

## HETARYL AND ARYL DERIVATIVES OF 3,3'-DIINDOLYLMETHANE AS PROMISING COMPONENTS OF ANTIMICROBIAL DRUGS

*Vereshchak V. O.*<sup>1,2</sup>, Tsygankov A. V.<sup>1,2</sup>, Vakula V. M.<sup>1,3</sup>, Lipson V. V.<sup>1,3</sup>

<sup>1</sup>Division of Functional Materials Chemistry, State Scientific Institution "Institute for Single Crystals" of NAS of Ukraine, Kharkiv, Ukraine

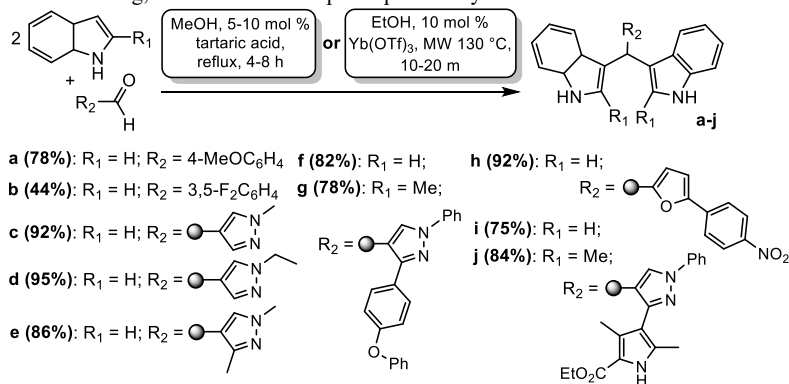
<sup>2</sup>National Technical University "Kharkiv Polytechnic Institute", Kharkiv, Ukraine

<sup>3</sup>Department of Medical Chemistry of the State Institution "V. Danilevsky Institute for Endocrine Pathology Problems of the NAMS of Ukraine", Kharkiv, Ukraine  
vladver02@gmail.com

Resistance to antimicrobial drugs and the emergence of multiresistant bacterial strains is a problem of global importance. Recent studies of 3,3'-diindolylmethane (DIM) and some of its derivatives proved the feasibility of finding new effective inhibitors for the formation of resistant biofilms by pathogenic microorganisms from the ESKAPE group [1]. In addition, information on the effect of bisindole on the synthesis of nucleic acids can become a prerequisite for a wide spectrum of antimicrobial activity of its derivatives [2].

Along with the traditional use of such catalysts as Brønsted or Lewis acids in the synthesis of DIMs, recently green activators have become widespread – graphene oxide, CaO, some enzymes and even milk whey or lemon juice. No less popular are modern methods of activation of chemical processes (microwave irradiation, ultrasonic and photoactivation) [3].

The purpose of this research is to synthesize several DIM derivatives using two alternative methods: with the participation of tartaric acid as a catalyst under the conditions of convection heating, as well as with the participation of ytterbium triflate and MW-activation.



Scheme 1. Synthesis of aryl and hetaryl derivatives of diindolylmethane

The structure of the compounds was proved by <sup>1</sup>H and <sup>13</sup>C NMR spectra, individually by chromatographic methods. In the <sup>1</sup>H NMR spectra characteristic signals are observed – a singlet proton of the methine group with δ 5.5–6.0 ppm and a singlet of two NH protons of indole fragments in a weak field with δ 10.5–11 ppm.

1. Golberg, K. Anti-virulence activity of 3,3'-diindolyl-methane (DIM): a bioactive cruciferous phytochemical with accelerated wound healing benefits. *Pharmaceutics*. 2022, 14, pp 967–989.

2. Jacobs, M. R. Novel bis-indole agents active against multidrug-resistant *Acinetobacter baumannii*. *Diagn. Microbiol. Infect. Dis.* 2011, 69, pp 114–116.

3. Penieres-Carrillo, J. G. Synthesis of novel benzimidazole-diindolylmethane hybrid compounds within the green chemistry context. *Arkivoc*. 2017, 4, pp 210–221.

*The work was carried out within the framework of NRFU grant № 2022.01/0087.*