Summary of doctoral thesis

„Design and synthesis of phenylethynylphenyl azomethine compounds with potential applications in analytics and pharmacy”

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The goal of this study was to design and synthesize azomethine analogues containing a phenylethynylphenyl function and to study their physicochemical properties, in particular, optical, electrochemical and thermal in a search for potential application in pharmacy and analytical chemistry. In particular, we focused on the new analog of resveratrol (IRA) carefully testing its chelating properties as well as biological activity.

In particular, different synthetic methods were tested to obtain phenylethynylphenyl azomethine derivatives. This included also heterogeneous catalysis. The tests performed in the model system have shown that the use of silica catalyst under ultrasound conditions allows for the efficient condensation of the amine with 4-(2-phenylethyny)-benzaldehyde. Accordingly, a series of condensations with various amines have been carried out using this method. Separation and purification problems have been encountered in this method. The structures of five imino analoges that were successfully obtained in a pure form were confirmed by ^{1}H and ^{13}C NMR. Purity was determined by elemental analysis. Then, optical (absorption and photoluminescence in solution), electrochemical, thermal (TG, DSC) measurements as well as DFT calculations were performed for these compounds. Optical measurements in various solvents have shown that all derivatives do not show fluorescence in organic solvents, whereas in water fluorescence effect could be observed. It has been shown that this effect is associated with azomethine hydrolysis. Accordingly the concentration of the released fluorogenic aldehyde (4-(2-phenylethynyl)-benzaldehyde) increases. The susceptibility of compounds to hydrolysis was tested by ^{1}H NMR. This shows a formation of aldehyde in a system under the addition of water. One of the obtained compounds is an imine analogue of resveratrol (compound 2b). First, the complexing properties of 2b in various solvents (acetonitrile, water) were tested for: Al^{3+}, Ba^{2+}, Co^{2+}, Cr^{3+}, Cu^{2+}, Fe^{2+}, Fe^{3+}, Mn^{2+}, Ni^{2+}, Pb^{2+}, Sr^{2+} and Zn^{2+}. Next, the biological activity of this compound on prostate cancer cells was verified. The studies of the complexing properties of the 2b derivative have shown a high selectivity of the compound against Cu(II) ions in acetonitrile or water. The extension of this research allowed for the development of a system for the selective determination of copper in tap water. Biological activity of IRA (2b), o-aminophenol (substrate) and the Cu(II)-2b complex against prostate cancer cells were studied. It was shown that only 2b showed a significant cytotoxic effect despite partial hydrolysis of the presented compounds. Therefore, the presence of undecomposed azomethine is crucial for cytotoxic properties of compound 2b.