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SHORT COMMUNICATIONS

Synthesis of 6-(5-Sulfanyl-1*H*-tetrazol-1-yl)-2*H*-chromen-2-one and 5-Methyl-1-(2-oxo-2*H*-chromen-6-yl)-1*H*-1,2,3-triazole-4-carboxylic Acid

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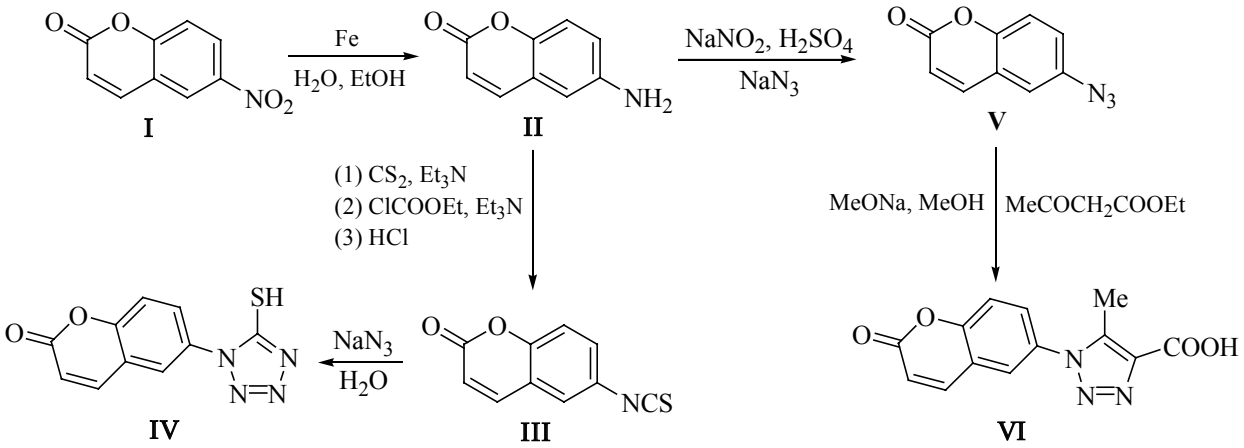
The constant interest to syntheses of coumarin derivatives to a large extent is due to the biological activity of this class compounds [1]. Coumarins are also used in practice owing to their photochemical and photophysical characteristics [2] as fluorophores in the fluorescence spectroscopy of the resonance energy transfer [3]. In this connection new approaches to the molecular design of coumarin derivatives are of considerable interest.

In this report we describe the methods of the synthesis of coumarin derivatives with tetrazole and 1,2,3-triazole rings that can be used as convenient linkers for introduction of a coumarin fragment. As the initial reagent 6-aminocoumarin (**II**) was used obtained by reduction of nitro derivative **I**, and we studied the possibility of its conversion into isothiocyanate **III** and azide **V**. The isothiocyanate was synthesized by method [4] having limitations at the use of weakly basic amines. It was established that amine **II** reacted with CS_2 to form a thiocarbamate salt that after acylation was decomposed by treating with HCl giving isothiocyanate **III**. By the 1,3-dipolar cycloaddition of an azide ion to isothiocyanate **III** in water medium we obtained tetrazole **IV**.

Azide **V** was obtained by treating with sodium azide the diazonium salt prepared from amine **II**. It was established that this azide reacted with ethyl acetoacetate in the presence of sodium methylate to give 1*H*-1,2,3-triazole-4-carboxylic acid **VI**. It should be noted that the reaction is accompanied by tarring. Apparently under the reaction conditions the partial opening of the chromen ring occurred resulting in competing reactions. Triazole **VI** was isolated in a moderate yield.

Hence we demonstrated the possibility of converting



the amino group of 6-aminocoumarin into the isothiocyanate and the azide functions which further were applied to the syntheses of tetrazole and triazole derivatives.

6-Isothiocyanato-2*H*-chromen-2-one (**III**). In a minimal quantity of benzene was dissolved 1.6 g (0.01 mol) of 6-amino-2*H*-chromen-2-one (**II**), it was mixed with 0.66 ml of carbon disulfide and 1.4 ml of triethylamine, and the mixture was cooled to 0°C. After 4–5 h the formed triethylammonium dithiocarbamate was filtered off, washed with anhydrous ether, and dried in air for 10 min. The salt obtained was dissolved in 20 ml of chloroform and mixed with 14 ml of triethylamine, and the solution was cooled to 0°C. To the solution was added dropwise at stirring within 15 min 1.02 ml of ethyl chlorocarbonate, the mixture was stirred at 0°C for 10 min and left standing at room temperqature for 1 h. The solution in chloroform was washed with 3M solution of HCl, twice with water, and dried with Na_2SO_4. Chloroform was distilled off, the residue was recrystallized from ethanol. Yield 1.48 g (73%), mp 176°C. ^{1}H NMR spectrum, δ, ppm: 6.57 d (1H, H^4, *J* 10.1 Hz), 7.45 d (1H, H^8, *J* 8.6 Hz), 7.62 d (1H, H^7, *J* 8.6 Hz), 7.82 s (1H, H^5), 7.99 d (1H, H^3, *J* 10.1 Hz). Mass spectrum: *m/z* 204 [*M* + H]$^+$. Found, %: C 59.01; H 2.32; N 6.62. $C_{10}H_5NO_2S$. Calculated, %: C 59.10; H 2.48; N 6.89.

6-(5-Sulfanyl-1*H*-tetrazol-1-yl)-2*H*-chromen-2-one (**IV**). A mixture of 1.02 g (5 mmol) of isothiocyanate **III** and 0.39 g (6 mmol) of NaN_3 in 10 ml of water was boiled at stirring till complete dissolution of solid. The reaction mixture was cooled to room temperature, and HCl was added till acid reaction. The precipitate was filtered off, washed with water on the filter, and dried in air. Yield 85%, mp 204°C. ^{1}H NMR spectrum, δ, ppm: 6.54 d (1H, H^4, *J*9.6 Hz), 7.58 d (1H, H^8, *J* 8.8 Hz), 8.13 d.d (1H, H^7, ^3J 8.8, ^4J 2.6 Hz), 8.16 d (1H, H^3, *J*9.6 Hz), 8.29 d (1H, H^5, ^4J 2.5 Hz). Mass spectrum: *m/z* 247 [*M* + H]$^+$. Found, %: C 48.37; H 2.42; N 22.86. $C_{10}H_6N_4O_2S$. Calculated, %: C 48.78; H 2.46; N 22.75.

5-Methyl-1-(2-oxo-2*H*-chromen-6-yl)-1*H*-1,2,3-triazole-4-carboxylic acid (**VI**). In a mixture of 2.5 ml of concn. H_2SO_4 and 7 ml of water was dissolved 1.6 g (10 mmol) of amine **II**, and the solution was cooled to 0°C. To the solution a saturated solution of 0.83 g (12 mmol) of $NaNO_2$ was added maintaining the temperature <5°C. After 5 min a solution of 0.65 g (10 mmol) of NaN_3 in 5 ml of water was added. The reaction mixture was kept for 10 min at room temperature and filtered. We obtained 1.4 g (75%) of azide **V** that was used without further purification.

In 7 ml of anhydrous methanol was dissolved 0.15 g (6.5 mmol) of sodium. To the cooled solution of the sodium methylate was added 0.64 ml (5 mmol) of ethyl acetoacetate, and at cooling with ice water was slowly added 0.94 g (5 mmol) of azide **V**. The mixture was maintained at cooling with ice bath for 30 min, then it was slowly heated to boiling and boiled for 1 h. To the formed precipitate was added 15–20 ml of hot water till its dissolution, and the boiling was continued for 1 h. The hot solution was poured into 10 ml of concn. HCl and left for crystallization. The formed crystals were filtered off, washed on the filter with a little water, and recrystallized from aqueous ethanol. Yield 31%, mp 179–180°C. ^{1}H NMR spectrum, δ, ppm: 2.46 s (3H, CH_3), 6.45 d (1H, H^4, *J* 9.6Hz), 7.25 d.d (1H, H^7, ^3J 8.8, ^4J 2.6 Hz), 7.37 d (1H, H^8, ^3J 8.8 Hz), 7.47 d (1H, H^5, ^4J 2.6 Hz), 8.00 d (1H, H^3, ^3J 9.6 Hz). Mass spectrum: *m/z* 272 [*M* + H]$^+$. Found, %: C 57.31; H 3.45; N 15.40. $C_{13}H_9N_3O_4$. Calculated, %: 57.57; H 3.34; N 15.49.

^{1}H NMR spectra were registered on a spectrometer Varian Mercury (400 MHz) in DMSO-d_6, internal reference TMS. Mass spectra were obtained on a GC-MS instrument Agilent 1100 LC/MSD at the chemical ionization.

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