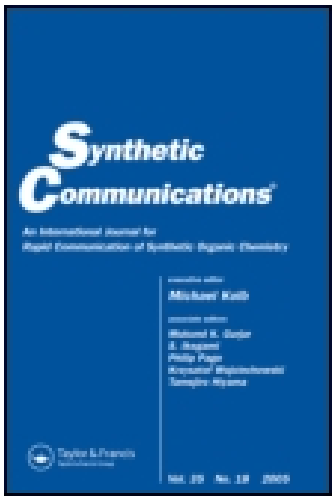


Synthetic Communications: An International Journal for Rapid Communication of Synthetic Organic Chemistry

Publication details, including instructions for authors and subscription information:
http://www.tandfonline.com/loi/lsyc20

CYCLOHEXENONE CARBOXYLATES. A VERSATILE SOURCE FOR FUSED ISOXAZOLES AND PYRAZOLES

V. Padmavathi [a] , K. Sharmila [a] , A. Balaiah [a] , A. Somasekhar Reddy [a] & D. Bhaskar Reddy [b]

[a] Department of Chemistry , Sri Venkateswara University , Tirupati, 517 502, India

[b] Department of Chemistry , Sri Venkateswara University , Tirupati, 517 502, India

Published online: 09 Nov 2006.

To cite this article: V. Padmavathi , K. Sharmila , A. Balaiah , A. Somasekhar Reddy & D. Bhaskar Reddy (2001) CYCLOHEXENONE CARBOXYLATES. A VERSATILE SOURCE FOR FUSED ISOXAZOLES AND PYRAZOLES, Synthetic Communications: An International Journal for Rapid Communication of Synthetic Organic Chemistry, 31:14, 2119-2126, DOI: 10.1081/SCC-100104462

To link to this article: http://dx.doi.org/10.1081/SCC-100104462

SYNTHETIC COMMUNICATIONS, 31(14), 2119–2126 (2001)

CYCLOHEXENONE CARBOXYLATES. A VERSATILE SOURCE FOR FUSED ISOXAZOLES AND PYRAZOLES

V. Padmavathi, K. Sharmila, A. Balaiah, A. Somasekhar Reddy, and D. Bhaskar Reddy*

Department of Chemistry, Sri Venkateswara University, Tirupati – 517 502, India

ABSTRACT

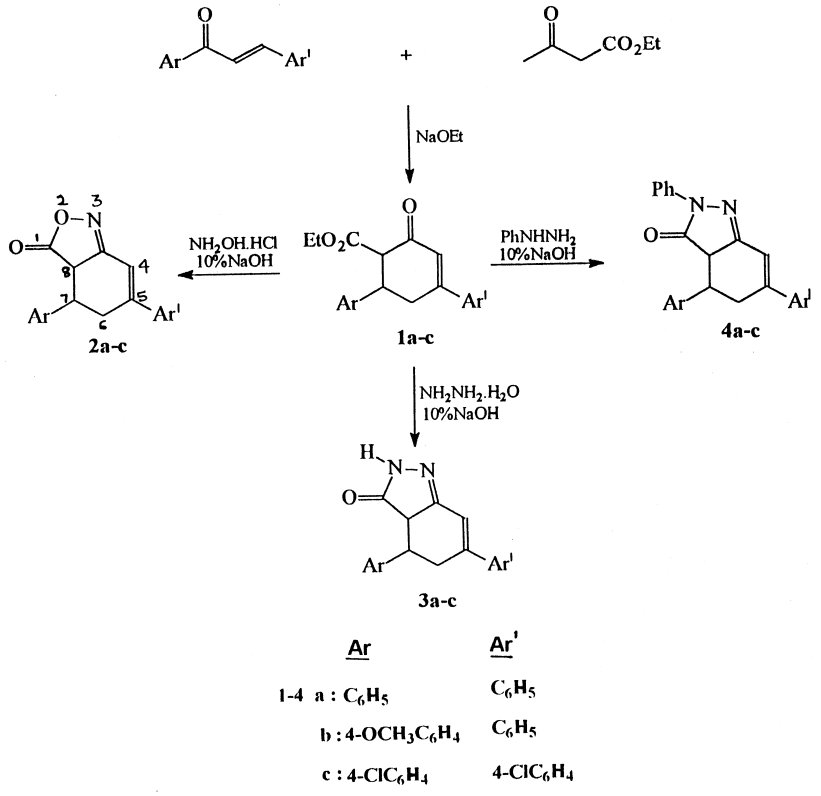
The 6-carbethoxy-3,5-diarylcyclohex-2-enone (**1**) was subjected to condensation and 1,3-dipolar cycloaddition reactions to get fused isoxazole and pyrazole derivatives.

In our earlier communications, we reported the synthesis and stereochemistry of various fused and spiro isoxazolines and pyrazolines prepared by 1,3 -dipolar cycloaddition of nitrile oxides and nitrile imines to activated olefins.[1–4] In continuation of this work, we now describe the use of 6-carbethoxy-3,5-diarylcyclohex-2-enone **1** an intermediate with three versatile functional groups i.e., ketone, olefin and ester, for the syntheses of various fused isoxazole and pyrazole derivatives.

6-Carbethoxy-3,5-diarylcyclohex-2-enone (**1**) was prepared by the Knoevenagel reaction of ethyl acetoacetate and 1,3-diary1-2-propen-1-one. The compound **1** on treatment with hydroxylamine hydrochloride/hydrazine hydrate/phenylhydrazine in ethanol in presence of 10% NaOH afforded the

* Corresponding author.

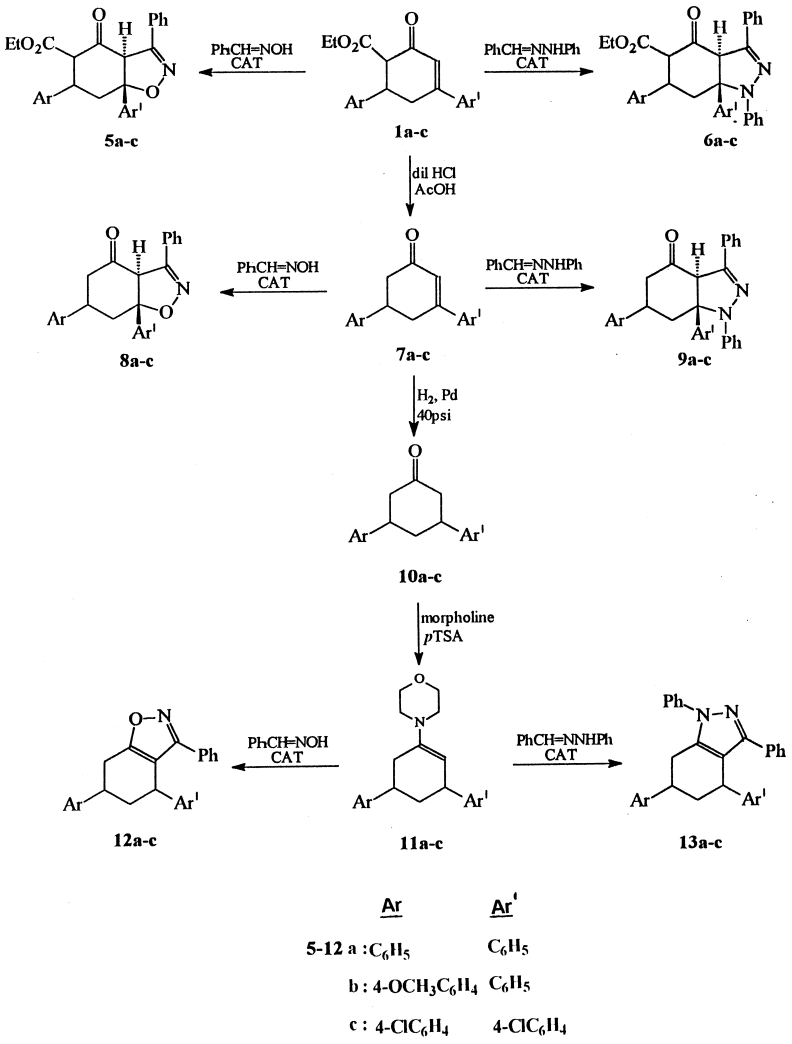
corresponding isoxazolinones (**2a–c**), pyrazolinones (**3a–c**) and 2-phenyl pyrazolinones (**4a–c**) (Scheme 1).



Scheme 1.

Further, the 1,3-cycloaddition of phenyl nitrile oxide or phenyl nitrile imine to the activated double bond in compound **1** led to the formation of tetrahydrobenzoisoxazolines (**5**) and tetrahydrobenzopyrazolines (**6**) (Scheme 2). In fact, the reagents were generated from araldoximes and araldehyde phenylhydrazones, respectively, in the presence of chloramine-T (CAT). As discussed in the literature this reaction process involves a one-step concerted ring closure mechanism,[6] which governs the regiochemistry of the cycloaddition (NMR, singlet at 2.44–2.55 ppm (C-9)).

The compound **1** on hydrolysis followed by decarboxylation gave 3,5-diarylcyclohex-2-enone (**7**).[5] Cycloaddition with nitrile oxide or imine, as



Scheme 2.

described above, gave tetrahydrobenzoisoxazolines (**8**) and tetrahydrobenzopyrazolines (**9**) (Scheme 2).

Compound **7** on reduction with H_2/Pd at 40 psi[5] gave ketone **10** which was derivatized to 3,5-diary1-1-morpholino-3,4,5,6-tetrahydrobenzene (**11**) with morpholine. On treatment with phenyl nitrile oxide and nitrile imine the respective isoxazole (**12a–c**) and pyrazole derivatives (**13a–c**) were

obtained (Scheme 2). This was contrary to the previous reaction, where the products were isoxazolines (**8**) and pyrazolines (**9**).

In conclusion the different functionalities in 6-carbethoxy-3,5-diarylcyclohex-2-enone **1** can be used advantageously in the preparation of various isoxazole and pyrazole derivatives.

EXPERIMENTAL

Melting points were determined in open capillaries on Tempo Mel-Temp apparatus and are uncorrected. The yield of the compounds given are after purification. The purity of the compounds was checked by thin layer chromatography [Silica gel-G(60–120 mesh, BDH), pet.ether (40–60°C); ethyl acetate (3:1) as eluents].

The IR spectra were recorded on a Perkin-Elmer grating Infrared spectrophotometer (ν_{max} in cm^{-1}) model 337 in KBr pellets. The ^1H NMR spectra were recorded in $CDCl_3$/DMSO-d_6 at 90 and 200 MHz on Bruker spectrospin and Varian EM-360 spectrometers with TMS as an internal standard (chemical shifts in δ ppm). Microanalyses were performed by microanalytical laboratory, University of Pune, Pune, India. The 6-carbethoxy-3,5-diarylcyclohex-2-enone (**1a–c**), 3,5-diarylcyclohex-2-enone (**7a–c**), 3-5-diarylcyclohexanone (**10a–c**) were prepared according to the literature procedures.[5]

5,7-Diaryl-6,7,8-trihydrobenzo[3,4,-*d*]isoxazolin-1-one (2a–c)/5,7-diaryl-2,6,7,8-tetrahydrobenzo[3,4,-*d*]pyrazolin-1-one(3a–c)/5,7-diaryl-2-phenyl-6,7,8-trihydrobenzo[3,4,-*d*]pyrazolin-1-one (4a–c)

General Procedure: A mixture of **1** (0.005 mol), hydroxylamine hydrochloride/hydrazine hydrate/phenylhydrazine (0.005 mol), 10% NaOH solution (5 mL) and methanol (30 mL) was refluxed on a water bath for 3 hrs. Then the content was cooled and poured onto crushed ice. The separated solid was filtered, washed with aqueous methanol (1:1) and recrystallized from aqueous alcohol. **2a**: m.p. 139–141°C, Yield 65%; IR (KBr): 1610 (C=C), 1710 (C=O); ^1H NMR ($CDCl_3$): 2.01–2.23 (m, 2H, C_6-H_a & C_8-H), 2.30–2.52 (dd, 1H, J=4.0 & 15.4 Hz, C_6-H_b), 2.99–3.17 (m, 1H, C_7-H), 5.34 (s, 1H, C_4-H); Anal. Calcd. for $C_{19}H_{15}NO_2$: C, 78.87; H, 5.25; N, 4.84; Found: C, 78.72; H, 5.39; N, 4.67. **2b**: m.p. 179–180°C, Yield 63%; IR (KBr); 1607 (C=C), 1714 (C=O); Anal. Calcd. for $C_{20}H_{17}NO_3$: C, 75.21; H, 5.36; N, 4.36; Found: C, 75.32; H, 5.45; N, 4.47. **2c**: m.p. 150–151°C, Yield 65%; IR (KBr): 1605 (C=C), 1709

MARCEL DEKKER, INC.
270 Madison Avenue, New York, New York 10016

(C = O), Anal. Calcd. for $C_{19}H_{13}Cl_2NO_2$: C, 63.70; H, 3.65; N, 3.91; Found: C, 63.55; H, 3.53; N, 4.01. **3a**: m.p. 158–160°C, Yield 61%; IR (KBr); 1614 (C = C), 1698 (C = O), 3410 (NH); ^{1}H NMR ($CDCl_3$): 2.15–2.36 (m, 2H, C_6-H_a & C_8-H), 2.32–2.99 (dd, 1H, J = 3.5 & 14.8 Hz, C_6-H_b), 3.10–3.30 (m, 1H, C_7-H), 5.22 (s, 1H, C_4-H), 6.73 (s, 1H, NH); Anal. Calcd. for $C_{19}H_{16}N_2O$: C, 79.14; H, 5.59; N, 9.71; Found: C, 79.02; H, 5.70; N, 9.85. **3b**: 177–178°C, Yield 63%; IR (KBr): 1615 (C = C), 1720 (C = O), 3395 (NH); Anal. Calcd. for $C_{20}H_{18}N_2O_2$: C, 75.45; H, 5.69; N, 8.79; Found: C, 75.56; H, 5.56; N, 8.68. **3c**: m.p. 98–100°C, Yield 60%; IR (KBr): 1605 (C = C), 1709, (C = O), 3405 (NH); Anal. Calcd. for $C_{19}H_{14}Cl_2N_2O$: C, 63.88; H, 3.95: N, 7.84; Found: C, 64.03; H, 3.84; N, 7.71. **4a**: m.p. 118–120°C, Yield 60%; IR (KBr): 1615 (C = C), 1720 (C = O), ^{1}H NMR ($CDCl_3$): 2.38–2.64 (m, 2H, C_6-H_a & C_8-H), 2.60–2.90 (dd, 1H, J = 3.5 & 17.0 Hz-C_6-H_b), 3.15–3.52 (m, 1H, C_7-H), 5.65 (s, 1H, C_4-H); Anal. Calcd. for $C_{25}H_{20}N_2O$: C, 82.39; H, 5.53; N, 7.68; Found: C, 82.26; H, 5.41; N, 7.57. **4b**: m.p. 127–128°C, Yield 65%; IR (KBr): 1609 (C = C), 1720 (C = O); Anal. Calcd. for $C_{26}H_{22}N_2O_2$: C, 78.96; H, 5.73; N, 7.17; Found: C, 79.16; H, 5.64; N, 7.10. **4c**: m.p. 138–139°C, Yield 63%; IR (KBr) : 1615 (C = C), 1720 (C = O). Anal. Calcd. for $C_{25}H_{18}Cl_2N_2O$: C, 75.46; H, 4.55; N, 7.04; Found: C, 75.33; H, 4.43; N, 7.17.

6,8-Diaryl-5-carbethoxy-4-oxo-3-phenyl-5,6,7,9-tetrahydrobenzo-[3,4,-*d*] isoxazoline (5a–c)

General Procedure: A solution of benzaldoxime (0.60 g, 0.005 mol) in ethanol (20 mL) was heated to 30–40°C. To this, chloramine-T (CAT) (1.40 g, 0.005 mol) was added and the contents were heated to reflux. The solvent was removed under vacuo. The residue obtained was extracted with ether and washed with 1 N NaOH, brine and dried (an. Na_2SO_4). When the solvent was removed under reduced pressure, nitrile oxide was obtained.[4] This was added to **1a/b/c** (0.005 mol) in ether (25 mL) and the mixture was stirred for 30 min. and kept aside for another 1 hr. Evaporation of the solvent gave **5a–c** which were purified by filtration through a column of silica gel [silica gel (BDH), 60–120 mesh:ethyl acetate:hexane; 1:3]. **5a**: m.p. 144–145°C, Yield 72%; IR (KBr): 1690 (C = O) 1715 (C = O of ester), 1316 (C-O); ^{1}H NMR ($CDCl_3$): 0.92 (t, 3H, $CO_2CH_2\underline{CH_3}$), 2.00 (d, 2H, C_7-H) 2.44 (s, 1H, C_9-H), 2.80 (d, 1H, C_5-H), 3.68 (q, 2H, $CO_2\underline{CH_2}CH_3$), 3.84–4.00 (m, 1H, C_6-H); Anal. Calcd. for $C_{28}H_{25}NO_4$: C, 76.50; H, 5.73; N, 3.18; Found: C, 76.63; H, 5.60; N, 3.06. **5b**: m.p. 144–145°C, Yield 70%; IR (KBr): 1688 (C = O), 1710 (C = O of ester), 1315 (C-O); Anal. Calcd. for $C_{29}H_{27}NO_5$: C, 74.16; H, 5.79; N, 2.98;

MARCEL DEKKER, INC.
270 Madison Avenue, New York, New York 10016

Found: C, 74.07; H, 5.90; N, 2.85. **5c**: m.p. 127–129°C, Yield 67%; IR (KBr): 1692 (C = O), 1715 (C = O of ester) 1310 (C-O). Anal. Calcd. for $C_{28}H_{23}Cl_2NO_4$: C, 66.15; H, 4.55; N, 2.75; Found: C, 66.29; H, 4.42; N, 2.62.

6,8-Diaryl-5-carbethoxy-4-oxo-1,3-diphenyl-5,6,7,9-tetrahydrobenzo[3,4,-*d*]pyrazoline (6a–c)

General Procedure: A mixture of benzaldehyde phenylhydrazone (0.98 g, 0.005 mol) and CAT (1.54 g, 0.0055 mol) was dissolved in ethanol (20 mL) and swirled on water bath for 15–20 min. The solvent was removed under vacuo (4–5 mm/Hg) and the residue obtained was extracted with ether washed with 1 N NaOH, brine and dried (an. Na_2SO_4). Evaporation of the solvent gave nitrile imine.[4] To this **1a/b/c** (0.005 mol) in ethanol (10 mL) was added and the contents were refluxed for another 1 hr. Then it was cooled and poured onto crushed ice. The solid separated was filtered and recrystallized from aqueous ethanol (1:1). **6a**: m.p. 109–110°C, Yield 61%; IR (KBr): 1698 (C = O), 1715 (C = O of ester); ^{1}H NMR ($CDCl_3$): 0.98 (t, 3H, $CO_2CH_2\underline{CH_3}$), 2.15 (d, 2H, C_7-H), 2.56 (d, 1H, C_5-H), 2.55 (s, 1H, C_9-H), 3.80 (q, 2H, $CO_2\underline{CH_2}CH_3$), 3.95–4.25 (m, 1 H, C_6-H); Anal. Calcd. for $C_{34}H_{30}N_2O_3$: C, 79.35; H, 5.87; N, 5.44; Found: C, 79.47; H, 5.66; N, 5.32. **6b**: m.p. 120–121°C, Yield 60%; IR (KBr): 1690 (C = O), 1722 (C = O of ester); Anal. Calcd. for $C_{35}H_{32}N_2O_4$: C, 77.18; H, 5.92; N, 5.14; Found: C, 77.07; H, 5.81; N, 5.24. **6c**: m.p. 127–128°C, Yield 65%; IR (KBr): 1684 (C = O), 1715 (C = O of ester). Anal. Calcd. for $C_{34}H_{28}Cl_2N_2O_3$: C, 69.98; H, 4.83; N, 4.80; Found: C, 69.85; H, 4.74; N, 4.90.

6,8-Diaryl-4-oxo-3-phenyl-5,6,7,9-tetrahydrobenzo[3,4,-*d*]isoxazoline (8a–c)/6,8-diaryl-4-oxo-1,3-diphenyl-5,6,7,9-tetrahydrobenzo-[3,4,-*d*]pyrazoline (9a–c)

General Procedure: The compounds **8/9a–c** were prepared by the reaction of nitrile oxide and nitrile imine with **7a/b/c** as described for **5** and **6**. The compounds were purified by recrystallization from aqueous ethanol (1:1). **8a**: m.p. 187–188°C, Yield 64%; IR (KBr): 1695 (C = O), 1312 (C-O); ^{1}H NMR ($CDCl_3$): 2.10 (d, 2H, C_7-H), 2.56 (s, 1H, C_9-H), 2.84 (d, 2H, C_5-H), 3.45–3.80 (m, 1H, C_6-H); Anal. Calcd. for $C_{25}H_{21}NO_2$: C, 81.71; H, 5.76; N, 3.81; Found: C, 81.58; H, 5.64; N, 3.90. **8b**: m.p. 198–200°C, Yield 62%; IR (KBr): 1690 (C = O), 1298 (C-O); Anal. Calcd. for $C_{26}H_{23}NO_3$: C, 78.56; H, 5.83; N, 3.52; Found: C, 78.43; H, 5.74; N,

MARCEL DEKKER, INC.
270 Madison Avenue, New York, New York 10016

3.63. **8c**: m.p. 164–165°C, Yield 66%; IR (KBr): 1698 (C = O), 1309 (C-O); Anal. Calcd. for $C_{25}H_{19}Cl_2NO_2$: C, 74.26; H, 4.73; N, 3.46; Found: C, 74.40; H, 4.82; N, 3.35. **9a**: 92–94°C; Yield 60%; IR (KBr): 1698 (C = O) ^{1}H NMR ($CDCl_3$): 2.15 (d, 2H, C_7-H), 2.62 (s, 1H, C_9-H), 2.89 (d, 2H, C_5-H), 3.05–3.45 (m, 1H, C_6-H); Anal. Calcd. for $C_{31}H_{26}N_2O$: C, 84.13; H, 5.92; N, 6.32; Found: C, 84.00; H, 5.80; N, 6.23. **9b**: m.p. 95–97°C, Yield 63%; IR (KBr): 1705 (C = O); Anal. Calcd. for $C_{32}H_{28}N_2O_2$: C, 81.32; H, 5.97; N, 5.92; Found: C, 81.42; H, 6.06; N, 5.78. **9c**: m.p. 105–106°C, Yield 66%; IR (KBr): 1700 (C = O). Anal. Calcd. for $C_{31}H_{24}Cl_2N_2O$: C, 72.80; H, 4.72; N, 5.47; Found: C, 72.94; H, 4.82; N, 5.39.

3,5-Diaryl-1-morpholino-3,4,5,6-tetrahydrobenzene (11a–c)

General Procedure: A mixture of **10a/b/c** (0.01 mol), morpholine (2 mL, 0.018 mol), a catalytic amount of p-toluene sulfonic acid and dry benzene (30 mL) was taken in a round bottomed flask equipped with Dean-Stark apparatus and refluxed until the water separation was seized. The contents were cooled, extracted with benzene and washed with sat. $NaHCO_3$ solution and water. Evaporation of solvent in vacuo gave a semi-solid which was purified by filtration through column of silica gel chromatography [silica gel (BDH), 60–120 mesh; ethyl acetate:hexane, 1:2]. **11a**: m.p. 111–112°C, Yield 68%; **11b**: m.p. 127–128°C; Yield 65%; **11c**: m.p. 115–116°C; Yield 65%.

4,6-Diaryl-3-phenyl-4,5,6,7-tetrahydrobenzo[3,4,-*d*]isoxazole (12a–c)

General Procedure: A solution of **11a/b/c** (0.005 mol), benzaldoxime (0.005 mol) and a catalytic amount of CAT in ethanol (25 mL) was refluxed for 4 hrs. The reaction mixture was extracted with ether, washed with dil. NaOH, brine, water and dried (an. Na_2SO_4). Evaporation of the solvent gave oily substance which contains amine and isoxazole, (**12**). Pure **12** was separated by column chromatography [silica gel (BDH), 60–120 mesh; ethyl acetate:hexane, 1:3]. **12a**: m.p. 98–99°C, Yield 68%; IR (KBr): 1613 (C = C), 1332 (C-O); ^{1}H NMR ($CDCl_3$): 2.30–2.55 (m, 2H, C_5-H), 2.70 (d, 2H, C_7-H), 3.80–3.88 (m, 1H, C_6-H), 4.03 (t, 1H, C_4-H); Anal. Calcd. for $C_{25}H_{21}NO$: C, 85.43; H, 6.16; N, 3.98; Found: C, 85.56; H, 6.29; N, 3.89. **12b**: m.p. 111–112°C, Yield 64%; IR (KBr): 1615 (C = C), 1348 (C-O); Anal. Calcd. for $C_{26}H_{23}NO_2$: C, 81.8; H, 6.07; N, 3.68; Found: C, 81.65; H, 6.16; N, 3.80. **12c**: m.p. 86–87°C, Yield 65%; IR (KBr): 1611 (C = C), 1320 (C-O). Anal. Calcd. for $C_{25}H_{19}Cl_2NO$: C, 71.30; H, 4.54; N, 3.32; Found: C, 71.42; H, 4.64; N, 3.23.

MARCEL DEKKER, INC.
270 Madison Avenue, New York, New York 10016

4,6-Diaryl-1,3-diphenyl-4,5,6,7-tetrahydrobenzo[3,4,-*d*] pyrazole(13a–c)

General Procedure: The compounds **13a–c** were obtained by the reaction of **11a/b/c** with benzaldehyde phenylhydrazone following the above described procedure. The compounds were purified by column chromatography [silica gel (BDH), 60–120 mesh; ethyl acetate:hexane, 1:3]. **13a**: m.p. 120–121°C, Yield 63%; IR (KBr): 1613 (C = C); ^{1}H NMR ($CDCl_3$): 2.12–2.38 (m, 2H, C_5-H), 2.85 (d, 2H, C_7-H), 3.72–3.81 (m, 1H,C_6-H); 4.05 (t, 1H, C_4-H); Anal. Calcd. for $C_{31}H_{26}N_2$: C, 87.29; H, 6.14; N, 6.56; Found: C, 87.18; H, 6.24; N, 6.44. **13b**: m.p. 112–113°C, Yield 65%; IR (KBr): 1620, (C = C); Anal. Calcd. for $C_{32}H_{28}N_2O$: C, 84.17; H, 6.18; N, 6.13; Found: C, 84.30; H, 6.09; N, 6.26. **13c**: m.p. 118–119°C, Yield 64%; IR (KBr): 1619 (C = C). Anal. Calcd. for $C_{31}H_{24}Cl_2N_2$: C, 75.15; H, 4.88; N, 5.65; Found: C, 75.01; H, 5.03; N, 5.55.

ACKNOWLEDGMENT

One of the authors (ASSR) is grateful to CSIR, New Delhi for the award of Senior Research Fellowship.

REFERENCES

1. Padmavathi, V.; Bhaskar Reddy, A.V.; Sumathi, R. P.; Padmaja, A. and Bhaskar Reddy, D. Indian J. Chem. **1998**, *37B*, 1286.
2. Padmavathi, V.; Sumathi, R.P.; Bhaskar Reddy, A.V. and Bhaskar Reddy, D. Heterocycl. Commun. **1998**, *4*, 163.
3. Bhaskar Reddy, D.; Somasekhar Reddy, A. and Padmavathi, V. J. Chem. Research(s), **1998**, 784.
4. Padmavathi, V.; Sumathi, R.P.; Chandrasekhar Babu, N. and Bhaskar Reddy, D. J. Chem. Research(s) **1999**, 610.
5. Balasubramanian, M. and D'souza, A. Tetrahedron **1968**, *24*, 5399.
6. Caramella, P. and Grunanger, P. in "*1,3-Dipolar Cycloaddition Chemistry*", Padva, A. (Ed.) John Wiley and Sons, 1984, Vol. 1, Chapter 3, pp. 291; Huisgen, R.; Grashey, R. and Sauer, J. in "*Chemistry of Alkenes*", Patai, S. (Ed.), Interscience, New York, 1964, pp. 806 ff.

Received in the USA October 11, 2000

MARCEL DEKKER, INC.
270 Madison Avenue, New York, New York 10016