

LITERATURE CITED

- Arnold, E., K. Das, P.N. Yadav, Y. Hsiou, P.L. Boyer and S.H. Hughes. 1996. Tageting HIV reverse transcriptase for anti-AIDS drug design. **Drug. Des. Discov.** 13: 29-47.
- Bednarek, E., J.C. Dobrowolski and K. Kamińska-Trela. 2003. Theoretical and experimental ^1H , ^{13}C and ^{15}N NMR spectra of monomethyl substituted tetramethyl 9a*H*-and 4*H*-quinolizine-1,2,3,4-tetracarboxylate. **J. Mol. Struct.** 651-653: 719-727.
- Berman, H.M., J. Westbrook, Z. Feng, G. Gililand, T.N. Bhat, H. Weissig and I.N. Shindyalov, P.E. Bourne. 2000. Protein data bank. **Nucleic. Acids. Res.** 28: 235-242.
- Buckingham, A.D. 1960. Chemical shifts in the nuclear magnetic resonance spectra of molecules containing polar groups. **Can. J. Chem.** 38: 300-307.
- _____. and T.P. Schaefer, W.G. Schneider. 1960. Solvent effects in nuclear magnetic resonance spectra. **J. Chem. Phys.** 32: 1227-1233.
- Casanovas, J., A.M. Namba, S. LeÓN, Gilberto L.B. Aquino, Gil Valdo José da Silva and C. Alemán. 2001. Calculated and experimental NMR chemical shifts of p-menthane-3,9-diols. A combination of molecular dynamics and quantum mechanics to determine the structure and the solvent. **J. Org. Chem.** 66: 3775-3782.
- Case, D. A., D.A. Pearlman, J.W. Caldwell, T.E.C. III, J. Wang, W.S. Ross, C. Simmerling, T. Darden, K.M. Merz, R.V. Stanton, A. Cheng, J.J. Vincent, M. Crowley, V. Tsui, H. Gohlke, R. Radmer, Y. Duan, J. Pitera, I. Massova, G. L.

Seibel, U.C. Singh, P. Weiner, and P. A. Kollman. 2002. **AMBER 7** University of California, San Francisco, CA.

Cheeseman, J.R. G.W. Trucks, T.A. Keith and M.J. Frisch. 1996. A comparison of models for calculating nuclear magnetic resonance shielding tensors. **J. Chem. Phys.** 104: 5497-5509.

Cossi, M., G. Scalmani, N and Rega, V. Barone. 2002. New developments in the polarizable continuum model for quantum mechanical and classical calculations on molecules in solution. **J. Chem. Phys.** 117: 43-54.

Cramer, C.J. and D.G. Truhlar. 1995. Continuum salvation models: Classical and quantum mechanical implementations. Review in Computational Chemistry , Lipkowitz KB, Boyd D B (eds.), VCH, New York, Vol. 6, pp. 1-72, 1995.

Dapprich S., I. Komaromi, K.S. Byun, K. Morokuma, and M.J. Frisch. 1999. A New ONIOM implementation in Gaussian98. Part I. The calculation of energies, gradients, vibrational frequencies and electric field derivatives. **J. Mol. Struct. (Theochem)**. 461-462: 1-21.

De Clercq, E. 1992. HIV inhibitors targeted at the reverse transcriptase. **AIDS Res. Hum. Retroviruses**. 8: 119-134.

_____. 1995. Trends in the development of new antiviral agents for the chemotherapy of infections caused by herpesviruses and retroviruses. **Reviews in Medical Virology**. 5: 149-64.

_____. 1998. The role of nonnucleoside reverse transcriptase inhibitors (NNRTIs) in the therapy of HIV-1 infection. **Antiviral Res.** 38: 153-179.

De Clercq, E. 2001. New developments in anti-HIV chemotherapy. **Current Medicinal Chemistry**. 8: 1543-1572.

- De Clercq, E. 2002. New developments in anti-HIV chemotherapy. **Biochimica et Biophysica Acta**. 1587: 258-275.
- _____. 2004. Non-nucleoside reverse transcriptase inhibitors (NNRTIs): past, present, and future. **Chem. Biodivers**. 1:44–64
- Ding, J., K. Das, C. Tantillo, W. Zhang, A. D. Jr. Clark, S. Jessen, X. Lu, Y. Ysiou and A. Jacobo-Molina. 1995. Structure of HIV-1 reverse transcriptase in a complex with the non-nucleoside inhibitor α -APA R 95845 at 2.8 Å resolution. **Structure**. 3: 365-379.
- _____,_____, H. Moereels, L. Koymans, K. Andries, P.A.J. Janssen and S. H. Hughes, E. Arnold. 1995. Structure of HIV-1 RT/TIBO R 86183 complex reveals similarity in the binding of diverse nonnucleoside inhibitors. **Nat. Struct. Bio**. 2: 407-415.
- Dokalik, A., H. Kalchhauser, W. Mikenda and G. Schweng. 1999. NMR spectra of nitrogen-containing compounds. Correlations between experimental and GIAO calculated data. **Magn. Reson. Chem**. 37: 895-902.
- Esnouf, R., A.L. Hopkins, C. K. Ross, E.Y. Jones, D.K. Stammers and D.I. Stuart. 1997. Unique features in the structure of the complex between HIV-1 reverse transcriptase and the bis(heteroaryl)piperazine (BHAP) U-90152 explain resistance mutations for this nonnucleoside inhibitor. **Proceedings of the National Academy of Sciences of the United States of America**. 94: 3984-3989.
- Fazaeli, R., M. Monajjemi, F. Ataherian and K. Zare. 2002. Solvent effects on relative stabilities and ^{14}N NMR shielding of cytosine tautomers : continuous set of gauge transformation calculation using polarizable continuum model. **J. Mol. Struct**. 581: 51-58.

Foresman, J.B. and A. Frisch. 1993. Exploring Chemistry with Electronic Structure Methods. 2d ed., Gaussian, Inc., Pittsburgh, U.S.A. 301p.

Fox, T. and P.A. Kollman. 1998. Application of the RESP methodology in the parametrization of organic solvents. **J. Phys. Chem. B.** 102: 8070-8079.

Frisch, M.J., G.W. Trucks, H.B. Schlegel, G.E. Scuseria, M.A. Robb, J.R. Cheeseman, V.G. Zakrzewski, J.A. Montgomery, Jr., R.E. Stratmann, J.C. Burant, S. Dapprich, J.M. Millam, A.D. Daniels, K.N. Kudin, M.C. Strain, O. Farkas, J. Tomasi, V. Barone, M. Cossi, R. Cammi, B. Mennucci, C. Pomelli, C. Adamo, S. Clifford, J. Ochterski, G.A. Petersson, P.Y. Ayala, Q. Cui, K. Morokuma, D.K. Malick, A.D. Rabuck, K. Raghavachari, J.B. Foresman, J. Cioslowski, J.V. Ortiz, B.B. Stefanov, G. Liu, A. Liashenko, P. Piskorz, I. Komaromi, R. Gomperts, R.L. Martin, D.J. Fox, T. Keith, M.A. Al-Laham, C. Y. Peng, A. Nanayakkara, C. Gonzalez, M. Challacombe, P.M. W. Gill, B. Johnson, W. Chen, M. W. Wong, J.L. Andres, C. Gonzalez, M. Head-Gordon, E.S. Replogle, and J.A. Pople, 1998. **Gaussian**, Inc., Pittsburgh PA.

_____, T. Vreven, K.N. Kudin, J.C. Burant, J.M. Millam, S. S. Iyengar, J. Tomasi, V. Barone, B. Mennucci, M. Cossi, G. Scalmani, N. Rega, G.A. Petersson, H. Nakatsuji, M. Hada, M. Ehara, K. Toyota, R. Fukuda, J. Hasegawa, M. Ishida, T. Nakajima, Y. Honda, O. Kitao, H. Nakai, M. Klene, X. Li, J.E. Knox, H.P. Hratchian, J.B. Cross, V. Bakken, C. Adamo, J. Jaramillo, R. Gomperts, R.E. Stratmann, O. Yazyev, A.J. Austin, R. Cammi, C. Pomelli, J.W. Ochterski, P.Y. Ayala, K. Morokuma, G.A. Voth, P. Salvador, J.J. Dannenberg, V.G. Zakrzewski, S. Dapprich, A.D. Daniels, M. C. Strain, O. Farkas, D.K. Malick, A.D. Rabuck, K. Raghavachari, J.B. Foresman, J. V. Ortiz, Q. Cui, A.G. Baboul, S. Clifford, J. Cioslowski, B., B. Stefanov, G. Liu, A. Liashenko, P. Piskorz, I. Komaromi, R. L. Martin, D. J. Fox, T. Keith, M. A. Al-Laham, C. Y. Peng, A. Nanayakkara, M. Challacombe, P. M. W. Gill, B. Johnson, W. Chen, M. W. Wong, C. Gonzalez and J. A. Pople, 2004. **Gaussian**, Inc., Wallingford CT.

- Galván, I. F., M.E. Martín, M.Á. Aguilar and M.F. Ruiz-López. 2006. Comparison of Three Effective Hamiltonian Models of Increasing Complexity: Triazene in Water as a Test Case. **J. Chem. Phys.** 124: 214504-214508.
- Gauss, J. 1993. Accurate calculation of NMR chemical shifts. *Ber. Bunsenges. Phys. Chem.* 99: 1001-1008.
- Goff, P. 1990. Retroviral reverse transcriptase: Synthesis, structure and function. **Journal of Acquired Immune Deficiency Syndromes.** 3: 817-831.
- Hannongbua, S., S. Prasithchokekul and P. Pungpo. 2001. Conformational analysis of nevirapine, a non-nucleoside HIV-1 reverse transcriptase inhibitor, based on quantum mechanical calculations. **Comput-Aided Mol Des.** 15: 997-1004.
- Hansen, A.E. and T.D. Bouman. 1985. Localized orbital/local origin method for calculation and analysis of NMR shieldings. Applications to ^{13}C shielding tensors.
- Hargrave, K.D., J.R. Proudfoot, K.G. Grozinger, E. Cullen, S.R. Kapadia, U.R. Petal, V.U. Fuchs, S.C. Mauldin, J. Vitous, M.L. Behnke, J.M. Klunder, K. Pal, J.W. Skiles, D.W. McNeil, J.M. Rose, G.C. Chow, M.T. Skoog, J.C. Wu, G. Schmidt, W.W. Engel, W.G. Eberlein, T.D. Saboe, S.J. Campbell, A.S. Rosenthal and J. Adams. 1991. Novel non-nucleoside inhibitors of HIV-1 reverse transcriptase. 1. Tricyclic pyridobenzo- and dipyrindiazepinones. **J. Med. Chem.** 34: 2231-2241.
- Jonckheere, H., J. Anne and E. De Clercq. 2000. The HIV-1 reverse transcription (RT) process as target for RT inhibitors. **Med. Res. Rev.** 20: 129-154.

Karadakov P.B. and K. Morokuma. 2000. ONIOM as an Efficient Tool for calculating NMR Chemical Shielding Constants in Large Molecules. **Chem. Phys. Lett.** 317: 589-59.

Lawtrakul L., S. Hannongbua, A. Beyer and P. Wolschann. 1999. Conformational study of the HIV-1 reverse transcriptase inhibitor 1-[(2-hydroxyethoxy)methyl]-6-phenylthio)thymine (HEPT). **Biological. Chemistry.** 380: 265-267.

_____,_____,_____,_____. 1999. Molecular calculations on the conformation of the HIV-1 reverse transcriptase inhibitor 1-((2-hydroxyethoxy)methyl)-6-(phenylthio)thymine (HEPT). **Monatshefte. Chem.** 130: 1347-1363.

Marek, R. and A. Lyčka. 2002. ^{15}N NMR Spectroscopy in structural analysis. **Current Organic Chemistry.** 6: 35-66.

Maseras F. and K. Morokuma. 1995. IMOMM: A New Ab Initio + Molecular Mechanics Geometry Optimization Scheme of Equilibrium Structures and Transition States **J. Comp. Chem.** 16: 1170-1179.

Megiel, E., T. Kasprzycka-Guttman, A. Jagielska and L. Wróblewska. 2001. A theoretical and experimental ^{14}N NMR study of association of pyridine. **J. Mol. Struct.** 569: 111-119.

Mennucci, B., M. M. José and T. Joco. 2001. Solvent effects on nuclear shieldings: Continuum or discrete solvation models to treat hydrogen bond and polarity effects? **J. Phys. Chem. A.** 105: 7287-7296.

Mphahlele, M.J., A.M. El-Nahas and T.M. El-Gogray. 2004. Spectroscopic and quantum chemical studies on the structure of 2-arylquinoline-4(1*H*)-thione derivatives. **J. Mol. Struct.** 690 : 151-157.

- Norman, M.H., D.J. Minick and G.E. Martin. 1993. Structure elucidation of an oxazolo[5,4-*b*]pyridine: An alternative cyclization product related to nevirapine. **J. Heterocyclic. Chem.** 30: 771-779.
- Novak, P., D. Škare, S. Sekušak and D. Vikić-Topić. 2000. Substituent, temperature and solvent effects on keto-enol equilibrium in symmetrical pentane-4,1,3,5-triones. Nuclear magnetic resonance and theoretical studies. **CCACAA**. 73: 1153-1170.
- Paiola, C., R. Cammi, P. Pelagatti and C. Pelizzi. 2003. A density functional theory study of structural and NMR properties of SNN theiosemicarbazone ligands and their Pd(II) chlorocomplexes. **J. Mol. Struct.: THEOCHEM**. 623: 105-119.
- Patel, M., S.S. Ko, R.J.Jr. McHugh, J.A. Markwalder, A.S. Srivastava, B.C. Cordava, R.M. Klabe, S. Ericson-Viitanen, G.L. Trainor and S.P. Seitz. 1999. Synthesis and evaluation of analogs of efavirenz (SUSTIVATM) as HIV-1 reverse transcriptase inhibitors. **Bioorg. Med. Chem. Lett.** 9: 2805-2810.
- Pauwels, R., K. Andries, J. Desmyter, D. Schols, M.J., Kukla, H. J. Breslin, A. Raeymaechers, J.V. Gelder, R. Westenborghs, J. Heykants, K. Schellekens, M. A.C. Janessen, E. De Clercq and P.A.J. Janssen. 1990. Potent and selective inhibition of HIV-1 replication in vitro by a novel series of TIBO derivatives. **Nature**. 343: 470-474.
- Pejov, L., D. Spngberg and K. Hermansson. 2005. Using MD Snapshots in ab Initio and DFT Calculations: OH Vibrations in the First Hydration Shell around Li⁺(aq). **J. Phys. Chem. A**. 109: 5144-5152.
- Radom, L. and A P. Scott. 1996. Harmonic vibrational frequencies: An evaluation of Hartree-Fock, Moller-Plesset, quadratic configuration interaction, density

functional theory, and semiempirical scale factors. **J. Phys. Chem.** 100: 16502-16513.

Ren, J., R. Esnouf, E. Garman, D. Somers, C. Ross, I. Kirby, J. Keeling, G. Darby, Y. Jones, D. Stuart and D. Stammers. 1995. High resolution structures of HIV-1 RT from four RT-inhibitor complexes. **Nat. Struct. Biol.** 2: 293-302.

_____, _____. A. Hopkins, C. Ross, Y. Jones, D. Stammers and D. Stuart. 1995. The structure of HIV-1 reverse transcriptase complexed with 9-chloro-TIBO: lessons for inhibitor design. **Structure.** 3: 915-926.

Rickard, G.A., P.B. Karadakov, G.A. Webb and K. Morokuma. Calculation of NMR chemical shifts in carbohydrates with ONIOM: A study of the conformers of β -D-Glucopyranose. **J. Phys. Chem. A.** 107: 292-300.

Rodriguez-Barrios, F., J. Balzarini and F. Gago. 2005. The molecular basis of resilience to the effect of the Lys103Asn mutation in non-nucleoside HIV-1 reverse transcriptase inhibitors studied by targeted molecular dynamics simulations. **J. Am. Chem. Soc.** 127: 7570-7578.

Romines, K.R., G.A. Freeman, L.T. Schaller, J.R. Cowan, S.S. Gonzales, J.H. Tidwell, C.W. Andrews III, D.K. Stammers, R.J. Hazen, R.G. Ferris, S. A. Short, J.H. Chan and L.R. Boone. 2006. Structure-activity relationship studies of novel benzophenones leading to the discovery of a potent, next generation HIV nonnucleoside reverse transcriptase inhibitor. **J. Med. Chem.** 49: 727-739.

Ryckaert, J.P., G. Ciccotti and J.C. Berendsen. 1977. Numerical integration of the Cartesian equations of motion of a system with constraints: molecular dynamics of n-alkanes. **J. Comput. Phys.** 23: 327-341.

- Saen-oon, S., S. Hannongbua and P. Wolschann. 2003. Structural Flexibility on nonucleoside HIV-1 reverse transcriptase inhibitor: 9-Cl TIBO as explained by potential energy surface and ^{13}C and ^1H NMR calculations, based on *ab initio* and density functional study. **J. Chem. Inf. Comput. Sci.** 43: 1412-1422.
- Sarafianos, S.G., K. Das, S.H. Hughes and E. Arnold. 2004. Taking aim at a moving target: Designing drugs to inhibit drug-resistant HIV-1 reverse transcriptases. **Curr. Opin. Struct. Biol.** 14: 716-730.
- Schindler, M. and W. Kutzelnigg. 1982. Theory of magnetic susceptibilities and NMR chemical shifts in terms of localized quantities. II. Applications to some simple molecules. **J. Chem. Phys.** 76: 1919-1933.
- Singh, U.C. and P.A. Kollman. 1984. An Approach to Computing Electrostatic Charges for Molecules **J. Comp. Chem.** 5: 129 - 145.
- Smith, M.B. K., B.M. Hose, A. Hawkins, J. Lipchock, D.W. Farnsworth, R.C. Rizzo, J. Tirado-Rives, E. Arnold, W. Zhang, S.H. Hughes, W.L. Jorgensen, C.J. Michejda and R.H. Smith Jr. 2003. Molecular modeling calculations of HIV-1 reverse transcriptase nonnucleoside inhibitors: Correlation of binding energy with biological activity for novel 2-aryl-substituted benzimidazole analogues. **J. Med. Chem.** 46: 1940-1947.
- Svensson, M., S. Humbel, R.D.J. Froese, T. Matsubara, S. Sieber and K. Morokuma. 1996. ONIOM: A multilayered integrated MO + MM method for geometry optimizations and single point energy predictions. A test for diels-alder reactions and $\text{Pt}(\text{P}(\text{t-Bu})_3)_2 + \text{H}_2$ oxidative addition. **J. Phys. Chem.** 100: 19357-19363.

- Tachedjian, G., M. Orlova, S.G. Sarafianos, E. Arnold and S.P. Goff. 2001. Nonnucleoside reverse transcriptase inhibitors are chemical enhancers of dimerization of the HIV-type 1 transcriptase. **Proc. Natl. Acad. Sci.** 98: 7188-7193.
- Tanaka, H., H. Takashima, M. Ubasawa, K. Sekiya, I. Nitta, M. Baba, S. Shigeta, R.T. Walker and E. De Clercq. 1992. Synthesis and antiviral activity of deoxy analogs of 1-[(2-Hydroxyethoxy)-methyl]-6-(phenylthio)thymine (HEPT) as potent and selective anti-HIV-1 agents. **J. Med.Chem.** 38: 4713-4719.
- Telesnitsky, A., S.P. Goff. 1997. Reverse transcriptase and the generation of retroviral DNA. **Retroviruses.** 121-160.
- Temiz, N.A and I. Bahar. 2002. Inhibitor binding alters the directions of domain motions in HIV-1 reverse transcriptase. **Proteins: Structure, Function, and Genetics.** 49: 61-70.
- Terence A. K., J.R. Proudfoot, D.W. McNeil, U.R. Patel, E. David, K.D. Hargrave, P. M. Grob, M. Cardozo, A. Agarwal and J. Adams. 1995. Novel non-nucleoside inhibitors of human immunodeficiency virus type 1 reverse transcriptase. 5. 4-substituted and 2, 4-disubstituted analogs of nevirapine. **J. Med. Chem.** 38: 4839-4847.
- Tomasi, J., B. Mennucci and E. Cancés. 1999. The IEF version of the PCM solvation method: an overview of a new method addressed to study molecular solutes at the ZM ab initio level. **J. Mol. Struct.** 464: 211-226.
- Torimoto, N., I. Ishii, M. Hata, H. Nakamura, H. Imada, N. Ariyoshi, S. Ohmori, T. Igarashi and M. Kitada. 2003. Direct interaction between substrates and endogenous steroids in the active site may change the activity of cytochrome P450 3A4. **Biochemistry.** 42: 15068-15077.

- Vaara, J., K. Ruud, O. Vahtras, H. Agren and J. Jokisaari. 1998. Quadratic response calculations of the electronic spin-orbit contribution to nuclear shielding tensors. **J. Chem. Phys.** 109: 1212-1222.
- Verlet, J. 1967. Computer "experiments" on classical fluids: I. Thermodynamical properties of Lennard-Jones molecules. **Phys. Rev.** 159: 98-103.
- Vikić-Topić, D. and L. Pejov. 2000. Computational studies of the ^{13}C and ^1H NMR isotropic chemical shifts using density functional optimized geometries. Adamantane and 2,4-methano-2,4-dehydroadamantane (a[3.1.1]Propellane) as case studies. **Croatica Chemica Acta.** 73: 1057-1075.
- Vreven, T. and K. Morokuma. 2000. The ONIOM (our own N-layered integrated molecular orbital + molecular mechanics) method for the first singlet excited (S1) state photoisomerization path of a retinal protonated Schiff base. **J. Chem. Phys.** 113: 2969-2975.
- Witanowski, M., Z. Biedrzycka, W. Sicinska and G.A. Webb. 2000. Nitrogen NMR shieldings of thiourea systems as a function of solvent polarity and hydrogen bond effects. **J. Mol. Struct.** 516: 107-112.
- Wolinski, K., J.F. Hinton and P. Pulay. 1990. Efficient implementation of the gauge independent atomic orbital method for NMR chemical shift calculations. **J. Am. Chem. Soc.** 112: 8251-8262.
- Yadav, A. and S.K. Singh. 2005. Common binding mode for structurally and chemically diverse non-nucleosidic HIV-1RT inhibitors. **J. Mol. Struct.: THEOCHEM.** 723: 205-209.
- Zheng, A., L. Chen, J. Yang, Y. Yue, C. Ye, X. Lu and F. Deng. 2005. Prediction of the ^{13}C NMR chemical shifts of organic species adsorbed on H-ZSM-5 zeolite by the ONIOM-GIAO method. **Chem. Commun.** 2474-2476.

- Zheng, A., M. Yang, Y. Yue, C. Ye and F. Deng. 2004. ^{13}C NMR shielding tensors of carboxyl carbon in amino acids calculated by ONIOM method. **Chem. Phys. Lett.** 399: 172-176.
- Zhou, Z., M. Madrid, J.D. Evanseck and J.D. Madura. 2005. Effect of a bound non-nucleoside RT inhibitor on the dynamics of wild-type and mutant HIV-1 reverse transcriptase. **J. Am. Chem. Soc.** 127: 17253-17260.