Nuclear Overhauser effect in determining the configuration of nitrofuran-3-carboxylates semicarbazones

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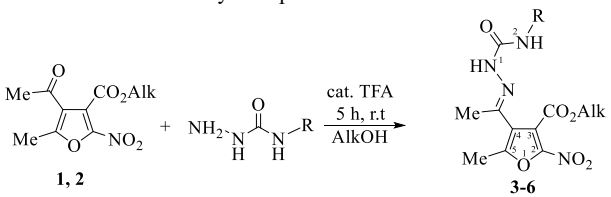
Previously, it was shown that of the interaction of furan-3-carboxylates with substituted hydrazines, furan-3-carboxylate hydrazones with *E-s-cis*-configuration are formed [1].

As the interaction result of acetyl-containing 2-nitrofuran-3-carboxylates **1,2** with semicarbazide hydrochloride and its phenyl-substituted analogue, we obtained 2-nitrofuran-3-carboxylates semicarbazones **3-6** with a yield up to 88%.



1, 2 **3-6**

Alk = Me (**1**, **3**, **5**), Et (**2**, **4**, **6**); R = H (**3**, **4**), Ph (**5**, **6**)

The synthesized 2-nitrofuran-3-carboxylates semicarbazones **3-6**, according to the ^{1}H and $^{13}C\{^{1}H\}$ NMR spectra, are formed stereohomogeneously. The correct assignment of signals in the ^{1}H and $^{13}C\{^{1}H\}$ NMR spectra of compounds **3-6** is confirmed by the results of $^{1}H–^{13}C$ HMQC and HMBC NMR experiments.

However, semicarbazones **3-6** can exist in the form of *E*- и *Z*-izomers relative to the C=N bond, as well as *s-cis*- и *s-trans*-conformers (Fig. 1).

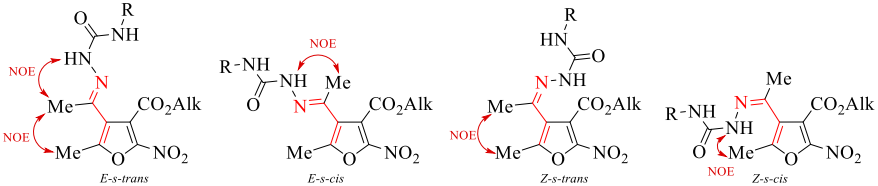


Figure 1. Hypothetical NOE in nitrofuran-3-carboxylate semicarbazones molecules

The aim of this work is to determine the geometric configuration of the obtained semicarbazones **3-6** using $^{1}H–^{1}H$ NOESY NMR spectroscopy experiment.

The results of $^{1}H–^{1}H$ NOESY experiments for semicarbazones **6** carried out with varying mixing times (τ = 0.5-1.5 s) indicate the presence of a nuclear Overhauser effect (NOE) between the amino group proton $N^{1}H$ and the protons of methyl group ones to the azomethine bond (Me–C=N). Also, the presence of NOE between the methyl group protons of the furan ring and the azomethine bond. This makes it possible to determine the *E-s-trans*-configuration of

the fragment C^5=C^4–C=N (Fig. 2). In addition, the spectra also contain a cross-peak of the amino group proton N^2H with both the proton of the benzene ring H^o and the methylene protons of the ester group, which also give a cross peak with each other.

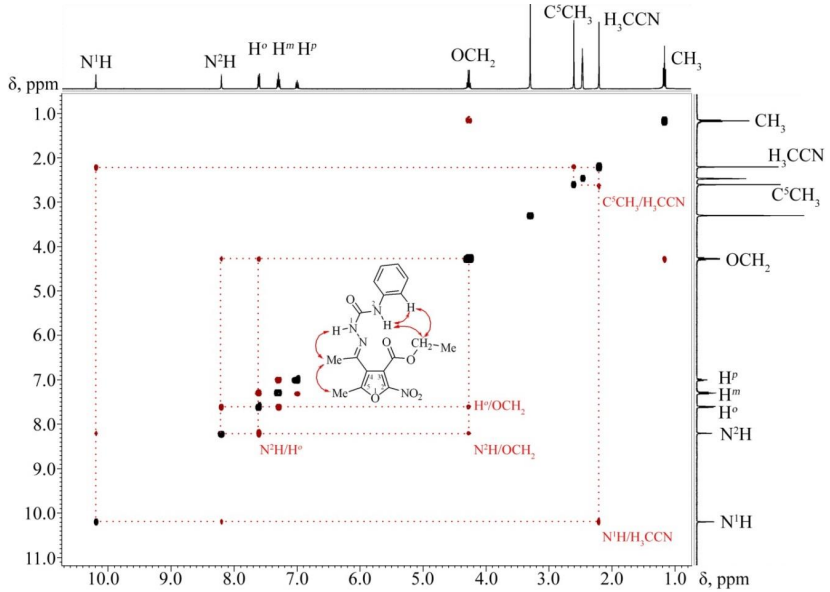


Figure 2. NOE in nitrofuran-3-carboxylates semicarbazones 6

Thus, according to NMR data, the configuration of the synthesized 2-nitrofuran-3-carboxylates semicarbazones was established and their structure was confirmed using X-ray diffraction analysis on example of compound **6**.

The studies were carried out at the Central Collective Use Center at the Faculty of Chemistry of the Herzen State Pedagogical University of Russia on the Jeol ECX-400A spectrometer (Royal probe) with an operating frequency of 399.78 (^{1}H), 100.53 (^{13}C) MHz at standard experimental settings, using the solvent signal as an internal standard.

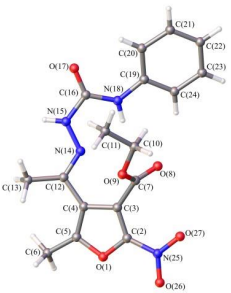


*Figure 3. X-ray diffraction analysis of compound **6***

Acknowledgements

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References

1. Gomonov K.A., Pelipko V.V., Baichurin R.I., Makarenko S.V. Carbonyl-containing furan-3-carboxylates in the synthesis of original mono- and biheterocyclic structures // Book of abstracts Conference "New Emerging Trends in Chemistry (NewTrendsChem-2023)". Yerevan (Armenia). 24-28 September 2023. P. 80.