al.* Myeloid leukaemia inhibitory factor maintains the developmental potential of embryonic stem cells. *Nature.* **336**, 684-687. (1988).

Wobus, A. M., Holzhausen, H., Jakel, P. & Schoneich, J. Characterization of a pluripotent stem cell line derived from a mouse embryo. *Exp Cell Res.* **152**, 212-219. (1984).

Xu, L. *et al.* BTB proteins are substrate-specific adaptors in an SCF-like modular ubiquitin ligase containing CUL-3. *Nature.* **425**, 316-321. Epub 2003 Sep 2003. (2003).

Yamamoto, M., Boyer, A. M. & Schwarting, G. A. Fucose-containing glycolipids are stage- and region-specific antigens in developing embryonic brain of rodents. *Proc Natl Acad Sci U S A.* **82**, 3045-3049. (1985).

Yamashita, T. *et al.* A vital role for glycosphingolipid synthesis during development and differentiation. *Proc Natl Acad Sci U S A.* **96**, 9142-9147. (1999).

Yeyati, P. L. *et al.* Leukemia translocation protein PLZF inhibits cell growth and expression of cyclin A. *Oncogene.* **18**, 925-934. (1999).

Zeitler, R. *et al.* Inhibition of N-acetylglucosamine kinase and N-acetylmannosamine kinase by 3-O-methyl-N-acetyl-D-glucosamine in vitro. *Eur J Biochem.* **204**, 1165-1168. (1992).

Zhang, T. *et al.* Genomic sequence, structural organization, molecular evolution, and aberrant rearrangement of promyelocytic leukemia zinc finger gene. *Proc Natl Acad Sci U S A.* **96**, 11422-11427. (1999).

Zimmer, G. *et al.* Modification of sialic acids by 9-O-acetylation is detected in human leucocytes using the lectin property of influenza C virus. *Glycobiology.* **4**, 343-349. (1994).

Zuber, C. & Roth, J. The relationship of polysialic acid and the neural cell adhesion molecule N-CAM in Wilms tumor and their subcellular distributions. *Eur J Cell Biol.* **51**, 313-321. (1990).