Brief Communications

Unprecedented intermolecular aldol-type condensation involving CH-acid and the nitro group

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The first evidence that α-acylnitrone is an intermediate in the base-promoted reaction of 4-nitro-*N,N*-diethylaniline with acetophenone to give an enaminoketone was obtained.

Key words: aryl methyl ketones, mononitroarenes, α-acylnitrone, nucleophilic addition to the nitro group.

It is known that base-catalyzed reactions of mononitroarenes with CH-acids often involve the stage of nucleophilic substitution of hydrogen.[1] The nitro group is traditionally considered[2] to participate in condensation with CH-acids very rarely, except for reactions of intramolecular cyclization of *ortho*-substituted nitroarenes.[3,4] It has been previously asserted that it is difficult to find at least one example convincingly proving the aldol-type interaction of the nitro group and a C-nucleophile.[3] Moreover, it has been concluded that only cyclic nitrones can be synthesized, because molecules with open chains are solvolyzed to the starting components under the reaction conditions.[5]

We have previously shown[6,7] that the condensation with aryl methyl ketones in the basic medium is a new general reaction of mononitroarenes, which can be used for preparing (*Z*)-arylamino-1,2-diaroylethenes and 1,2,4-triones.[8] It was assumed that the reaction included the stage of nucleophilic 1,2-addition to the nitro group and the formation of α-acylnitrone as an intermediate.

In fact, as we established in the present work (Scheme 1), acetophenone (**2**) reacts with α-acylnitrone (**5**) prepared by the Krohnke method[9] in a superbasic system KOH—DMSO within 5 min (20 °C) to give the expected enaminoketone **6** in 85% yield. It is known that nitrones can also be the condensation products of nitrosoarenes with CH-acids (Ehrlich—Sachs reaction).[10,11] To check this possibility, we performed the reactions of ketone **2** with 4-nitroso-*N,N*-diethylaniline (**7**) and its mixture with 4-nitro-*N,N*-diethylaniline (**1**). In both cases, the reaction occurs almost instantaneously with the formation of the same product, azo compound **8** (yield 80%). Nitro compound **1** was recovered unchanged from the reaction mixture. It is significant that product **6** is formed in 81% yield on prolonged heating of the reagents (**1** and **2**), and azo compound **8** was not detected in the reaction mixture.[8] Therefore, nitrosoarene **7** cannot be the precursor of nitrone **5** in the condensation of **1** and **2**. Perhaps, slow formation of nitrone **5** is preceded by equilibrium stages (involving

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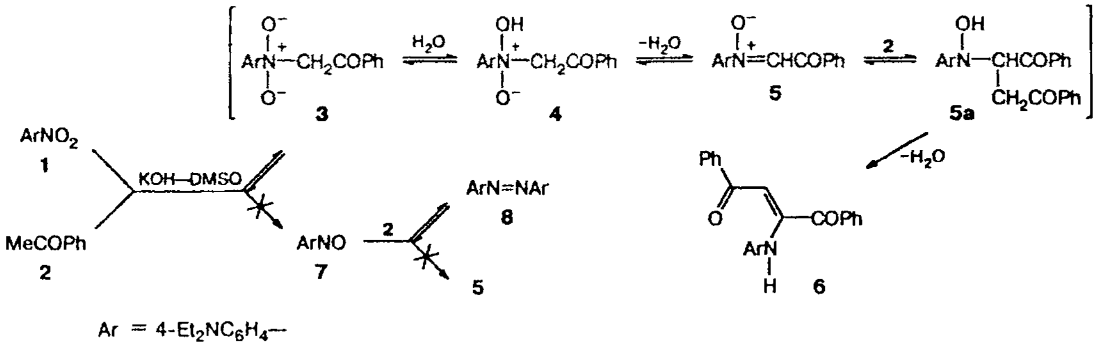
Scheme 1



tetrahedral intermediates **3** and **4**), which are strongly shifted to the left (see Scheme 1).

It should be emphasized that Bartoli and co-workers[12,13] assumed the formation of an intermediate of the same type in the reactions of nucleophilic addition of allylmagnesium halides to the nitro group. In addition, tetrahedral intermediate **3** can be formed due to the radical ion process:

$$ArNO_2 + PhCOCH_2^- \rightleftharpoons ArNO_2^{\cdot -} + PhCOCH_2^{\cdot} \rightleftharpoons \mathbf{3}.$$

It is likely that further transformation of nitrone **5** into enaminoketone **6** occurs rapidly and irreversibly. Unlike the reactions of aldol condensation, the second molecule of methyl ketone adds not to the carbonyl group of the primary adduct **5**, but to its α-carbon atom to give adduct **5a**, so that oxidative coupling of the starting methyl ketone occurs at the expense of the nitro group.

The results presented here along with the previous data open new challenges for studying analogies in reactivity of the carbonyl and nitro groups and could be additional evidence for the existence of a fundamental interrelation between different classes of organic compounds.

Experimental

^{1}H NMR spectra were recorded on a Tesla BS-567 instrument (100 MHz) using HMDS as the internal standard. IR spectra were recorded on a UR-20 instrument. Mass spectra were obtained on an MX-1310 spectrometer with the electron ionization energy of 20 eV.

A mixture of nitrone **5** (4 g, 13 mmol) and acetophenone (3 g, 25 mmol) was added to a suspension of powdered KOH (10 g, 180 mmol) in DMSO (30 mL) at 20 °C. According to the TLC data, the reaction was over in 5 min. The reaction mixture was poured in 10% HCl (250 mL) and extracted with benzene (3×50 mL). After drying with Na_2CO_3 and evaporation of benzene, the extract was passed through a layer of Al_2O_3 (heptane as the eluent) to obtain dark-red crystals of compound **6** in 85% yield (4.6 g). All characteristic parameters of this compound correspond to those for (*Z*)-1,4-diphenyl-2-[4-(*N*,*N*-diethylamino)anilino]but-2-ene-1,4-dione obtained previously[8] from nitroarene **1** and ketone **2**.

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References

1. M. Makosza, *Izv. Akad. Nauk, Ser. Khim.*, 1996, 531 [*Russ. Chem. Bull.*, 1996, **45**, 331 (Engl. Transl.)].
2. R. K. Mackie and D. M. Smith, *Guidebook to Organic Synthesis*, Longman, New York, 1982.
3. J. D. Loudon and G. Tennant, *Quart. Rev. (Chem. Soc., London)*, 1964, **18**, 389.
4. Z. Wrobel, A. Kwast, and M. Makosza, *Synthesis*, 1993, 31.
5. H. G. O. Becker, *Einfuhrung in die Elektronentheorie Organisch-Chemischer Reaktionen*, VEB Dentscher Verlag der wissenschaften, Berlin, 1974.
6. N. V. Moskalev, M. I. Tartynova, V. D. Ogorodnikov, and P. B. Kadychagov, *Zh. Org. Khim.*, 1994, **30**, 740 [*Russ. J. Org. Chem.*, 1994, **30** (Engl. Transl.)].
7. N. V. Moskalev, M. I. Tartynova, I. Yu. Bagryanskaya, and Yu. V. Gatilov, *Izv. Akad. Nauk, Ser. Khim.*, 1996, 480 [*Russ. Chem. Bull.*, 1996, **45**, 462 (Engl. Transl.)].
8. N. V. Moskalev and M. I. Tartynova, *Mendeleev Commun.*, 1996, 72.
9. F. Krohnke, *Angew Chem., Int. Ed. Engl.*, 1963, **2**, 380.
10. K. V. Vatsuro and G. L. Mishchenko, *Imennye reaktsii v organicheskoi khimii* [*Name Reactions in Organic Chemistry*], Khimiya, Moscow, 1976, 503 pp. (in Russian).
11. I. M. Lyapkalo, S. L. Ioffe, Y. A. Strelenko, and V. A. Tartakovskii, *Mendeleev Commun.*, 1994, 51.
12. G. Bartoli, E. Markantoni, M. Bosco, and R. Dalpozzo, *Tetrahedron Lett.*, 1988, **29**, 2251.
13. G. Bartoli, E. Markantoni, M. Petrini, and R. Dalpozzo, *J. Org. Chem.*, 1990, **55**, 4456.

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