

Reaction of Cyano Active Methylene Compounds with 2-Hydroxy-1-naphthal-4-acetylaniline: An Unexpected Result

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Received: 5 August 2016;

Accepted: 7 January 2017;

Published online: 31 January 2017;

AJC-18238

Condensation of cyano active methylene compounds (**1-5**) with 2-hydroxy-1-naphthal-4-acetylaniline, the compound containing both carbon-nitrogen double bond as well as carbon-oxygen double bond, in equimolar ratio resulted in the formation of crude solids (**1a-5a**) which were crystallized from benzene. The products were characterized as 3-imino-3*H*-benzo[*f*]chromene derivatives (**1a-5a**) on the basis of elemental analysis and spectral studies. Reaction of compounds (**1-5**) with 2-hydroxy-1-naphthal-4-acetylaniline in 2:1 molar ratio also yielded the same products (**1a-5a**). Thus, cyano active methylene compounds reacted chemoselectively with carbon-nitrogen double bond of 2-hydroxy-1-naphthal-4-acetylaniline, leaving the carbon-oxygen double bond, considered to be more reactive, intact, leading to the formation of mono addition-elimination products which cyclized due to interaction between hydroxyl group and cyano group.

Keywords: Cyanoacetic acid, Malononitrile, 2-Hydroxy-1-naphthal-4-acetylaniline, 3-Imino-3*H*-benzo[*f*]chromene derivatives.

INTRODUCTION

The chemistry of multiple bonds has achieved a dramatic development in recent decades [1,2], because these compounds have been utilized as substrates in the synthesis of industrial [3] and bioactive compounds [4]. The carbon-nitrogen double bond is intermediate in reactivity [5] between carbon-oxygen and carbon-carbon double bonds. Reaction of active methylene compounds with carbonyl compounds yields condensation products [6] whereas such a reaction with imines, the compounds containing carbon-nitrogen double bond, results in the formation of either adducts [7] or addition-elimination products [8] depending on the nature of active methylene compound and reaction conditions. The present work was aimed to study the reaction of active methylene compounds containing at least one cyano group with 2-hydroxy-1-naphthal-4-acetylaniline, the compound containing both carbon-nitrogen double bond as well as carbon-oxygen double bond and the unexpected results of this work are being presented in this communication.

EXPERIMENTAL

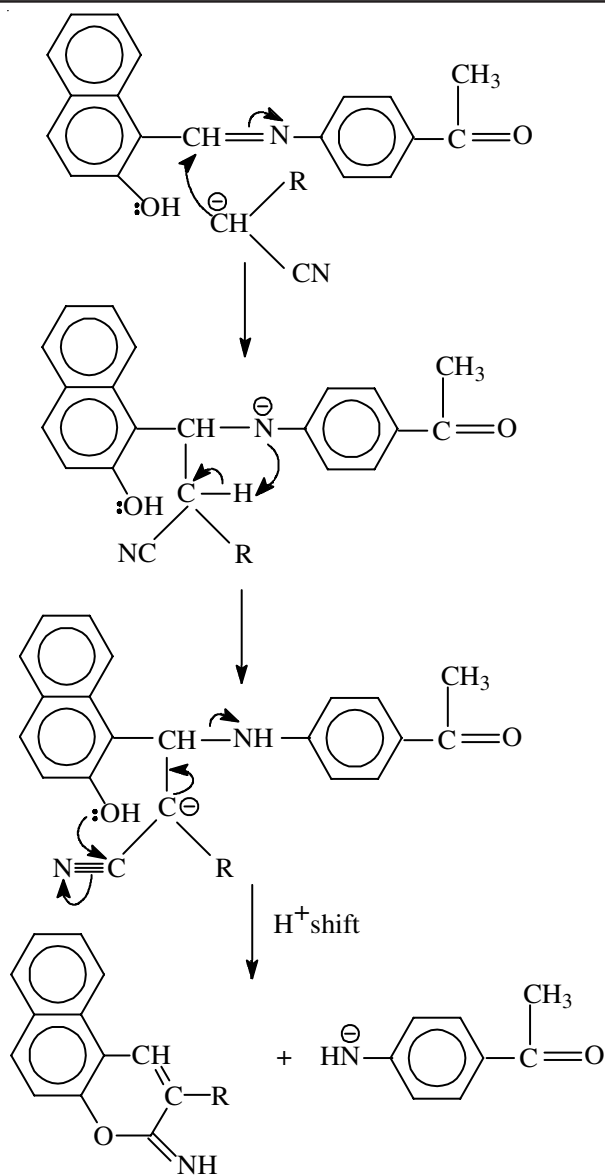
The purity of the compounds was checked by TLC. The melting points were recorded on electrical melting point apparatus and are uncorrected. The IR spectra were recorded on a Perkin Elmer FT-IR spectrometer using KBr disc. The ¹H NMR spectra were recorded on a Bruker Spectrospin 300 MHz spectrometer in CDCl₃ with TMS as internal standard.

Mass spectra were recorded on Perkin Elmer Clarus 500 mass spectrometer.

Synthesis of 2-hydroxy-1-naphthal-4-acetylaniline: A mixture of 2-hydroxy-1-naphthaldehyde (0.01 mol), dry ethanol (20 mL) and 4-acetylaniline (0.01 mol) was refluxed in a flask (150 mL) using a 'Dean and Stark' water separator. The solution was then allowed to cool and the separated solid was filtered and purified by recrystallization from ethanol to get shining crystals of 2-hydroxy-1-naphthal-4-acetylaniline, m.p. 155°C, yield 96 %.

General procedure for the reaction of cyano active methylene compounds with 2-hydroxy-1-naphthal-4-acetylaniline: 2-Hydroxy-1-naphthal-4-acetylaniline (0.01 mol) was taken in dry benzene (20 mL) in a conical flask (100 mL). Then active methylene compound (**1-5**) (0.01 mol) and a few drops of pyridine were added to the above solution. The reaction mixture was heated and shaken briskly for 30-45 min. The contents were then cooled, the flask was stoppered and allowed to stand at room temperature for overnight. The crude solid which separated out was filtered and recrystallized from benzene to get respective 3-imino-3*H*-benzo[*f*]chromene derivative (**1a-5a**). Evaporation of the solvent from the filtrate yielded jelly like mass, TLC of which indicated the presence of 4-acetylaniline and unreacted starting materials.

Reaction of one mole of 2-hydroxy-1-naphthal-4-acetylaniline with two moles of cyano active methylene compounds (**1-5**) was also carried out by following the above procedure (**Scheme-I**).



RESULTS AND DISCUSSION

Condensation of cyanoacetic acid (**1**), ethyl cyanoacetate (**2**), methyl cyanoacetate (**3**), cyanoacetamide (**4**) and malononitrile (**5**) with 2-hydroxy-1-naphthal-4-acetylaniline, the compound synthesized by reaction of 4-acetylaniline with 2-hydroxy-1-naphthaldehyde, in equimolar ratio in the presence of pyridine resulted in the formation of crude solids (**1a-5a**) which were purified by recrystallization from benzene. Elemental analysis of the compounds **1a-5a** fit well in the molecular formula of respective addition-elimination product. This fact was further confirmed by respective molecular ion peak in the mass spectrum and the molecular ion peak was also found to constitute the base peak.

However, IR and ^1H NMR spectral data of the products did not indicate these compounds to be normal addition-elimination products. The infrared spectra of the products lacked absorption due to phenolic group. The IR spectra of **1a-4a** also did not exhibit any absorption in the region 2250-2235 cm^{-1} showing the absence of nitrile group. The IR spectra

of the products contained absorption bands in the range 1625-1615 and 3250-3200 cm^{-1} which were assigned to $>\text{C}=\text{NH}$ group and $=\text{N}-\text{H}$ linkage respectively. The IR spectrum of **1a** indicated absorption band due to carbonyl of acid group, that of **2a** and **3a** exhibited band for carbonyl of ester group and IR spectrum of **4a** depicted absorption due to carbonyl of amide group. The IR spectrum of **4a** and **5a** showed bands at 3325 and 2240 cm^{-1} which were assigned to primary amide and nitrile group respectively.

^1H NMR spectra of the products lacked signal at $\sim 9.8 \delta$ showing the absence of phenolic proton but they contained a broad signal at 3.5 δ which was assigned to proton of $=\text{N}-\text{H}$ linkage. ^1H NMR spectra of the products also contained a multiplet between 6.9-8.0 δ for seven aromatic protons. A quartet for two protons at 4.2 δ and a triplet for three protons at 1.5 δ in the ^1H NMR spectrum of **2a** accounted for the protons of ethyl group. The ^1H NMR spectrum of compounds **3a** and **4a** contained a singlet each at 3.8 δ for three protons and at 6.6 δ for two protons which were assigned to the protons of methyl and primary amide group respectively.

On the basis of analytical and spectral data, the products were characterized as 3-imino-3H-benzo[f]chromene-2-carboxylic acid (**1a**), ethyl 3-imino-3H-benzo[f]chromene-2-carboxylate (**2a**), methyl 3-imino-3H-benzo[f]chromene-2-carboxylate (**3a**), 3-imino-3H-benzo[f]chromene-2-carboxamide (**4a**) and 3-imino-3H-benzo[f]chromene-2-carbonitrile (**5a**) respectively. The 3-imino-3H-benzo[f]chromene derivatives along with their physical characteristics and molecule ion peak are recorded in Table-1.

TABLE-1
PHYSICAL CHARACTERISTICS AND MOLECULAR ION PEAK
OF 3-IMINO-3H-BENZO[f]CHROMENE DERIVATIVES

Compd.	R	m.p. ($^{\circ}\text{C}$)	Yield (%)	M^+ (m/z)	m.f.
1a	COOH	117	80	239	$\text{C}_{14}\text{H}_9\text{NO}_3$
2a	COOC_2H_5	145	75	267	$\text{C}_{16}\text{H}_{13}\text{NO}_3$
3a	COOCH_3	134	72	253	$\text{C}_{15}\text{H}_{11}\text{NO}_3$
4a	CONH_2	110	61	238	$\text{C}_{14}\text{H}_{10}\text{N}_2\text{O}_2$
5a	CN	165	70	220	$\text{C}_{14}\text{H}_8\text{N}_2\text{O}$

Reaction of active methylene compounds (**1-5**) with 2-hydroxynaphthal-4-acetylaniline in 2:1 molar ratios also yielded the same products (**1a-5a**). The formation of the products **1a-5a** can be explained on the basis of attack of the carbanion formed from the active methylene compounds on carbon-nitrogen double bond of 2-hydroxy-1-naphthal-4-acetylaniline to give unstable addition products which lose 4-acetylaniline to yield addition-elimination products which cyclized due to interaction between hydroxy group and cyano group [6,9].

Thus, active methylene compounds containing at least one cyano group, reacted chemoselectively with carbon-nitrogen double bond of 2-hydroxy-1-naphthal-4-acetylaniline, leaving the carbon-oxygen double bond considered to be more reactive, intact under reaction conditions, leading to the formation of addition-elimination products which cyclized due to interaction between hydroxyl and cyano group, rather than double attack at both the reactive centres even when the reaction was carried out with two moles of cyano active methylene compounds.

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