SYNTHESIS AND SPECTRAL STUDIES OF NOVEL HETEROCYCLES FROM 2-CYANO-N'-(9H-FLUOREN-9-YLIDENE)ACETOHYDRAZIDE

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Keywords: 9-Fluorenone, spirofluorene, dithiolan, dithian derivatives

2-Cyano-N'-(9H-fluoren-9-ylidene)acetohydrazide was prepared from the readily obtainable cyanoethanoic acid hydrazide with 9-fluorenone. The title compound underwent a series of heterocyclization reactions through its reaction with different electrophilic reagents such as aromatic aldehydes, arylidene malononitriles, malononitrile, ethyl acetoacetate, phenyl isothiocyanate and CS_2 to give novel heterocyclic compounds. Moreover, its reaction with thioglycolic acid was also investigated. The spectral characterization (IR, ^{1}H NMR, MS) of the newly synthesized compounds are discussed.

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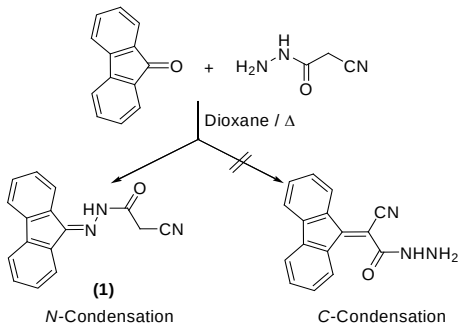
Introduction

Cyanoethanoic acid hydrazide is a versatile and convenient intermediate for the synthesis of wide variety of heterocyclic compounds. The β-functional nitrile[1-4] moiety of the molecule is a favorable unit for addition followed by cyclization or *via* cycloaddition with numerous reagents providing heterocyclic compounds of different ring sizes with one or several heteroatoms that are interesting as pharmaceuticals,[5,6] herbicides,[7] antibacterial agents,[8] and dyes.[9,10] We report here the synthesis of coumarin, 2-pyridone, thiazole and dithiane derivatives using the title compound **(1)**.

Results and Discussions

Cyanoethanoic acid hydrazide reacts with 9-fluorenone in dioxane to give the *N*-condensation product 2-cyano-N'-(9H-fluoren-9-ylidene) acetohydrazide **(1)** rather than the *C*-condensation product. The structure of compound **(1)** was established on the basis of analytical and spectral data. The IR spectrum revealed the absence of the coupling bands of NH_2 group. Also, the ^{1}H NMR spectrum showed the presence of singlet signal for the active methylene protons at δ 3.53 ppm and this ruled out the *C*-condensation.



Scheme 1

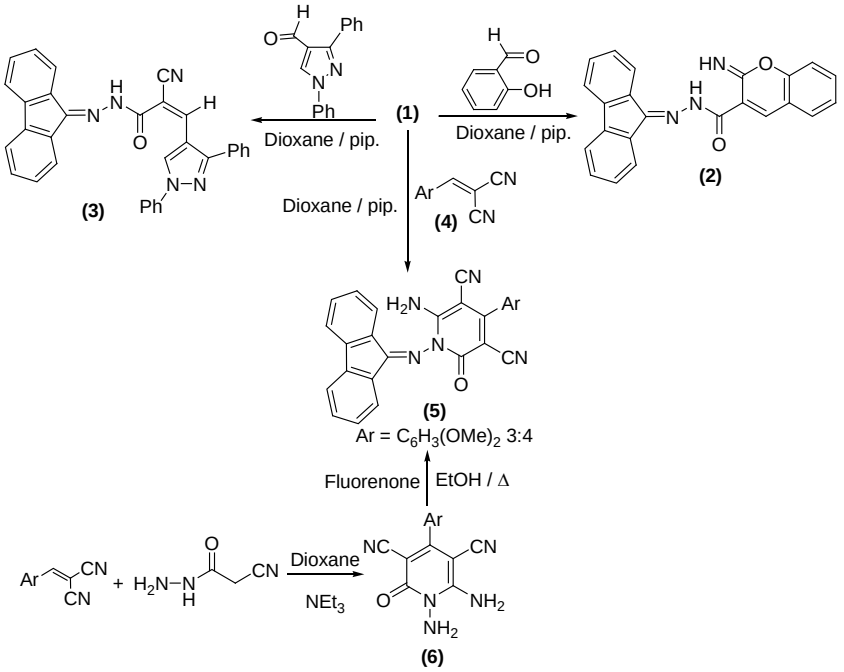
2-Cyano-N'-(9H-fluoren-9-ylidene)aceto hydrazide **(1)** was expected to be highly reactive compound. The carbonyl and cyano functions are suitably situated to enable reactions with common reagents to form a variety of heterocyclic compounds. Also, the active methylene of **(1)** can take part in condensation and substitution reactions.

The proclivity of compound **(1)** towards electrophilic reagents was investigated. Thus, treatment of **(1)** with salicyaldehyde in refluxing dioxane in the presence of catalytic amount of piperidine afforded the corresponding iminocoumarin derivative **(2)** in analogy with the reported literature.[11,12] On the other hand, the reaction of **(1)** with 1,3-diphenyl-1H-pyrazole-4-carbaldehyde under the same conditions yielded the condensation product 2-cyano-3-(1,3-diphenyl-1H-pyrazol-4-yl)-N'-(9H-fluoren-9-ylidene)acrylo-hydrazide **(3)**. The structures **(2)** and **(3)** were confirmed by analytical and spectral data (c.f. Exp.). **(Scheme 2)**

In the context, N-substituted amino-2-pyridones have proved to be useful synthetic intermediates. However, there are few synthetic procedures for the preparation of N-amino-2-pyridones. These compounds are usually obtained[13,14] in low yield by reaction of hydrazine with 2-pyrones, which are in turn, prepared in low yields from open chain compounds.[15] Furthermore, N-amino-2-pyridones could be prepared from the reaction of arylidene malononitriles with cyanoethanoic acid hydrazide.[16,17]

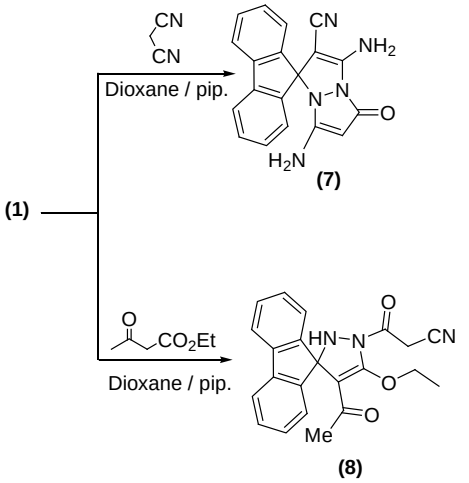
Herein, we report a new one-step synthesis of N-substituted aminopyridin-2-ones from the reaction of compound **(1)** with arylidene malononitrile. Thus, treatment of **(1)** with α-cyano-3,4-dimethoxy cinnamonitrile **(4)** in boiling dioxane in the presence of catalytic amount of piperidine afforded the 2-pyridone derivative **(5)**. **(Scheme 2)**

The structure **(5)** was deduced from the micro analytical and spectroscopic data. Furthermore, structure **(5)** was chemically supported by identity with an authentic sample prepared from reaction of **(4)** with α-cyano acetohydrazide to give the N-amino pyridine derivative **(6)** followed by condensation with fluorenone[16] **(Scheme 2)**.



Scheme 2

Spirocyclic system containing one sp^3 carbon atom common to two rings are structurally interesting.[18] The asymmetric structure of the molecule due to the chiral spiro carbon atom is one of the important criteria of the biological activities.[19,20] The presence of sterically constrained spiro structure in various natural products also adds to the interest in the investigations of spiro compounds.[21] Fortunately, treatment of compound **(1)** with malononitrle and/or ethylacetoacetate in boiling dioxane in the presence of catalytic amount of piperidine afforded the spiro compounds **(7)** and **(8)**, respectively **(Scheme 3)**.

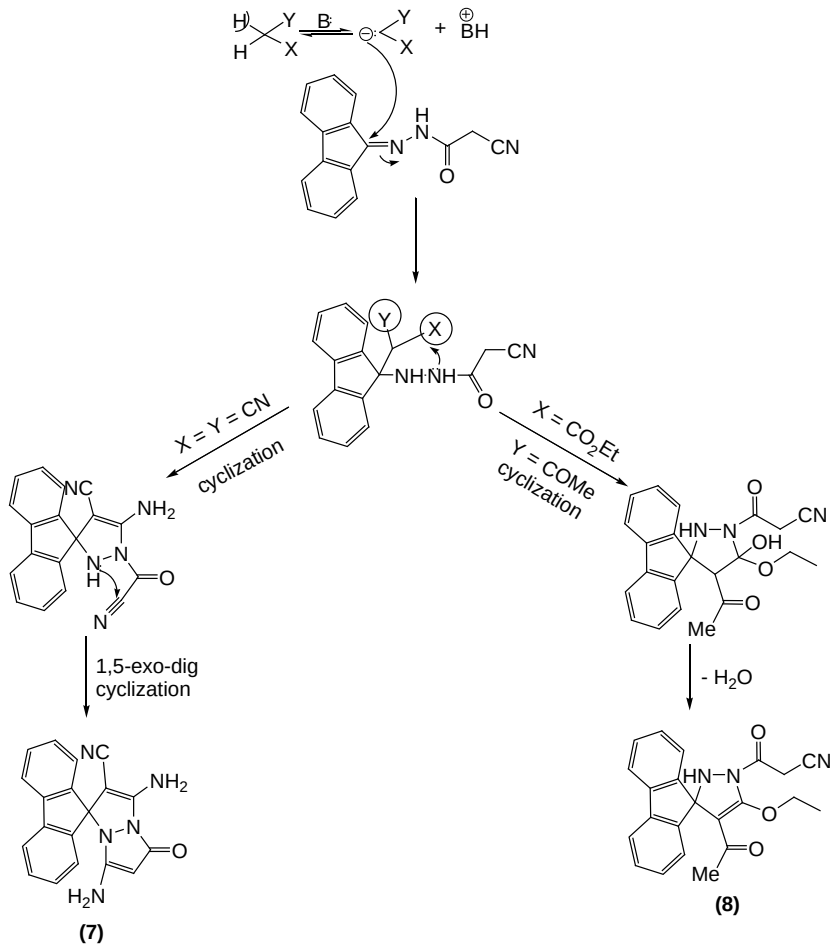


Scheme 3.

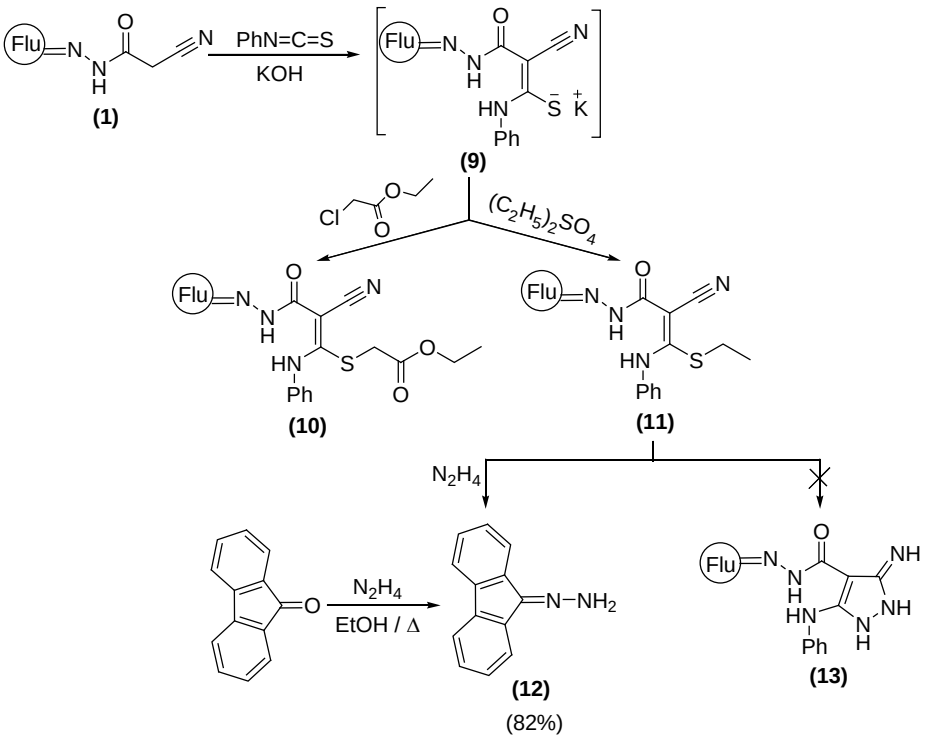
IR spectrum of **(7)** displayed the stretching absorption bands at 3482, 3364, 3346, 3278 cm^{-1} (ν_{NH2}), 2182 cm^{-1} ($\nu_{C\equiv N}$) and 1712 cm^{-1} (ν_{CO}). ^{1}H-NMR spectrum of **(7)** (DMSO-d_6) revealed the signals at 7.9-7.3 (m, $8H_{arom.}$), 7.06 (s, 1H, olefinic proton), 5.63 (br.s, 2H, NH_2, exchangeable with D_2O) and 5.5 (br.s, 2H, NH_2, exchangeable with D_2O). Furthermore, the mass spectrum of **(7)** show the correct molecular ion at m/z = 327 (64.1%) which completely in accord with the assigned structure. Similarly, the reaction of **(1)** with ethylacetoacetate under the same reaction conditions yielded the spiro compound **(8)** (Scheme 3). ^{1}H-NMR spectrum of **(8)** ($CDCl_3$) revealed the presence of multiplet integrated for 8H (aromatic protons) at δ 8.48-7.18 ppm, a singlet for 2H at δ 3.81 ppm ($CO-CH_2-CN$), a quartet for 2H and triplet for 3H representing the O-ethyl group at δ 3.57 and 1.51 ppm, respectively. The methyl group observed at δ 1.72 ppm which in accord with the proposed structure. Moreover, the EI-MS of compound **(8)** devoid the molecular ion peak and the highest recorded peak at m/z = 313 (50%) represent the radical cation [M-CH_2=C=O, H_2O]. [c.f. Exp.]

The conversion of compound **1** to compounds **7** and **8** could be visualized as shown in scheme 4. The base-catalyzed reaction of active methylene compound (**1**) with phenyl isothio-cyanate in dry DMF at room temperature yields the non-isolable potassium salt (**9**). Treatment of (**9**) with ethyl chloroacetate afforded 2-cyano-3-(ethoxycarbonylmethylthio)-N'-(9H-fluoren-9-ylidene)-3-(phenylamino)acrylohydrazide (**10**). The IR spectrum of compound (**10**) revealed the presence of strong absorption band at 1732 cm^{-1} due to (CO) group of ester. Another piece of evidence for this ester derivative was from the ^{1}H NMR spectrum which revealed signals at δ 12.61 (s, 1H, NH, exchangeable with D_2O), 10.25 (s, 1H, NH, exchangeable with D_2O), 8.01-7.26 (m, $13H_{arom.}$), 4.2 (q, 2H, CH_2, J = 7.2, 7.2 Hz), 3.44 (s, 2H, CH_2), 1.28 (t, 3H, CH_3, J = 7.2, 6.9 Hz). Also, reaction of the potassium salt (**9**) with diethyl sulfate yield 2-cyano-3-(ethylthio)-N'-(9H-fluoren-9-ylidene)-3-(phenyl-amino) acrylohydrazide (**11**). The structure of compound (**11**) was established on the basis of elemental analysis and spectral data. **(Scheme 5)**

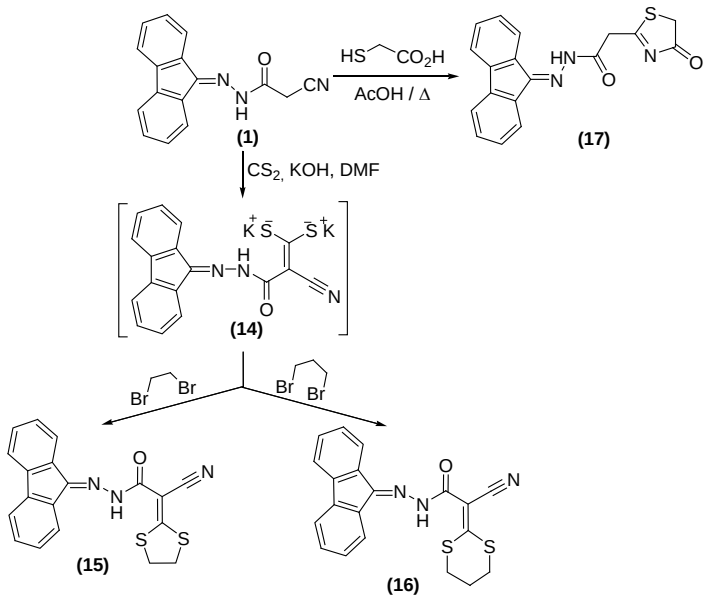
Hydrazinolysis of compound (**11**) using hydrazine hydrate (80%) in boiling dioxane yielded the sulfur free compound with molecular formula $C_{13}H_{10}N_2$ [$M^{+\cdot}$ = 194 (100%)] which devoid the stretching absorption bands characteristic for the carbonyl and the nitrile group in the IR spectrum.



Scheme 4



Scheme 5.



Scheme 6.

This product was identified as the hydrazone of fluorenone **(12)** whose structure was chemically supported by identity with an authentic sample prepared from the condensation of fluorenone with hydrazine in refluxing ethanol **(Scheme 5)**. No evidence supports the structure **(13)**.

Furthermore, the reaction of **(1)** with carbon disulfide in DMF and potassium hydroxide afforded intermediate **(14)** which upon treatment with 1,2-dibromoethane and/or 1,3-dibromo-propane yielded the cyclized products 1,3-dithiolane derivative **(15)** and 1,3-dithiane derivative **(16)**, respectively. **(Scheme 6)**

The structures **(15)** and **(16)** were substantiated from the correct analytical and spectroscopic data (IR, ^{1}H-NMR and MS spectra) (c.f. Exp.). The mass spectrum of compound **(15)** show the molecular ion peak at m/z = 363 (27.9%) which in a good accord with the assigned structure.

Cyclocondensation of hydrazide-hydrazone **(1)** with thioglycolic acid in boiling glacial acetic acid furnished the thiazolinone derivatives **(17)**. Formation of **(17)** is assumed to proceed via the initial nucleophilic addition of the mercapto function to the nitrile group, followed by dehydration. **(Scheme 6)**

Full analysis of the spectroscopic data (IR, ^{1}H NMR, and mass spectra) was completely in accord with the proposed structures (c.f. Exp.).

Experimental

All melting points were taken on a Griffin and George melting-point apparatus and are uncorrected. Infrared (IR) spectra were recorded on a Pye Unicam SP 1200 spectrophotometer using the KBr wafer technique. ^{1}H NMR spectra were determined on a Varian Gemini 300-MHz instrument using tetramethylsilane (TMS) as internal standard (chemical shifts in δ). Electron impact–mass spectrometry (EI-MS) was measured on a Schimadzu GC-MS, QP 1000 EX instrument operating at 70 eV.

Elemental analyses were carried out at the Microanalytical Unit, Faculty of Science, Ain Shams University using a Perkin-Elmer 2400 CHN elemental analyzer, and satisfactory analytical data (±0.4) were obtained for all compounds. The homogeneity of the synthesized compounds was controlled by thin-layer chromatography (TLC) using TLC aluminum sheets with silica gel F_{254} (Merck).

2-Cyano-N'-(9H-fluoren-9-ylidene) acetohydrazide (1). To a solution of 2-cyanoacetohydrazide (1.0 g, 0.01 mol) in 1,4-dioxane (30 mL) 9-fluorenone (1.8 g, 0.01 mol) was added. The reaction mixture was heated under reflux for 3 h. The solid product which precipitated whilst hot was collected by filtration, washed with ethanol, dried, and then recrystallized from dioxane to give **(1)** as pale yellow crystals, 2.21 (85%), mp 242-244^{o}C, IR: NH 3255, $CH_{arom.}$ 3052, CH_2 2959, 2923, C≡N 2259, C=O 1699 cm^{-1}. ^{1}H NMR (DMSO-d_6): δ 9.82 (s, 1H, NH, exchangeable with D_2O), 8.26–7.33 (m, 8$H_{arom.}$), 3.53 (s, 2H, CH_2). MS: m/z 261 (78.1), 221 (43.8), 193 (73.4), 165 (100), 139 (26.6), 87 (21.9), 68 (85.9). Anal. calcd. for $C_{16}H_{11}N_3O$ (261.09): C, 73.55; H, 4.24; N, 16.08. Found: C, 73.39; H, 4.11; N, 15.95.

N'-(9H-Fluoren-9-ylidene)-2-imino-2H-chromene-3-carbohydrazide (2). A mixture of (**1**) (2.61 g, 0.01 mol) and salicylaldehyde (1.22 mL, 0.01 mol) in 1,4-dioxane (20 mL) containing piperidine (0.50 mL) was heated under reflux for 2 h. The reaction mixture was left to cool. The solid deposited after cooling was collected by filtration, washed with ethanol, dried, and then recrystallized from ethanol/dioxane to give **(2)** as red crystals; 2.4 g (66%), mp >300 ^{o}C, IR: NH 3217, C=O 1668 cm^{-1}. MS: m/z 364 (M-1, 61.5), 261 (56.4), 165 (100), 115 (30.8). Anal. calcd. for $C_{23}H_{15}N_3O_2$ (365): C, 75.61; H, 4.10; N, 11.5. Found: C, 75.77; H, 3.93; N, 11.46.

2-Cyano-3-(1,3-diphenyl-1H-pyrazol-4-yl)-N'-(9H-fluoren-9-ylidene) acrylohydrazide (3). Equimolecular mixture of (**1**) (2.61 g, 0.01 mol) and 1,3-diphenyl-1H-pyrazole-4-carbaldehyde (2.48 g, 0.01 mol) in dioxane (30

mL) containing piperidine (0.5 mL) was heated under reflux for 3 h. The reaction mixture was left to cool then poured onto ice/water containing few drops of hydrochloric acid and the solid product was collected by filtration, dried, and then recrystallized from benzene to give (**3**) as yellow crystals, 2.84 g (58%), mp 122-124 ^{o}C, IR: NH 3422, CH_{arom} 3062, CH-olefinic 2925, C≡N 2205 , C=O 1693 cm^{-1}. ^{1}H NMR (DMSO-d_6) δ 7.86 (s, 1H, NH, exchangeable with D_2O), 7.80-7.27 (m, 18$H_{arom.}$ + C'$_3$-H), 4.07 (s, 1H, olefinic). MS (*m/z*, %): 491 (16.2), 424 (28.6), 260 (100), 203 (76.2), 166 (95.2), 93 (52.4), 60 (57.1). Anal. calcd. for $C_{32}H_{21}N_5O$ (491.17): C, 78.19; H, 4.31; N, 14.25. Found: C, 78.03; H, 4.22; N, 14.10.

1-(9H-Fluoren-9-ylideneamino)-6-amino-4-(3,4-dimethoxyphenyl)-2-oxo-1,2-dihydropyridine-3,5-dicarbonitrile (5). To a solution of compound **(1)** (2.61 g, 0.01 mol) in 1,4-dioxane (30 mL) containing piperidine (0.5 mL), 3,4-dimethoxybenzylidene malononitrile (2.14 g, 0.01 mol) was added. The reaction mixture was heated under reflux for 6 h then poured onto ice/water containing few drops of hydrochloric acid and the formed solid product was collected by filtration, dried, and then recrystallized from ethanol to give **(5)** as beige crystals, 2 g (43%), mp 230-232 ^{o}C, IR: NH_2 3305, 3198 , C≡N 2213, C=O 1695 cm^{-1}. ^{1}H NMR (DMSO-d_6) δ 8.4-7.04 (m, 11$H_{arom.}$), 5.65 (s, 2H, NH_2, exchangeable with D_2O), 3.79 (s, 6H, Ar-OMe). MS: m/z: 456 ([M-H_2O], 8.9), 311 (100), 252 (19.6), 180 (32.1), 108 (30.4). Anal. calcd. for $C_{28}H_{19}N_5O_3$ (473.15): C, 71.03; H, 4.04; N, 14.79. Found: C, 70.87; H, 3.92; N, 14.56.

Preparation of authentic sample: A mixture of 2-cyanoethanoic acid hydrazide (1 g, 0.01 mol) and 3,4-dimethoxybenzylidene malononitrile (2.14 g, 0.01 mol) is suspended in dry ethanol (30 ml) under magnetic stirring. When a few drops of piperidine are added, the reactants dissolve completely. After a few minutes of standing at room temperature, a precipitate is formed. The deposited solid is isolated by suction filtration, washed well with methanol, and dried in air. Compound **(6)** thus obtained was of good purity, recrystallization from ethanol left **(6)** as yellowish-white crystals, mp 252-4 ^{o}C. [^{1}H NMR of **(6)** (DMSO-d_6) δ 8.11 (br.s, 2H, NH_2, exchangeable with D_2O), 6.91 (m, 3$H_{arom.}$), 5.33 (br.s, 2H, NH_2, exchangeable with D_2O), 3.8 (br.s, 6H, Ar-OMe)]. A mixture of compound **(6)** (0.01 mol) and 9-fluorenone (0.01 mol) in dioxane (30 ml) was magnetically stirred under reflux for 6 hrs. the solid separated was collected by filtration, dried and recrystallized from ethanol to give compound **(5)** (identity mp, mixed mp, ir and TLC comparison).

3',7'-Diamino-5'-oxo-5'H-spiro[fluorene-9,1'-pyrazolo-[1,2-a]pyrazole]-2'-carbonitrile (7). Compound **(1)** (2.61 g, 0.01 mol) and malononitrile (0.66 g, 0.01 mol) in 1,4-dioxane (30 mL) containing piperidine (0.5 mL) was heated under reflux for 6 h. The reaction mixture was cooled then acidified with cold dilute hydrochloric acid and the deposited solid product was collected by filtration, dried, and then recrystallized from ethanol to give **(7)** as beige crystals, 2.28 g (70%), mp 258-260 ^{o}C, IR: 2NH_2 3482, 3364, 3346, 3278, C≡N 2182, C=O 1712 cm^{-1}. ^{1}H NMR (DMSO-d_6) δ 7.9-7.3 (m, 8$H_{arom.}$), 7.06 (s, 1H, C_4-H), 5.63 (br.s, 2H, NH_2, exchangeable with D_2O), 5.57 (br.s, 2H, NH_2, exchangeable with D_2O). MS: m/z: 327 (64.1), 259 (100), 176 (22.5), 108 (23.2), 67 (19.0). Anal. calcd. for $C_{19}H_{13}N_5O$ (327.11): C, 69.70; H, 3.97; N, 21.39. Found: C, 69.60; H, 3.87; N, 21.06.

3-(4'-acetyl-5'-ethoxyspiro[fluorene-9,3'-pyrazole]-1'(2'H)-yl)-3-oxopropanenitrile (8). Equimolecular amounts of compound **(1)** (2.61 g, 0.01 mol) and ethyl acetoacetate (1.3 mL, 0.01 mol) in 1,4-dioxane (30 mL) containing piperidine (0.5 mL) was heated under reflux for 8 h. The reaction mixture was cooled then acidified with cold dilute hydrochloric acid and the deposited solid product was collected by filtration, dried, and then recrystallized from benzene to give **(8)** as yellow crystals, 1.49 g (40%), mp 178–180 ^{o}C, IR:NH 3260, C≡N 2201, C=O 1682, 1671 cm^{-1}. ^{1}H NMR ($CDCl_3$) δ 8.48-7.18 (m, 8$H_{arom.}$), 7.1 (br.s, 1H, NH, exchangeable with D_2O), 3.81 (s, 2H, $COCH_2CN$), 3.57 (q, 2H, CH_2, J = 6.7 Hz), 1.72 (s, 3H, CH_3), 1.51 (t, 3H, J = 6.7 Hz). MS: m/z: 373 (6.0), 313 (50.0), 201 (85.7), 162 (17.9), 87 (14.3), 55 (100). Anal. calcd. for $C_{22}H_{19}N_3O_3$ (373): C, 70.77; H, 5.09; N, 11.26. Found: C, 70.66; H, 4.94; N, 11.43.

2-Cyano-3-(ethoxycarbonylmethylthio)-N'-(9H-fluoren-9-ylidene)-3-(phenylamino)acrylohydrazide (10). Suspension of finally divided KOH (0.28 g; 0.005 mol) in dry dimethyl formamide (10 ml), compound **(1)** (1.3 g, 0.005 mol) was added. After stirring for 15 min., phenyl isothiocyante (0.76 mL, 0.005 mol) was added dropwise. The mixture was stirred at room temperature for 3h, then cooled again to 0^{o}C, treated with ethyl chloroacetate (0.53 mL, 0.005 mol) and the stirring was continued at room temperature for further 3h, then left to stand overnight. The mixture was poured into ice-cold water. The resulting precipitate was filtered off, dried then recrystallized from benzene to give **(10)** as yellow crystals, 1.25 g (52%), mp 158-160 ^{o}C, IR: NH 3434, 3385, C≡N 2193, C=O_{ester} 1732, C=O_{amide} 1647 cm^{-1}. ^{1}H NMR ($CDCl_3$) δ 12.61 (s, 1H, NH, exchangeable with D_2O), 10.25 (s, 1H, NH, exchangeable with D_2O), 8.01-7.26 (m, 13$H_{arom.}$), 4.2 (q, 2H, CH_2, *J* = 7.2 Hz), 3.44 (s, 2H, CH_2), 1.28 (t, 3H, *J* = 7.2 Hz). MS: m/z: 429 (10.9), 356 (12.7), 262 (10.9), 163 (72.7), 76 (100). Anal. calcd. for $C_{27}H_{22}N_4O_3S$ (482.14): C, 67.21; H, 4.56; N, 11.61. Found: C, 67.44; H, 4.35; N, 11.46.

2-Cyano-3-(ethylthio)-N'-(9H-fluoren-9-ylidene)-3-(phenylamino)acrylohydrazide (11). To a cold suspension of finally divided KOH (0.28 g; 0.005 mol) in dry dimethyl formamide (10 ml), compound **(1)** (1.3 g, 0.005 mol) was added. After stirring for 15 min., phenyl isothiocyante (0.76 mL, 0.005 mol) was added dropwise. The mixture was stirred at room temperature for 3h, then cooled again to 0^{o}C, treated with diethyl sulphate (0.65 mL, 0.005 mol) and the stirring was continued at room temperature for further 3h, then left to stand overnight. The mixture was poured into ice-cold water. The resulting precipitate was filtered off, dried then recrystallized from benzene to give **(11)** as orange crystals, 1.6 g (75%), mp 122-124 ^{o}C, IR: NH 3374, 3166, $CH_{arom.}$ 3054, CH_3, CH_2 2964, 2925, C≡N 2191, C=O 1653 cm^{-1}. ^{1}H NMR ($CDCl_3$) δ 12.67 (s, 1H, NH, exchangeable with D_2O), 10.25 (s, 1H, NH, exchangeable with D_2O), 8.02-7.27 (m, 13$H_{arom.}$), 3.7 (q, 2H, CH_2, *J* = 4.6 Hz), 1.24 (t, 3H, CH_3, *J* = 4.6 Hz). MS: m/z: 424 (3.6), 363 (6.6), 305 (10.3), 220 (26.5), 164 (84.3), 77 (100). Anal. calcd. for $C_{25}H_{20}N_4OS$ (424.14): C, 70.73; H, 4.71; N, 13.20. Found: C, 70.41; H, 4.55; N, 13.09.

Hydrazinolysis of 11; Formation of 9-fluorenone hydrazone (12). To a solution of compound **(11)** (0.85 g, 0.002 mol) in ethanol (20 ml), hydrazine hydrate (0.5 ml, 0.011 mol) was added portionwise with stirring for one hour at room temperature then under reflux for 3 hrs. After cooling, the solid separated was collected by filtration, dried and recrystallized from benzene to give hydrazone **(12)** as pale yellow crystals; mp 154-156 ^{o}C (did not depressed with an authentic sample prepared from the condensation of 9-fluorenone with hydrazine hydrate).

2-Cyano-2-(1,3-dithiolan-2-ylidene)-N'-(9H-fluoren-9-ylidene)acetohydrazide (15). To a cold suspension of finally divided KOH (0.28 g; 0.005 mol) in dry dimethyl formamide (10 ml), compound **(1)** (1.3 g, 0.005 mol) was added. After stirring for 15 min., carbon disulphide (0.3 mL, 0.005 mol) was added dropwise. The mixture was stirred at room temperature for 3h, then cooled again to 0^{o}C, treated with 1,2-dibromoethane (0.43 mL, 0.005 mol) and the stirring was continued at room temperature for further 3h, then left to stand overnight. The mixture was poured into ice-cold water. The resulting precipitate was filtered off, dried then recrystallized from ethanol/dioxane to give **(15)** as yellow crystals, 1.45 g (80 %), mp 272-274 ^{o}C, IR: NH 3356, $CH_{arom.}$ 3054 , CH_2 2978, 2933, C≡N 2195, C=O 1677 cm^{-1}. ^{1}H NMR (DMSO-d_6) δ 11.32 (s, 1H, NH, exchangeable with D_2O), 8.11-7.37 (m, 8$H_{arom.}$), 3.7 (br.s, 4H, 2 CH_2). MS: m/z: 365 (M+2, 9.1), 363 (27.7), 194 (17.3), 170 (100), 166 (9.4), 114 (22.1). Anal. calcd. for $C_{19}H_{13}N_3OS_2$ (363.05): C, 62.79; H, 3.61; N, 11.56. Found: C, 62.59; H, 3.42; N, 11.26.

2-Cyano-2-(1,3-dithian-2-ylidene)-N'-(9H-fluoren-9-ylidene)acetohydrazide (16). Suspension of finally divided KOH (0.28 g; 0.005 mol) in dry dimethyl formamide (10 ml), compound **(1)** (1.3 g, 0.005 mol) was added. After stirring for 15 min., carbon disulphide (0.3 mL, 0.005 mol) was added dropwise. The mixture was stirred at room temperature for 3h, then cooled again to 0^{o}C, treated with 1,3-dibromopropane (0.5 mL, 0.005 mol) and the stirring was continued at room temperature for further 3h, then left to stand overnight. The mixture was poured into ice-cold water. The resulting precipitate was filtered off, dried then recrystallized from toluene to give **(16)** as yellow crystals, 1.5 g (82%) mp 210-212 ^{o}C, IR: NH 3352, $CH_{arom.}$ 3050, CH_2 2923, C≡N 2192, C=O 1673 cm^{-1}. ^{1}H NMR (DMSO-d_6) δ 11.34 (s, 1H, NH, exchangeable with D_2O), 8.13-7.34 (m, 8$H_{arom.}$), 3.25 (t, 2H, CH_2, J = 7.2 Hz), 3.08 (t, 2H, CH_2, J = 7.2 Hz), 2.23 (m, 2H, CH_2). MS: m/z: 379 (M+2, 12.9), 329 (56.5), 288 (56.5), 246 (39.1), 179 (82.6), 115 (73.9), 77 (100). Anal. calcd. for $C_{20}H_{15}N_3OS_2$ (377.07): C, 63.64; H, 4.01; N, 11.13. Found: C, 63.55; H, 3.78; N, 11.02.

N'-(9H-fluoren-9-ylidene)-2-(4-oxo-4,5-dihydrothiazol-2-yl)acetohydrazide (17). A mixture of compound **(1)** (2.61 g, 0.01 mol) and thioglycollic acid (0.69, 0.01 mol) in glacial acetic acid (20 ml) was refluxed for 3 h. The mixture was poured into ice-cold water.

The resulting precipitate was filtered off, dried then recrystallized from benzene/ethanol to give **(17)** as beige crystals, 1.87 g (56 %), mp 220-224 ^{o}C, IR: NH 3377, $CH_{arom.}$ 3062, CH_2 2923, C=O 1675 cm^{-1}. ^{1}H NMR (DMSO-d_6) δ 10.09 (s, 1H, NH, exchangeable with D_2O), 7.84-7.21 (m, 8$H_{arom.}$), 3.64 (s, 2H, CH_2), 2.44 (s, 2H, CH_2). MS: m/z: 335 (61.5), 288 (56.4), 260 (41.0), 226 (17.9), 205 (92.3), 165 (79.5), 127 (51.3), 99 (71.8), 83 (66.7), 55 (100). Anal. calcd. for $C_{18}H_{13}N_3O_2S$ (335.07): C, 64.46; H, 3.91; N, 12.53. Found: C, 64.20; H, 3.65; N, 12.34.

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Received: 28.01.2113.
Accepted: 02.02.2013.