ISSN: 0975-766X
CODEN: IJPTFI
Available Online through
www.ijptonline.com
Research Article

SYNTHESIS OF PYRANO [2, 3-F] ISOFLAVONES (3-PHENYL-4H, 8H-PYRANO [2,3F]CHROMEN-4-ONES

Glory Arava and Lingappa Yeramanchi*
Department of chemistry, Sri Venkateswara University, Tirupathi-517502, A.P, India.
Email: aglory999@gmail.com

Received on 30-04-2012 *Accepted on 15-05-2012*

Abstract

The Claisen sigmatropic rearrangement of 7-propargyloxyisoflavones **(3a-d)** refluxed N, N-diethylaniline at 220 ºC for 24 hours to gives pyrano[2,3-f]isoflavones(3-phenyl-4H,8H-pyrano[2,3-f] chromen-4-ones **(4a-d)**

Keywords: 7-Hydroxyisoflavones, 7-propargyloxyisoflavones, N, N-diethylaniline, propargyl bromide, Claisen rearrangement.

Introduction

Isoflavones and their oxygen heterocycle fused derivatives are naturally occurring and have a variety of biological properties such as fish toxicity, coronary vasodilator, and antitumour activity. Earlier we reported the synthesis of 4-(2H-chromen-3yl)-3-methoxy phenyl azetidin-2-ones. There is no report in the literature for the synthesis of pyrano [2,3-f] isoflavones.

In view of the 7-hydroxyisoflavones were synthesized by the modified Baker-Venkataramann transformation and these condensation with propargyl bromide in K_2CO_3-acetone gave the corresponding 7-propargyloxyisoflavones **(3a-d).** Compounds on Claisen rearrangement in N, N-diethylaniline at 220 ºC gave the pyrano [2,3-f]isoflavones (3-phenyl-4H,8H-pyrano[2,3f] chromen-4-ones**(4a-d)**.

Material and Methods

General

Melting points were determined on a Polmon instrument (model no. MP 96).IR spectra were recorded on FT-IR Perkin-Elmer 1605 spectrometer, and ^{1}H NMR (200 MHz) and ^{13}C NMR (100.6 MHz) were recorded on a Varian

Gemini 200 spectrometer using TMS as internal standard (chemical shifts and ppm). UV spectra were obtained on a Shimadzu UV-visible spectrophotometer (model UV-1601). Mass spectra were recorded on a VG micromass 70-70H instrument.

General procedure for the synthesis of 7-propargyloxyisoflavones (3a-d)

i) 7-Propargyloxyisoflavone (3a)

7-Hydroxyisoflavone **(1a)** (2.7g, 10.0mmol) dissolved in acetone (40ml). Propargylbromide **(2)** (0.74g, 40mmol) and potassium carbonate (5.52g, 40mmol) is added and refluxed on water bath for 6 hrs. Acetone decanted and evaporated and ice cold water is added. The solid, which separated on column chromatography and elution with petroleum ether: ethylacetate (9:1) gave 7-propargyloxyisoflavone **(3a)**, 2.2g, 75% yield.

Recrystallized from chloroform as pale yellow needles m.p 156 °C.

IR (KBr): 1635 cm^{-1} (C=O), 3211 cm^{-1} (≡C-H), 2122 cm^{-1} (C≡C).

UV (MeOH): 208 nm (log ε 4.4), 220 nm (log ε 4.3).

^{1}H NMR (200 MHz, $CDC1_3$) : δ 7.93 (s,H-2), 7.55 (d,J=10.0 Hz,H-5), 7.05 (d,J=10.0Hz, 2.5Hz,H-6), 7.40(m,H-3',4',5'), 7.52(m,H-2',6'), 6.95(d, J=2.5 Hz, H-8), 2.35 (d,J=2.0Hz, OCH_2), 2.55 (t,J=2.0 Hz, H-2, ≡C-H).

^{13}C NMR(100.6 MHz): δ 175.36 (C-4), 161.70 (C-7), 157.57 (C-8a), 152.57 (C-2), 131.83 (C-1'), 128.03 (C-5), 125.29 (C-3), 119.08 (C-4a), 128.88 (C-2',6'), 128.34 (C-3',5'),127.88 (C-4'), 114.77 (C-6), 101.62 (C-8), 56.32 (C-1''), 77.31 (C-2''), 76.52 (C-3'').

MS: M^+ 304 (100%), 305 (28%).

Employing the similar procedure as mentioned for **3a, 3b-d** were obtained from **1b-d** as solids in 70-80% yield.

ii) 7-Propargyloxy-6-chloro-4'-methoxyisoflavone (3b)

Recrystallized from chloroform as pale yellow needles, yield 74%, m.p 156 ^{o}C.

IR (KBr): 1636 cm^{-1} (C=O), 3290 cm^{-1}(≡C-H), 2369 cm^{-1} (C≡C).

UV (MeOH): 244 nm (log ε 3.9), 264 nm (log ε 3.8).

^{1}H NMR (200 MHz, $CDC1_3$): δ 7.53 (d, J=9.0 Hz, H-5), 8.0 (s.H-2), 7.19 (d.J =9.0 Hz, H-2',6'),7.05(d,J=9.0Hz,3',5'),7.0(bs,H-8),4.85 (d, J=2.0Hz, OCH_2), 2.62 (t, J=2.0 Hz,≡C-H),3.75 (s,OCH_3).

^{13}C NMR(100.6MHz,CDC1$_3$): δ175.65 (C-4), 161.68 (C-7), 159.65 (C-4'), 157.63 (C-8a), 152.04 (C-2), 130.07 (C-2',6'), 127.93 (C-5), 119.10 (C-4a), 124.17 (C-3), 124.96 (C-1'), 114.72 (C-6), 113.99 (C-3',5'), 101.64 (C-8), 56.26 (C-l''),77.40(C-2''),76.36 (C-3''), 55.29 (4'-OCH_3).

MS: M^+ 300 (100%), 370 (32%), 369 (20%).

iii) 7-Propargyloxy-2□,6-dibromo-4'-chloroisoflavone (3c)

Recrystallized from chloroform as pale yellow needles, yield 73%, m.p 158 ^oC.

IR (KBr): 1637 cm^{-1} (C=O), 3220 cm^{-1}(≡C-H), 2363 cm^{-1} (C≡C).

UV (MeOH): 210 nm (log ε 4.9), 225 nm (log ε 4.8).

^{1}H NMR (200 MHz, CDC1$_3$): δ 7.65 (d.J=10.0 Hz, H-5), 7.95 (s,H-2),7.15 (d. J=10.0Hz, H-,6'), 7.16 (d,J=10.0Hz, H-3',5'), 6.65 (d.J=2.5Hz,H-8), 2.35 (d, J=2.0 Hz, OCH_2), 2.55 (t, J=2.0 Hz, ≡C-H).

^{13}C NMR (100.6 MHz, CDC1$_3$): δ174.70 (C-4), 161.88 (C-7), 157.79 (C-8a), 152.58 (C-2), 134.56 (C-4'), 130.22 (C-3',5'), 128.68 (C-6'), 128.02 (C-5), 124.14 (C-3), 118.81 (C-4a), 115.02 (C-6), 101.79 (C-8), 76.99 (C-2''), 76.59 (C-3''), 56.34 (C-l'').

MS: M^+ 496 (100%).

iv) 7-Propargyloxy-2', 6-dimethylisoflavone (3d)

Recrystallized from chloroform as pale yellow needles, yield 75%, m.p160 °C.

IR (KBr): 1637 cm^{-1} (C=O), 3299 cm^{-1}(≡C-H), 2365 cm^{-1} (C≡C).

UV (MeOH): 211nm (log ε 5.0), 255 nm (log ε 4.7).

^{1}H NMR (200 MHz, CDC1$_3$): δ 7.35 (d,J=10.0Hz,H-5), 7.93 (s,H-2), 6.88 (d, J=9.0Hz, H-6'), 6.95 (J=2.0 Hz, H-3'), 7.00 (dd, J=9.0, 2.5Hz, H-5'),7.18 (d, J=2.5 Hz, H-8), 4.80(d, J=2.0Hz,OCH_2),2.35(s,6-CH_3),2.35 (s,2'-CH_3), 2.53 (t, J=2.0, ≡C-H).

^{13}C NMR (100.6 MHz, $CDCl_3$): δ175.0 (C-4), 161.72 (C-7), 157.62 (C-8a). 152.25 (C-2), 149.23 (C-2'), 149.20 (C-4'), 127.92 (C-6), 124.59 (C-3), 121.45 (C-6'), 114.81 (C-5), 114.90 (C-1'), 112.69 (C-3'), 111.33 (C-5'), 101.63 (C-8), 119.0 (C-4a), 76.35 (C-3''), 76.54 (C-2''), 56.26 (C-l''), 17.5 (CH_3-6), 17.7 (CH_3-2').

MS: M^+ 366 (100%).

Synthesis of pyrano [2, 3-f] isoflavones (3-phenyl-4H, 8H-pyrano [2, 3-f] chromen-4-ones (4a-d)

7-Propargyloxyisoflavone **(3a)**(2.7g,10.0mmol) was dissolved in N.N-diethyl aniline (20ml) and refluxed for 24 hrs then the reaction mixture was cooled and poured in cold dilute hydrochloric acid (100ml) and extracted with ethyl acetate (200 ml) and concentrated. The crude product was chromatographed over silica gel by eluting with chloroform to give pyrano[2,3-f]isoflavone **(4a)**, which was recrystallized from chloroform to give white needles 2.0g, 70% yield.

i) Pyrano[2,3-f]isoflavone,(3-phenyl-4H,8H-pyrano[2,3-f]chromen-4-one(4a).

Recrystallized from chloroform m.p 120 °C.

IR (KBr): 1630cm^{-1}(C=O).

UV (MeOH): 205 nm (log ε 4.4), 220 nm (log ε 4.3).

^{1}H NMR (200 MHz, $CDC1_3$) :δ 8.05 (d, J=9.0Hz, H-5), 7.95 (s,H-2), 7.55 (m,H-2',6'), 7.40 (m,H-3',4',5'), 6.88 (d, J=10.0Hz, H-10), 6.80 (d, J=9.0Hz, H-6), 5.85 (dt, J=3.0Hz, 10.0 Hz, H-9), 4.95 (d, J=1.5 Hz, OCH_2 -8).

^{13}C NMR (100.6 MHz, $CDC1_3$): δ175.2 (C-4), 158.15 (C-6a), 152.18 (C-2), 152.18 (C-l0b), 131.83 (C-1'), 128.82 (C-3',5'), 128.27 (C-2',6'), 127.95 (C-4'), 126.72 (C-9), 126.72 (C-5), 124.98 (C-3), 121.35 (C-10), 117.15 (C-4a), 114.43 (C-6), 110.16 (C-10a), 65.97 (C-8).

MS: M^+ 276 (100%), 275(10%).

Employing the similar procedure as mentioned for **4a, 4b-d** were obtained from **3b-d** as solids in 60-70% yield.

ii) Pyrano[2,3-f]-6-chloro-4'-methoxyisoflavone,3-(4-methoxyphenyl)-4H,8H-pyrano[2,3-f] chromen-4-one (4b)

Recrystallized from chloroform to give white needles, yield 68%, mp 158 °C.

IR (KBr): 1631 cm^{-1}(C=O). UV (MeOH): 244 nm (log ε 3.9).

^{1}H NMR (200 MHz, $CDCl_3$): δ7.45 (d, J=10.0Hz,H-5), 7.90 (s, H-2), 6.95 (d,J=9.0Hz. H-3',5'),7.50 (d, J=9.0Hz, H-2',6'), 6.85 (d,J=10.0Hz, H-10), 5.85 (dt, J-10.0Hz, 3.0Hz, H-9), 4.95 (d, J=1.5Hz. OCH_2, H-8), 3.82 (s, OCH_3-4').

^{13}C NMR (100.6 MHz, $CDC1_3$): δ 176.0 (C-4), 157.78 (C-6a), 151.5 (C-10b), 152.20 (C-2) 160.03 (C-4'), 130.0 (C-2',6'), 127.0 (C-5), 127.0 (C-9), 125.0 (C-3), 124.0 (C-1'), 114.0 (C-3',5'), 122.0 (C-10), 118.0 (C-4a), 115.0 (C-6), 110.0 (C-10a), 66.0 (C-8), 55.0 (4'-OCH_3).

MS: M^+ 340 (100%), 342 (30%), 341 (20%).

iii) Pyrano[2,3-f]-6,2'-dibromoisoflavone,(3-(2'-bromo-4'-chlorophenyl)-4H,8H-pyrano[2,3-f] chromen-4-one (4c)

Recrystallized from chloroform to give white needles,yield 70%, m.p 182 ^oC.

IR (KBr): 1635 cm^{-1}(C=O).UV (MeOH): 226 nm (log ε 4.8).

^{1}H NMR (200 MHz, $CDCl_3$): δ 7.55(d, J=9.0 Hz, H-5), 7.35 (s,H-2), 7.20-7.50 (m,H-3', 5',6'), 6.86 (d, J=10.0 Hz, H-10), 5.83 (dt, J=10Hz, 3,0Hz, H-9), 4.95(d,J=1.5Hz, OCH_2-8).

^{13}C NMR (100.6 MHz, $CDCl_3$) : δ174.64 (C-4), 158.58 (C-6a), 153.73 (C-2), 152.35 (C-10b), 135.31 (C-2'), 135.06 (C-4'), 133.07 (C-6'), 131.13 (C-l'), 129.71 (C-5'), 127.07 (C-9), 126.92 (C-3'), 121.67 (C-5), 118.65 (C-4a), 110.49 (C-10a), 122.96 (C-3), 114.87 (C-6), 117.30(C-10), 66.14 (C-8).

MS: M^+ 467 (100%), 469 (70%), 465 (40%).

iv) Pyrano[2,3-f]-6,2'-dimethylispflavone,(3-(4-chlorophenyl)-4H,8H-pyrano[2,3-f] chromen- 4-one (4d)

Recrystallized from chloroform to give white needles,yield 69%, m.p 186 °C.

IR (KBr): 1651 cm^{-1} (C=O).UV (MeOH):204 nm (log ε 5.1), 226 nm (log ε 4.3).

^{1}H NMR (200 MHz, $CDC1_3$) : δ 7.20 (d,J=10Hz,H-5), 7.39 (s,H-2), 7.50 (d.J=9.0Hz, H-,6'), 7.05 (d, J=9.0 Hz, H-3',5'), 6.82 (m, H-6, H-10), 5.85 (dt,J=10Hz, 3.0Hz, H-9), 4.99 (bs,OCH_2-8),2.35(s,CH_3-6), 2.35 (s,CH_3-2').

^{13}C NMR (100.6 MHz, $CDC1_3$) : δ 175.81 (C-4), 159.58 (C-6a), 158.16 (C-l 0b), 152.15 (C-2), 130.27 (C-4'), 130.07 (C-6'), 126.88 (C-5), 126.84 (C-9), 126.84 (C-l'), 126.86 (C- 2'), 126.33 (C-3'), 126.31 (C-5'), 124.09 (C-3), 121.38 (C-10), 118.73 (C-4a), 114.49 (C-6), 110.23 (C-10a), 66.07 (C-8).

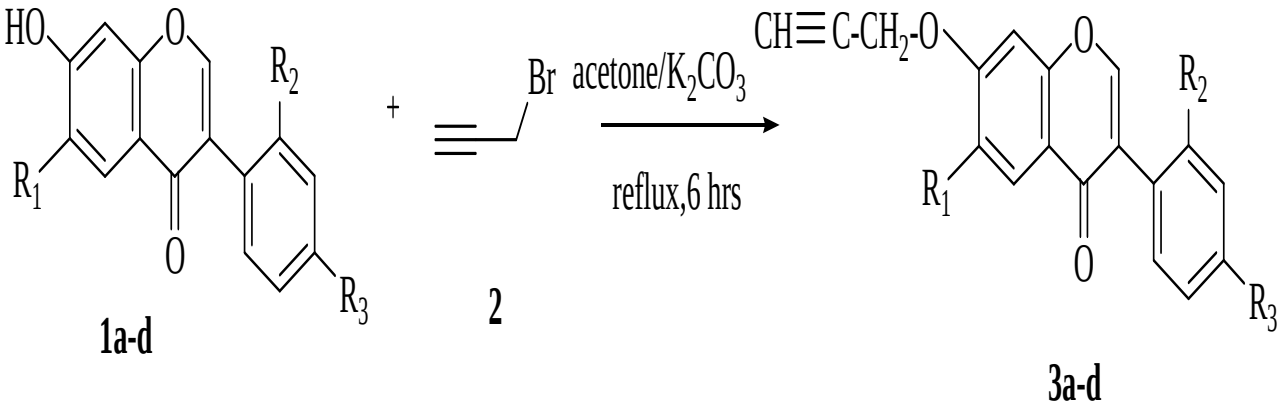
MS: M^+ 338(100%), 340(30%), 339 (20%).

Results and Discussion

Synthesis of pyrano [2,3-f]isoflavones (3-phenyl-4H,8H-pyrano[2,3-f|chromen-4-ones (4a-d)

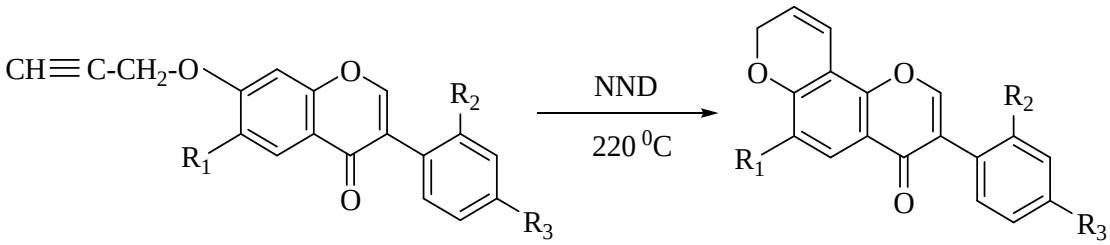
7-Propargyloxyisoflavones **(3a)** dissolved in N, N-diethylaniline were refluxed at 220 °C for 24 hrs to give pyrano[2,3-f]isoflavones, (3-phenyl-4H,8H-pyrano[2,3-f]chromen-4-ones) **(4a)**, In its IR spectrum of pyrano[2,3-f]isoflavone **(4a)** carbonyl peak appeared at 1630 cm^{-1}. Its UV spectrum showed bands at 205 nm (log ε 4.4), 220 nm (log ε 4.3). In the ^1H NMR of pyrano [2.3-f] isoflavone (200 MHz) the OCH_2 group of the new ring system appears as a doublet at δ 4.95 (J=1.5Hz), the olefinic proton H-10 appeared as a doublet at δ 6.88 (J=10.0Hz), while H-9 appeared at δ 5.85 as a double triplet (J=10.0.3.0 Hz). The other signals are due to the original isoflavone moiety. H-2 appeared as a singlet at δ 7.95. H-5 appeared as a doublet at δ 8.05 (J=9.0 Hz), H-6 as a doublet at δ 6.80 (J=9.0 Hz), The aromatic protons H-2', 6' appeared as multiplet at δ 7.55 and H-3',4',5' at δ 7.40 as multiplet.

Scheme-1



1,3 **a** = R_1 = H R_2=H R_3= H
b = R_1 = Cl R_2=H R_3=OCH_3
c = R_1 = Br R_2= Br R_3=Cl
d = R_1 = CH_3 R_2=CH_3 R3=Cl

Scheme-2



3a-d **4a-d**

3,4 **a** = R_1 = H R_2=H R_3= H
b = R_1 = Cl R_2=H R_3=OCH_3
c = R_1 = Br R_2= Br R_3=Cl
d = R_1 = CH_3 R_2=CH_3 R3=Cl

References:

1. Seshadri T R & Sood M S, Curr Sci, 32, 1963, 195.

2. Re PD, Sagramora L, Mancini V, Valanti P & Cima P.J Med Chem, 13, 1970, 527.

3. Atassi G, Briet P, Berthalon J J & Collenges T, Eur J Med Chem Chemther, 20,1985, 393.

4. Prasada Rao, Ch., David Krupadanam,G.L., and Srimannarayana,G., Ind. J. Chem., 30B, 1991, 666

5. Prakash Rao, Ch., David Krupadanam, G.L., and Srimannarayana, G., Ind., J. Chem., 33B, 1994, 591.

6. Otter, B.A., Saluja, S.S., and Fox J., .J. Org. Chem., 37, 1972, 2858.

7. Balasubramaniam, K.K., and Venugopalan, B., Tetrahedron Lett. 1973 2707.

8. Bhupal Reddy T, Rami Reddy Y V, J.Chem.Pharm. Res., 3(2) 2011, 617.

9. Bhupal Reddy T, Rami Reddy Y V, IJPT 3(1) 2011, 1777.

10. Reddy, G.B., Holt, G., and Pickless, W., *.J. Chem. Soc.*, 1952, 4162.

Corresponding Author:

Lingappa Yeramanchi*

Email: *aglory999@gmail.com*