

## OPINION

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Concerning the materials submitted for the competition for academic position "Associate Professor" within the Institute of Organic Chemistry with Centre of Phytochemistry, Bulgarian Academy of Science (IOCCP-BAS) in professional field 4.2 Chemical Sciences: scientific specialty "Organic Chemistry" for the needs of the Laboratory "Organic Synthesis and Stereochemistry"

#### 1. Evaluation of the documents in the procedure

According to order № RD-09-54/28.03.2024 of the Director of IOCCP-BAS, I have been approved as a member of the academic board in connection with a procedure for a competition for the academic position of "Associate Professor" for the needs of the "Organic synthesis and stereochemistry" laboratory, announced in the Newspaper of State, issue 9 of 30.01.2024. The only candidate participating in the competition is Assist. Prof. Vera Ventsislavova Deneva, PhD. The set of materials presented by the candidate is in accordance with the Regulations for the Development of the Academic Staff of the IOCCP-BAS and meets the criteria

Dr. Deneva participates in the competition with a 16 scientific work outside her thesis for "Doctor", which are on the issues of the competition and are accepted for review:

- Publications equivalent to habilitation report (**Indicator C**) – **6 pieces, divided by the relevant Q factors as follows: - Q1 - 5 pcs., Q2 - 1 pc.**
- Publications outside the equivalent of habilitation report (**Indicator D**) – **10 pieces, divided by the relevant Q factors, as follows: Q1 – 7 pcs., Q2 - 3 pcs.**

Dr. Deneva holds 118 citations of her scientific publications. A check in the *Scopus* database shows that Dr. Deneva holds an h factor of 10 (self-citations excluded), which meets the criteria of the IOCCP-BAS for the academic position.

The results of the investigations are presented at 13 national and international forums such as poster presentations and oral reports. Dr. Deneva has presented participations in 12 scientific research projects, with the candidate being the head of one project for young scientists funded by FNI.

The presented articles as a number, as an impact factor and citations, meet the requirements set by IOCCP-BAS for holding the position of "Associate Professor".

#### 2. General characteristics of the candidate's research activity

The candidate's scientific interests are mainly focused on the study of the tautomeric properties of various organic compounds in the UV-Vis field, their ability to complex and their potential applications as molecular switches. Contributions from the research activity of Assist. Prof. Vera Deneva are summarized into three main sections - (1) tautomerism of azo dyes, (2) tautomerism of Schiff bases and (3) other tautomeric systems.

The first part involves the study of the tautomeric behaviour of aryl-azo derivatives of naphthols for proton transfer control. Tautomerism as the main switching mechanism in the selective complexation with the ligand 4-(phenyldiazenyl)naphthalen-1-ol as a tautomeric fragment and an amide group as an antenna for metal ion binding was investigated. A system has been developed in which complexation with metal ions completely shifts the tautomeric equilibrium to the keto tautomer. Within the same strand, the switching mechanism of ethyl-2-(2-(quinolin-8-yl)hydrazono)-2-(pyridin-2-yl)acetate was investigated by a combination of experimental and theoretical methods. The results indicate that the most likely mechanism for the switching process is proton transfer. Two new 4-hydroxycoumarin-based rotary switches containing fixed carbonyl groups in the rotor were analysed. The structure of the stator and the polarity of the solvents were found to have no effect on the azohydrazone tautomerism and both compounds exist as keto tautomers.

Contributions in the second strand of the candidate's research work can be summarized to:

1. Two 5-substituted phthalimide Schiff bases containing a salicylic or hydroxy naphthyl moiety have been characterized. It was found that the compound with the naphthyl moiety exhibits a solvent-dependent tautomeric equilibrium, while the compound with the phenyl moiety lacks tautomerism. For both compounds, excited-state intramolecular proton transfer to keto tautomers and emissions with large Stokes shifts in various solvents were recorded.

2. Tautomeric equilibrium studies of 7-hydroxyquinoline Schiff bases show that 8-((phenylimino)methyl)quinolin-7-ol exists as a mixture of tautomers, while its pentafluoro phenyl analogue exists solely in its enol form. Upon irradiation, both compounds exhibit rotation around the C<sub>quin</sub>-CH bond *via* excited-state intramolecular proton transfer, making them suitable candidates for use as switches.

3. The preferred switching mode for *N*-(benzo[d]thiazol-2-yl)picolinamide and *N*-(benzo[d]thiazol-2-yl)isonicotinamide is shown to be excited-state proton transfer from the amide to the benzothiazole nitrogen in both studied compounds.

In the third part, the studies on the tautomeric behaviour and the mechanism of proton transfer in different tautomeric systems are again presented. In the case of 10-hydroxybenzo[h]quinoline and its nitro derivatives, the influence of electron-withdrawing substituents was studied. The addition of nitro substituents has been shown to lead to the appearance of the corresponding keto tautomers in the ground state and to changes in the excited state. The tautomeric behaviour and association in solution and in the solid state of two pinene-type ligands were investigated. The dynamic equilibrium between the different structural forms of favipiravir in solution has been elucidated using molecular spectroscopy and quantum-chemical calculations, which affects its biological activity and efficiency.

The works outside the candidate's habilitation report are related to the use of near infrared spectroscopy for the rapid quantitative and non-destructive determination of the active components in *Arnicae flos*, a substance obtained from the plants *Arnica montana L.* and *Arnica chamissonis Less.* Raman spectroscopy is used as a fast, non-destructive analytical technique for classifying Bulgarian wines and evaluating their chemical composition.

### 3. Critical notes and recommendations

I would like to point out that the extended habilitation report would be better organized if the numbering of the publications cited in it corresponds to their number entered in indicators C

and **D**. For better visualization, files with publications under indicator **C** and **D** can be presented bibliographically, namely with journal name (*Standard Journal Abbreviation*), year of the publication, volume and page number.

I have some remarks about the names of the compounds:

- According to the IUPAC nomenclature, the substituents in phthalimide Schiff bases are in the 5-position, not in 4-position as indicated.
- It is not correct 4-hydroxycoumarin to be named "4-OH coumarin".

Scheme 2 in the habilitation report does not illustrate the writing, the structure with an amide group is missing: "*Publication 2, explores the use of tautomerism as a primary signalling mechanism in metal sensing, focusing on a ligand with 4-(phenyldiazenyl) naphthalene-1-ol as a tautomeric block and an amide group as a metal capturing antenna (Scheme 2)*"

Discrepancies between the habilitation report and the publications cited in it are also noted. For example: "*The incorporation of electron acceptor substituents on position 7 of the HBQ backbone led to the appearance of a keto tautomer in the ground state and changes in the excited state potential energy surface.*" The reported compounds are three, two of them having a nitro substituent at position 7 (7-nitrobenzo[h]quinolin-10-ol) and at position 7,9 (7,9-dinitrobenzo[h]quinolin-10-ol), as is also indicated in scheme 4 of the habilitation certificate, which is not clear from the text therein.

The outlined prospects for research in the next three years in the habilitation report are presented very generally. It may be appropriate to specify at least the classes of organic compounds to be investigated.

The noted errors and inaccuracies do not affect my generally good impression of the submitted documents and materials for the competition.

## CONCLUSION

The documents and materials presented by Dr. Vera Deneva fully comply with the requirements of the Act for the development of the academic staff in the Republic of Bulgaria, The Regulations govern the implementation of the Act for the development of the academic staff in the Republic of Bulgaria, and meets the criteria of IOCCP-BAS for academic positions "Assistant Professor". Based on the materials presented in the competition and the scientific and scientific-applied contributions reflected in them, I give my positive assessment and recommend to the other members of the Scientific Jury that a report-proposal be prepared to the Scientific Council of IOCCP for conferment of the academic position "Associate Professor" of Dr. Vera Ventsislavova Deneva in professional direction 4.2. "Chemical Sciences", scientific specialty "Organic Chemistry" for the needs of the "Organic Synthesis and Stereochemistry".

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