REFERENCES

- Abath, F.G.C., Montenegro, S.M.L., Gomes, Y.M. (1998) Vaccines against human parasitic diseases: an overview. *Acta Tropica* **71**, 237-254.
- Adams, R.L.P., Knowler, J.T., Leader, D.P. (1992) The Biochemistry of the Nucleic Acids, 11th Edition. Chapman and Hall.
- Aikawa, M. 1971, Plasmodium: the fine structure of malaria parasites, *Experimental Parasitology* **30**, 284-320.
- Aitman, T.J., Cooper, L.D., Norsworthy, P.J., Wahid, F.N., Gray, J.K., Curtis, B.R., McKeigue, P.M., Kwiatkowski, D., Greenwood, B.M., Snow, R.W., Hill, A.V., Scott, J. (2000) Malaria susceptibility and CD36 mutation. *Nature* **405**, 1015-1016.
- Alvarez, J., Lee, D.C., Baldwin, S.A., Chapman, D. (1987) Fourier transform infrared spectroscopic study of the structure and conformational changes of the human erythrocyte glucose transporter. *The Journal of Biological Chemistry* **262**(8), 3502-3509.
- Arbuckle, M.I., Kane, S., Porter, L.M., Seatter, M.J., Gould, G.W. (1996) Structure-function analysis of liver-type (GLUT2) and brain-type (GLUT3) glucose transporters: Expression of chimeric transporters in *Xenopus* oocytes suggests an important role for putative transmembrane helix 7 in determining substrate selectivity. *Biochemistry* **35**, 16519-16527.
- Baldwin, S.A. (1992) Mechanisms of active and passive transport in a family of homologous sugar transporters found in both prokaryotes and eukaryotes. *Molecular Aspects of Transport Proteins*. Elsevier Science Publishers.
- Baldwin, S.A., Baldwin, J.M., Lienhard, G.E. (1982) Monosaccharide transporter of the human erythrocyte. Characterization of an improved preparation. *Biochemistry* **21**(16), 3837-3842.
- Bannister, L.H., Hopkins, J.M., Fowler, R.E., Krishna, S., Mitchell, G.H. (2000) A brief guide to the ultrastructure of *Plasmodium falciparum* asexual blood stages. *Parasitology Today* **16**(10), 427-433.

- Barrett, M.P., Tetaud, E., Seyfang, A., Bringaud, F., Baltz, T. (1998) Trypanosome glucose transporters. *Molecular and Biochemical Parasitology* **91**, 195-205.
- Benting, J., Mattei, D., Lingelbach, K. (1994) Brefeldin A inhibits transport of the glycophorin-binding protein from *Plasmodium falciparum* into the host erythrocyte. *Biochemical Journal* **300**, 821-826.
- Bianco C, Patrick R, Nussenzweig V. (1970) A population of lymphocytes bearing a membrane receptor for antigen-antibody-complement complexes. I. Separation and characterization. *J Exp Med.* **132**(4), 702-20.
- Bozdech, Z., Van Wye, J., Haldar, K., Schurr, E. (1998) The human malaria parasite *Plasmodium falciparum* exports the ATP-binding cassette protein PFGCN20 to membrane structures in the host red blood cell. *Molecular and Biochemical Parasitology* **97**(1-2), 81-95.
- Bradley, T. (1996) Leicester University, United Kingdom, http://www-micro.msb.le.ac.uk/224/Bradley/History.html
- Bretzel, G., Janeczek, J., Born, J., John, M., Tiedemann, He., Tiedemann, Hi. (1986) Isolation of plasma membranes from *Xenopus* embryos. *Roux's Arch Developmental Biology* **195**, 117-122.
- Bringaud, F. and Baltz, T. (1993) African trypanosome glucose transporter genes: organisation and evolution of a multigene family. *Molecular Biology Evolution* **13**, 1146-1154.
- Brown, G.V., Beck, H-P, Molyneux, M. Marsh, K. (2000) Molecular approaches to epidemiology and clinical aspects of malaria. *Parasitology Today* **16**(10), 448-450.
- Buchs, A.E., Sasson, S., Joost, H.G., Cerasi, E. (1998) Characterisation of GLUT5 domains responsible for fructose transport. *Endocrinology* **139**(3), 827-831.
- Buffet, P.A., Gamain, B., Scheidig, C., Baruch, D., Smith, J.D., Hernandez-Rivas, R., Pouvelle, B., Oishi, S., Fujii, N., Fusai, T., Parzy, D., Miller, L.H., Gysin, J., Scherf, A. (1999) *Plasmodium falciparum* domain mediating adhesion to chondroitin sulfate A: a receptor for human placental infection. *Proceedings of the National Academy of Science of the USA* **96**(22), 12743-12748.
- Cairns, M.T., Alvarez, J., Panico, M., Gibbs, A.F., Morris, H.R., Chapman, D., Baldwin, S.A. (1987) Investigation of the structure and function of the human

erythrocyte glucose transporter by proteolytic dissection. *Biochemica et Biophysica Acta* **905**, 295-310.

- Camacho P, Lechleiter JD. (1993) Increased frequency of calcium waves in Xenopus laevis oocytes that express a calcium-ATPase. *Science*. **260**(5105), 226-229.
- Carayannopoulos, M.O., Chi, M.M-Y., Cui, Y., Pingsterhaus, J.M., McKnight, R.A., Mueckler, M., Devaskar, S.U., Moley, K.H. (2000) GLUT8 is a glucose transporter responsible for insulin-stimulated glucose uptake in the blastocyst. *Proceedings of the National Academy of Science, USA* **97**(13), 7313-7318.
- Carter, N.S., Mamoun, C.B., Liu, W., Silva, E.O., Landfear, S. M., Goldberg, D. E., Ullman, B. (2000) Isolation and functional characterisation of the PfNT1 nucleoside transporter gene from *Plasmodium falciparum*. *Journal of Biological Chemistry* **265**(14), 10683-10691.
- Chin, J.J., Jung, E.K.Y., Jung, C.Y. (1986) Structural basis of human erythrocyte glucose transporter function in reconstructed vesicles. *The Journal of Biological Chemistry* **261**(16), 7101-7104.
- Clark, I.A. and Chaudhri, G. (1988) Tumour necrosis factor may contribute to the anaemia of malaria by causing dyserythropoiesis and erythrophagocytosis. *British Journal of Haematology* **70**, 99-103.
- Clark, I.A. and Cowden, W.B. (1999) Why is the pathology of *falciparum* worse than that of *vivax* malaria? *Parasitology Today* **15**(11), 458-461.
- Clark, I.A. and Scholfield, L. (2000) Pathogenesis of malaria. *Parasitology Today* **16**(10), 451-454.
- Clark, I.A., Rockett, K.A., Cowden, W.B. (1991) Proposed link between cytokines, nitric oxide and human cerebral malaria. *Parasitology Today* **7**, 205-207.
- Clyde DF, Most H, McCarthy VC, Vanderberg JP. (1973) Immunization of man against sporozite-induced falciparum malaria. *Am J Med Sci.***266**(3), 169-77.
- Coady, M.J., Jalal, F., Bissonnette, P., Cartier, M., Wallendorff, B., Lemay, G., Lapointe, J-Y. (2000) Functional studies of a chimeric protein containing portions of the Na^+/glucose and Na^+/*myo*-inositol cotransporters. *Biochemica et Biophysica Acta* **1466**, 139-150.

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- Concha, I.I., Velasquez, F.V., Martinez, J.M., Angulo, C., Droppelmann, A., Reyes, A.M., Slebe, J.C., Vera, J.C., Golde, D.W. (1997) Human erythrocytes express GLUT5 and transport fructose. *Blood* **89**(11), 4190-4195.
- Cooke, B.M. and Cowman, A.F. (2000) Molecular approaches to malaria. *Parasitology Today* **16**(5), 177-178.
- Cooke, B.M., Wahlgren, M., Coppel, R.L. (2000) *Falciparum* malaria: sticking up, standing out and out-standing. *Parasitology Today* **16**(10), 416-420.
- Curtis, C.F. and Lines, J.D. (2000) Should DDT be banned by international treaty? *Parasitology Today* **16**(3), 119-121.
- Deans, J.A., Thomas, A.W., Alderson, T., Cohen, S. (1984) Biosynthesis of a putative protective *Plasmodium knowlesi* merozoite antigen. *Molecular and Biochemical Parasitology* **11**, 189-204.
- Degen, R., Weis, N., Beck, H.P. (2000) *Plasmodium falciparum*: cloned and expressed CIDR domains of PfEMP1 bind to chonroitin sulfate A. *Experimental Parasitology* **95**(2), 113-121.
- Deitsch, K.W. and Wellems, T.E. (1996) Membrane modifications in erythrocytes parasitised by *Plasmodium falciparum. Molecular and Biochemical Parasitology* **76**, 1-10.
- Desai, S.A., Krogstad, D.J., McCleskey, E.W. (1993) A nutrient-permeable channel on the intraerythrocytic malaria parasite. *Nature* **362**(6421), 643-646.
- Divo, A.A., Geary, T.G., Davis, N.L., Jensen, J.B. (1985) Nutrient requirements of *Plasmodium falciparum* in culture. I. Exogenously supplied dialyzable components necessary for continuous growth. *Journal of Protozoology* **32**, 59-64.
- Doolan, D.L. and Hoffman, S.L. (2001) DNA-based vaccines against malaria: status and promise of the Multi-Stage Malaria DNA Vaccine Operation. *International Journal for Parasitology* **31**, 753-762. Patience
- Ducarme, P., Rahman, M., Lins, L., Brasseur, R., (1996) The erythrocyte/brain glucose transporter (GLUT1) may adopt a two-channel transmembrane α/β structure. *Journal of Molecular Modelling* **2**, 27-45.
- Elford, B.C., Cowan, G.M., Ferguson, D.J.P. (1995) Parasite-regulated membrane transport processes and metabolic control in malaria-infected erythrocytes. *Biochemical Journal* **308**, 361-374.

- Elmendorf, H.G. and Haldar, K. (1993) Identification and localisation of ERD2 in the malaria parasite *Plasmodium falciparum*: Separation from sites of sphingomyelin synthesis and implications for organization of the Golgi. *The EMBO Journal* **12**(12), 4763-4773.
- Elmendorf, H.G. and Haldar, K. (1994) *Plasmodium falciparum* exports the Golgi marker sphingomyelin synthase into a tubovesicular network in the cytoplasm of mature erythrocytes. *The Journal of Cell Biology* **124**, 449-462.
- Etlinger, H.M Caspers P., Matile H., Schoenfeld H.J., Stueber D., Takacs B. (1991) Ability of recombinant or native proteins to protect monkeys against heterologous challenge with *Plasmodium falciparum*. *Infectious Immunology* **59**, 3498-3503.
- Fernandez-Reyes D., Craig, A.G., Kyes, S.A., Peshu, N., Snow, R.W., Berendt, A.R., Marsh, K., Newbold, C.I. (1997) A high frequency African coding polymorphism in the N-terminal domain of ICAM-1 predisposing to cerebral malaria in Kenya. *Human Molecular Genetics* **6**, 1357-1360.
- Feugeas, J-P., Neel, D., Pavia, A.A., Laham, A., Goussault, Y., Derappe, C. (1990) Glycosylation of the human erythrocyte glucose transporter is essential for glucose transport activity. *Biochemica et Biophysica Acta* **1030**, 60-64.
- Fischbarg, J., Cheung, M., Czegledy, F., Li, J., Iserovich, P., Kuang, K., Hubbard, J., Garner, M., Rosen, O.M., Golde, D.W., Vera, J.C. (1993) Evidence that facilitative glucose transporters may fold as beta-barrels. *Proceedings of the National Academy of Science USA* **90**, 11658-11662.
- Foley, M. and Tilley, L. (1998) Protein trafficking in malaria-infected erythrocytes. *International Journal for Parasitology* **28**, 1671-1680.
- Fujioka, H. and Aikawa, M. (1993) Morphological changes of clefts in *Plasmodium*-infected erythrocytes under adverse conditions. *Experimental Parasitology* **76**, 302-307.
- Gamain, B., Smith, J.D., Miller, L.H., Baruch, D.I. (2001) Modifications in the CD36 binding domain of the *Plasmodium falciparum* variant antigen are responsible for the inability of chondroitin sulfate A adherent parasites to bind CD36. *Blood* **97**(10), 3268-3274.
- Garcia, J.C., Strube, M., Leingang, K., Keller, K., Mueckler, M.M. (1992) Amino acid substitution at tryptophan 388 and tryptophan 412 of the HepG2 (Glut1)

glucose transporter inhibit transport activity and targeting to the plasma membrane in *Xenopus* oocytes. *The Journal of Biological Chemistry* **267**(11), 7770-7776.

- Gero, A. M. and Kirk, K. (1994) Nutrient trafficking in *Plasmodium*-infected erythrocytes. *Parasitology Today* **10**(10), 393-401.
- Ginsburg, H. and Stein, W.D. (1987) Biophysical analysis of novel transport pathways induced in red blood cell membranes. *Journal of Membrane Biology* **96**, 1-10.
- Ginsburg, H., Kutner, S., Krugliak, M., Cabantchik, Z.I. (1985) Characterisation of permeation pathways appearing in the host membrane of *Plasmodium falciparum* infected red blood cells. *Molecular and Biochemical Parasitology* **14**, 313-322.
- Ginsburg, H., Kutner, S., Zangwil, M., Cabantchik, Z.I. (1986) Selectivity properties of pores induced in host erythrocyte membrane by *Plasmodium falciparum*. Effect of parasite maturation. *Biochimica et Biophysica Acta* **861**, 194-196.
- Goodyer, D., Hayes, D.J., Eisenthal, R. (1997) Efflux of 6-deoxy-D-glucose from *Plasmodium falciparum*-infected erythocytes via two saturable carriers. *Molecular and Biochemical Parasitology* **84**, 229-239.
- Gould, G.W. and Holman, G.D. (1993) The glucose transporter family: structure, function and tissue-specific expression. *Biochemical Journal* **295**, 329-341.
- Gowda, D.C. and Davidson, E.A. (1999) Protein glycosylation in the malaria parasite. *Parasitology Today* **15**(4), 147-152.
- Gritzmacher, C.A. and Reese, R.T. (1982) Translation *in vitro* of RNA from the human malaria parasite *Plasmodium falciparum*. *Bioscience Report* **2**(9), 667-673.
- Haldar, K., Uyetake, L., Ghori, N., Elmendorf, H.G., Li, W. (1991) The accumulation and metabolism of a fluorescent ceramide derivative in *Plasmodium falciparum*-infected erythrocytes. *Molecular and Biochemical Parasitology* **49**, 143-156.
- Hanahan, D., Jessee, J., Bloom, F.R. (1991) Plasmid transformation of *Escherichia coli* and other bacteria. *Methods in Enzymology* **204**, 63-114.
- Harper, P.A., Lisansky, E.T., Sasse, B.E. (1947) Malaria and other insect-borne diseases in the South Pacific campaign. *American Journal of Tropical medicine* **27**, 1-68.

- Hashiramoto, M., Kadowaki, T., Clark, A.E., Muraoka, A., Momomura, K., Sakura, H., Tobe, K., Akanuma, Y., Yazaki, Y., Holman, G.D., Kasuga, M. (1992) Site-directed mutagenesis of GLUT1 in helix 7 residue 282 results in pertubation of exofacial ligand binding. *The Journal of Biological Chemistry* **267**(25), 17502-17507.
- Hastings, I.M. and D'Alessandro, U. (2000) Modelling a predictable disaster: the rise and spread of drug-resistant malaria. *Parasitology Today* **16**(8), 340-347.
- Heal, K.G., Sheikh, N.A., Hollingdale, M.R., Morrow, W.J.W., Taylor-Robinson, A.W.T. (2001) Potentiation by a novel alkaloid glycoside adjuvant of a protective cytotoxic T cell immune response specific for a preerythrocytic malaria vaccine candidate antigen. *Vaccine* **19**, 4153-4161.
- Hediger, M.A., Coady, M.J., Ikeda, T.S., Wright, E.M. (1987) Expression cloning and cDNA sequencing of the Na+/glucose co-transporter. *Nature* **330**(6146), 379-381.
- Holder, A.A., Blackman, M.J., Borre, M., Burghaus, P.A., Chappel, J.A., Keen, J.K., Ling, I.T., Ogun, S.A., Owen, C.A., Sinha, K.A. (1994) Malaria parasites and erythrocyte invasion. *Biochemical Society Transactions* **22** (2), 291-295.
- Hommel, M. (1990) Cytoadherence of malaria-infected erythrocytes. *Blood Cells* **16**(2-3), 605-619.
- Howard, R.F. and Schmidt, C.M. (1995) The secretory pathway of *Plasmodium falciparum* regulates transport of p82/RAP-1 to the rhoptries. *Molecular and Biochemical Parasitology* **74**, 43-54.
- Howard, R.J. and Pasloske, B.L. (1993) Target antigens for asexual malaria vaccine development. *Parasitology Today* **9**(10), 369-372.
- Hresko, R.C., Kruse, M., Strube, M., Mueckler, M. (1994) Topology of the Glut 1 glucose transporter deduced from glycosylation scanning mutagenesis. *Journal of Biological Chemistry* **269**(32), 20482-20488.
- Hruz, P.W. and Mueckler, M.M. (1999) Cysteine-scanning mutagenesis of transmembrane segment 7 of the GLUT1 glucose transporter. *The Journal of Biological Chemistry* **279**(51), 36176-36180.
- Inukai, K., Katagiri, H., Takata, K., Asano, T., Anai, M., Ishihara, H., Nakazaki, M., Kikuchi, M., Yazaki, Y., Oka, Y. (1995) Characterization of rat GLUT5 and

functional analysis of chimeric proteins of GLUT1 glucose transporter and GLUT5 fructose transporter. *Endocrinology* **136**(11), 4850-4857.

- Jones, T.R. and Hoffman, S.L. (1994) Malaria vaccine development. *Clinical Microbiology Review* **7**, 303-310.
- Kassenbrock, C.R., Garcia, P.D., Wlater, P., Kelly, R.B. (1988) Heavy-chain binding protein recognises aberrant polypeptides translocated *in vivo*. *Nature* **333**, 90-93.
- Kayano, T., Burant, C.F., Fukumoto, H., Gould, G.W., Fan, Y., Eddy, R.L., Byers, M.G., Shows, T.B., Seino, S., Bell, G.I. (1990) Human facilitative glucose transporters. *The Journal of Biological Chemsitry* **265**(22), 13276-13282.
- Keough, D.T., Ng, A.L., Winzor, D.J., Emmerson, B.T., de Jersey, J. (1999) Purification and characterization of *Plasmodium falciparum* hypoxanthine–guanine–xanthine phosphoribosyltransferase and comparison with the human enzyme. *Molecular and Biochemical Parasitology* **98**, 29-41.
- Kirk, K. (2001) Membrane transport in the malaria-infected erythrocyte. *Physiological Reviews* **81**(2), 495-537.
- Kirk, K., Ashworth, K.J., Elford, B.C., Pinches, R.A., Ellory, J.C. (1991) Characteristics of $^{86}Rb^{+}$ transport in human erythrocytes infected with *Plasmodium falciparum*. *Biochemica et Biophysica Acta* **1061**, 305-308.
- Kirk, K., Horner, H.A., Kirk, J. (1996) Glucose uptake in *Plasmodium falciparum*-infected erythrocytes is an equilibrative not an active process. *Molecular and Biochemical Parasitology* **82**, 196-205.
- Kolakovich, K.A., Gluzman, I.Y., Duffin, K.L., Goldberg, D.E. (1997) Generation of heamoglobin peptides in the acidic digestive vacuole of *Plasmodium falciparum* implicates peptide transport in amino acid production. *Molecular and Biochemical Parasitology* **87**, 123-135.
- Krause, T., Luersen, K., Wrenger, C., Gilberger, T.W., Muller, S., Walter, R.D. (2000) The ornithine decarboxylase domain of the bifunctional ornithine decarboxylase/S-adenosylmethionine decarboxylase of *Plasmodium falciparum*: recombinant expression and catalytic properties of two different constructs. *Biochemical Journal* **352**(2), 287-297.
- Krieg PA, Melton DA. (1984) Functional messenger RNAs are produced by SP6 in vitro transcription of cloned cDNAs. *Nucleic Acids Res.* **1912**(18), 7057-70.

- Krishna, S., Woodrow, C., Webb, R., Penny, J., Takeyasu, K., Kimura, M., East, J.M. (2001) Expression and functional characterisation of a *Plasmodium falciparum* Ca2+-ATPase (PfATP4) belonging to a subclass unique to apicomplexan organisms. *Journal of Biological Chemistry* **276**(14), 10782-10787.
- Krishna, S., Woodrow, C.J., Burchmore, R.J.S., Saliba, K.J., Kirk, K. (2000) Hexose transport in asexual stages of *Plasmodium falciparum* and kinetoplastidae. *Parasitology Today* **16**(12), 516-521.
- Kumar, N. and Zheng, H. (1992) Nucleotide sequence of a *Plasmodium falciparum* stress protein with similarity to mammalian 78-kDa glucose-regulated protein. *Molecular and Biochemical Parasitology* **56**, 353-356.
- Kumar, N., Koski, G., Harada, M., Aikawa, M., Zheng, H. (1991) Induction and localisation of *Plasmodium falciparum* stress proteins related to the heat shock protein 70 family. *Molecular and Biochemical Parasitology* **48**, 47-58.
- Kumar, N., Syin, C., Carter, R., Quakyi, I., Miller, L.H. (1988) *Plasmodium falciparum* gene encodes a protein similar to the 78-kDa rat glucose-regulated stress protein. *Proceedings of the National Academy of Science of the United States of America* **85**, 6277-6281.
- Kwiatkowski, D. and Marsh, K. (1997) Development of a malaria vaccine. *Lancet* **350**, 1696-1701.
- Langreth, S.G.; Jensen, J.B.; Reese, R.T., Trager, W. (1978). Fine structure of human malaria *in vitro*. *Journal of Protozoology* **25**(4), 443-452.
- Lauer, S.A., Rathod, P.K., Ghori, N., Haldar, K. (1997) A membrane network for nutrient import in red cells infected with the malaria parasite. *Science* **276**, 1122-1125.
- Liem HH, Noy N, Muller-Eberhard U. (1994) Studies on the efflux of heme from biological membranes. *Biochim Biophys Acta.* **1194**(2), 264-70.
- Liman ER, Tytgat J, Hess P. (1992) Subunit stoichiometry of a mammalian K+ channel determined by construction of multimeric cDNAs. *Neuron.* **9**(5), 861-71.
- Lindsay, S.W. and Gibson, M.E. (1988) Bednets revisited – old idea new angle. *Parasitology Today* **4**.
- Lines, J.D. and Zaim, M. (2000) Insecticide products: treatment of mosquito nets at home. *Parasitology Today* **16**(3), 91-92.

- Lingelbach, K. (1997) Protein trafficking in the *Plasmodium falciparum*-infected erythrocyte – from models to mechanisms. *Annals of Tropical Medicine and Parasitology* **91**(5), 543-549.
- Lippincott-Schwartz, J., Yuan, L.C., Bonifacino, J.S., Klausner, R.D. (1989) Rapid redistribution of Golgi proteins into the ER in cells treated with Brefeldin A: evidence for the membrane cycling from Golgi to ER. *Cell* **56**, 801-813.
- Lodish, H., Baltimore, D., Berk, A., Zipursky, S.L., Matsudaira P., Darnell, J. (1995) Molecular Cell Biology. Third Edition. W. H. Freeman & Company.
- Malaria: an Online Resource (2001) http://www.rph.wa.gov.au/labs/haem/malaria.
- Matthews, G.M. (1999) Protein Expression: A Practical Approach. Expression in *Xenopus* oocytes and cell-free extracts. S. J. Higgins, B. D. Hames. USA, Oxford: 29-59.
- Misumi, Y., Misumi, Y., Miki, K., Takatsuki, A., Tamura, G., Ikehara, Y. (1986) Novel blockage by Brefeldin A of intracellular transport of secretory proteins in cultured rat hepatocytes. *The Journal of Biological Chemistry* **261**(24), 11398-11403
- Mueckler, M. (1994) Facilitative glucose transporters. *European Journal of Biochemistry* **219**, 713-725.
- Mueckler, M. and Makepeace, C. (1999) Transmembrane segment 5 of the Glut1 glucose transporter is an amphipathic helix that forms part of the sugar permeation pathway. *The Journal of Biological Chemistry* **274**(16), 10923-10926.
- Mueckler, M., Caruso, C., Baldwin, S.A., Panico, M., Blench, I., Morris, H.R., Allard, W.J., Lienhard, G.E., Lodish, H.F. (1985) Sequence and structure of a human glucose transporter. *Science* **229**, 941-945.
- Mueckler, M., Weng, W., Kruse, M. (1994) Glutamine 161 of Glut1 glucose transporter is crucial for transport activity and exofacial ligand binding. *The Journal of Biological Chemistry* **269**(32), 20533-20538.
- Munro, S. and Pelham, H.R.B. (1987) A C-terminal signal prevents secretion of luminal ER proteins. *Cell* **48**, 899-907.
- Mwenesi, H.A. (1999) Insecticide impregnated bednets for Africa – implimentation, prospects and challenges for malaria control. *Proceedings of the MIM African Malaria Conference,* 186-193.

- Noel, L.E. and Newgard, C.B. (1997) Structural domains that contribute to substrate specificity in facilitated glucose transporters are distinct from those involved in kinetic function: studies with GLUT-1/GLUT-2 chimeras. *Biochemistry* **36**(18), 5465-5475.
- Nussenzweig RS, Vanderberg J, Most H, Orton C. (1967) Protective immunity produced by the injection of x-irradiated sporozoites of plasmodium berghei. *Nature.* **216**,160-2.
- Oatey, P.B., Van Weering, D.H., Dobson, S.P., Gould, G.W., Tavare, J.M. (1997) GLUT4 vesicle dynamics in living 3T3 L1 adipocytes visualised with green-fluorescent protein. *Biochemical Journal* **327**(3), 637-642.
- Oka, Y., Asano, T., Shibasaki, Y., Lin, J-L., Tsuukda, K., Katagiri, H., Akanuma, Y., Takaku, F. (1990) C-terminal truncated glucose transporter is locked into an inward-facing form without transport activity. *Nature* **345**, 550-553.
- Oliveira-Ferreira, J. and Daniel-Ribeiro, C.T. (2001) Protective $CD8^+$ T cell responses against the pre-erythrocytic stages of malaria parasites: an overview. *Memoria Instituto Oswaldo Cruz* **96**(2), 221-227.
- Olliaro, P.L. and Yuthavong, Y. (1999) An overview of chemotherapeutic targets for antimalarial drug discovery. *Pharmacology and Therapy* **81**(2), 91-110.
- Olsowski, A., Monden, I., Keller, K. (1998) Cysteine-scanning mutagenesis of flanking regions at the boundary between external loop I or IV and transmembrane segment II or VII in the GLUT1 glucose transporter. *Biochemistry* **37**, 10738-10745.
- Olsowski, A., Monden, I., Krause, G., Keller, K. (2000) Cysteine scanning mutagenesis of helices 2 and 7 in GLUT1 identifies an exofacial cleft in both transmembrane segments. *Biochemistry* **39**, 2469-2474.
- Othoro, C., Lal, A.A. Nahlen, B., Koech, D., Orago, A.S.S., Udhayakumar, V. (1999) A low interleukin-10 tumor necrosis factor-α ratio is associated with malaria anemia in children residing in a holoendemic malaria region in Western Kenya. *The Journal of Infectious Diseases* **179**, 279-282.
- Pagano, R.E., Sepanski, M.A., Martin, O.C. (1989) Molecular trapping of a fluorescent ceramide analogue at the Golgi apparatus of fixed cells: interaction with endogenous lipids provides a *trans* Golgi marker for both light and electron microscopy. *Journal of Cell Biology* **109**, 2067-2079.

- Pao, S.S., Paulsen, I.T., Saier, M.H. (1998) Major facilitator superfamily. *Microbiology and Molecular Biology Reviews* **62**(1), 1-34.
- Parker, M.D., Hyde, R.J., Yao, S.Y.M., Robert, L.M., Cass, C.E., Young, J.D., Conkey, G.A.M., Baldwin, S.A. (2000) Identification of a nucleoside/nucleobase transporter from *Plasmodium falciparum*, a novel target for anti-malarial chemotherapy. *Biochemical Journal* **349**, 67-75.
- Penny, J.I., Hall, S.T., Woodrow, C.J., Cowan, G.M., Gero, A.M., Krishna, S. (1998) Expression of substrate-specific transporters encoded by *Plasmodium falciparum* in *Xenopus laevis* oocytes. *Molecular and Biochemical Parasitology* **93**(1), 81-89.
- Powell, K.A., Campbell, L.C., Tavare, J.M., Leader, D.P., Wakefield, J.A., Gould, G.W. (1999) Trafficking of Glut4-green fluorescent protein chimeras in 3T3-L1 adipocytes suggests distinct internalisation mechanisms regulating cell surface glut4 levels. *Biochemical Journal* **344**(2), 535-543.
- Preiser, P., Kaviratne, M., Khan, S., Bannister, L., Jarra, W. (2000) The apical organelles of malaria merozoites: host cell selection, invasion, host immunity and immune evasion. *Microbes and Infection* **2**, 1461-1477.
- Renia, L., Marussig, M.S., Grillot, D., Pied, S., Corradin, G., Miltgen, F., Del Giudice, G., Mazier, D. (1991) *In vitro* activity of $CD4^+$ and $CD8^+$ T lymphocytes from mice immunised with synthetic malaria peptides. *Proceedings of the National Academy of Science, USA* **88**, 7963-7967.
- Rohdich, F., Eisenreich, W., Wungsintawwekul, J., Hecht, S., Schuhr, C.A., Bacher, A. (2001) Biosynthesis of terpenoids 2C-Methyl-D-erythritol 2,4-cyclodiphosphate synthase (IspF) from *Plasmodium falciparum*. *European Journal of Biochemistry* **268**(11), 3190-3197.
- Rosenthal, P.J. and Meshnick, S.R (1996) Hemoglobin catabolism and iron utilization by malaria parasites. *Molecular and Biochemical Parasitology* **83**, 131-139.
- Rychlik, W., Spencer, W.J., Roads, R.E. (1990) Optimisation of the annealing temperature for DNA amplification *in vitro*. *Nucleic Acids Research* **18**, 6409-6412
- Sambrook, J., Fritsch, E.F., Maniatis, T. (1989) *Molecular cloning, a laboratory manual*.Cold Spring Harbor, Cold Spring Habor Laboratory Press.

- Saul, A., Lord R., Jones G.L., Spencer L. (1992) Protective immunization with invariant peptides of the *Plasmodium falciparum* antigen MSA2. *Journal of Immunology* **148**, 208-211.
- Schofield, L., Villaquiran, J., Ferreira, A., Schellekens, H., Nussenzweig, R.S., Nussenzweig, V. (1987) γ interferon $CD8^+$ cells and antibodies required for immunity to malaria sporozoites. *Nature* **330**, 664-666.
- Seatter, M.J., De La Rue, S.A., Porter, L.M., Gould, G.W. (1998) QLS motif in transmembrane helix VII of the glucose transporter family interacts with the C-1 position of D-glucose and is involved in substrate selection at the exofacial binding site. *Biochemistry* **37**, 1322-1326.
- Seguin, M.C., Klots, F.W., Scheneider, I., Weir, J.P., Goodbary, M., Slayter, M., Raney, J.J., Aniagolu, J.U., Green, S.J. (1994) Induction of nitrix oxide synthetase protects against malaria in mice exposed to irradiated *P. berghei* infected mosquitoes involvement of interferon-gamma and $CD8^+$ T cells. *Journal of Experimental Medicine* **180**, 353-358.
- Sharma, S. (2000) The Institute for Fundamental Research, Bombay, India, http://www.malaria.org/lifecycle.html
- Sherman, I.W. (1988) Mechanisms of molecular trafficking in malaria. *Parasitology* **96**, S57-S81.
- Sherman, I.W. and Tanigoshi, L. (1974) Glucose transport in the malarial (*Plasmodium lophurae*) infected erythrocyte. *Journal of Protozoology* **21**, 603-7.
- Singh, S., Puri, S.K., Singh, S.K., Srivastava, R., Gupta, R.C., Pandey, V.C. (1997) Characterisation of simian malaria parasite (*Plasmodium knowlesi*)-induced putrescine transport in rhesus monkey erythrocytes. A novel putrescine conjugate arrests *in vitro* growth of simian parasite (*Plasmodium knowlesi*) and cures multidrug resistant murine malaria (*Plasmodium yoelii*) infection *in vivo*. *Journal of Biological Chemistry* **272**, 13505-13511.
- Smart, T.G. and Krishek, B.J. (1995) *Xenopus* oocyte microinjection and ion-channel expression. *Neuromethods* **26**, 259-307.
- Tamori, Y., Hashiramoto, M., Clark, A.E, Mori, H., Muraoka, A., Kadowaki, T., Holman, G.D., Kasuga, M. (1994) Substitution at Pro^{385} of GLUT1 perturbs the glucose transport function by reducing conformational flexibility. *The Journal of Biological Chemistry* **269**(4), 2982-2986.

- Tanabe, K., (1990) Glucose transport in malaria infected erythrocytes. *Parasitology Today* **6**(7), 225-229.
- Tetaud, E., Barrett, M.P., Bringaud, F., Baltz, T. (1997) Kinetoplastid glucose transporters. *Biochemical Journal* **325**, 569-580.
- Toure', Y.T. (1999) Malaria vector population studies: potential contribution for selective control measures. *Proceedings of the MIM African Malaria Conference*, 179-185.
- Trager, W. and Jensen, J.B. (1976) Human malaria parasite in continuos cultures. *Science* **193**, 673-675.
- Tripatara, A. and Yuthavong, Y. (1986) Effect of inhibitors on glucose transport in malaria (*Plasmodium berghei*) infected erythrocytes. *International Journal for Parasitology* **16**, 441-446.
- Tsuji, M., Romero, P.J., Nussenzweig, R.S., Zavala, F. (1990) $CD4^+$ cytolitic T cell clone confers protection against murine malaria. *Journal of Experimental Medicine* **172**, 1353-1358.
- Upston, J.M. and Gero, A.M. (1995) Parasite-induced permeation of nucleosides in *Plasmodium falciparum* malaria. *Biochemica et Biophysica Acta* **1236**, 249-258.
- van Bemmelen, M.X., Beghdadi-Rais, C., Desponds, C., Vargas, E., Herrera, S., Reymond, C.D., Fasel, N. (2000) Expression and one-step purification of *Plasmodium* proteins in *Dictyostelium*. *Molecular and Biochemical Parasitology* **111**(2), 377-390.
- van Es, H.H., Karcz, S., Chu, F., Cowman, A.F., Vidal, S., Gros, P., Schurr, E. (1994) Expression of the *Plasmodium* PfMDR1 gene in mammalian cells is associated with increased susceptibility to chloroquine. *Molecular and Cellular Biology* **14**(4), 2419-2428.
- Van Hensbroek, M.B. (1996) A trial of artemether or quinine in children with cerebral malaria. *New England Journal of Medicine* **335**, 69-75.
- Van Wye, J., Ghori, N., Webster, P., Mitschel, R.R., Elmendorf, H.G., Haldar, K. (1996) Identification and localisation of rab6, separation of rab6 from ERD2 and implications for an 'unstacked' Golgi, in *Plasmodium falciparum*. *Molecular and Biochemical Parasitology* **83**, 107-120.

- Virtual Naval Hospital, Navy Medical Department Guide to Malaria Prevention and Control (1998) http://www.vnh.org/Malaria/Malaria.html
- Waddell, I.D., Zomerschoe, A.G., Voice, M.W., Burchell, A. (1992) Cloning and expression of a hepatic microsomal glucose transport protein. *Biochemical Journal* **286**, 173-177.
- Walmsley, A.R. (1988) The dynamics of the glucose transporter. *Trends in Biochemical Sciences* **13**, 226-231.
- Walmsley, A.R., Barrett, M.P., Bringaud, F., Gould, G.W. (1998) Sugar transporters from bacteria, parasites and mammals: structure activity relationships. *Trends in Biochemical Sciences* **23**, 476-481.
- Wang, J., Kim, S., Gallagher, S. (1995) Dealing with A/T content differences when using the H33258/TKO 100 DNA assay. *Hoefer news* **3**.
- Wang, L., Richie, T.L., Stowers, A., Nhan, D.H., Coppel, R.L. (2001) Naturally acquired antibody responses to *Plasmodium falciparum* merozoite surface protein 4 in a population living in an area of endemicity in Vietnam. *Infection and Immunology* **69**(7), 4390-4397.
- Weiss, W.R., Sedegah, M., Beaudoin, R.L., Miller, L.H., Good, M.F. (1988) $CD8^+$ T cells (cytotoxic/suppressor) are required for protection in mice immunised with malaria sporozoites. *Proceedings of the National Academy of Science, USA* **85**, 573-576.
- Wellner, M., Monden, I., Keller, K. (1994) The role of cysteine residues in glucose-transporter-GLUT1-mediated transport and transport inhibition. *Biochemical Journal* **299**, 813-817.
- Wellner, M., Monden, I., Mueckler, M.M., Keller, K. (1995) Functional consequences of proline mutations in the putative transmembrane segment 6 and 10 of the glucose transporter GLUT1. *European Journal of Biochemistry* **227**, 454-458.
- Winkler, S., Willheim, M., Baier, K., Schmid, D., Aichelburg, A., Graninger, W., Kremsner, P.G. (1999) Frequency of cytokine-producing T cells in patients of different age groups with *Plasmodium falciparum* malaria. *The Journal of Infectious Diseases* **179**, 209-216.
- Winstanley, P.A. (2000) Chemotherapy for *falciparum* malaria: the armoury, the problems and the prospects. *Parasitology Today* **16**(4), 146-153.

- Wiser, M.F., Lanners, H.N., Bafford, R.A., Favaloro, J.M. (1997) A novel alternative secretory pathway for the export of *Plasmodium* proteins into the host erythrocyte. *Proceedings of the National Academy of Science of the United States of America* **94**, 9108-9113.
- Withers-Martinez C, Carpenter EP, Hackett F, Ely B, Sajid M, Grainger M, Blackman MJ. (1999) PCR-based gene synthesis as an efficient approach for expression of the A+T-rich malaria genome. *Protein Eng.* **12**(12), 1113-20.
- Woodrow, C.J., Burchmore, B.J., Krishna, S. (2000) Hexose permeation pathways in *Plasmodium falciparum*-infected erythrocytes. *Proceedings of the National Academy of Science of USA* 97 (18), 9931-9936.
- Woodrow, C.J., Penny, J.L., Krishna, S. (1999) Intraerythrocytic *Plasmodium falciparum* expresses a high affinity facilitative hexose transporter. *The Journal of Biological Chemistry* **274**(11), 7272-7277.
- Wu, L., Fritz, J.D., Powers, A.C. (1998) Different functional domains of GLUT2 glucose transporter are required for glucose affinity and substrate specificity. *Endocrinology* **139**(10), 4250-4212.
- Yao, S.Y.M., Cass, C.E., Young, J.D. (2000) Membrane Transport, Chapter 3, The *Xenopus* oocyte expression system for the cDNA cloning and characterisation of plasma membrane transport proteins. S. A. Baldwin. USA, Oxford: 47-78.

APPENDIX I:

CLONING VECTORS

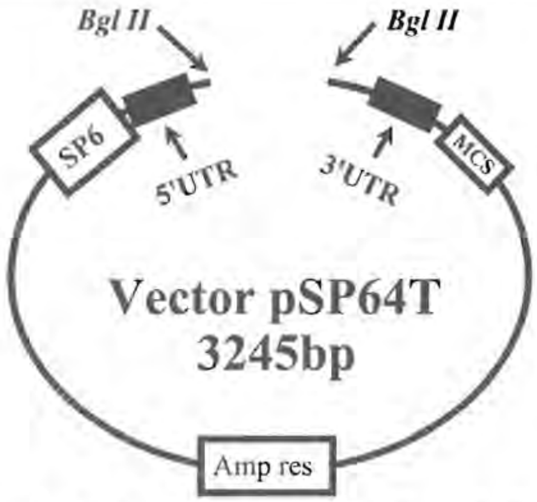


Figure Ia: Schematic representation of the *Xenopus* oocyte expression vector pSP64T. UTR = untranslated region of the *β*-globin gene of *Xenopus*, Amp^r = ampicillin resistant gene, SP6 = RNA promoter region used for cRNA transcription.

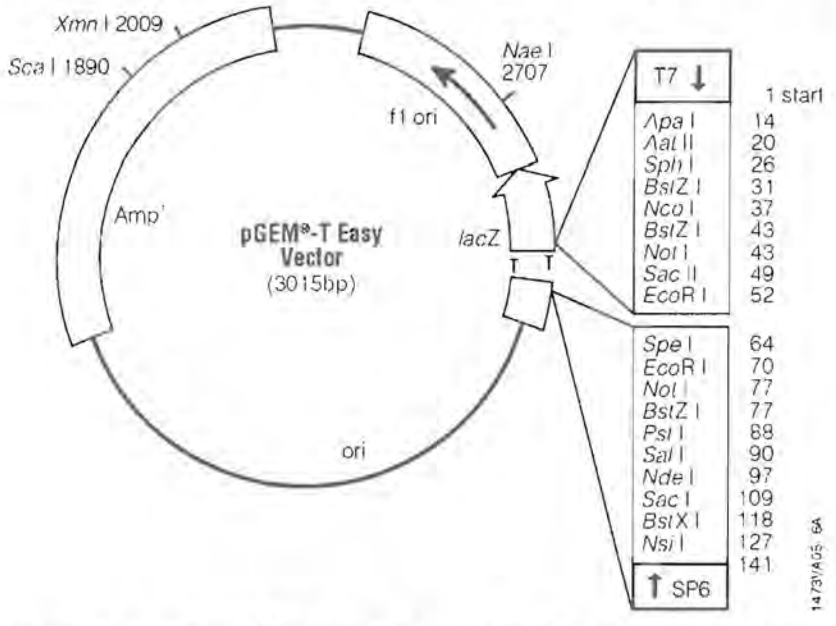
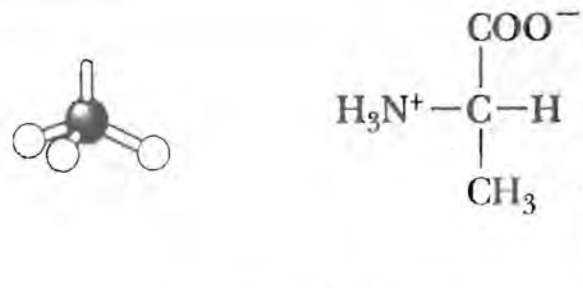


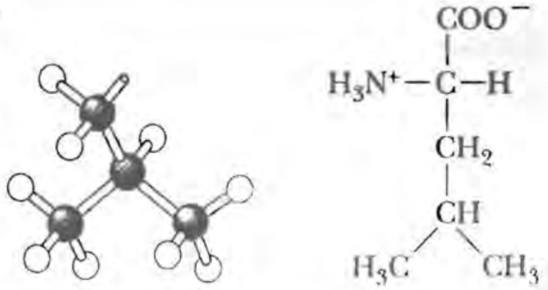
Figure Ib: pGEM®-T Easy Vector circle map. The vector is prepared by cutting Promega's pGEM-T Easy Vector with *Eco*R V and adding a 3' terminal thymidine to both ends. The vector contains a SP6 and T7 polymerase promoter flanking a multiple cloning site within the *α*-peptide coding region of the enzyme *β*-galactosidase. The vector also contains the origin of replication of the filamentous phage f1 (f1 ori) for the preparation of single-stranded DNA, as well as an ampicillin resistant gene.

APPENDIX II:

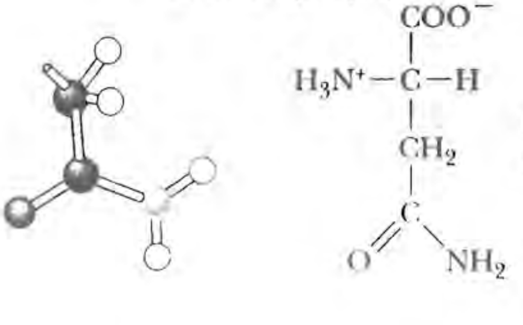
AMINO ACID STRUCTURES



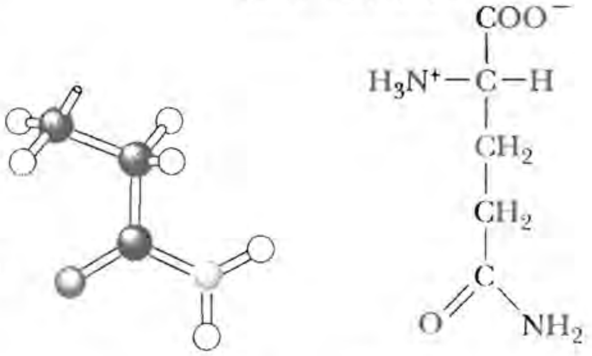
Alanine (Ala, A)



Leucine (Leu, L)

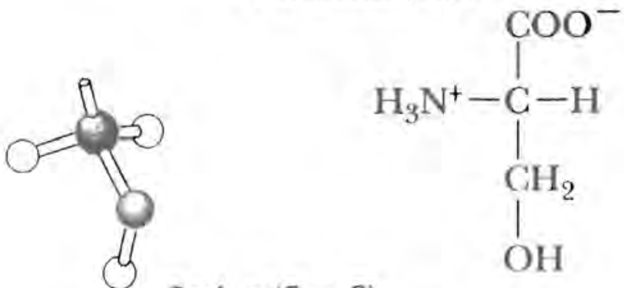


Asparagine (Asn, N)



Glutamine (Gln, Q)

Threonine (Thr, T)



Serine (Ser, S)

Figure IIa: Structures of amino acids used in the mutational experiments. Amino acids are shown in their predominant forms at pH 7. The R groups are shown as ball and stick models and can be seen as structures against a white background. Amino acids in green have polar, uncharged side chains. Amino acids in yellow have nonpolar side chains.

APPENDIX III:

OVERLAPPING ALIGNMENT OF FACILITATOR SUPERFAMILY HELICES

Figure IIIa: Amino acid sequence and helical mapping of the PfHT1 and GLUT1 glucose transporters and Chimeras 1 and 2. Transmembrane regions are in bold and underlined. The transmembrane region number is indicated above each region.

	1
Chimaera 1	MTKSSKDICSENEGKKNGKSGFFSTSFK**YVLSACIASFIFGYQVSV**
Chimaera 2	MTKSSKDICSENEGKKNGKSGFFSTSFK**YVLSACIASFIFGYQVSV**
PfHT1	MTKSSKDICSENEGKKNGKSGFFSTSFK**YVLSACIASFIFGYQVSV**
Rat GLUT1	MEPSSKKLTGR**LMLAVGGAVLGSLQFGYNTGVI**NAPQKVIEEFYNQ
	2
Chimaera 1	**LN**TIKNFIVVEFEWCKGEKDRLNCSNNTIQSS**FLLASVFIGAVLGC**
Chimaera 2	**LN**TIKNFIVVEFEWCKGEKDRLNCSNNTIQSS**FLLASVFIGAVLGC**
PfHT1	**LN**TIKNFIVVEFEWCKGEKDRLNCSNNTIQSS**FLLASVFIGAVLGC**
Rat GLUT1	TWVHRYGESILPTTLTT**LWSLSVAIFSVGGMIGSFSVGLFV**NRFGR
	3
Chimaera 1	**GFSGYL**VQFGRR**LSLLIIYNFFFLVSILTSIT**HHFHTILFAR**LLSG**
Chimaera 2	**GFSGYL**VQFGRR**LSLLIIYNFFFLVSILTSIT**HHFHTILFAR**LLSG**
PfHT1	**GFSGYL**VQFGRR**LSLLIIYNFFFLVSILTSIT**HHFHTILFAR**LLSG**
Rat GLUT1	RNS**MLMMNLLAFVSAVLMGFS**KLGKSFEM**LILGRFIIGVYCGLTTG**
	4 5
Chimaera 1	**FGIGLVTVSVPMYI**SEMTHKDKKG**AYGVMHQLFITFGIFVAVMLGL**
Chimaera 2	**FGIGLVTVSVPMYIS**EMTHKDKKGAYG**VMHQLFITFGIFVAVMLGL**
PfHT1	**FGIGLVTVSVPMYIS**EMTHKDKKGAYG**VMHQLFITFGIFVAVMLGL**
Rat GLUT1	**FVPMYVG**EVSPTAFRGA**LGTLHQLGIVVGILIAQVFGL**DSIMGNKD
	6 6
Chimaera 1	**AMG**EGPKADSTEPLTSFAKLWWR**LMFLFPSVISLIGILALVVF**FKE
Chimaera 2	**A**MGEGPKADSTEPLTSFAKLWWR**LMFLFPSVISLIGILALVVF**FKE
PfHT1	**A**MGEGPKADSTEPLTSFAKLWWR**LMFLFPSVISLIGILALVVF**FKE
Rat GLUT1	**LWPLLLSIIFIPALLQCIVL**PFCPESPRFLLINRNEENRAKSVLKK
Chimaera 1	ETPYFLFEKGRIEESKNILKKIYETDNVDEPQEMKEEGRQMMREKK
Chimaera 2	ETPYFLFEKGRIEESKNILKKIYETDNVDEPLNAIKEAVEQNESAK
PfHT1	ETPYFLFEKGRIEESKNILKKIYETDNVDEPLNAIKEAVEQNESAK
Rat GLUT1	LRGTADVTHDLQEMKEESRQMMREKKVTILELFRSPAYRQP**ILIAV**
	7 8
Chimaera 1	VTILELFRSPAYRQ**PILIAVVLQLSQQLSGINAV**FYYSTSIFEKAG
Chimaera 2	KNSLSLLSALKIPSYRYV**IILGCLLSGLQQFTGINVLV**SNSNELYK
PfHT1	KNSLSLLSALKIPSYRYV**IILGCLLSGLQQFTGINVLV**SNSNELYK
Rat GLUT1	**VLQLSQQLSGINAVF**YYSTSIFEKAGVQQ**PVYATIGSGIVNTAFTV**

8 9

Chimaera 1 VQQPVY**ATIGSGIVNTAFTVVSLFVV**ERAGRRTLHL**IGLAGMAGCA**
Chimaera 2 EFLDSH**LITILSVVMTAVNFLMTFPAIYIV**EKLGRK**TLLLWGCVGV**
PfHT1 EFLDSH**LITILSVVMTAVNFLMTFPAIYI**VEKLGRK**TLLLWGCVGV**
Rat GLUT1 **VSLFVV**ERAGRRTLHL**IGLAGMAGCAILMTIALALL**EQLPWMSY**LS**

10

Chimaera 1 **VLMTIALALL**EQLPWMSY**LSIVAIFGFVAFFEVGPGPIPWFIV**AEL
Chimaera 2 **LVAYLPTAIA**NEINRNSNFVKI**LSIVATFVMIISFAVSYGPVLWIY**
PfHT1 **LVAYLPTAIA**NEINRNSNFVKI**LSIVATFVMIISFAVSYGPVLWIY**
Rat GLUT1 **IVAIFGFVAFFEVGPGPIPWFIV**AELFSQGPRP**AAIAVAGFSNWTS**

11 12

Chimaera 1 FSQGPRP**AAVAVAGFSNWTSNFIVGMC**FQYVEQLCGP**YVFIIFTVL**
Chimaera 2 LHEMFPSEIKDS**AASLASLVNWVCAIIVVF**PSDIIIKKSPSI**LFIV**
PfHT1 LHEMFPSEIKDS**AASLASLVNWVCAIIVVF**PSDIIIKKSPSI**LFIV**
Rat GLUT1 **NFIVGMC**FQYVEQLC**GPYVFIIFTVLLVLFFIFTY**FKVPETKGRTF

12

Chimaera 1 **LVLFFIFTYF**KVPETKGRTFDEIASGFRQGGASQSDKTPEELFHPL
Chimaera 2 **FSVMSILTFFFIFFFI**KETKGRTFDEIASGFRQGGASQSDKTPEEL
PfHT1 **FSVMSILTFFFIFFFI**KETKGGEIGTSPYITMEERQKHMTKSVV
Rat GLUT1 DEIASGFRQGGASQSDKTPEELFHPLGADSQV

Chimaera 1 GADSQV
Chimaera 2 FHPLGADSQV