

8 Literatur

Aktorics, K. und Hall, A. (1989): Botulinum ADP-ribosyltransferase C3: a new tool to study low molecular weight GTP-binding proteins. *Trends Pharmacol Sci*, 10: 415-8.

Allard, J., Barrón, S., Diaz, J., Lubetzki, C., Zalc, B., Schwartz, J. C. und Sokoloff, P. (1998): A rat G protein-coupled receptor selectively expressed in myelin-forming cells. *Eur J Neurosci*, 10: 1045-53.

Allard, J., Barrón, S., Trottier, S., Cervera, P., Dumas-Duport, C., Leguern, E., Brice, A., Schwartz, J. C. und Sokoloff, P. (1999): Edg-2 in myelin-forming cells: isoforms, genomic mapping, and exclusion in Charcot-Marie-Tooth disease. *Glia*, 26: 176-85.

Amatruda, T. T. d., Steele, D. A., Slepak, V. Z. und Simon, M. I. (1991): G alpha 16, a G protein alpha subunit specifically expressed in hematopoietic cells. *Proc Natl Acad Sci U S A*, 88: 5587-91.

An, S., Bleu, T., Hallmark, O. G. und Goetzl, E. J. (1998a): Characterization of a novel subtype of human G protein-coupled receptor for lysophosphatidic acid. *J Biol Chem*, 273: 7906-10.

An, S., Bleu, T., Huang, W., Hallmark, O. G., Coughlin, S. R. und Goetzl, E. J. (1997b): Identification of cDNAs encoding two G protein-coupled receptors for lysosphingolipids. *FEBS Lett*, 417: 279-82.

An, S., Bleu, T. und Zheng, Y. (1999): Transduction of intracellular calcium signals through G protein-mediated activation of phospholipase C by recombinant sphingosine 1-phosphate receptors. *Mol Pharmacol*, 55: 787-94.

An, S., Dickens, M. A., Bleu, T., Hallmark, O. G. und Goetzl, E. J. (1997a): Molecular cloning of the human Edg2 protein and its identification as a functional cellular receptor for lysophosphatidic acid. *Biochem Biophys Res Commun*, 231: 619-22.

An, S., Goetzl, E. J. und Lee, H. (1998b): Signaling mechanisms and molecular characteristics of G protein-coupled receptors for lysophosphatidic acid and sphingosine 1-phosphate. *J Cell Biochem Suppl*, 31: 147-57.

Arshavsky, V. Y., Dumke, C. L., Zhu, Y., Artemyev, N. O., Skiba, N. P., Hamm, H. E. und Bownds, M. D. (1994): Regulation of transducin GTPase activity in bovine rod outer segments. *J Biol Chem*, 269: 19882-7.

Arvidsson, U., Riedl, M., Chakrabarti, S., Lee, J. H., Nakano, A. H., Dado, R. J., Loh, H. H., Law, P. Y., Wessendorf, M. W. und Elde, R. (1995): Distribution and targeting of a mu-opioid receptor (MOR1) in brain and spinal cord. *J Neurosci*, 15: 3328-41.

Balboa, M. A., Balsinde, J., Dillon, D. A., Carman, G. M. und Dennis, E. A. (1999): Proinflammatory macrophage-activating properties of the novel phospholipid diacylglycerol pyrophosphate. *J Biol Chem*, 274: 522-6.

Bandoh, K., Aoki, J., Hosono, H., Kobayashi, S., Kobayashi, T., Murakami-Murofushi, K., Tsujimoto, M., Arai, H. und Inoue, K. (1999): Molecular cloning and characterization of a novel human G-protein-coupled receptor, EDG7, for lysophosphatidic acid. *J Biol Chem*, 274: 27776-85.

Benkirane, M., Jin, D. Y., Chun, R. F., Koup, R. A. und Jeang, K. T. (1997): Mechanism of transdominant inhibition of CCR5-mediated HIV-1 infection by ccr5delta32. *J Biol Chem*, 272: 30603-6.

Berstein, G., Blank, J. L., Jhon, D. Y., Exton, J. H., Rhee, S. G. und Ross, E. M. (1992): Phospholipase C-beta 1 is a GTPase-activating protein for Gq/11, its physiologic regulator. *Cell*, 70:

411-8.

Bluml, K., Schnepf, W., Schroder, S., Beyermann, M., Macias, M., Oschkinat, H. und Lohse, M. J. (1997): A small region in phosphoinositide 3-kinase inhibits G-protein betagamma-subunit function. *Embo J*, 16: 4908-15.

Bond, R. A., Leff, P., Johnson, T. D., Milano, C. A., Rockman, H. A., McMinn, T. R., Apparsundaram, S., Hyek, M. F., Kenakin, T. P., Allen, L. F. und et al. (1995): Physiological effects of inverse agonists in transgenic mice with myocardial overexpression of the beta 2-adrenoceptor. *Nature*, 374: 272-6.

Buhl, A. M., Johnson, N. L., Dhanasekaran, N. und Johnson, G. L. (1995): G alpha 12 and G alpha 13 stimulate Rho-dependent stress fiber formation and focal adhesion assembly. *J Biol Chem*, 270: 24631-4.

Bullock, W. O., Fernandez, J. M. und Short, J. M. (1987): XL1-Blue: A high efficiency plasmid transforming recA Escherichia coli strain with beta-galactosidase selection. *Bio-Techniques*, 5: 376.

Bunemann, M. und Hosey, M. M. (1999): G-protein coupled receptor kinases as modulators of G-protein signalling. *J Physiol (Lond)*, 517: 5-23.

Burstein, E. S., Spalding, T. A. und Brann, M. R. (1998): The second intracellular loop of the m5 muscarinic receptor is the switch which enables G-protein coupling. *J Biol Chem*, 273: 24322-7.

Casey, P. J. (1995): Mechanisms of protein prenylation and role in G protein function. *Biochem Soc Trans*, 23: 161-6.

Chidiac, P., Hébert, T. E., Valiquette, M., Dennis, M. und Bouvier, M. (1994): Inverse agonist activity of beta-adrenergic antagonists. *Mol Pharmacol*, 45: 490-9.

Chun, J., Contos, J. J. und Munroe, D. (1999): A growing family of receptor genes for lysophosphatidic acid (LPA) and other lysophospholipids (LPs). *Cell Biochem Biophys*, 30: 213-42.

Clapham, D. E. (1994): Direct G protein activation of ion channels? *Annu Rev Neurosci*, 17: 441-64.

Clapham, D. E. (1995): Calcium signaling. *Cell*, 80: 259-68.

Conklin, B. R. und Bourne, H. R. (1993): Structural elements of G alpha subunits that interact with G beta gamma, receptors, and effectors. *Cell*, 73: 631-41.

Contos, J. J. und Chun, J. (2000): Genomic characterization of the lysophosphatidic acid receptor gene, lp(A2)/Edg4, and identification of a frameshift mutation in a previously characterized cDNA. *Genomics*, 64: 155-69.

Costa, T. und Herz, A. (1989): Antagonists with negative intrinsic activity at delta opioid receptors coupled to GTP-binding proteins. *Proc Natl Acad Sci U S A*, 86: 7321-5.

Daub, H., Wallasch, C., Lanckenau, A., Herrlich, A. und Ullrich, A. (1997): Signal characteristics of G protein-transactivated EGF receptor. *Embo J*, 16: 7032-44.

Daub, H., Weiss, F. U., Wallasch, C. und Ullrich, A. (1996): Role of transactivation of the EGF receptor in signalling by G-protein- coupled receptors. *Nature*, 379: 557-60.

Davies, A., Schertler, G. F., Gowen, B. E. und Saibil, H. R. (1996): Projection structure of an invertebrate rhodopsin. *J Struct Biol*, 117: 36-44.

Davignon, I., Barnard, M., Gavrilova, O., Sweet, K. und Wilkie, T. M. (1996): Gene structure of murine Gna11 and Gna15: tandemly duplicated Gq class G protein alpha subunit genes. *Genomics*, 31: 359-66.

De Vries, L., Zheng, B., Fischer, T., Elenko, E. und Farquhar, M. G. (2000): The regulator of G protein signaling family. *Annu Rev Pharmacol Toxicol*, 40: 235-71.

Dennis, E. A. (1997): The growing phospholipase A2 superfamily of signal transduction enzymes. *Trends Biochem Sci*, 22: 1-2.

Dhanasekaran, N., Prasad, M. V., Wadsworth, S. J., Dermott, J. M. und van Rossum, G. (1994): Protein kinase C-dependent and -independent activation of Na⁺/H⁺ exchanger by G alpha 12 class of G proteins. *J Biol Chem*, 269: 11802-6.

Dohlman, H. G., Thorner, J., Caron, M. G. und Lefkowitz, R. J. (1991): Model systems for the study of seven-transmembrane-segment receptors. *Annu Rev Biochem*, 60: 653-88.

Elbe, A., Schleisitz, S., Strunk, D. und Stingl, G. (1994): Fetal skin-derived MHC class I+,

MHC class II- dendritic cells stimulate MHC class I-restricted responses of unprimed CD8+ T cells. *J Immunol*, 153: 2878-89.

Emrich, T., Förster, R. und Lipp, M. (1993): Topological characterization of the lymphoid-specific seven transmembrane receptor BLR1 by epitope-tagging and high level expression. *Biochem Biophys Res Commun*, 197: 214-20.

Feinberg, A. P. und Vogelstein, B. (1983): A technique for radiolabeling DNA restriction endonuclease fragments to high specific activity. *Anal Biochem*, 132: 6-13.

Feng, Y. H., Noda, K., Saad, Y., Liu, X. P., Husain, A. und Karnik, S. S. (1995): The docking of Arg2 of angiotensin II with Asp281 of AT1 receptor is essential for full agonism. *J Biol Chem*, 270: 12846-50.

Ferguson, S. S. und Caron, M. G. (1998): G protein-coupled receptor adaptation mechanisms. *Semin Cell Dev Biol*, 9: 119-27.

Fischer, D. J., Liliom, K., Guo, Z., Nusser, N., Virag, T., Murakami-Murofushi, K., Kobayashi, S., Erickson, J. R., Sun, G., Miller, D. D. und Tigyi, G. (1998): Naturally occurring analogs of lysophosphatidic acid elicit different cellular responses through selective activation of multiple receptor subtypes. *Mol Pharmacol*, 54: 979-88.

Foord, S. M. und Marshall, F. H. (1999): RAMPs: accessory proteins for seven transmembrane domain receptors. *Trends Pharmacol Sci*, 20: 184-7.

Förster, R., Kremmer, E., Schubel, A., Breitfeld, D., Kleinschmidt, A., Nerl, C., Bernhardt, G. und Lipp, M. (1998): Intracellular and surface expression of the HIV-1 coreceptor CXCR4/fusin on various leukocyte subsets: rapid internalization and recycling upon activation. *J Immunol*, 160: 1522-31.

Förster, R., Mattis, A. E., Kremmer, E., Wolf, E., Brem, G. und Lipp, M. (1996): A putative chemokine receptor, BLR1, directs B cell migration to defined lymphoid organs and specific anatomic compartments of the spleen. *Cell*, 87: 1037-47.

Förster, R., Schubel, A., Breitfeld, D., Kremmer, E., Renner-Müller, I., Wolf, E. und Lipp, M. (1999): CCR7 coordinates the primary immune response by establishing functional microenvironments in secondary lymphoid organs. *Cell*, 99: 23-33.

Fourcade, O., Simon, M. F., Viode, C., Rugani, N., Leballe, F., Ragab, A., Fournie, B., Sarda, L. und Chap, H. (1995): Secretory phospholipase A2 generates the novel lipid mediator lysophosphatidic acid in membrane microvesicles shed from activated cells. *Cell*, 80: 919-27.

Fraser, N. J., Wise, A., Brown, J., McLatchie, L. M., Main, M. J. und Foord, S. M. (1999): The amino terminus of receptor activity modifying proteins is a critical determinant of glycosylation state and ligand binding of calcitonin receptor-like receptor. *Mol Pharmacol*, 55: 1054-9.

Frohman, M. A. (1994): On beyond classic RACE (rapid amplification of cDNA ends). *PCR Methods Appl*, 4: 40-58.

Fukushima, N., Kimura, Y. und Chun, J. (1998): A single receptor encoded by *vzg-1/lpA1/edg-2* couples to G proteins and mediates multiple cellular responses to lysophosphatidic acid. *Proc Natl Acad Sci U S A*, 95: 6151-6.

Gantz, I., DelValle, J., Wang, L. D., Tashiro, T., Munzert, G., Guo, Y. J., Konda, Y. und Yamada, T. (1992): Molecular basis for the interaction of histamine with the histamine H2 receptor. *J Biol Chem*, 267: 20840-3.

Garcia-Higuera, I., Gaitatzes, C., Smith, T. F. und Neer, E. J. (1998): Folding a WD repeat propeller. Role of highly conserved aspartic acid residues in the G protein beta subunit and Sec13. *J Biol Chem*, 273: 9041-9.

Gether, U. (2000): Uncovering molecular mechanisms involved in activation of G protein-coupled receptors. *Endocr Rev*, 21: 90-113.

Glickman, M., Malek, R. L., Kwitek-Black, A. E., Jacob, H. J. und Lee, N. H. (1999): Molecular cloning, tissue-specific expression, and chromosomal localization of a novel nerve growth factor-regulated G-protein-coupled receptor, *nrg-1*. *Mol Cell Neurosci*, 14: 141-52.

Goetzl, E. J. und An, S. (1998): Diversity of cellular receptors and functions for the lysophospholipid growth factors lysophosphatidic acid and sphingosine 1-phosphate. *Faseb J*, 12: 1589-98.

Goetzl, E. J., Dolezalova, H., Kong, Y., Hu, Y. L., Jaffe, R. B., Kalli, K. R. und Conover, C. A. (1999a): Distinctive expression and functions of the type 4 endothelial differentiation gene-encoded

- G protein-coupled receptor for lysophosphatidic acid in ovarian cancer. *Cancer Res*, 59: 5370-5.
- Goetzl, E. J., Kong, Y. und Mei, B.** (1999b): Lysophosphatidic acid and sphingosine 1-phosphate protection of T cells from apoptosis in association with suppression of Bax. *J Immunol*, 162: 2049-56.
- Goetzl, E. J., Kong, Y. und Voice, J. K.** (2000a): Cutting edge: differential constitutive expression of functional receptors for lysophosphatidic acid by human blood lymphocytes. *J Immunol*, 164: 4996-9.
- Goetzl, E. J., Lee, H., Azuma, T., Stossel, T. P., Turck, C. W. und Karliner, J. S.** (2000b): Gelsolin binding and cellular presentation of lysophosphatidic acid. *J Biol Chem*, 275: 14573-8.
- Gohla, A., Harhammer, R. und Schultz, G.** (1998): The G-protein G13 but not G12 mediates signaling from lysophosphatidic acid receptor via epidermal growth factor receptor to Rho. *J Biol Chem*, 273: 4653-9.
- Gohla, A., Offermanns, S., Wilkie, T. M. und Schultz, G.** (1999): Differential involvement of Galpha12 and Galpha13 in receptor-mediated stress fiber formation. *J Biol Chem*, 274: 17901-7.
- Gonda, K., Okamoto, H., Takuwa, N., Yatomi, Y., Okazaki, H., Sakurai, T., Kimura, S., Sillard, R., Harii, K. und Takuwa, Y.** (1999): The novel sphingosine 1-phosphate receptor AGR16 is coupled via pertussis toxin-sensitive and -insensitive G-proteins to multiple signalling pathways. *Biochem J*, 337: 67-75.
- Gottesman, S., Halpern, E. und Trisler, P.** (1981): Role of sulA and sulB in filamentation by lon mutants of Escherichia coli K-12. *J Bacteriol*, 148: 265-73.
- Gouldson, P. R. und Reynolds, C. A.** (1997): Simulations on dimeric peptides: evidence for domain swapping in G- protein-coupled receptors? *Biochem Soc Trans*, 25: 1066-71.
- Gräler, M. H.** (1997): Identifizierung von Chemokinrezeptoren und verwandten Rezeptoren aus dendritischen Zellen. *Diplomarbeit*.
- Gräler, M. H., Bernhardt, G. und Lipp, M.** (1998): EDG6, a novel G-protein-coupled receptor related to receptors for bioactive lysophospholipids, is specifically expressed in lymphoid tissue. *Genomics*, 53: 164-9.
- Gräler, M. H., Bernhardt, G. und Lipp, M.** (1999): A lymphoid tissue-specific receptor, EDG6, with potential immune modulatory functions mediated by extracellular lysophospholipids. *Curr Top Microbiol Immunol*, 246: 131-6.
- Grosse, R., Schmid, A., Schöneberg, T., Herrlich, A., Muhn, P., Schultz, G. und Guder-mann, T.** (2000): Gonadotropin-releasing hormone receptor initiates multiple signaling pathways by exclusively coupling to G(q/11) proteins. *J Biol Chem*, 275: 9193-200.
- Guo, Z., Liliom, K., Fischer, D. J., Bathurst, I. C., Tomei, L. D., Kiefer, M. C. und Tigyi, G.** (1996): Molecular cloning of a high-affinity receptor for the growth factor-like lipid mediator lysophosphatidic acid from Xenopus oocytes. *Proc Natl Acad Sci U S A*, 93: 14367-72.
- Hamm, H. E.** (1991): Molecular interactions between the photoreceptor G protein and rhodopsin. *Cell Mol Neurobiol*, 11: 563-78.
- Hamm, H. E.** (1998): The many faces of G protein signaling. *J Biol Chem*, 273: 669-72.
- Handyside, A. H., O'Neill, G. T., Jones, M. und Hooper, M. L.** (1989): Use of BRL-conditioned medium in combination with feeder layers to isolate a diploid embryonal stem cell line. *Roux's Arch Dev Biol*, 198: 48-55.
- Hart, M. J., Jiang, X., Kozasa, T., Roscoe, W., Singer, W. D., Gilman, A. G., Sternweis, P. C. und Bollag, G.** (1998): Direct stimulation of the guanine nucleotide exchange activity of p115 RhoGEF by Galpha13. *Science*, 280: 2112-4.
- Hartl, P. und Lipp, M.** (1987): Generation of a variant t(2;8) translocation of Burkitt's lymphoma by site-specific recombination via the kappa light-chain joining signals. *Mol Cell Biol*, 7: 2037-45.
- Hébert, T. E. und Bouvier, M.** (1998): Structural and functional aspects of G protein-coupled receptor oligomerization. *Biochem Cell Biol*, 76: 1-11.
- Hecht, J. H., Weiner, J. A., Post, S. R. und Chun, J.** (1996): Ventricular zone gene-1 (vzg-1) encodes a lysophosphatidic acid receptor expressed in neurogenic regions of the developing cerebral cortex. *J Cell Biol*, 135: 1071-83.
- Heerding, J. N., Yee, D. K., Jacobs, S. L. und Fluharty, S. J.** (1997): Mutational analysis of the angiotensin II type 2 receptor: contribution of conserved extracellular amino acids. *Regul Pept*, 72:

97-103.

Henderson, R. und Schertler, G. F. (1990): The structure of bacteriorhodopsin and its relevance to the visual opsins and other seven-helix G-protein coupled receptors. *Philos Trans R Soc Lond B Biol Sci*, 326: 379-89.

Hepler, J. R. und Gilman, A. G. (1992): G proteins. *Trends Biochem Sci*, 17: 383-7.

Hjorth, S. A., Schambye, H. T., Greenlee, W. J. und Schwartz, T. W. (1994): Identification of peptide binding residues in the extracellular domains of the AT1 receptor. *J Biol Chem*, 269: 30953-9.

Hla, T., Lee, M. J., Ancellin, N., Liu, C. H., Thangada, S., Thompson, B. D. und Kluk, M. (1999): Sphingosine-1-phosphate: extracellular mediator or intracellular second messenger? *Biochem Pharmacol*, 58: 201-7.

Hla, T. und Maciag, T. (1990): An abundant transcript induced in differentiating human endothelial cells encodes a polypeptide with structural similarities to G-protein-coupled receptors. *J Biol Chem*, 265: 9308-13.

Holtmann, M. H., Ganguli, S., Hadac, E. M., Dolu, V. und Miller, L. J. (1996): Multiple extracellular loop domains contribute critical determinants for agonist binding and activation of the secretin receptor. *J Biol Chem*, 271: 14944-9.

Hoon, M. A., Adler, E., Lindemeier, J., Battey, J. F., Ryba, N. J. und Zuker, C. S. (1999): Putative mammalian taste receptors: a class of taste-specific GPCRs with distinct topographic selectivity. *Cell*, 96: 541-51.

Hughes, J., Smith, T. W., Kosterlitz, H. W., Fothergill, L. A., Morgan, B. A. und Morris, H. R. (1975): Identification of two related pentapeptides from the brain with potent opiate agonist activity. *Nature*, 258: 577-80.

Igarashi, Y. und Yatomi, Y. (1998): Sphingosine 1-phosphate is a blood constituent released from activated platelets, possibly playing a variety of physiological and pathophysiological roles. *Acta Biochim Pol*, 45: 299-309.

Im, D. S., Heise, C. E., Harding, M. A., George, S. R., O'Dowd, B. F., Theodorescu, D. und Lynch, K. R. (2000): Molecular cloning and characterization of a lysophosphatidic acid receptor, Edg-7, expressed in prostate. *Mol Pharmacol*, 57: 753-9.

Inglese, J., Koch, W. J., Touhara, K. und Lefkowitz, R. J. (1995): G beta gamma interactions with PH domains and Ras-MAPK signaling pathways. *Trends Biochem Sci*, 20: 151-6.

Iniguez-Lluhi, J. A., Simon, M. I., Robishaw, J. D. und Gilman, A. G. (1992): G protein beta gamma subunits synthesized in Sf9 cells. Functional characterization and the significance of prenylation of gamma. *J Biol Chem*, 267: 23409-17.

Iyengar, R. (1993): Molecular and functional diversity of mammalian Gs-stimulated adenylyl cyclases. *Faseb J*, 7: 768-75.

Jalink, K., Eichholtz, T., Postma, F. R., van Corven, E. J. und Moolenaar, W. H. (1993): Lysophosphatidic acid induces neuronal shape changes via a novel, receptor-mediated signaling pathway: similarity to thrombin action. *Cell Growth Differ*, 4: 247-55.

Jalink, K., van Corven, E. J., Hengeveld, T., Morii, N., Narumiya, S. und Moolenaar, W. H. (1994): Inhibition of lysophosphatidate- and thrombin-induced neurite retraction and neuronal cell rounding by ADP ribosylation of the small GTP-binding protein Rho. *J Cell Biol*, 126: 801-10.

Jedlicka, A. E., Taylor, E. W., Meyers, D. A., Liu, Z. und Levitt, R. C. (1994): Localization of the highly polymorphic locus D19S120 to 19p13.3 by linkage. *Cytogenet Cell Genet*, 65: 140.

Jensen, A. A., Pedersen, U. B., Kiemer, A., Din, N. und Andersen, P. H. (1995): Functional importance of the carboxyl tail cysteine residues in the human D1 dopamine receptor. *J Neurochem*, 65: 1325-31.

Ji, T. H., Grossmann, M. und Ji, I. (1998): G protein-coupled receptors. I. Diversity of receptor-ligand interactions. *J Biol Chem*, 273: 17299-302.

Jones, K. A., Borowsky, B., Tamm, J. A., Craig, D. A., Durkin, M. M., Dai, M., Yao, W. J., Johnson, M., Gunwaldsen, C., Huang, L. Y., Tang, C., Shen, Q., Salon, J. A., Morse, K., Laz, T., Smith, K. E., Nagarathnam, D., Noble, S. A., Branchek, T. A. und Gerald, C. (1998): GABA(B) receptors function as a heteromeric assembly of the subunits GABA(B)R1 and GABA(B)R2. *Nature*, 396: 674-9.

- Jordan, B. A. und Devi, L. A.** (1999): G-protein-coupled receptor heterodimerization modulates receptor function. *Nature*, 399: 697-700.
- Kanashiro, C. A. und Khalil, R. A.** (1998): Signal transduction by protein kinase C in mammalian cells. *Clin Exp Pharmacol Physiol*, 25: 974-85.
- Karnik, S. S., Sakmar, T. P., Chen, H. B. und Khorana, H. G.** (1988): Cysteine residues 110 and 187 are essential for the formation of correct structure in bovine rhodopsin. *Proc Natl Acad Sci U S A*, 85: 8459-63.
- Kaupmann, K., Malitschek, B., Schuler, V., Heid, J., Froestl, W., Beck, P., Mosbacher, J., Bischoff, S., Kulik, A., Shigemoto, R., Karschin, A. und Bettler, B.** (1998): GABA(B)-receptor subtypes assemble into functional heteromeric complexes. *Nature*, 396: 683-7.
- Kawate, N. und Menon, K. M.** (1994): Palmitoylation of luteinizing hormone/human chorionic gonadotropin receptors in transfected cells. Abolition of palmitoylation by mutation of Cys-621 and Cys-622 residues in the cytoplasmic tail increases ligand-induced internalization of the receptor. *J Biol Chem*, 269: 30651-8.
- Kennedy, M. E. und Limbird, L. E.** (1993): Mutations of the alpha 2A-adrenergic receptor that eliminate detectable palmitoylation do not perturb receptor-G-protein coupling. *J Biol Chem*, 268: 8003-11.
- Kimura, T., Watanabe, T., Sato, K., Kon, J., Tomura, H., Tamama, K., Kuwabara, A., Kanda, T., Kobayashi, I., Ohta, H., Ui, M. und Okajima, F.** (2000): Sphingosine 1-phosphate stimulates proliferation and migration of human endothelial cells possibly through the lipid receptors, Edg-1 and Edg-3. *Biochem J*, 348 Pt 1: 71-6.
- Kjøller, L. und Hall, A.** (1999): Signaling to Rho GTPases. *Exp Cell Res*, 253: 166-79.
- Klages, B., Brandt, U., Simon, M. I., Schultz, G. und Offermanns, S.** (1999): Activation of G12/G13 results in shape change and Rho/Rho-kinase-mediated myosin light chain phosphorylation in mouse platelets. *J Cell Biol*, 144: 745-54.
- Knall, C. und Johnson, G. L.** (1998): G-protein regulatory pathways: rocketing into the twenty-first century. *J Cell Biochem Suppl*, 31: 137-46.
- Kobayashi, T., Tanaka-Ishii, R., Taguchi, R., Ikezawa, H. und Murakami-Murofushi, K.** (1999): Existence of a bioactive lipid, cyclic phosphatidic acid, bound to human serum albumin. *Life Sci*, 65: 2185-91.
- Kobilka, B.** (1992): Adrenergic receptors as models for G protein-coupled receptors. *Annu Rev Neurosci*, 15: 87-114.
- Koenig, J. A. und Edwardson, J. M.** (1997): Endocytosis and recycling of G protein-coupled receptors. *Trends Pharmacol Sci*, 18: 276-87.
- Kolakowski, L. F., Jr.** (1994): GCRDb: a G-protein-coupled receptor database. *Receptors Channels*, 2: 1-7.
- Kon, J., Sato, K., Watanabe, T., Tomura, H., Kuwabara, A., Kimura, T., Tamama, K., Ishizuka, T., Murata, N., Kanda, T., Kobayashi, I., Ohta, H., Ui, M. und Okajima, F.** (1999): Comparison of intrinsic activities of the putative sphingosine 1-phosphate receptor subtypes to regulate several signaling pathways in their cDNA-transfected Chinese hamster ovary cells. *J Biol Chem*, 274: 23940-7.
- Kozma, R., Ahmed, S., Best, A. und Lim, L.** (1995): The Ras-related protein Cdc42Hs and bradykinin promote formation of peripheral actin microspikes and filopodia in Swiss 3T3 fibroblasts. *Mol Cell Biol*, 15: 1942-52.
- Krupnick, J. G. und Benovic, J. L.** (1998): The role of receptor kinases and arrestins in G protein-coupled receptor regulation. *Annu Rev Pharmacol Toxicol*, 38: 289-319.
- Kuner, R., Kohr, G., Grunewald, S., Eisenhardt, G., Bach, A. und Kornau, H. C.** (1999): Role of heteromer formation in GABAB receptor function. *Science*, 283: 74-7.
- Kupperman, E., An, S., Osborne, N., Waldron, S. und Stainier, D. Y.** (2000): A sphingosine-1-phosphate receptor regulates cell migration during vertebrate heart development. *Nature*, 406: 192-5.
- Lado, D. C., Browe, C. S., Gaskin, A. A., Borden, J. M. und MacLennan, A. J.** (1994): Cloning of the rat edg-1 immediate-early gene: expression pattern suggests diverse functions. *Gene*, 149: 331-6.

-
- Laugwitz, K. L., Allgeier, A., Offermanns, S., Spicher, K., Van Sande, J., Dumont, J. E. und Schultz, G.** (1996): The human thyrotropin receptor: a heptahelical receptor capable of stimulating members of all four G protein families. *Proc Natl Acad Sci U S A*, 93: 116-20.
- Laugwitz, K. L., Spicher, K., Schultz, G. und Offermanns, S.** (1994): Identification of receptor-activated G proteins: selective immunoprecipitation of photolabeled G-protein alpha subunits. *Methods Enzymol*, 237: 283-94.
- Lee, H., Goetzl, E. J. und An, S.** (2000): Lysophosphatidic acid and sphingosine 1-phosphate stimulate endothelial cell wound healing. *Am J Physiol Cell Physiol*, 278: C612-8.
- Lee, M. J., Evans, M. und Hla, T.** (1996): The inducible G protein-coupled receptor edg-1 signals via the G(i)/mitogen-activated protein kinase pathway. *J Biol Chem*, 271: 11272-9.
- Lee, M. J., Thangada, S., Liu, C. H., Thompson, B. D. und Hla, T.** (1998a): Lysophosphatidic acid stimulates the G-protein-coupled receptor EDG-1 as a low affinity agonist. *J Biol Chem*, 273: 22105-12.
- Lee, M. J., Van Brocklyn, J. R., Thangada, S., Liu, C. H., Hand, A. R., Menzeleev, R., Spiegel, S. und Hla, T.** (1998b): Sphingosine-1-phosphate as a ligand for the G protein-coupled receptor EDG-1. *Science*, 279: 1552-5.
- Leff, P.** (1995): The two-state model of receptor activation. *Trends Pharmacol Sci*, 16: 89-97.
- Leong, S. R., Kabakoff, R. C. und Hébert, C. A.** (1994): Complete mutagenesis of the extracellular domain of interleukin-8 (IL-8) type A receptor identifies charged residues mediating IL-8 binding and signal transduction. *J Biol Chem*, 269: 19343-8.
- Li, Y., MacLennan, A. J. und Rogers, M. B.** (1998): A putative G-protein-coupled receptor, H218, is down-regulated during the retinoic acid-induced differentiation of F9 embryonal carcinoma cells. *Exp Cell Res*, 239: 320-5.
- Liliom, K., Fischer, D. J., Virag, T., Sun, G., Miller, D. D., Tseng, J. L., Desiderio, D. M., Seidel, M. C., Erickson, J. R. und Tigyi, G.** (1998): Identification of a novel growth factor-like lipid, 1-O-cis-alk-1'-enyl-2-lyso-sn-glycero-3-phosphate (alkenyl-GP) that is present in commercial sphingolipid preparations. *J Biol Chem*, 273: 13461-8.
- Lin, X., Voyno-Yasenetskaya, T. A., Hooley, R., Lin, C. Y., Orlowski, J. und Barber, D. L.** (1996): Galpha12 differentially regulates Na⁺-H⁺ exchanger isoforms. *J Biol Chem*, 271: 22604-10.
- Linder, M. E., Kleuss, C. und Mumby, S. M.** (1995): Palmitoylation of G-protein alpha subunits. *Methods Enzymol*, 250: 314-30.
- Linseman, D. A., Benjamin, C. W. und Jones, D. A.** (1995): Convergence of angiotensin II and platelet-derived growth factor receptor signaling cascades in vascular smooth muscle cells. *J Biol Chem*, 270: 12563-8.
- Lippert, E., Baltensperger, K., Jacques, Y. und Hermouet, S.** (1997): G alpha16 protein expression is up- and down-regulated following T-cell activation: disruption of this regulation impairs activation-induced cell responses. *FEBS Lett*, 417: 292-6.
- Liu, C. H. und Hla, T.** (1997): The mouse gene for the inducible G-protein-coupled receptor edg-1. *Genomics*, 43: 15-24.
- Liu, C. H., Thangada, S., Lee, M. J., Van Brocklyn, J. R., Spiegel, S. und Hla, T.** (1999): Ligand-induced trafficking of the sphingosine-1-phosphate receptor EDG-1. *Mol Biol Cell*, 10: 1179-90.
- Luttrell, L. M., Della Rocca, G. J., van Biesen, T., Luttrell, D. K. und Lefkowitz, R. J.** (1997): Gbetagamma subunits mediate Src-dependent phosphorylation of the epidermal growth factor receptor. A scaffold for G protein-coupled receptor-mediated Ras activation. *J Biol Chem*, 272: 4637-44.
- MacLennan, A. J., Browe, C. S., Gaskin, A. A., Lado, D. C. und Shaw, G.** (1994): Cloning and characterization of a putative G-protein coupled receptor potentially involved in development. *Mol Cell Neurosci*, 5: 201-9.
- MacLennan, A. J., Marks, L., Gaskin, A. A. und Lee, N.** (1997): Embryonic expression pattern of H218, a G-protein coupled receptor homolog, suggests roles in early mammalian nervous system development. *Neuroscience*, 79: 217-24.
- Macrae, A. D., Premont, R. T., Jaber, M., Peterson, A. S. und Lefkowitz, R. J.** (1996): Cloning, characterization, and chromosomal localization of rec1.3, a member of the G-protein-coupled receptor family highly expressed in brain. *Brain Res Mol Brain Res*, 42: 245-54.

- Mansour, A., Meng, F., Meador-Woodruff, J. H., Taylor, L. P., Civelli, O. und Akil, H. (1992): Site-directed mutagenesis of the human dopamine D2 receptor. *Eur J Pharmacol*, 227: 205-14.
- Masana, M. I., Brown, R. C., Pu, H., Gurney, M. E. und Dubocovich, M. L. (1995): Cloning and characterization of a new member of the G-protein coupled receptor EDG family. *Receptors Channels*, 3: 255-62.
- McKiernan, C. J. und Friedlander, M. (1999): The retinal rod Na(+)/Ca(2+),K(+) exchanger contains a noncleaved signal sequence required for translocation of the N terminus. *J Biol Chem*, 274: 38177-82.
- McLatchie, L. M., Fraser, N. J., Main, M. J., Wise, A., Brown, J., Thompson, N., Solari, R., Lee, M. G. und Foord, S. M. (1998): RAMPs regulate the transport and ligand specificity of the calcitonin- receptor-like receptor. *Nature*, 393: 333-9.
- McLaughlin, S. K., McKinnon, P. J. und Margolskee, R. F. (1992): Gustducin is a taste-cell-specific G protein closely related to the transducins. *Nature*, 357: 563-9.
- Meyer zu Heringdorf, D., Niederdraing, N., Neumann, E., Frode, R., Lass, H., Van Koppen, C. J. und Jakobs, K. H. (1998): Discrimination between plasma membrane and intracellular target sites of sphingosylphosphorylcholine. *Eur J Pharmacol*, 354: 113-22.
- Moffett, S., Adam, L., Bonin, H., Loisel, T. P., Bouvier, M. und Mouillac, B. (1996): Palmitoylated cysteine 341 modulates phosphorylation of the beta2- adrenergic receptor by the cAMP-dependent protein kinase. *J Biol Chem*, 271: 21490-7.
- Moffett, S., Mouillac, B., Bonin, H. und Bouvier, M. (1993): Altered phosphorylation and desensitization patterns of a human beta 2- adrenergic receptor lacking the palmitoylated Cys341. *Embo J*, 12: 349-56.
- Mohle, R., Bautz, F., Rafii, S., Moore, M. A., Brugger, W. und Kanz, L. (1998): The chemokine receptor CXCR-4 is expressed on CD34+ hematopoietic progenitors and leukemic cells and mediates transendothelial migration induced by stromal cell-derived factor-1. *Blood*, 91: 4523-30.
- Moolenaar, W. H. (1999): Bioactive lysophospholipids and their G protein-coupled receptors. *Exp Cell Res*, 253: 230-8.
- Moolenaar, W. H., Kranenburg, O., Postma, F. R. und Zondag, G. C. (1997): Lysophosphatidic acid: G-protein signalling and cellular responses. *Curr Opin Cell Biol*, 9: 168-73.
- Morris, A. J. und Malbon, C. C. (1999): Physiological regulation of G protein-linked signaling. *Physiol Rev*, 79: 1373-430.
- Motohashi, K., Shibata, S., Ozaki, Y., Yatomi, Y. und Igarashi, Y. (2000): Identification of lysophospholipid receptors in human platelets: the relation of two agonists, lysophosphatidic acid and sphingosine 1- phosphate. *FEBS Lett*, 468: 189-93.
- Mukai, M., Imamura, F., Ayaki, M., Shinkai, K., Iwasaki, T., Murakami-Murofushi, K., Murofushi, H., Kobayashi, S., Yamamoto, T., Nakamura, H. und Akedo, H. (1999): Inhibition of tumor invasion and metastasis by a novel lysophosphatidic acid (cyclic LPA). *Int J Cancer*, 81: 918-22.
- Mumby, S. M. und Linder, M. E. (1994): Myristoylation of G-protein alpha subunits. *Methods Enzymol*, 237: 254-68.
- Neer, E. J. und Clapham, D. E. (1988): Roles of G protein subunits in transmembrane signalling. *Nature*, 333: 129-34.
- Nietgen, G. W. und Durieux, M. E. (1998): Intercellular signaling by lysophosphatidate. *Cell Adhes Commun*, 5: 221-35.
- Nikmo, A., Bjorklund, S., Vainio, M., Ekokoski, E. und Tornquist, K. (1999): Sphingosylphosphorylcholine activates Gq, Gi-2, and Gi-3 in thyroid FRTL-5 cells: implications for the activation of calcium fluxes and Na+- H+ exchange. *Biochem Biophys Res Commun*, 258: 812-5.
- Nussenzveig, D. R., Heinfink, M. und Gershengorn, M. C. (1993): Agonist-stimulated internalization of the thyrotropin-releasing hormone receptor is dependent on two domains in the receptor carboxyl terminus. *J Biol Chem*, 268: 2389-92.
- O'Dowd, B. F., Hnatowich, M., Caron, M. G., Lefkowitz, R. J. und Bouvier, M. (1989): Palmitoylation of the human beta 2-adrenergic receptor. Mutation of Cys341 in the carboxyl tail leads to an uncoupled nonpalmitoylated form of the receptor. *J Biol Chem*, 264: 7564-9.

-
- Offermanns, S., Laugwitz, K. L., Spicher, K. und Schultz, G.** (1994): G proteins of the G12 family are activated via thromboxane A2 and thrombin receptors in human platelets. *Proc Natl Acad Sci U S A*, 91: 504-8.
- Okamoto, H., Takuwa, N., Gonda, K., Okazaki, H., Chang, K., Yatomi, Y., Shigematsu, H. und Takuwa, Y.** (1998): EDG1 is a functional sphingosine-1-phosphate receptor that is linked via a Gi/o to multiple signaling pathways, including phospholipase C activation, Ca²⁺ mobilization, Ras-mitogen-activated protein kinase activation, and adenylate cyclase inhibition. *J Biol Chem*, 273: 27104-10.
- Okamoto, H., Takuwa, N., Yatomi, Y., Gonda, K., Shigematsu, H. und Takuwa, Y.** (1999): EDG3 is a functional receptor specific for sphingosine 1-phosphate and sphingosylphosphorylcholine with signaling characteristics distinct from EDG1 and AGR16. *Biochem Biophys Res Commun*, 260: 203-8.
- Okazaki, H., Ishizaka, N., Sakurai, T., Kurokawa, K., Goto, K., Kumada, M. und Takuwa, Y.** (1993): Molecular cloning of a novel putative G protein-coupled receptor expressed in the cardiovascular system. *Biochem Biophys Res Commun*, 190: 1104-9.
- Palczewski, K.** (1997): GTP-binding-protein-coupled receptor kinases—two mechanistic models. *Eur J Biochem*, 248: 261-9.
- Palczewski, K., Kumasaka, T., Hori, T., Behnke, C. A., Motoshima, H., Fox, B. A., Le Trong, I., Teller, D. C., Okada, T., Stenkamp, R. E., Yamamoto, M. und Miyano, M.** (2000): Crystal structure of rhodopsin: A G protein-coupled receptor. *Science*, 289: 739-45.
- Piazza, G. A., Ritter, J. L. und Baracka, C. A.** (1995): Lysophosphatidic acid induction of transforming growth factors alpha and beta: modulation of proliferation and differentiation in cultured human keratinocytes and mouse skin. *Exp Cell Res*, 216: 51-64.
- Pickering, D. S., Taverna, F. A., Salter, M. W. und Hampson, D. R.** (1995): Palmitoylation of the GluR6 kainate receptor. *Proc Natl Acad Sci U S A*, 92: 12090-4.
- Pitcher, J. A., Freedman, N. J. und Lefkowitz, R. J.** (1998): G protein-coupled receptor kinases. *Annu Rev Biochem*, 67: 653-92.
- Postma, F. R., Jalink, K., Hengeveld, T. und Moolenaar, W. H.** (1996): Sphingosine-1-phosphate rapidly induces Rho-dependent neurite retraction: action through a specific cell surface receptor. *Embo J*, 15: 2388-92.
- Proia, R. L.** (2000): A vital role for Edg-1, a receptor for sphingosine-1-phosphate, in the development of the vascular system. *Keystone Symposium abstract book on Cell activation and signal transduction: Lipid second messengers IV*, February 5-10, Taos: 46.
- Pykett, M. J., Murphy, M., Harnish, P. R. und George, D. L.** (1994): Identification of a microsatellite instability phenotype in meningiomas. *Cancer Res*, 54: 6340-3.
- Pyne, S. und Pyne, N. J.** (2000): Sphingosine 1-phosphate signalling in mammalian cells. *Biochem J*, 349: 385-402.
- Ramirez-Solis, R., Rivera-Perez, J., Wallace, J. D., Wims, M., Zheng, H. und Bradley, A.** (1992): Genomic DNA microextraction: a method to screen numerous samples. *Anal Biochem*, 201: 331-5.
- Rao, G. N., Delafontaine, P. und Runge, M. S.** (1995): Thrombin stimulates phosphorylation of insulin-like growth factor-1 receptor, insulin receptor substrate-1, and phospholipase C-gamma 1 in rat aortic smooth muscle cells. *J Biol Chem*, 270: 27871-5.
- Renbäck, K., Inoue, M., Yoshida, A., Nyberg, F. und Ueda, H.** (2000): Vzg-1/lysophosphatidic acid-receptor involved in peripheral pain transmission. *Brain Res Mol Brain Res*, 75: 350-4.
- Rhee, S. G. und Choi, K. D.** (1992): Multiple forms of phospholipase C isozymes and their activation mechanisms. *Adv Second Messenger Phosphoprotein Res*, 26: 35-61.
- Rhodes, C. H., Call, K. M., Budarf, M. L., Barnoski, B. L., Bell, C. J., Emanuel, B. S., Bigner, S. H., Park, J. P. und Mohandas, T. K.** (1997): Molecular studies of an ependymoma-associated constitutional t(1;22)(p22;q11.2). *Cytogenet Cell Genet*, 78: 247-52.
- Risinger, J. I., Berchuck, A., Kohler, M. F., Watson, P., Lynch, H. T. und Boyd, J.** (1993): Genetic instability of microsatellites in endometrial carcinoma. *Cancer Res*, 53: 5100-3.
- Rodriguez-Frade, J. M., Vila-Coro, A. J., de Ana, A. M., Albar, J. P., Martinez, A. C. und Mellado, M.** (1999): The chemokine monocyte chemoattractant protein-1 induces functional responses through dimerization of its receptor CCR2. *Proc Natl Acad Sci U S A*, 96: 3628-33.

- Rohrer, S. P., Birzin, E. T., Mosley, R. T., Berk, S. C., Hutchins, S. M., Shen, D. M., Xiong, Y., Hayes, E. C., Parmar, R. M., Foor, F., Mitra, S. W., Degrado, S. J., Shu, M., Klopp, J. M., Cai, S. J., Blake, A., Chan, W. W., Pasternak, A., Yang, L., Patchett, A. A., Smith, R. G., Chapman, K. T. und Schaeffer, J. M. (1998): Rapid identification of subtype-selective agonists of the somatostatin receptor through combinatorial chemistry. *Science*, 282: 737-40.
- Roper, D., Jacoby, E., Krüger, P., Engels, M., Grotzinger, J., Wollmer, A. und Strassburger, W. (1994): Modeling of G-protein coupled receptors with bacteriorhodopsin as a template. A novel approach based on interaction energy differences. *J Recept Res*, 14: 167-86.
- Sadahira, Y., Zheng, M., Ruan, F., Hakomori, S. und Igarashi, Y. (1994): Sphingosine-1-phosphate inhibits extracellular matrix protein-induced haptotactic motility but not adhesion of B16 mouse melanoma cells. *FEBS Lett*, 340: 99-103.
- Sahin-Toth, M., Nicoll, D. A., Frank, J. S., Philipson, K. D. und Friedlander, M. (1995): The cleaved N-terminal signal sequence of the cardiac Na(+)-Ca2+ exchanger is not required for functional membrane integration. *Biochem Biophys Res Commun*, 212: 968-74.
- Saito, S. (1997): Effects of lysophosphatidic acid on primary cultured chick neurons. *Neurosci Lett*, 229: 73-6.
- Sakata-Kaneko, S., Wakatsuki, Y., Usui, T., Matsunaga, Y., Itoh, T., Nishi, E., Kume, N. und Kita, T. (1998): Lysophosphatidylcholine upregulates CD40 ligand expression in newly activated human CD4+ T cells. *FEBS Lett*, 433: 161-5.
- Sakmar, T. P. (1998): Rhodopsin: a prototypical G protein-coupled receptor. *Prog Nucleic Acid Res Mol Biol*, 59: 1-34.
- Samama, P., Cotecchia, S., Costa, T. und Lefkowitz, R. J. (1993): A mutation-induced activated state of the beta 2-adrenergic receptor. Extending the ternary complex model. *J Biol Chem*, 268: 4625-36.
- Samama, P., Pei, G., Costa, T., Cotecchia, S. und Lefkowitz, R. J. (1994): Negative antagonists promote an inactive conformation of the beta 2- adrenergic receptor. *Mol Pharmacol*, 45: 390-4.
- Sasagawa, T., Suzuki, K., Shiota, T., Kondo, T. und Okita, M. (1998): The significance of plasma lysophospholipids in patients with renal failure on hemodialysis. *J Nutr Sci Vitaminol (Tokyo)*, 44: 809-18.
- Sato, K., Kon, J., Tomura, H., Osada, M., Murata, N., Kuwabara, A., Watanabe, T., Ohta, H., Ui, M. und Okajima, F. (1999): Activation of phospholipase C-Ca2+ system by sphingosine 1-phosphate in CHO cells transfected with Edg-3, a putative lipid receptor. *FEBS Lett*, 443: 25-30.
- Sato, K., Murata, N., Kon, J., Tomura, H., Nochi, H., Tamoto, K., Osada, M., Ohta, H., Tokumitsu, Y., Ui, M. und Okajima, F. (1998): Downregulation of mRNA expression of Edg-3, a putative sphingosine 1- phosphate receptor coupled to Ca2+ signaling, during differentiation of HL-60 leukemia cells. *Biochem Biophys Res Commun*, 253: 253-6.
- Savarese, T. M. und Fraser, C. M. (1992): In vitro mutagenesis and the search for structure-function relationships among G protein-coupled receptors. *Biochem J*, 283: 1-19.
- Schaeffer, H. J. und Weber, M. J. (1999): Mitogen-activated protein kinases: specific messages from ubiquitous messengers. *Mol Cell Biol*, 19: 2435-44.
- Schertler, G. F., Villa, C. und Henderson, R. (1993): Projection structure of rhodopsin. *Nature*, 362: 770-2.
- Schulein, R., Hermosilla, R., Oksche, A., Dehe, M., Wiesner, B., Krause, G. und Rosenthal, W. (1998): A dileucine sequence and an upstream glutamate residue in the intracellular carboxyl terminus of the vasopressin V2 receptor are essential for cell surface transport in COS.M6 cells. *Mol Pharmacol*, 54: 525-35.
- Schulein, R., Liebenhoff, U., Müller, H., Birnbaumer, M. und Rosenthal, W. (1996): Properties of the human arginine vasopressin V2 receptor after site- directed mutagenesis of its putative palmitoylation site. *Biochem J*, 313: 611-6.
- Schwartz, T. W., Gether, U., Schambye, H. T. und Hjorth, S. A. (1995): Molecular mechanism of action of non-peptide ligands for peptide receptors. *Curr Pharm Design*, 1: 325-42.
- Schwartz, T. W. und Rosenkilde, M. M. (1996): Is there a 'lock' for all agonist 'keys' in 7TM receptors?. *Trends Pharmacol Sci*, 17: 213-6.
- Shapiro, M. J., Trejo, J., Zeng, D. und Coughlin, S. R. (1996): Role of the thrombin recep-

tor's cytoplasmic tail in intracellular trafficking. Distinct determinants for agonist-triggered versus tonic internalization and intracellular localization. *J Biol Chem*, 271: 32874-80.

Smith, D. B. und Johnson, K. S. (1988): Single-step purification of polypeptides expressed in *Escherichia coli* as fusions with glutathione S-transferase. *Gene*, 67: 31-40.

Spiegel, S. (1999): Sphingosine 1-phosphate: a prototype of a new class of second messengers. *J Leukoc Biol*, 65: 341-4.

Stam, J. C., Michiels, F., van der Kammen, R. A., Moolenaar, W. H. und Collard, J. G. (1998): Invasion of T-lymphoma cells: cooperation between Rho family GTPases and lysophospholipid receptor signaling. *Embo J*, 17: 4066-74.

Strader, C. D., Fong, T. M., Tota, M. R., Underwood, D. und Dixon, R. A. (1994): Structure and function of G protein-coupled receptors. *Annu Rev Biochem*, 63: 101-32.

Stroop, S. D., Nakamuta, H., Kuestner, R. E., Moore, E. E. und Epand, R. M. (1996): Determinants for calcitonin analog interaction with the calcitonin receptor N-terminus and transmembrane-loop regions. *Endocrinology*, 137: 4752-6.

Tigyi, G. und Miledi, R. (1992): Lysophosphatidates bound to serum albumin activate membrane currents in *Xenopus* oocytes and neurite retraction in PC12 pheochromocytoma cells. *J Biol Chem*, 267: 21360-7.

Tobin, A. B. (1997): Phosphorylation of phospholipase C-coupled receptors. *Pharmacol Ther*, 75: 135-51.

Tones, M. A., Bendali, N., Flor, P. J., Knopfel, T. und Kuhn, R. (1995): The agonist selectivity of a class III metabotropic glutamate receptor, human mGluR4a, is determined by the N-terminal extracellular domain. *Neuroreport*, 7: 117-20.

Tsai, W., Morielli, A. D. und Peralta, E. G. (1997): The m1 muscarinic acetylcholine receptor transactivates the EGF receptor to modulate ion channel activity. *Embo J*, 16: 4597-605.

Turcatti, G., Zoffmann, S., Lowe, J. A., 3rd, Drozda, S. E., Chassaing, G., Schwartz, T. W. und Chollet, A. (1997): Characterization of non-peptide antagonist and peptide agonist binding sites of the NK1 receptor with fluorescent ligands. *J Biol Chem*, 272: 21167-75.

Unger, V. M., Hargrave, P. A., Baldwin, J. M. und Schertler, G. F. (1997): Arrangement of rhodopsin transmembrane alpha-helices. *Nature*, 389: 203-6.

Van Brocklyn, J. R., Gräler, M. H., Bernhardt, G., Hobson, J. P., Lipp, M. und Spiegel, S. (2000): Sphingosine-1-phosphate is a ligand for the G protein-coupled receptor EDG-6. *Blood*, 95: 2624-9.

Van Brocklyn, J. R., Lee, M. J., Menzeleev, R., Olivera, A., Edsall, L., Cuvillier, O., Thomas, D. M., Coopman, P. J., Thangada, S., Liu, C. H., Hla, T. und Spiegel, S. (1998): Dual actions of sphingosine-1-phosphate: extracellular through the Gi-coupled receptor Edg-1 and intracellular to regulate proliferation and survival. *J Cell Biol*, 142: 229-40.

Van Brocklyn, J. R., Tu, Z., Edsall, L. C., Schmidt, R. R. und Spiegel, S. (1999): Sphingosine 1-phosphate-induced cell rounding and neurite retraction are mediated by the G protein-coupled receptor H218. *J Biol Chem*, 274: 4626-32.

Van Corven, E. J., Hordijk, P. L., Medema, R. H., Bos, J. L. und Moolenaar, W. H. (1993): Pertussis toxin-sensitive activation of p21ras by G protein-coupled receptor agonists in fibroblasts. *Proc Natl Acad Sci U S A*, 90: 1257-61.

Vanhaesebroeck, B., Leeyers, S. J., Panayotou, G. und Waterfield, M. D. (1997): Phosphoinositide 3-kinases: a conserved family of signal transducers. *Trends Biochem Sci*, 22: 267-72.

Vieira, J. und Messing, J. (1982): The pUC plasmids, an M13mp7-derived system for insertion mutagenesis and sequencing with synthetic universal primers. *Gene*, 19: 259-68.

Wan, Y., Kurosaki, T. und Huang, X. Y. (1996): Tyrosine kinases in activation of the MAP kinase cascade by G-protein-coupled receptors. *Nature*, 380: 541-4.

Wang, C. D., Gallaher, T. K. und Shih, J. C. (1993): Site-directed mutagenesis of the serotonin 5-hydroxytryptamine₂ receptor: identification of amino acids necessary for ligand binding and receptor activation. *Mol Pharmacol*, 43: 931-40.

Weiner, J. A., Hecht, J. H. und Chun, J. (1998): Lysophosphatidic acid receptor gene vzg-1/lpA1/edg-2 is expressed by mature oligodendrocytes during myelination in the postnatal murine brain. *J Comp Neurol*, 398: 587-98.

- Wess, J.** (1997): G-protein-coupled receptors: molecular mechanisms involved in receptor activation and selectivity of G-protein recognition. *Faseb J*, 11: 346-54.
- Wess, J.** (1998): Molecular basis of receptor/G-protein-coupling selectivity. *Pharmacol Ther*, 80: 231-64.
- Wheatley, M. und Hawtin, S. R.** (1999): Glycosylation of G-protein-coupled receptors for hormones central to normal reproductive functioning: its occurrence and role. *Hum Reprod Update*, 5: 356-64.
- White, J. H., Wise, A., Main, M. J., Green, A., Fraser, N. J., Disney, G. H., Barnes, A. A., Emson, P., Foord, S. M. und Marshall, F. H.** (1998): Heterodimerization is required for the formation of a functional GABA(B) receptor. *Nature*, 396: 679-82.
- Wilkie, T. M., Gilbert, D. J., Olsen, A. S., Chen, X. N., Amatruda, T. T., Korenberg, J. R., Trask, B. J., de Jong, P., Reed, R. R., Simon, M. I. und et al.** (1992): Evolution of the mammalian G protein alpha subunit multigene family. *Nat Genet*, 1: 85-91.
- Wilmen, A., Van Eyll, B., Goke, B. und Goke, R.** (1997): Five out of six tryptophan residues in the N-terminal extracellular domain of the rat GLP-1 receptor are essential for its ability to bind GLP-1. *Peptides*, 18: 301-5.
- Windh, R. T., Lee, M. J., Hla, T., An, S., Barr, A. J. und Manning, D. R.** (1999): Differential coupling of the sphingosine 1-phosphate receptors Edg-1, Edg-3, and H218/Edg-5 to the G(i), G(q), and G(12) families of heterotrimeric G proteins. *J Biol Chem*, 274: 27351-8.
- Xu, Y., Zhu, K., Hong, G., Wu, W., Baudhuin, L. M., Xiao, Y. und Damron, D. S.** (2000): Sphingosylphosphorylcholine is a ligand for ovarian cancer G-protein-coupled receptor 1. *Nat Cell Biol*, 2: 261-267.
- Yamaguchi, F., Tokuda, M., Hatase, O. und Brenner, S.** (1996): Molecular cloning of the novel human G protein-coupled receptor (GPCR) gene mapped on chromosome 9. *Biochem Biophys Res Commun*, 227: 608-14.
- Yamaguchi, F., Yamaguchi, K., Tokuda, M. und Brenner, S.** (1999): Molecular cloning of EDG-3 and N-Shc genes from the puffer fish, Fugu rubripes, and conservation of synteny with the human genome. *FEBS Lett*, 459: 105-10.
- Yamamura, S., Sadahira, Y., Ruan, F., Hakomori, S. und Igarashi, Y.** (1996): Sphingosine-1-phosphate inhibits actin nucleation and pseudopodium formation to control cell motility of mouse melanoma cells. *FEBS Lett*, 382: 193-7.
- Yamamura, S., Yatomi, Y., Ruan, F., Sweeney, E. A., Hakomori, S. und Igarashi, Y.** (1997): Sphingosine 1-phosphate regulates melanoma cell motility through a receptor-coupled extracellular action and in a pertussis toxin-insensitive manner. *Biochemistry*, 36: 10751-9.
- Yamazaki, Y., Kon, J., Sato, K., Tomura, H., Sato, M., Yoneya, T., Okazaki, H., Okajima, F. und Ohta, H.** (2000): Edg-6 as a putative sphingosine 1-phosphate receptor coupling to Ca(2+) signaling pathway. *Biochem Biophys Res Commun*, 268: 583-9.
- Yoshida, A. und Ueda, H.** (1999): Activation of G_{i1} by lysophosphatidic acid receptor without ligand in the baculovirus expression system. *Biochem Biophys Res Commun*, 259: 78-84.
- Yu, R. und Hinkle, P. M.** (1997): Effect of cell type on the subcellular localization of the thyrotropin-releasing hormone receptor. *Mol Pharmacol*, 51: 785-93.
- Zoffmann, S., Gether, U. und Schwartz, T. W.** (1993): Conserved His^{VI-17} of the NK-1 receptor is involved in binding of non-peptide antagonists but not substance P. *FEBS Lett*, 336: 506-10.
- Zondag, G. C., Postma, F. R., Etten, I. V., Verlaan, I. und Moolenaar, W. H.** (1998): Sphingosine 1-phosphate signalling through the G-protein-coupled receptor Edg-1. *Biochem J*, 330: 605-9.