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ATTEMPTED PREPARATION OF N-SUBSTITUTED DIPHENYLCYCLOPROPENEIMINE N-OXIDE

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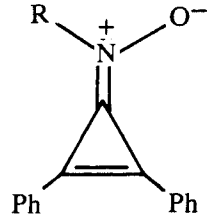
Abstract

The reaction of diphenylcyclopropenone with several N-substituted hydroxylamine and primary amines are investigated. Most of these reactions led to ring opened or ring enlarged products, instead of the desired N-Oxide or imine. The reaction of cyclopropeneimine with peracid-another possible route to N-substituted cyclopropeneimine N-Oxide is studied. Most of the unexpected products are identified and herein reported.

Introduction

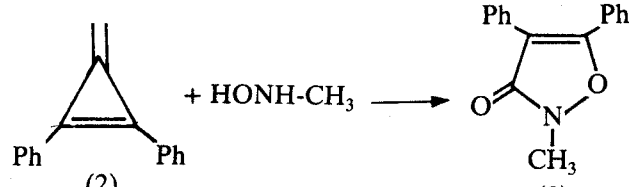
Our previous communication [1] was concerned with nitrone groups in which diazomethine N-Oxide was conjugated with an electron withdrawing group. Nitrones which are conjugated with an electron donating group, have received little attention in the past, but they clearly are a relevant area of interest in nitrone chemistry. The present work deals with attempts to prepare N-substituted diphenylcyclopropeneimine N-Oxide (**1**).



(1)

Results and Discussion

In order to achieve the synthesis of N-substituted 2,3 diphenylcyclopropeneimine N-Oxide (**1**), several possible routes were attempted. One route to the synthesis of nitrones is via reaction of N-substituted hydroxylamine with ketone [2]. It was, therefore, envisaged that diphenylcycloprodpenone (**2**) may thus be reacted with N-substituted hydroxylamine to give the corresponding nitrone. The reaction of ketone (**2**) with N-methylhydroxylamine in methanol and at room temperature gave white crystals. The infrared spectrum of these crystals showed a band at 1670 cm^{-1}. The NMR spectrum comprised of a singlet at 3.5 for 3 protons and distorted singlet at δ 7.45 for 10 protons. Elemental analysis gave the empirical formula as $C_{16}H_{13}NO$. Furthermore the absence of any band around 1800-2000 cm^{-1} in the infrared spectrum, which is characteristic of the cyclopropenone ring, indicated that the ring had been destroyed during the reaction. The product, therefore, was not the expected nitrone (**1**), but 2-methyl-4,5-diphenyl-3- isoxasolone (**3**).



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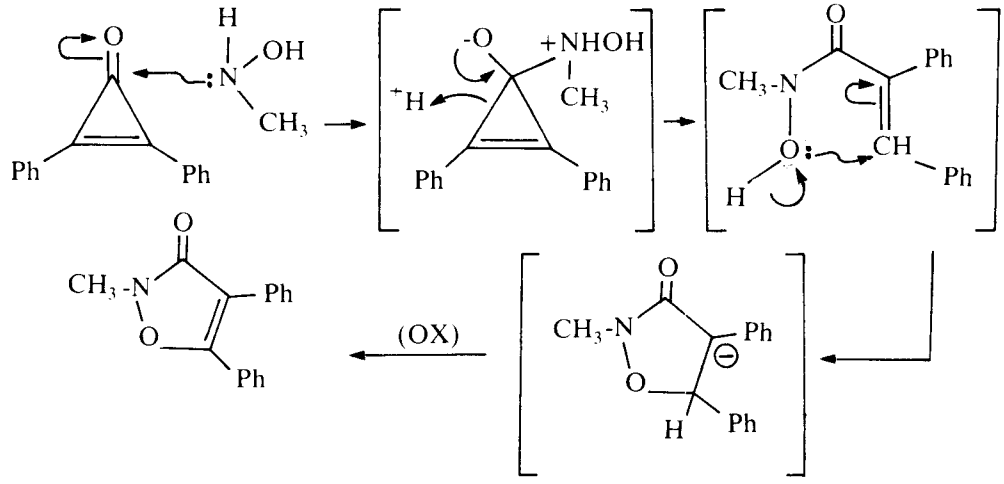


Scheme 1

The mechanism for the formation of this product (**3**) may be explained as the initial attack of the nitrogen lone pair of N-methylhydroxylamine on the carbonyl group, followed by ring opening and subsequent ring closure, as shown in scheme (1).

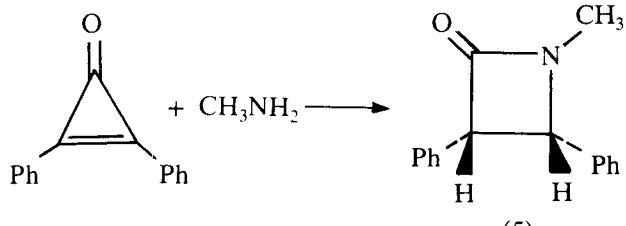
This mechanism involves an unusual oxidation process, which was reported previously in the reaction of unsubstituted hydroxylamine with cyclopropenone to give 5-isoxasolone [6].

Reaction of imine with methylhydroxylamine-o-sulphonic acid is an excellent method for the preparation of nitrones[7]. In view of the liability of the carbonyl group in cyclopropenone towards nucleophiles, the reaction of methylhydroxylamine-o-sulphonic acid is expected to occur easily and would hopefully lead to the desired nitrone (**1**).

The reaction of methylhydroxylamine-o-sulphonic acid with diphenylcyclopropenone in methanol occured at room temperature. The reaction was very fast and after a short interval a white precipitate appeared. The compound was insoluble in most organic solvents. Attempts to recrystallize the product from ethanol or methanol led to decomposition to diphenylcyclopropenone. Elemental analysis of the crude material gave an empirical formula close to $C_{16}H_{13}NSO_4$. The infrared spectrum indicated the presence of cyclopropenone unit as indicated by weak band at 1910 cm^{-1}. No NH or OH stretching band was observed. Because of the insolubility of the product in most organic solvents, it was not possible to obtain its NMR spectrum. Using the infrared spectrum, the product was assigned as the betaine (**4**).

Since the reaction of hydroxylamines with cyclopropenone failed to give the desired nitrone (**1**) , preparation of this compound by the second route, i.e. converting the ketone (**2**) to its imine followed by N-oxidation with peracid was attempted.

Addition of methylamine to methanolic solution of ketone (**2**) at room temperature, however, afforded *cis*-diphenylazetidinone (**5**) . The physical properties of (**5**) are identical to those reported by *Toda et.al*[9] for *cis*-diphenylazetidinone.



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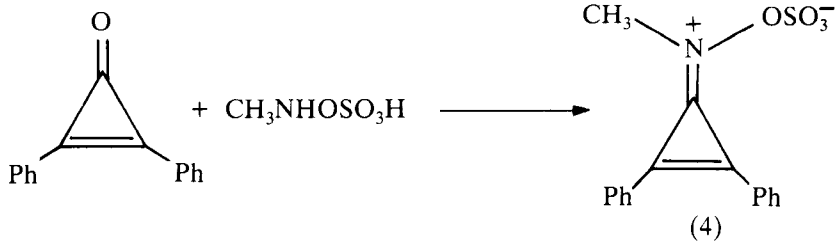

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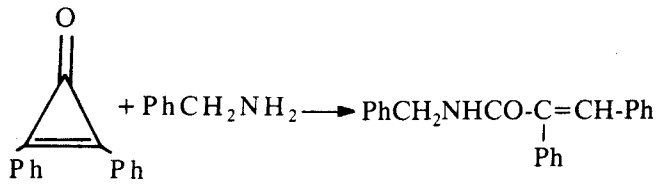
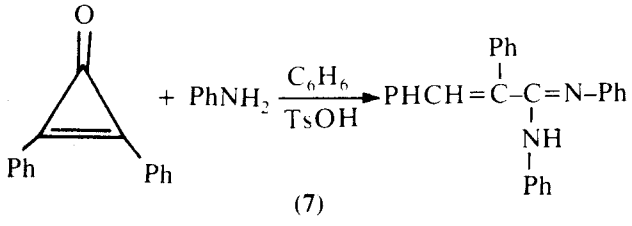


(6)

The reaction of benzylamine with ketone (**2**) in ether or methanol at room temperature gave amide (**6**), a ring opened product, instead of the desired imine.

Aniline, on the other hand, did not react with cyclopropenone (**2**) at room temperature. When stoichiometric amount of aniline and ketone (**2**) in benzene were heated under reflux, the reaction has occured and according to TLC (toluene-hexane, 50/05), many products were formed. The reaction was, therefore, repeated under the same condition but, using p-toluenesulphonic acid as catalyst. The course of the reaction changed completely and the ring opened product (**7**) was isolated in 50% yield.



(7)

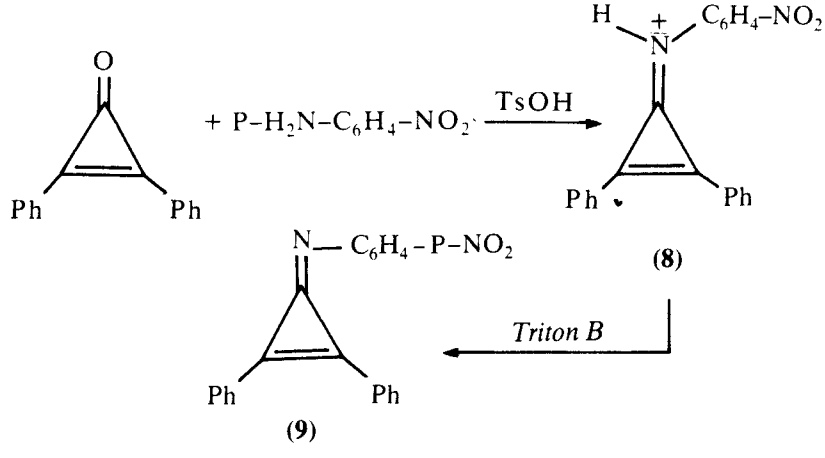
p- Nitroaniline in the presence of p-toluenesulphonic acid was the only amine which reacted in desired manner and led to the tosylate (**8**) in 90% yield. The product was easily isolated as it precipitates during the course of the reaction and was recrystallized from methanol. The conjugate base (**9**) was obtained in 20% yield by treatment of the salt (**8**) with triethylamine. The rest of the product polymerized. The imine (**9**), when exposed to the air, undergoes slow polymerization, after which the conjugate acid (**8**) could not be generated.

It was hoped that the reaction of imine (**9**) with peracids would furnish the desired nitone (**1**). The reaction of imine (**9**) with several peracids led, however, to the formation of a complex mixture as well as polymers. Attempts to separate the nitrone (**1**) from this mixture was unsuccessful.

Experimental Section

Elemental analyses were performed with a Technicon instrument. Melting points were measured on a Kofler hot stage and were not corrected. Infrared spectra were obtained on a Perkin Elmer 237 or 257 spectrophotometer. NMR spectra were obtained on a Perkin Elmer R12 spectrometer.

Reaction of Diphenylcyclopropenone with N-Methylhydroxylamine. To a solution of Sodium metal (lg, 43 mmol) in methanol (10 ml) was added a solution of N-methylhydroxylamine hydrochloride (3.7g, 44mmol) in methanol (11 ml). The sodium chloride which was subsequently formed was removed by filtration. The N-methylhydroxylamine solution (5 ml) was then added to a stirred solution of diphenyl cyclopropenone (1g, 4.8 mmol) in methanol (5 ml). The temperature rose and the colour changed from colourless to yellow. Stirring was maintained overnight. The solvent was then removed *in vacuo* (20 mm Hg). The oily residue was dissolved in pet. ether (40-60°) and absolute ethanol and cooled over-night to give a white precipitate (0.6g), cystallization of which from cyc-



lohexane gave **N-methyl-4, 5-diphenyl-3-isoxasolone** (3) as white plates (0.5g, 41.6%), m.p. 107-109°. IR (Nujol): ν_{max} 1670, 770, 690 cm^{-1}; NMR($CDCL_3$): δ 3.8 (S, 3H), 7.45 (S, 10H); Anal. Calcd. for $C_{16}H_{13}NO_2$: C,76.4; N,5.6; H, 5.2.Found: C, 76.0; N,5.7: H, 5.3.

Reaction of Methylhdroxylamine-O-sulphonic Acid with Diphenylcyclopropenone.- A solution of diphenylcyclopropenone (lg, 4. 8mmol) in methanol (10 ml) was added to a solution of methylhydroxylamine-O- sulphonic acid (0. 5g, 4mmol) in methanol (15 ml) at room temperature. After a while, a white precipitate was formed. The reaction mixture was stirred for a further 10 min. and the precipitate filtered off. The precipitate was washed with hot toluene. Filtration offered a white powder (0.8g, 53%) (note 1), which seemed to be **N-methyl 2,3- diphenyl-3-N- Sulphato cyclopropene immonium (4)**;m.p. 243-245°(decomp.); IR (Nujol): ν_{max} 1910, 1280, 1050. Anal. calcd. for $C_{16}H_{13}NSO_4$: C, 60.9; N,4.4;H,4.1; S,10.16, Found: C, 59.7; N,4.5;H, 4.45, S, 10.25. **Note 1:** Attempted recrystallisation of the crude material in boiling methanol or ethanol led to decomposition to diphenylcyclopropenone.

Reaction of Diphenylcyclopropenone with Methylamine.- To diphenylcyclopropenone (0.5g, 2.4 mmol) in absolute methanol (3 ml) was added methylamine (0.15g, 4.8mmol) in ethanol (1ml) The reaction mixture was stirred at room temperature for 8 h.during which time the colour of the reaction mixture changed from yellow to red. The solvent was removed *in vacuo* and the red oily residue dissolved in absolute ethanol and petroleum ether (40 -60°). The solution was cooled overnight to give a white precipitate which was recrystallized from cyclohexane to give **N-methyl-*cis*-2,3-diphenylazetidinone (5)** (0.2g, 35%), m.p.135 - 137° (lit.,m.p.132°)[9] IR (nujol): ν_{max} 1750 cm^{-1}; NMR ($CDCl_3$):δ 2.9 (d, 3H), 4.85 (d,lH), 4.95 (d,1H), 7.03 (m,10H), Anal. Calcd. for $C_{16}H_{15}NO$ C,81.0;N, 5.9;H,6.3.Found: C,80.5;N,5.7;H, 6.3.
The mother liquid was evaporated off *in vacuo*. Several attempts to solidify the oily residue, by means of distillation or precipitation were unsuccessful.

Reaction of Diphenylcyclopropenone with benzylamine. To diphenylcyclopropenone (1g, 4.8 mmol) in methanol was added benzylamine (0.5g, 4.7 mmol). The reaction mixture was stirred at room temperature overnight. The solvent was evaporated *in vacuo* and the oily residue was dissolved in petroleum ether (40 -60°, 5 ml) and ethanol (few drops). Cooling the solution in an ice bath led to a pale yellow precipitate. The solution was cooled for another 3 h. and the precipitate filtered off. It was recrystallized from cyclohexane to give **N-benzyl-2,3-diphenylacrylamide (6)** as white needles (lg, 67%), m.p.129-131°; IR (nujol): υ_{max} 3330, 1660 cm^{-1}; NMR ($CDCl_3$):δ4.50 (d,2H),5.80 (NH), 7.2 (m,15H), 7.9(s,1H). Anal. Calcd. for $C_{22}H_{19}NO$: C, 84.3; N,4.5; H, 6.1 Found: C, 84.1; N,4.6; H, 6.1.

Reaction of Diphenylcyclopropenone with aniline.- To diphenylcyclopropenone (1g, 4.8 mmol) in dry benzene (25ml), aniline (1g, 10 mmol) and p-toluenesulphonic acid (0.2g, 1 mmol) was added. The reaction mixture was heated under reflux for 4 h. The colour of the reaction mixture changed from slightly yellow to deep red. The solvent was removed *in vacuo* and the oily residue dissolved in absolute ethanol (20 ml) and petroleum ether (40-60°, 5ml). This solution was cooled in an ice bath to give a brown precipitate which, after several recrystallization from ethanol afforded **N,N'-2,3-tetraphenylacrylamidine (7)** as yellow needles (0.7g, 50%), m.p. 161-163°, IR (nujol) υ_{max} 3300,1600,1615 cm^{-1}; NMR ($CDCl_3$): δ6.20 (S,1H), 6.50-7.35 (m, 20H), 7.65 (NH). Anal. Calcd. for $C_{27}H_{22}N_2$ requires: C,86. 6;N, 7.5; H,5. 85. Found: C, 86.7;N, 7.45; H, 6.0.

N-(p-Nitrophenyl)-2,3- diphenylcyclopropeneiminium Tosylate(8).- To diphenylcyclopropenone (1g. 4. 8mmol) and p-nitroaniline (1g.7.2mmol) in toluene (10ml) was added p-toluenesulphonic acid (lg, 6mmol). The reaction mixture was heated under reflux for 3 h. during which a pale yellow precipitate separated out from the reaction mixture. It was refrigerated for 1 h. The precipitate was filtered off and recrystallized from ethanol or methanol to give the salt **(8)** as pale yellow crystals, (2.2g, 92%), m.p. 242-244°; IR (nujol):υ_{max} 1850, 1620, 1600, 1340 cm^{-1};NMR(DMSO–d_6): δ2.3 (s, 3H), 6.65 (d, 1H), 7.15 (d, 1H), 7.50-8.1.(m, 16H). Anal. Calcd. for $C_{28}H_{22}N_2O_5S$: C.67.5;N,5.6;H,4.4; S, 6.4 Found: C,67. 4; N,5.7; H, 4.7; S, 6.3.

N-(p-Nitrophenyl)-2,3-diphenylcyclopropeneim (9).-N-(p-Nitrophenyl)- diphenylcyclopropeniminum tosylate (1.8g, 3.6 mmol) was suspended in dichlormoethane (10ml) and water (5ml). Triethylamine (1.2g, 11 mmol) was added dropwise. At the end of the addition of triethylamine a clear yellow organic layer was obtained. It was removed, washed with water (2

x10ml), and dried over $MgSO_4$. The solvent was removed *in vacuo* (20 mmHg) and the oily residue was treated with ether. A yellow-red precipitate resulted; it was suspended in ethanol (10 ml) and heated under reflux for a short while. Filtration and concentration of the filtrate *in vacuo* gave, on cooling, light yellow needles of the imine (**9**) (0.25g, 20%), m.p.162-164° (lit.m.p. 163-163.5[10]).

References

1. J.A.Damavandy, R.A.Y. Jones, *J. Chem. Soc., Perkin Trans.* **I**, 712, (1981).
2. J.Hammer, A. Macluso, *Chem. Rev.*, **64,** 473, (1964).
3. E.P.Kohler, A.H.Blatt, *J. Amer. Chem. Soc.*, **50,** 504, (1928).
4. A.J.Bulton, A.R.Katritzky, *Tetrahedron*, **12,** 41, (1961).
5. L.Baver, C.N.V.Nambury, *J.Org. Chem.*,**26,** 4917,(1961).
6. R. Breslow, T. Eicker, A.Krebs, R.A. Peterson, J.Posner, *J.Amer. Chem. Soc.*, **87,** 1320, (1965).
7. M. Abou-Gharabia, M.M.Jollie, *Synthesis*, **318,** (1977).
8. K.T.Potts, J.S.Baum, *Chem.Rev.*,**74,** 189, (1974).
9. F.Toda, T.Mitote, K.Akagi, *Bull.Chem. Soc. Jap.*, **42** (6), 1777, (1969).
10. J.K.Crandall, W.W.Conover, *Tetrahedron Lett.*, **7,** 583, (1971).