

8 LITERATURVERZEICHNIS

- Amersham Pharmacia Biotech. (1999) Protein Purification Handbook and Gel Filtration, Principles and Methods.
- Aragay AM und Quick MW. (1999) Functional regulation of $G\alpha_{16}$ by protein kinase C. *J Biol Chem*, **274**, 4807-4815.
- Arshavsky VY und Bownds MD. (1992) Regulation of deactivation of photoreceptor G protein by its target enzyme and cGMP. *Nature*, **357**, 416-417.
- Arshavsky VY, Lamb TD, Pugh EN. (2002) G proteins and phototransduction. *Annu Rev Physiol*, **64**, 153-187.
- Balcueva EA, Wang Q, Hughes H, Kunsch C, Yu Z, Robishaw JD. (2000) Human G protein γ_{11} and γ_{14} subtypes define a new functional subclass. *Exp Cell Res*, **257**, 310-319.
- Bayewitch ML, Avidor-Reiss T, Levy R, Pfeuffer T, Nevo I, Simonds WF, Vogel Z. (1998) Differential modulation of adenylyl cyclases I and II by various $G\beta$ -subunits. *J Biol Chem*, **273**, 2273-2276.
- Berstein G, Blank JL, Jhon DY, Exton JH, Rhee SG, Ross EM. (1992) Phospholipase C- β_1 is a GTPase-activating protein for $G_{q/11}$, its physiologic regulator. *Cell*, **70**, 411-408.
- Blake BL, Wing MR, Zhou JY, Lei Q, Hillmann JR, Behe CI, Morris RA, Harden TK, Bayliss DA, Miller RJ, Siderovski DP. (2001) $G\beta$ association and effector interaction selectivities of the divergent $G\gamma$ subunit $G\gamma_{13}$. *J Biol Chem*, **276**, 49267-49274.
- Bockaert J, Pin JP. (1999) Molecular tinkering of G protein-coupled receptors: an evolutionary success. *EMBO J*, **18**, 1723-1729.
- Breitwieser GE, Szabo G. (1985) Uncoupling of cardiac muscarinic and β -adrenergic receptors from ion channels by a guanine nucleotide analogue. *Nature*, **317**, 538-540.
- Brundage L, Avery L, Katz A, Kim UJ, Mendel JE, Sternberg PW, Simon MI. (1996) Mutations in a *C. elegans* $G\alpha_q$ gene disrupt movement, egg laying, and viability. *Neuron*, **16**, 999-1009.
- Cabrera JL, de Freitas F, Satpaev DK, Slepak VZ. (1998) Identification of the $G\beta_5$ /RGS7 protein complex in the retina. *Biochem Biophys Res Commun*, **249**, 898-902.
- Casey PJ. (1994) Lipid modifications of G proteins. *Curr Opin Cell Biol*, **6**, 219-225.
- Casey P., and Seabra MC. (1996) Protein prenyltransferases. *J Biol Chem*, **271**, 5289-5892.
- Chase DL, Patikoglou GA, Koelle MR. (2001) Two RGS proteins that inhibit $G\alpha_o$ and $G\alpha_q$ signaling in *C. elegans* neurons require a $G\beta_5$ -like subunit for function. *Curr Biol*, **11**, 222-231.

- Chen CK, Burns ME, He W, Wensel TG, Baylor DA, Simon MI. (2000) Slowed recovery of rod photoresponse in mice lacking the GTPase accelerating protein RGS9-1. *Nature*, **403**, 557-560.
- Chen WJ, Andres DA, Goldstein JL, Russell DW, Brown MS. (1991) cDNA cloning and expression of the peptide-binding β subunit of rat p21ras farnesyltransferase, the counterpart of yeast DPR1/RAM1. *Cell*, **66**, 327-334.
- Cismowski MJ, Takesono A, Ma C, Lizano JS, Xie X, Fuernkranz H, Lanier SM, Duzic E. (1999) Genetic screens in yeast to identify mammalian nonreceptor modulators of G-protein signaling. *Nat Biotechnol*, **17**, 878-883.
- Clapham DE, Neer EJ. (1997) G protein $\beta\gamma$ subunits. *Annu Rev Pharmacol Toxicol*, **37**, 167-203.
- Cook LA, Schey KL, Wilcox MD, Dingus J, Hildebrandt JD. (1998) Heterogenous processing of a G protein γ subunit at a site critical for protein and membrane interactions. *Biochemistry*, **37**, 12280-12286.
- De Vries L, Zheng B, Fischer T, Elenko E, and Farquhar MG. (2000) The regulator of G protein signaling family. *Annu Rev Pharmacol Toxicol*, **40**, 235-271.
- Dekker LV, Segal AW. (2000) Perspectives: signal transduction. Signals to move cells. *Science*, **287**, 982-983, 985.
- Dietrich A, Meister M, Spicher K, Schultz G, Camps M, Gierschik P. (1992) Expression, characterization and purification of soluble G-protein $\beta\gamma$ dimers composed of defined subunits in baculovirus-infected insect cells. *FEBS Lett*, **313**, 220-224.
- Dohlman HG, Thorner J, Caron MG, Lefkowitz RJ. (1991) Model systems for the study of seven-transmembrane-segment receptors. *Annu Rev Biochem*, **60**, 653-588.
- Downes GB, Gautam N. (1999) The G protein subunit gene families. *Genomics*, **62**, 544-552.
- Druey KM, Blumer KJ, Kang VH, Kehrl JH. (1996) Inhibition of G-protein-mediated MAP kinase activation by a new mammalian gene family. *Nature*, **379**, 742-746.
- Evans R. (1988) The steroid and thyroid hormone receptor subfamily. *Science*, **240**, 889-895.
- Exner T, Nürnberg B. (1999) Immuno- and gold staining of a single Western blot. *Anal Biochem*, **260**, 108-110.
- Exton JH. (1997) Cell signalling through guanine-nucleotide-binding regulatory proteins (G proteins) and phospholipases. *Eur J Biochem*, **243**, 10-20.
- Fields TA, Casey PJ. (1995) Phosphorylation of $G\alpha_z$ by protein kinase C blocks interaction with the beta gamma complex. *J Biol Chem*, **270**, 23119-23125.
- Fletcher JE, Lindorfer MA, DeFilippo JM, Yasuda H, Guilford M, Garrison JC. (1998) G protein $G\beta_5$ subunit interacts selectively with the $G\alpha_q$ subunit. *J Biol Chem*, **273**, 636-644.

- Ford CE, Skiba NP, Bae H, Daaka Y, Reuveny E, Shekter LR, Rosal R, Weng G, Yang CS, Iyengar R, Miller RJ, Jan LY, Lefkowitz RJ, Hamm HE. (1998) Molecular basis for interactions of G protein $\beta\gamma$ subunits with effectors. *Science*, **280**, 1271-1274.
- Fukada Y, Takao T, Ohguro H, Yoshizawa T, Akino T, Shimonishi Y. (1990) Farnesylated γ -subunit of photoreceptor G protein indispensable for GTP-binding. *Nature*, **346**, 658-660.
- Garbers D.L. (1990) The guanylyl cyclase receptor family. *New Biol*, **2**, 499-504.
- Garcia-Higuera I, Fenoglio J, Li Y, Lewis C, Panchenko MP, Reiner O, Smith TF, Neer EJ. (1996) Folding of proteins with WD-repeats: comparison of six members of the WD-repeat superfamily to the G protein β subunit. *Biochemistry*, **35**, 13985-13994.
- Gautam N, Downes GB, Yan K, Kisselev O. (1998) The G-protein $\beta\gamma$ -complex. *Cell Signal*, **10**, 447-455.
- Gilman AG (1987) G proteins: transducers of receptor-generated signals. *Annu Rev Biochem*, **56**, 615-649.
- Gold SJ, Ni YG, Dohlman HG, Nestler EJ. (1997) Regulators of G-protein signaling (RGS) proteins: region-specific expression of nine subtypes in rat brain. *J Neurosci*, **17**, 8024-8037.
- Guay-Woodford LM, Wright CJ, Walz G, (2000) Churchill GA. Quantitative trait loci modulate renal cystic disease severity in the mouse bpk model. *J Am Soc Nephrol*, **11**, 1253-1260.
- Gudermann T, Nürnberg B, Schultz G. (1995) Receptors and G proteins as primary components of transmembrane signal transduction. Part 1. G-protein-coupled receptors: structure and function. *J Mol Med*, **73**, 51-63.
- Gudermann T, Grosse R, Schultz G. (2000) Contribution of receptor/G protein signaling to cell growth and transformation. *Naunyn Schmiedebergs Arch Pharmacol*, **361**, 345-362.
- Hajdu-Cronin YM, Chen WJ, Patikoglou G, Koelle MR, Sternberg PW. (1999) Antagonism between $G\alpha_o$ and $G\alpha_q$ in *Caenorhabditis elegans*: the RGS protein EAT-16 is necessary for $G\alpha_o$ signaling and regulates $G\alpha_q$ activity. *Genes Dev*, **13**, 1780-1793.
- Hamm, H.E. (1998) The many faces of G Protein Signaling. *J Biol Chem*, **273**, 669-672.
- He W, Lu L, Zhang X, El-Hodiri HM, Chen CK, Slep KC, Simon MI, Jamrich M, Wensel TG. (2000) Modules in the photoreceptor. RGS9-1/G β_5L GTPase-accelerating protein complex control effector coupling, GTPase acceleration, protein folding, and stability. *J Biol Chem*, **275**, 37093-100.
- Hepler JR. (1999) Emerging roles for RGS proteins in cell signalling. *Trends Pharmacol Sci*, **20**, 376-382.

- Hofmann F, Lacinová L, Klugbauer N. (1999) Voltage-dependent calcium channels: from structure to function. *Rev Physiol Biochem Pharmacol*, **139**, 33-87.
- Hu G, Wensel TG. (2002) R9AP, a membrane anchor for the photoreceptor GTPase accelerating protein, RGS9-1. *Proc Natl Acad Sci U S A*, **99**, 9755-9760.
- Huang L, Shanker YG, Dubauskaite J, Zheng JZ, Yan W, Rosenzweig S, Spielman AI, Max M, Margolskee RF. (1999) G γ ₁₃ colocalizes with gustducin in taste receptor cells and mediates IP₃ responses to bitter denatonium. *Nat Neurosci*, **12**, 1055-1062.
- Hunter T. (1995) Protein kinases and phosphatases: the Yin and Yang of protein phosphorylation and signaling. *Cell*, **80**, 225-236.
- Illenberger D, Schwald F, Pimmer D, Binder W, Maier G, Dietrich A, Gierschik P. (1998) Stimulation of phospholipase C- β ₂ by the Rho GTPases Cdc42Hs and Rac1. *EMBO J*, **17**, 6241-6249.
- Iñiguez-Lluhi JA, Simon MI, Robishaw JD, Gilman AG. (1992) G protein $\beta\gamma$ subunits synthesized in Sf9 cells: Functional characterization and the significance of prenylation of γ . *J Biol Chem*, **267**, 23409-23417.
- Jan L, Jan Y. (1997) Receptor-regulated ion channels. *Curr Opin Cell Biol*, **9**, 155-160.
- Jansen G, Thijssen KL, Werner P, van der Horst M, Hazendonk E, Plasterk RH. The (1999) complete family of genes encoding G proteins of *Caenorhabditis elegans*. *Nat Genet*, **21**, 414-419.
- Jelsema CL, Axelrod J. (1987) Stimulation of phospholipase A₂ activity in bovine rod outer segments by the $\beta\gamma$ subunits of transducin and its inhibition by the α subunit. *Proc Natl Acad Sci U S A*, **84**, 3623-3627.
- Jentsch TJ, Stein V, Weinreich F, Zdebik AA. (2002) Molecular structure and physiological function of chloride channels. *Physiol Rev*; **82**, 503-568.
- Ji TH, Grossmann M, Ji I. (1998) G protein-coupled receptors. I. Diversity of receptor-ligand interactions. *J Biol Chem*, **273**, 17299-17302.
- Jones MB, Garrison JC. (1999) Instability of the G-protein β ₅ subunit in detergent. *Anal Biochem*, **268**, 126-133.
- Jones PG, Lombardi SJ, Cockett MI. (1998) Cloning and tissue distribution of the human G protein β ₅ cDNA. *Biochim Biophys Acta*, **1402**, 288-291.
- Keren-Raifman T, Bera AK, Zveig D, Peleg S, Witherow DS, Slepak VZ, Dascal N. (2001) Expression levels of RGS7 and RGS4 proteins determine the mode of regulation of the G protein-activated K(+) channel and control regulation of RGS7 by G β ₅. *FEBS Lett*, **492**, 20-28.
- Kim DU, Park SK, Chung KS, Choi MU, Yoo HS. (1996) The G protein β subunit Gpb1 of *Schizosaccharomyces pombe* is a negative regulator of sexual development. *Mol Gen Genet*, **252**, 20-32.

- Kim E, Arnould T, Sellin L, Benzing T, Comella N, Kocher O, Tsiokas L, Sukhatme VP, Walz G. (1999) Interaction between RGS7 and polycystin. *Proc Natl Acad Sci U S A*, **96**, 6371-6376.
- Kisselev OG, Ermolaeva MV, Gautam N. (1994) A farnesylated domain in the G protein γ subunit is a specific determinant of receptor coupling. *J Biol Chem.*, **269**, 21399-21402.
- Kisselev OG, Pronin A, Ermolaeva MV, Gautam N. (1995) Receptor-G protein coupling is established by a potential conformational switch in the $\beta\gamma$ complex. *Proc Natl Acad Sci U S A*, **90**, 9102-9106.
- Kleuss C, Scherubl H, Hescheler J, Schultz G, Wittig B. (1992) Different β -subunits determine G-protein interaction with transmembrane receptors. *Nature*, **358**, 424-426
- Kurachi Y, Nakajima T, Sugimoto T. (1986) Acetylcholine activation of potassium channels in cell-free membrane patches of atrial cells. *Am J Physiol*, **251**, H681-H684.
- Laemmli UK. (1970) Cleavage of structural proteins during the assembly of the head of bacteriophage T4. *Nature*, **227**, 680-685.
- Langhans-Rajasekaran SA, Wan Y, Huang XY. (1995) Activation of Tsk and Btk tyrosin kinases by G protein $\beta\gamma$ subunits. *Proc Natl Acad Sci U S A*, **92**, 8601-8605.
- Leopoldt D, Hanck T, Exner T, Maier U, Wetzker R, Nürnberg B. (1998) G $\beta\gamma$ stimulates phosphoinositide 3-kinase γ by direct interaction with two domains of the catalytic p110 subunit. *J Biol Chem*, **273**, 7024-7029.
- Leopoldt D, Harteneck C, Nürnberg B. (1997) G proteins endogenously expressed in Sf9 cells: interaction with mammalian histamine receptors. *Naunyn-Schmiedeberg's Arch Pharmacol*, **350**, 329-338.
- Levay K, Cabrera JL, Satpaev DK, Slepak VZ. (1999) G β_5 prevents the RGS7-G α_0 interaction through binding to a distinct G γ -like domain found in RGS7 and other RGS proteins. *Proc Natl Acad Sci U S A*, **96**, 2503-2507.
- Liang JJ, Cockett M, Khawaja XZ. (1998) Immunohistochemical localization of G protein β_1 , β_2 , β_3 , β_4 , β_5 , and γ_3 subunits in the adult rat brain. *J Neurochem*, **71**, 345-355.
- Linder ME, Ewald DA, Miller RJ, Gilman AG. (1990) Purification and characterization of G α_0 and three types of G α_i after expression in Escherichia coli. *J Biol Chem*, **265**, 8243-8251
- Lindorfer MA, Myung CS, Savino Y, Yasuda H, Khazan R, Garrison JC. (1998) Differential activity of the G protein $\beta_5\gamma_2$ subunit at receptors and effectors. *J Biol Chem*, **273**, 34429-34436.
- Liu Z, Chatterjee TK, Fisher RA. (2002) RGS6 Interacts with SCG10 and Promotes Neuronal Differentiation. Role of the G γ -subunit-like domain of RGS6. *J Biol Chem*, **277**, 37832-37839

- Logothetis DE, Kurachi Y, Galper J, Neer EJ, Clapham DE. (1987) The $\beta\gamma$ subunits of GTP-binding proteins activate the muscarinic K^+ channel in heart. *Nature*, **325**, 321-326
- Lounsbury KM, Casey PJ, Brass LF, Manning DR. (1991) Phosphorylation of G α in human platelets. Selectivity and site of modification. *J Biol Chem*, **266**, 22051-22056
- Lowry OH, Rosebrough NJ, Farr AL, Randall RJ. (1951): Protein measurement with the folin phenol reagent. *J Biol Chem*, **193**, 265-275.
- Lupas AN, Lupas JM, Stock JB. (1992) Do G protein subunits associate via a three-stranded coiled coil? *FEBS Lett*, **314**, 105-108.
- Maier U, Babich A, Macrez N, Leopoldt D, Gierschik P, Illenberger D, Nürnberg B. (2000) G $\beta_5\gamma_2$ is a highly selective activator of phospholipid-dependent enzymes. *J Biol Chem*, **275**, 13746-13754.
- Maier U, Babich A, Nürnberg B. (1999) Roles of non-catalytic subunits in G $\beta\gamma$ -induced activation of class I phosphoinositide 3-kinase isoforms β and γ . *J Biol Chem*, **274**, 29311-29317.
- Makino ER, Handy JW, Li T, Arshavsky VY. (1999) The GTPase activating factor for transducin in rod photoreceptors is the complex between RGS9 and type 5 G protein β subunit. *Proc Natl Acad Sci U S A*, **96**, 1947-1952.
- Mattingly RR, Macara IG. (1996) Phosphorylation-dependent activation of the Ras-GRF/CDC25Mm exchange factor by muscarinic receptors and G-Protein $\beta\gamma$ subunits. *Nature*, **382**, 268-272.
- McNaught KS, Olanow CW, Halliwell B, Isacson O, Jenner P. (2001) Failure of the ubiquitin-proteasome system in Parkinson's disease. *Nat Rev Neurosci*, **2**, 589-594.
- Morishita R, Kato K, Asano T. (1994) A brain-specific γ subunit of G protein freed from the corresponding β subunit under non-denaturing conditions. *FEBS Lett*, **337**; 23-26.
- Mukhopadhyay S, Ross EM. (1999) Rapid GTP binding and hydrolysis by G(q) promoted by receptor and GTPase-activating proteins. *Proc Natl Acad Sci U S A*, **96**, 9539-9544.
- Myung CS, Yasuda H, Liu WW, Harden TK. and Garrison JC. (1999) Role of isoprenoid lipids on the heterotrimeric G protein γ subunit in determining effector activation. *J Biol Chem*, **274**, 16595-16603.
- Natochin M, Lester B, Peterson YK, Bernard ML, Lanier SM, Artemyev NO. (2000) AGS3 inhibits GDP dissociation from G α subunits of the Gi family and rhodopsin-dependent activation of transducin. *J Biol Chem*, **275**, 40981-40985.
- Neer EJ. (1995) Heterotrimeric G proteins: organizers of transmembrane signals. *Cell*, **80**, 249-257.
- Nürnberg B, Spicher K, Harhammer R, Bosserhoff A, Frank R, Hilz H, Schultz G. (1994) Purification of a novel G-protein α_o -subtype from mammalian brain. *Biochem J*, **300**, 387-394.

- Nürnberg B. (1994) Signal transduction by heterotrimeric G-proteins. *Pharmazie*, **49**, 795-800.
- Nürnberg B, Gudermann T, Schultz G. (1995) Receptors and G proteins as primary components of transmembrane signal transduction. Part 2. G proteins: structure and function. *J Mol Med*, **73**,123-32.
- Nürnberg B. (2000) Pertussis toxin as a pharmacological tool. In: Aktories K., Just I., (Hrsg.): Handbook of Experimental Pharmacology, Vol. 145, Bacterial Protein Toxins. Springer Verlag, Berlin, Heidelberg, S. 187-206
- Offermanns S, Schultz G. (1994) Complex information processing by the transmembrane signaling system involving G proteins. *Naunyn Schmiedebergs Arch Pharmacol*, **350**, 329-338.
- O'Reilly DR, Miller LK, Luckow VA. (1992) Baculovirus expression vectors. WH Freeman, New York.
- Peleg S, Varon D, Ivanina T, Dessauer CW, Dascal N. (2002) $G\alpha_i$ controls the gating of the G protein-activated $K(+)$ channel, GIRK. *Neuron*, **33**, 87-99.
- Peterson YK, Bernard ML, Ma H, Hazard S 3rd, Graber SG, Lanier SM. (2000) Stabilization of the GDP-bound conformation of $G\alpha_i$ by a peptide derived from the G-protein regulatory motif of AGS3. *J Biol Chem*, **275**, 33193-33196.
- Peterson GL. (1983): Determination of total protein. *Meth Enzymol*, **91**, 95-119.
- Pitcher JA, Freedman NJ, Lefkowitz RJ. (1998) G protein-coupled receptor kinases. *Annu Rev Biochem*, **67**, 653-692.
- Posner BA, Gilman AG, Harris BA. (1999) Regulators of G protein signaling 6 and 7. Purification of complexes with $G\beta_5$ and assessment of their effects on G-protein-mediated signaling pathways. *J Biol Chem*, **274**, 31087-31093.
- Possee LA, Possee RD. (1992) The baculovirus expression system: A laboratory guide. Chapman & Hall. London.
- Pumiglia KM, LeVine H, Haske T, Habib T, Jove R, Decker SJ. (1995) A direct interaction between G protein $\beta\gamma$ subunits and the Raf-1 protein kinase. *J Biol Chem*, **270**, 14251-14254.
- Rahman Z, Gold SJ, Potenza MN, Cowan CW, Ni YG, He W, Wensel TG, Nestler EJ. (1999) Cloning and characterization of RGS9-2: a striatal-enriched alternatively spliced product of the RGS9 gene. *J Neurosci*, **19**, 2016-2026.
- Ray K, Kunsch C, Bonner LM, Robishaw JD. (1995) Isolation of cDNA clones encoding eight different human G protein γ subunits, including three novel forms Designated the γ_4 , γ_{10} , and γ_{11} subunits. *J Biol Chem*, **270**, 21765-21771.
- Rechsteiner M, Rogers SW. (1996) PEST sequences and regulation by proteolysis. *Trends Biochem Sci*, **21**, 267-271.
- Robatzek M, Niacaris T, Steger K, Avery L, Thomas JH. (2001) eat-11 encodes GPB-2, a $G\beta_5$ ortholog that interacts with $G\alpha_o$ and $G\alpha_q$ to regulate *C. elegans* behavior. *Curr Biol*, **11**, 288-293.

- Ross EM, Wilkie TM. (2000) GTPase-activating proteins for heterotrimeric G proteins: regulators of G protein signaling (RGS) and RGS-like proteins. *Annu Rev Biochem*, **69**, 795-827.
- Runnels LW, Scarlata SF. (1998) Regulation of the rate and extent of phospholipase C- β_2 effector activation by the $\beta\gamma$ subunits of heterotrimeric G proteins. *Biochemistry*, **37**, 15563-15574.
- Schmidt CJ, Neer EJ. (1991) In vitro synthesis of G protein $\beta\gamma$ dimers. *J Biol Chem*, **266**, 4538-4544.
- Schnabel P, Camps M, Carozzi A, Parker PJ, Gierschik P. (1993) Mutational analysis of phospholipase C- β_2 . Identification of regions required for membrane association and stimulation by guanine-nucleotide-binding protein $\beta\gamma$ subunits. *Eur J Biochem*, **217**, 1109-1115.
- Schulz S, Huber A, Schwab K, Paulsen R. (1999) A novel $G\gamma$ isolated from *Drosophila* constitutes a visual G protein γ subunit of the fly compound eye. *J Biol Chem*, **274**, 37605-37610.
- Shevchenko A, Schaft D, Roguev A, Pijnappel WW, Stewart AF, Shevchenko A. (2002) Deciphering protein complexes and protein interaction networks by tandem affinity purification and mass spectrometry: analytical perspective. *Mol Cell Proteomics*, **1**, 204-212.
- Siderovski DP, Hessel A, Chung S, Mak TW, Tyers M. (1996) A new family of regulators of G-protein-coupled receptors? *Curr Biol*, **6**, 211-212.
- Siffert W, Roskopf D, Siffert G, Busch S, Moritz A, Erbel R, Sharma AM, Ritz E, Wichmann HE, Jakobs KH, Horsthemke B. (1998) Association of a human G-protein β_3 subunit variant with hypertension. *Nat Genet*, **18**, 45-8.
- Simon MI, Strathmann MP, Gautam N. (1991) Diversity of G proteins in signal transduction. *Science*, **252**, 802-808.
- Snow BE, Betts L, Mangion J, Sondek J, Siderovski DP. (1999) Fidelity of G protein β_5 -subunit association by the G protein γ -subunit-like domains of RGS6, RGS7, and RGS11. *Proc Natl Acad Sci U S A*, **96**, 6489-6494.
- Snow BE, Krumins AM, Brothers GM, Lee SF, Wall MA, Chung S, Mangion J, Arya S, Gilman AG, Siderovski DP. (1998) A G protein γ subunit-like domain shared between RGS11 and other RGS proteins specifies binding to $G\beta_5$ subunits. *Proc Natl Acad Sci U S A*, **95**, 13307-13312.
- Sondek J, Bohm A, Lambright DG, Hamm HE, Sigler PB. (1996) Crystal structure of a G-protein $\beta\gamma$ dimer at 2.1Å resolution. *Nature*, **379**, 369-374.
- Sprang SR. (1997) GAP into the breach. *Science*, **277**, 329-330.
- Spring DJ, Neer EJ. (1994) A 14-amino acid region of the G protein γ subunit is sufficient to confer selectivity of γ binding to the β subunit. *J Biol Chem*, **269**, 22882-22886.

- Sternweis PC. (1986) The purified α subunits of G_0 and G_i from bovine brain require $\beta\gamma$ for association with phospholipid vesicles. *J Biol Chem*, **261**, 631-637.
- Stoyanov B, Volinia S, Hanck T, Rubio I, Loubtchenkov M, Malek D, Stoyanova S, Vanhaesebroeck B, Dhand R, Nürnberg B, Gierschik P, Seedorf K, Hsuan JJ, Waterfield MD, Wetzker R. (1995) Cloning and characterization of a G protein-activated human phosphoinositide-3 kinase. *Science*, **269**, 690-693.
- Sunahara RK, Dessauer CW, Gilman AG. (1996): Complexity and diversity of mammalian adenylyl cyclases. *Annu Rev Pharmacol Toxicol*, **36**, 461-480.
- Takesono A, Cismowski MJ, Ribas C, Bernard M, Chung P, Hazard S 3rd, Duzic E, Lanier SM. (1999) Receptor-independent activators of heterotrimeric G-protein signaling pathways. *J Biol Chem*, **274**, 33202-33205.
- Tesmer JJ, Berman DM, Gilman AG, Sprang SR. (1997) Structure of RGS4 bound to AlF₄-activated $G\alpha_{i1}$: stabilization of the transition state for GTP hydrolysis. *Cell*, **89**, 251-261
- Towbin H, Staehelin T, Gordon J. (1979): Electrophoretic transfer of proteins from polyacrylamide gels to nitrocellulose sheets. *Proc Natl Acad Sci USA*, **76**, 4350-4354.
- Tsukada S, Simon MI, Witte ON, Katz A. (1994) Binding of $\beta\gamma$ subunits of heterotrimeric G proteins to the PH domain of Bruton tyrosine kinase. *Proc Natl Acad Sci USA*, **91**, 11256-11260.
- van Der Linden AM, Simmer F, Cuppen E, Plasterk RH. (2001) The G-protein β -subunit GPB-2 in *Caenorhabditis elegans* regulates the $G\alpha_o$ - $G\alpha_q$ signaling network through interactions with the regulator of G-protein signaling proteins EGL-10 and EAT-16. *Genetics*, **158**, 221-235.
- Viard P, Exner T, Maier U, Mironneau J, Nürnberg B, Macrez N. (1999) $G\beta\gamma$ dimers stimulate vascular L-type Ca^{2+} channels via phosphoinositide 3-kinase. *FASEB J*, **13**, 685-694.
- Wang P, Perfect JR, Heitman J. (2000) The G-protein β subunit GPB1 is required for mating and haploid fruiting in *Cryptococcus neoformans*. *Mol Cell Biol*, **20**, 352-362.
- Watson AJ, Aragay AM, Slepak VZ, Simon MI. (1996) A novel form of the G protein β subunit $G\beta_5$ is specifically expressed in the vertebrate retina. *J Biol Chem*, **271**, 28154-28160.
- Watson AJ, Katz A, Simon MI. (1994) A fifth member of the mammalian G-protein β -subunit family. Expression in brain and activation of the β_2 isotype of phospholipase C. *J Biol Chem*, **269**, 22150-22156.
- Wess J. (1997) G-protein-coupled receptors: molecular mechanisms involved in receptor activation and selectivity of G-protein recognition. *FASEB J*, **11**, 346-354
- Wilkie TM, Gilbert DJ, Olsen AS, Chen XN, Amatruda TT, Korenberg JR, Trask BJ, de Jong P, Reed RR, Simon MI, et al. (1992) Evolution of the mammalian G protein α subunit multigene family. *Nat Genet*, **1**, 85-91.

- Wing MR, Houston D, Kelley GG, Der CJ, Siderovski DP, Harden TK. (2001) Activation of phospholipase C- ϵ by heterotrimeric G protein $\beta\gamma$ -subunits. *J Biol Chem*, **276**, 48257-48261.
- Witherow DS, Wang Q, Levay K, Cabrera JL, Chen J, Willars GB, Slepak VZ. (2000) Complexes of the G protein subunit β_5 with the regulators of G protein signaling RGS7 and RGS9. Characterization in native tissues and in transfected cells. *J Biol Chem*, **275**, 24872-24880.
- Yasuda H, Lindorfer MA, Woodfork KA, Fletcher JE, Garrison JC. (1996): Role of the prenyl group on the G protein γ subunit in coupling trimeric G proteins to A1 adenosine receptors. *J Biol Chem*, **271**, 18588-18595.
- Zhang JH, Barr VA, Mo Y, Rojkova AM, Liu S, Simonds WF (2001) Nuclear localization of G protein β_5 and regulator of G protein signaling 7 in neurons and brain. *J Biol Chem*, **276**, 10284-9.
- Zhang JH, Simonds WF. (2000) Copurification of brain G-protein β_5 with RGS6 and RGS7. *J Neurosci*, **20**, RC59.
- Zhang S, Coso OA, Lee C, Gutkind JS, Simonds WF. (1996) Selective activation of effector pathways by brain-specific G protein β_5 . *J Biol Chem*, **271**, 33575-33579.
- Zhou JY, Siderovski DP, Miller RJ. (2000) Selective regulation of N-type Ca channels by different combinations of G-protein $\beta\gamma$ subunits and RGS proteins. *J Neurosci*, **20**, 7143-7148.
- Zwaal RR, Ahringer J, van Luenen HG, Rushforth A, Anderson P, Plasterk RH. (1996) G proteins are required for spatial orientation of early cell cleavages in *C. elegans* embryos. *Cell*, **86**, 619-629.