Generation and Cycloaddition Reactions of the 1,2,3-Triazole Analogue of o-Quinodimethane

George E. Mertzanos, Julia Stephanidou-Stephanatou*, Constantinos A. Tsoleridis and Nicholas E. Alexandrou^{*}

> Chemistry Department , Laboratory of Organic Chemistry, University of Thessaloniki, Thessaloniki 54006, Greece

Key words: 1,2,3-Triazole; o-Quinodimethane; Diels-Alder Cycloadditions, AM Calculations

Abstract: 4,5-Dihydro-4,5-dimethylene-1-phenyl-1,2,3-triazole (4), the 1,2,3-triazole analogue of o-quinodimethane, can be generated in situ from 4,5-bis(bromomethyl) derivative (3) by sodium iodide induced 1,4-elimination process. By trapping the 1,4-dimethylene-triazole with symmetrically and unsymmetrically substituted dienophiles the Diels-Alder cycloadducts were isolated in moderate to low yields; in the presence of activated molecular sieves the yields are markedly improved.

The generation of o-quinodimethanes from aromatic systems and their Diels-Alder trapping reactions provided a powerful method for the preparation of polycyclic systems. 1 Although recently interest has been turned to the heterocyclic analogues of *o*-quinodimethanes,² their synthetic potential has been especially demonstrated in the indole series³.

As a further study on heterocyclic o-quinodimethanes⁴ and in continuation of our synthetic investigations on the 1,2,3-triazole chemistry⁵ we wish to disclose our results concerning the generation and the intermolecular cycloaddition reactions of the hitherto unknown 4,5-dihydro-4,5-dimethylene-l-phenyl-1,2,3-triazole (4).

Our approach, shown in the Schene, utilizes the unknown 4,5-bis(bromomethyl)-1-phenyl-1,2,3-triazole (3), which can be synthesized from the dimethyl 1-phenyl-1,2,3-triazole-4,5-dicarboxylate (1) in two steps. Sodium borohydride reduction^{6,7} of the diester 1 afforded the corresponding 4,5-bismethanol⁸ 2 (np 156-159°, 70% yield), which upon bromination⁷ with phosphorous tribromide gave the bisbromide 3 (np 92-94°, 78% yield). By 1,4-elimination of bromine, achieved by treatment of 3 with sodium iodide in DMF at



[a] Yields in the presence of molecular sieves (41).

All Diels-Alder adducts had analytical and spectroscopic data in agreement with the proposed structure.

 80° according to the reported procedure⁹, the 1,2,3-triazole-4,5-quinodimethane 4 was generated and was trapped as its Diels-Alder adducts 5-9. When the less reactive dienophiles methyl vinyl ketone and methyl acrylate were used very low yields 2% and 4% of the corresponding cycloadducts 8 and 9 were isolated, although these dienophiles were in large excess (5:1). However, in the presence of highly activated molecular shieves¹⁰ (4Å) the reaction yields were improved to 20% and 11% respectively. The poor yields of Diels-Adler adducts 5-9 might be explained considering that 4 is a more reactive intermediate compared to other heterocyclic o-quinodimethanes⁴, leading thus to the formation of several polymer by-products.

The [4+2] cycloaddition between 4 and dienophiles was also examined considering the FMO of the reacting species. On the basis of AML calculations¹¹ carried out on compound 4, methyl acrylate and N-methylmaleinide it is concluded that this cycloaddition, in spite of the presence of the triazole ring, is HDMD-diene controlled (Figure) like other normal Diels-Alder reactions.¹²



Figure. HOMO-LUMD interactions between diene 4 and the dienophiles methyl acrylate (a) and N-methylmaleinide (b) after AML calculations.

In respect with the regioselectivity of the cycloaddition of 4 with methyl acrylate it is predicted after examination of the orbital coefficients (Figure) that the sterically favored regio-product 10 should be the predominant isomer. However, the structure of the isolated cyclo-adduct 9 as well as that of 8 is under further consideration.

On the other hand, the energy difference $AE = LUMO_{diene} - HOMO_{diene}$ for dimerization of 4, is equal to 8.08 eV, a value which is higher than the allowed process for the reaction with N-methylmaleimide, but lower than for the reaction of 4 with methyl acry-

late and this might be the reason for the low yield of the corresponding Diels-Alder adduct.

References and Notes

- 1. a) Oppolzer, W Synthesis 1978, 793. b) Funk, R. L.; Vollhardt, K. P. C. Chem. Soc. Rev. 1980, 9, 41. c) Charlton, J. L.; Alauddin, M. M. Tetrahedron 1987, 43, 2873.
- For representative recent examples see: a) Pindur, U.; Erfanian-Abdoust, H. Dam. Rev. 1989, 89, 1681. b) Chaloner, L.M; Crew, A.P.A.; Storr, R.C.; Yelland, M. Betakatan Lett. 1991, 32, 7609. c) Jackson, P.M; Moody, C.J.; Priton, S.; J. Chem. Soc., Patin Trax 1 1990, 2909. d) Bedford, S.B.; Begley, MJ.; Cornwall, P.; Knight, D.W. Synlett 1991, 627.
- 3. a) Magnus, P.; Gallangher, T.; Brown, P.; Pappalardo, P. Acc. Chem. Res. 1984, 17, 35. b) Mody, C.J.; Rahimtoola, K.F. J. Chem. Soc., Perkin Trans. 1 1990, 673.
- 4. a) Mtkidou, S.; Stephanidou-Stephanatou, J. Tetrahedron Lett. 1990, 31, 5197. b) Mtkidou, S.; Stephanidou-Stephanatou, J. Tetrahedron Lett. 1991, 32, 4603.
- a) Theocharis, A.B.; Alexandrou, N.E.; Terzis, A. J. Heterocyclic Chem. 1990, 27, 1741. b) Theocharis, A.B.; Maroulis, A.J.; Hadjiantoniou-Maroulis, C.P.; Alexandrou, N.E. J. Chem. Soc., Perkin Trans. 1 1989, 619.
- 6. Lalezari, I.; Gomez, L.A.; Khorshidi, M J. Heterocyclic Chem. 1990, 27, 687.
- 7. Cherton, J.C.; Lanson, M; Ladjama, D.; Quichon, Y.; Basselier, J.J. Carl Chem 1990, 68, 1271.
- 8. Sodium borohydride improves the reported in ref. 6 reduction yield from 26% to 70%, where the lithium aluminum hydride was used.
- 9. Cava, M.P.; Deana, A.A.; Muth, K. J. Am. Chem. Soc. 1959, 81, 6458.
- 10. Haber, M; Pindur, U., Tetrahedron 1991, 47, 1925.
- Dewar, M.J.S.; Zoebisch, E.G.; Healey, E.F.; Stewart, J.J.P., J. Am. Chem. Soc. 1985, 107, 3902.
- a) Boger, D. L.; Brotherton-Pleis, C.E., in Advances in Cycloaddition Vol. 2, Curran, D.P., Ed., JAI Press: London, 1990, p. 151. b) Sauer, J.; Sustmann, R. Angew. Chem. Int. Ed. 1980, 19, 779.

(Received in UK 22 May 1992)