Supporting Information

A concise synthesis of 3,5-Dicyano-6-trifluoromethylpyridine and preparation of a mono thioamide.

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1. Experimental methods
2. Spectra of compounds

1. EXPERIMENTAL

All the chemical reagents were purchased and used as received, unless otherwise indicated. Grignard reagent used was $\text{C}_2\text{H}_5\text{MgBr}$ (3.40 M solution in diethyl ether, Aldrich) unless otherwise noted. ^1H , ^{19}F & ^{13}C NMR spectra were recorded on a Bruker Avance II-400 and 600 spectrometer and all chemical shift values refer to $\delta_{\text{TMS}} = 0.00$ ppm or CDCl_3 δ (^1H), 7.26 ppm; δ (^{13}C), 77.1 ppm). The HRMS analyses were performed on an Agilent QTOF 6520 mass spectrometer and LCMS on THERMO MSQ PLUS mass spectrometer. IR spectra were recorded on Shimadzu DRS Prestige 21. Column chromatographic purifications were performed on a CombiFlash Rf (Teledyne Isco) with silica gel using a mobile phase indicated.

4-Dimethylaminomethyleneglutacononitrile (2)^{8,9}

Trans- Dimethylacrylonitrile (50.00gm, 0.52mol) was added drop-wise to acetic acid (500ml) whilst maintaining the temperature at 15°C. The reaction mixture was then stirred at room temperature overnight, the acetic acid removed by evaporation and the residue was taken up in water (300 ml). The solid precipitated was collected by filtration, washed with water (100ml) and dried to give (2) (31.15gm, 41%) as an orange solid with melting point 121-122°C.

IR (KBr): 3000, 2206, 1640, 1593, 1481, 1424, 1405, 1283, 1246, 1189, 1121, 1055, 969, 937, 867, 753 cm^{-1} .

^1H NMR (400 MHz, CDCl_3): δ = 3.25 (br d, 6 H, $\text{N}(\text{CH}_3)_2$), 5.20 (d, $J = 15\text{Hz}$ s, 1 H), 6.75 (s, 1 H), 6.80 (d, $J = 15\text{Hz}$, 1H).

HRMS: calc for $\text{C}_8\text{H}_{10}\text{N}_3$ ($\text{M}+\text{H}$)⁺: 148.15723; found: 148.08685

was poured onto water, and extracted three times with ethyl acetate. The combined organic layers were then dried using magnesium sulfate, and the crude material purified by chromatography using a mixture of ethyl acetate: heptane, varying the amount of ethyl acetate from 0 to 30% to give compound (5) (2.62gm, 75%) of the product with melting point 141-145°C. Later fractions were collected and evaporated to give 0.7gm (17%) of 3,5-di-thioamido-6-trifluoromethyl pyridine with melting point 170-174°C.

IR (KBr): 3325, 3177, 2257, 1651, 1558, 1466, 1418, 1326, 1263, 1160, 1142, 1057, 968, 928, 848, 780, 685cm⁻¹.

¹H NMR (600 MHz, DMSO): δ = 8.9 (d, J = 2Hz, 1 H), 9.3 (d, J = 2Hz, 1 H), 10.05 (br.s, 1H), 10.5 (br.s, 1H)

¹⁹F NMR (376.6 MHz, CDCl₃): δ = 66ppm

¹³C NMR (150.93 MHz, DMSO): δ = 106.9, 114.1, 120.8 (q, J_{C-F} = 274Hz), 138.3, 141.7, 148.4 (q, J_{C-F} = 34Hz), 151.0, 194.4.

HRMS: calc for C₈H₅N₃F₃S (M+H)⁺: 232.1988; found: 232.01502

5-Cyano-3-thioamido-6-trifluoromethylpyridine (5): Method B

3,5-Dicyano-6-trifluoromethylpyridine (0.2gm, 1.0mmol) was dissolved in Dioxane (4ml) and water (0.02ml) was added. The solution was degassed by bubbling argon through, and then diethyl-dithiophosphate (0.19gm, 1.0mmol) added. The reaction mixture was then heated to 80°C for two days, after which time LCMS showed the reaction was not complete. A second quantity of diethyl-dithiophosphate (0.19gm, 1.0mmol) was added and the reaction stirred at 80°C for a further 10 hours. The reaction mixture was then allowed to cool to room temperature and poured onto water and stirred together with dichloromethane. The organic phase was separated and the aqueous phase washed twice with dichloromethane. The combined organic layers were dried using magnesium sulfate, the drying agent filtered and the solvent removed by evaporation. The crude product was purified by chromatography using a mixture of ethyl acetate: heptane, varying the amount of ethyl acetate from 0 to 30% to give (5) (150mg, 64%) with melting point 141-145°C. Later fractions were collected and evaporated to give 17mgs (6%) of 3,5-di-thioamido-6-trifluoromethyl pyridine with melting point 170-174°C.

2. Spectra of Compounds

[illegible]

IR

Name :
Sample :
crystals
ht std DMSO {C:\NMR0\2013} Fruenhuf 23
HOLDER = 23

Current Data Parameters
Date_ 20131129
Time_ 11:29
EXPNO 2
PROCNO 1
F2 - Acquisition Parameters
Date_ 20131129
Time_ 11:29
INSTRUM spect
PROBHD 5 mm PABBO BB-
PULPROG zgpg30
SOLVENT DMSO
NS 16
DS 4
SWH 12019.230 Hz
FIDRES 0.18339 Hz
AQ 2.13137 sec
RG 2.202.52
RM 41.660 usec
W 12.000 K
TE 299.6 K
D1 1.0000000 sec
TD 1
===== CHANNEL f1 =====
NUC1 13C
P1 15.00 usec
PL1 0 dB
PL1A 15.0000019 W
SFO1 400.131536 MHz
F2 - Processing Parameters
SI 32768
SF 400.131536 MHz
WDW EM
SSB 0
GB 0
PC 1.00

Name
Sample
crystals
f19std DMSO (C:\NMR2\2013) Fruehauf 42

-71.93
-72.36

Current Data Parameters
Date: 2011.12.19
Time: 9.10
Pulse: 9.10
Pulse: 5 mm PABP-80/
PULPROG: zgpg30
TD: 32768
SOLVENT: DMSO
NS: 32
DS: 4
SWH: 9375.000 Hz
FIDRES: 0.31525 Hz
AQ: 0.327 sec
RG: 327
DM: 5.333 usec
DE: 6.58 usec
TE: 300.2 K
D1: 1.0000000 sec
D11: 0.0300000 sec
TDO: 0.0002000 sec

===== CHANNEL f1 =====
NUC1: 1H
P1: 15.00 usec
PL1: 0.00 dB
SFO1: 376.529118 MHz

===== CHANNEL f2 =====
CPDPRG2: waltz16
NUC2: 1H
P2: 15.00 usec
PL2: 0.00 dB
PLM2: 0.391300 W
SFO2: 400.231509 MHz

F2 - Processing parameters
SI: 326214
SF: 376.529118 MHz
WDW: EM
SSB: 0
GB: 0
PC: 1.00

13C

11.07.2014

^{13}C NMR (151 MHz, $\text{DMSO-}d_6$) δ ppm 49.1 (s, 1 C) 81.9 (s, 1 C) 85.7 (s, 1 C) 116.7 (q, $J=292$ Hz, 1 C) 113.8 (s, 1 C) 114.1 (s, 1 C) 158.6 (s, 1 C) 165.7 (s, 1 C) 174.3 (q, $J=33$ Hz, 1 C)

IR

Name:
 Sample ID:
 h1std CDC13 {C:\NMR2} hall 9

Name
Sample ID
f19std_30_-230 CDCl3 {c:\NMR2} hal1 9

2

NAME NMR_2009_1_20
EXPNO 1
PROCNO 1
Date_ 20091120
Time 09:22
INSTRUM spect
PROBHD 5 mm QNP 1H/13
PULPROG zgpg30
TD 65536
SOLVENT CDCl3
NS 32
DS 4
SWH 75000.000 Hz
FIDRES 0.172005 Hz
AQ 0.8718223 sec
RG 6.567 usec
DW 10.00 usec
DE 320.0
TE 300.2 K
D1 1.00000000 sec
d11 0.03000000 sec
d12 0.00000000 sec
TD0 1 sec
PC 1.00

===== CHANNEL f1 =====
NUC1 13C
P1 14.50 usec
PL1 -1.50 dB
NUC2 1H
P2 18.4734842 usec
PL2 19.00 dB
SFO1 376.543034 MHz

===== CHANNEL f2 =====
CPDPRG2 waltz16
NUC3 1H
P3 9.00 usec
PL3 -1.00 dB
PL4 -1.00 dB
PL12 15.12 dB
PL14 11.0024692 usec
PL16 10.224692 usec
PL18 10.224692 usec
SFO2 400.216009 MHz
SI 32
SF 252.464 MHz
WDW EM
SSB 0
GB 0
PC 1.00

Scale: 5.042 ppm/cm, 1899 Hz/cm

54.11
52.45
52.09
51.72
51.35
45.41

NAME	NR1_309_11_25	
WAVE	50	
DATE	20091126	
TIME	2.16	
INSTRUM	5 m QRP 1B/13	
PROB	29310	
INTERFRO	29310	
TIME	29310	
STATUS	CRC13	
NOISE	800	
SWR		
PTILES	13467.53 Hz	
SWR	0.95641 Hz	
SWR	1.009304 sec	
WAVE	15.40 usec	
DI	20.0 usec	
DE	2.500000 sec	
DL	0.3030000 sec	
DL1	1	
TDR		

NAME	NR1_309_11_25	
WAVE	50	
DATE	20091126	
TIME	2.16	
INSTRUM	5 m QRP 1B/13	
PROB	29310	
INTERFRO	29310	
TIME	29310	
STATUS	CRC13	
NOISE	800	
SWR		
PTILES	13467.53 Hz	
SWR	0.95641 Hz	
SWR	1.009304 sec	
WAVE	15.40 usec	
DI	20.0 usec	
DE	2.500000 sec	
DL	0.3030000 sec	
DL1	1	
TDR		

NAME	NR1_309_11_25	
WAVE	50	
DATE	20091126	
TIME	2.16	
INSTRUM	5 m QRP 1B/13	
PROB	29310	
INTERFRO	29310	
TIME	29310	
STATUS	CRC13	
NOISE	800	
SWR		
PTILES	13467.53 Hz	
SWR	0.95641 Hz	
SWR	1.009304 sec	
WAVE	15.40 usec	
DI	20.0 usec	
DE	2.500000 sec	
DL	0.3030000 sec	
DL1	1	
TDR		

NAME	NR1_309_11_25	
WAVE	50	
DATE	20091126	
TIME	2.16	
INSTRUM	5 m QRP 1B/13	
PROB	29310	
INTERFRO	29310	
TIME	29310	
STATUS	CRC13	
NOISE	800	
SWR		
PTILES	13467.53 Hz	
SWR	0.95641 Hz	
SWR	1.009304 sec	
WAVE	15.40 usec	
DI	20.0 usec	
DE	2.500000 sec	
DL	0.3030000 sec	
DL1	1	
TDR		

NAME	NR1_309_11_25	
WAVE	50	
DATE	20091126	
TIME	2.16	
INSTRUM	5 m QRP 1B/13	
PROB	29310	
INTERFRO	29310	
TIME	29310	
STATUS	CRC13	
NOISE	800	
SWR		
PTILES	13467.53 Hz	
SWR	0.95641 Hz	
SWR	1.009304 sec	
WAVE	15.40 usec	
DI	20.0 usec	
DE	2.500000 sec	
DL	0.3030000 sec	
DL1	1	
TDR		

NAME	NR1_309_11_25	
WAVE	50	
DATE	20091126	
TIME	2.16	
INSTRUM	5 m QRP 1B/13	
PROB	29310	
INTERFRO	29310	
TIME	29310	
STATUS	CRC13	
NOISE	800	
SWR		
PTILES	13467.53 Hz	
SWR	0.95641 Hz	
SWR	1.009304 sec	
WAVE	15.40 usec	
DI	20.0 usec	
DE	2.500000 sec	
DL	0.3030000 sec	
DL1	1	
TDR		

NAME	NR1_309_11_25	
WAVE	50	
DATE	20091126	
TIME	2.16	
INSTRUM	5 m QRP 1B/13	
PROB	29310	
INTERFRO	29310	
TIME	29310	
STATUS	CRC13	
NOISE	800	
SWR		
PTILES	13467.53 Hz	
SWR	0.95641 Hz	
SWR	1.009304 sec	
WAVE	15.40 usec	
DI	20.0 usec	
DE	2.500000 sec	
DL	0.3030000 sec	
DL1	1	
TDR		

NAME	NR1_309_11_25	
WAVE	50	
DATE	20091126	
TIME	2.16	
INSTRUM	5 m QRP 1B/13	
PROB	29310

30 20 10 ppm
Scale: 6 ppm/cm, 603.8 Hz/cm

IR

Name,
Sample,
Fr. 3-8
histid DMSO (C:\NMR\02013) Fruhehauf 28
HOLDER = 28

Current Data Parameters
Date: 2013.12.11
Time: 13.34
EXPNO: 2
PROCNO: 1

F2 - Acquisition Parameters

Date_: 2013.12.11
Time_: 13.34
INSTRUM: spect
PROBHD: 5 mm PABBO BB-
P1: 1.5
TD: 65536
SOLVENT: DMSO
DS: 1
SWH: 12019.230 Hz
FIDRES: 0.183339 Hz
AQ: 2.120339 sec
RG: 2.20032
DA: 41.600 usec
DE: 1.00 usec
TE: 299.6 K
D1: 1.0000000 sec
D10: 1

===== CHANNEL f1 =====

NUC1: 1H
P1: 14.00 usec
PL1: 15.8000019 W
SFO: 400.1318306 MHz
F2 - Processing parameters
SI: 32768
SF: 400.130958 MHz
WDW: EM
SSB: 0
GB: 0
PC: 1.00

Name
Sample
Fr. 3-8
1stid DMSO (C:\NMR01\2013) Fruenhaut 28
HOLDER = 28

Current Data Parameters
Name: 1stid
EXPNO: 20
PROCNO: 1
F2 - Acquisition Parameters
Date_: 20131211
Time: 12.00
INSTRUM: spect
PROBHD: 5 mm PABBO BB-
PULPROG: zgpg30
TD: 65536
SOLVENT: DMSO
NS: 16
DS: 4
SWH: 12019.230 Hz
FIDRES: 0.183319 Hz
AQ: 2.1213339 Hz
RG: 2.20042 sec
BR: 41.600 usec
DC: 3.000 K
D1: 1.0000000 sec
D11: 1
D10: 100
===== CHANNEL f1 =====
NUC1: 1H
P1: 12.00 usec
PL1: 0 dB
PLX1: 15.8000019 W
SFO1: 400.1318306 MHz
F2 - Processing parameters
SI: 32768
SF: 400.1318306 MHz
WDW: EM
SSB: 0
GB: 0
PC: 1.00

$$\begin{array}{l} \text{---} < -65.39 \\ \quad \quad \quad \text{---} < -65.40 \end{array}$$
N=C1C(=S)C=C(C(F)(F)F)C(N#C)=C1

C13 DMSO {C:\NMR_600MHz_Prodigy\2013}

195.728
194.415

151.819
151.042
148.546
148.318
148.087
141.734
141.247
138.286

123.495
121.669
119.841
118.017
114.120
106.853

40.524
40.403
40.264
40.125
39.986
39.847
39.708
39.569

Scale: 10.58 ppm/cm, 1597 Hz/cm

Current Data Parameters
NAME 3307-01
EXPNO 13
PROCNO 1

F2 - Acquisition Parameters
Date_ 20130904
Time 6.21
TD 65536
NS 2048
SWH 36057.691 Hz
AQ 0.9087659 sec
TE 298.2 K
SOLVENT DMSO
INSTRUM spect
D1 2.0000000 sec
D11 0.03000000 sec

===== CHANNEL f1 =====

===== CHANNEL f2 =====

F2 - Processing parameters
WDW EM
SSB 0
LB 1.00 Hz
GB 0
SI 32768

IR