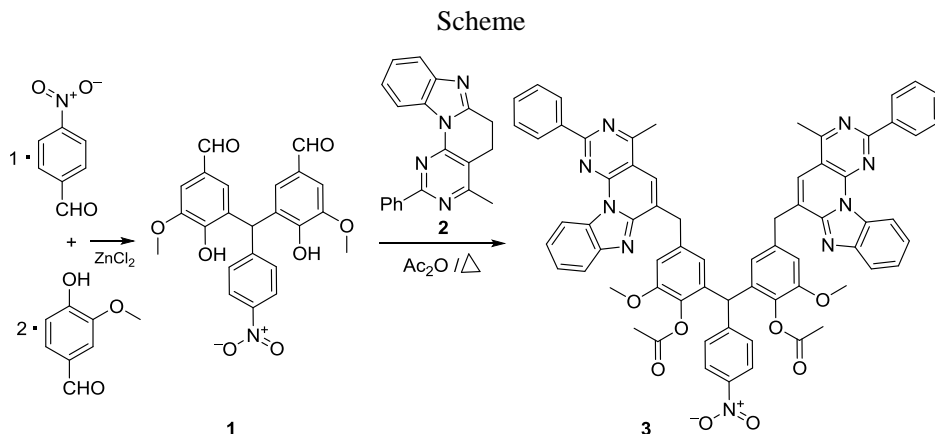


NEW THREE-DIMENSIONAL HETEROCYCLIC CLUSTER. BIS-BENZO[4',5']IMIDAZO[2',1':6,1]PYRIDO[2,3-d]PYRIMIDINES, SYMMETRICALLY LINKED BY A TRIARYLMETHANE LINKER

Modern methodology for finding new compounds for introduction into medical and industrial chemistry implies, among other approaches, the synthesis of chemical compounds of a fundamentally new design. In this report, we describe the synthesis of substituted bis-benzo[[4',5']imidazo-[2',1':6,1]pyrido[2,3-d]pyrimidines, in which two tetracyclic skeletons are symmetrically linked by a triarylmethane linker.

The design of the synthesized large molecule has a unique three-dimensional structure (Fig.1), which makes it interesting in terms of studying the affinity for various biomolecules and photophysical, chelating properties, and can be used for detection of nitro-containing explosives and ecotoxins, as well as fluorescent biomarkers in biomedical investigations.

The synthesis was carried out according to the following Scheme:



The initial dialdehyde of the triarylmethane series **1** was obtained by the interaction of 4-nitrobenzaldehyde and vanillin in a ratio of 1/2 in the presence of ZnCl_2 according to the method described in the literature [1]. However, in the cited work, the author was unable to establish the exact structure of the isomer of the synthesized compound, limiting himself only to the correct assignment of compound

1 to the triarylmethane derivative, in which aldehyde groups are present in the vanillin moiety.

We have established that two molecules of 4-hydroxy-3-methoxybenzaldehyde react on the carbonyl group of an electron-deficient 4-nitrobenzaldehyde (electrophile) in the presence of ZnCl_2 to form a single isomer in which the introduced group is in the *meta*-position to the formyl and *ortho*-position to the hydroxyl groups of the vanillin moiety. This is in accord with the orientation rule for substituents in the aromatic ring in the Friedel-Crafts reaction. Dialdehyde **1** is put into the interaction with 4-methyl-2-phenyl-5,6-dihydrobenzo[4',5']imidazo[2',1',6,1]pyrido-[2,3-d]pyrimidine (**2**) [2] in a molar ratio of 1/2 by boiling in acetic anhydride according to the previously described method [3] with the formation of bis-derivative **3**. As in the case of condensation of tetracycle **2** with aromatic and heterocyclic aldehydes in acetic anhydride [3] the reaction proceeds exclusively on the methylene group 6 of the heterocycle, followed by a 1,3-prototropic shift and the formation of 6-arylmethyl derivative **3**.

The structure of the synthesized compounds **1,3** was proved by ^1H NMR spectroscopy.

Visualization in the form of a ball and stick model, optimization of the three-dimensional structure and analysis of the geometry of the molecule (Figure) were carried out in the Chem3D 16.0 program, the ChemOffice software.

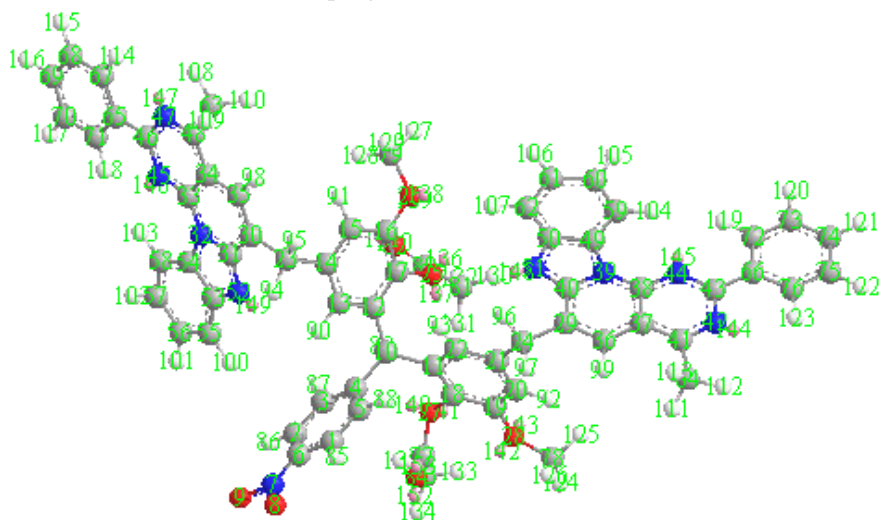


Figure. Ball and stick model of compound **3** after optimization of the three-dimensional structure.

The nearest contacts are presented only for hydrogen atoms: H(127)-Lp(152), H(112)-Lp(149), H(127)-H(135), N(74)-H(135), N(76)-H(131), N(76)-H(128), N(74)-H(127), N(50)-H(123), H(112)-H(119), N(52)-H(119), N(50)-H(117), N(52)-H(112), C(12)-H(93), C(35)-H(92), C(29)-H(91), C(4)-H(90), O(33)-H(89), C(3)-H(89), O(9)-H(86), O(8)-H(85).

The research was carried out at Russian–Armenian (Slavonic) University and supported by the funds allocated under the subsidy of the Ministry of Education and Science of the Russian Federation to finance research activities at Russian–Armenian (Slavonic) University, as well as with the financial support of the State Committee of Science of the Ministry of Education and Science of the Republic of Armenia within the framework of the scientific project No. 18T-1D249

Experimental part

The IR spectra were recorded on a Nicolet Avatar 330 spectrometer from samples dispersed in mineral oil. The ^1H NMR spectra were measured on a VarianMercury-300 spectrometer at 300 MHz using tetramethylsilan as internal reference. Thin-layer chromatography was performed on Silufol UV-254 plates in hexane – dichloroethane – ethanol / 1-1-1 system; spots were visualized by treatment with iodine vapor. Elemental analysis was carried out on an automated EA Eurovector elemental analyzer (Italy).

[(4-Nitrophenyl)-di-(2-hydroxy-3-methoxy-5-formylphenyl)]methane (1). Prepared according to the described method [1]. Yield 48%, mp 275-276°C from AcOH (lit. 276°C [1]), R_f 0.60. IR spectrum, ν , 3208 (OH), 1676 (CO), 1607, 1592 (C=C-C=N). ^1H NMR spectrum (DMSO- d_6 / CCl_4 : 1/3), δ , ppm, H_z : 3.94 s (6H, OMe); 6.26 brs (1H, CH); 6.92 brd (2H, $J = 1.8$, H-6.6' C_6H_3); 7.31-7.36 m (2H, H-2.6 C_6H_4); 7.33 d (2H, $J = 1.8$, H-2.2' C_6H_3); 8.11-8.16 m (2H, H-3.5 C_6H_4); 9.63 s (2H, CHO); 9.67 br (2H, OH).

{(4-Nitrophenyl)-bis-[2-acetoxy-5-[(4-methyl-2-phenylbenzo[4',5']imidazo[1',2':1,6]-pyrido-[2,3-d]pyrimidin-6-yl)]methyl-3-methoxy]phenyl]methane (3). A solution of 1.18 g (0.005 mol) of dialdehyde **1** and 3.12 g (0.01 mol) of 4-methyl-2-phenylbenzo[4',5']imidazo[2',1': 6,1]-pyrido[2,3-d] -pyrimidine (**2**) in 40 ml of acetic anhydride was heated under reflux for 24 hours, evaporated to half the volume and left overnight in the cold. The precipitated product was filtered and dried. Yield 64.8%, yellow-green crystals, mp 320-322°C (DMF), R_f 0.75. IR spectrum, ν , cm^{-1} : 1770, 1675 (CO), 1594 (C=C-C=N). ^1H NMR spectrum (DMSO- d_6), δ , ppm, H_z : 2.17 s (6H, 2 • Me); 2.24 brs (6H, 2 • Me); 3.54 brd (2H, $J = 14.7$ CH_2^a); 3.74 s (6H, 2 • Me); 4.02 d (2H, $J = 14.7$ CH_2^b); 5.85 s (1H, CH); 6.95 brs (2H, H-5); 7.15-7.20 m (4H, 2•H 2,6 C_6H_2); 7.25 ddd (2H, $J = 8.2, 7.3, 1.0$ C_6H_4); 7.37-7.43 m (6H, Ar); 7.47-7.54 m (4H, Ar); 7.85 brd (2H, $J = 8.0$ C_6H_4); 8.04-8.08 m (4H, *ortho*- C_6H_5); 8.22-8.26 m (2H, $\text{C}_6\text{H}_4\text{NO}_2$); 8.31 brd (2H, $J = 8.2$ C_6H_4). Found %, C 72.62; H 4.48; N 11.52. $\text{C}_{67}\text{H}_{51}\text{N}_9\text{O}_8$. Calculated, %: C 72.49; H 4.63; N 11.35.

**ՆՈՐ ԵՌԱԶԱՓ ՆԵՏԵՐՈՅԻԿԱԼԱՅԻՆ ԽՐԶԻԿ.
ԲԻՍ-ԲԵՆԶՈ[4', 5']ԻՄԻԴԱԶՈ[2', 1':6, 1]ՊԻՐԻԴՈ[2,3-D]ՊԻՐԻՄԻԴԻՆ՝
ՆԱՄԱԶԱՓՈՐԵՆ ԿԱՊԱԼԱԾ ԵՌԱՐԻԼՄԵԹԱՆԱՅԻՆ ԿԱՄՐՋԱԿՈՎ**

**Ա. Ա. ՆԱՐՈՒԹ-ՅՈՒՆՅԱՆ, Ն. Ա. ՓԱՆՈՍՅԱՆ,
Գ. Տ. ԴՈՒԿԱՍՅԱՆ և Գ. Կ. ԴԱՆԱԳՈՒԼՅԱՆ**

*4-Նիտրոբենզալդեհիդի և 4-Հիդրօքսի-3-մեթօքսիբենզալդեհիդի կոնդենսման ար-
դյունքում սինթեզված [(4-նիտրոֆենիլ)-դի-(2-Հիդրօքսի-3-մեթօքսի-5-ֆորմիլ)]մեթանը
փոխազդեցության մեջ է դրվել 4-մեթիլ-2-ֆենիլ-5,6-դեհիդրոբենզո[4',5']-իմիդազո
[2',1',6,1]պիրիդո[2,3-ձ]պիրիմիդինի հետ և ստացվել է [(4-նիտրոֆենիլ)-բիս-(2-
ացետօքսի-5-[(4-մեթիլ-2-ֆենիլ)բենզո[4',5']իմիդազո[1',2':1,6]-պիրիդո[2,3-ձ]պիրիմի-
դին-6-իլ)]մեթիլ-3-մեթօքսի]ֆենիլմեթան: Սինթեզված միացությունների կառուցվածքը
հաստատվել է ՄՄՊ- 1H սպեկտրալ եղանակով:*

**СИНТЕЗ БИС-БЕНЗО[4', 5']ИМИДАЗО[2', 1': 6, 1]ПИРИДО[2,3-
d]ПИРИМИДИНА, СИММЕТРИЧНО ПОДКЛЮЧЕННОГО ЧЕРЕЗ
ТРИАРИЛМЕТАНОВЫЙ ЛИНКЕР**

А. А. АРУТЮНЯН, Г. А. ПАНОСЯН, Г. Т. ГУКАСЯН и Г. Г. ДАНАГУЛЯН

Конденсацией 4-нитробензальдегида с 4-гидрокси-3-метоксибензальдегидом синтезирован 4-нитрофенилметил-3,3'-бис(4-гидрокси-5-метоксибензальдегид), взаимодействием которого с 4-метил-2-фенил-5,6-дигидробензо[4',5']имидазо [2',1',6,1]пиридо[2,3-d]пиримидином получен бис-бензо[4',5']имидазо[2',1': 6,1] пиридо[2,3-d]пиримидин. Строение синтезированных соединений подтверждено ЯМР ¹H спектроскопией.

REFERENCES

- [1] Rogoff M. // Ber., 1902, v. 35, p. 1961.
- [2] Harutyunyan A.A. // Chem. J. Armenia, 2012, v. 65, №2, p. 257.
- [3] Harutyunyan A.A., Ghukasyan G.T., Danagulyan G.G. // International Conference “100 Years of Development of Chemistry: From Synthesis of Polyethylene to Stereodivergence». May 16–18, 2018, Perm, Russia, p. 69.

¹ Russian-Armenian (Slavonic) University
² The Scientific Technological Center of Organic
and Pharmaceutical Chemistry NAS RA²
26, Azatutyan Str., Yerevan, 0014, Armenia.
E-mail: harutyunyan.arthur@yahoo.com

A. A. HARUTYUNYAN ^{1,2}
H. A. PANOSYAN ²
G. T. GHUKASYAN ^{1,2}
G. G. DANAGULYAN ^{1,2}