OPINION

by Associate Professor Detelin Stefanov Stamenov PhD

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REGARDING: procedure for a competition for the academic position of **Associate Professor** in the scientific field 4. "Natural Sciences, Mathematics and Informatics", in the professional field 4.3. Biological Sciences, scientific specialty "Biophysics", announced by the Institute of Biophysics and Biomedical Engineering-BAS in the State Gazette issue 69/16.08.2024 for the needs of the section "Photoexcitable Membranes",

The only candidate who submitted documents for participation in the announced competition is Senior Assistant Professor Dr. Georgi Dimitrov Rashkov from **the Institute of Biophysics and Biomedical Engineering (IBPBME), Bulgarian Academy of Sciences**

1. Data about the candidate Georgi Dimitrov Rashkov

Georgi Dimitrov Rashkov graduated in 2002 from the Faculty of Physics of Sofia University "St. Kl. Ohridski" – Master in "Nuclear Engineering and Energy" and second specialty "Metrology". Rashkov graduated with a Master of Science in Engineering Physics. Until 2006, Rashkov worked at the Institute of Nuclear Engineering and Energy – BAS as a physicist and in the same year he joined the Institute of Biophysics and Biomedical Engineering – BAS, Section "Photoexcitable Membranes" as a specialist physicist, and since 2010 as an assistant in the same section. In 2014, Rashkov was enrolled as a doctoral student in independent training in the Section "Photoexcitable Membranes" at the IBPBME – BAS. Rashkov successfully defended his dissertation "Possibility of application of photosynthetic membranes as a bioreceptor for pesticide registration" in 2019. He has a total of 21 publications with an h-index of 9 (source: Scopus). 225 citations have been noted (as of October 2024). Rashkov has participated in 22 scientific forums and in the development of 10 research projects, 3 of which are international one.

Georgi Rashkov has mastered a variety of biochemical and biophysical methods and has accumulated extensive research experience. He is working on a dissertation related to the search for effective biosensors based on photosynthetic membranes for the detection of pesticides and heavy metals in the environment. Working on various scientific projects, he also studies: The regulation of the functions and organization of the photosynthetic apparatus by brassinosteroids; The uptake of metal nanoparticles and their effect on photosynthesis; The effects of antioxidants and signaling molecules on the photosynthetic apparatus and its resistance to abiotic stress; The effects of salt stress and drought on photosynthesis and the role of nitric oxide and polyphenols in the presence of these stresses.

2. Evaluation of the submitted reference by Georgi Dimitrov Rashkov

The documents submitted by the candidate in the competition comply with the requirements of the Law on the State of the Republic of Bulgaria and the Regulations on the terms and conditions for acquiring scientific degrees and occupying academic positions at the Institute of Physics and Mathematics, Bulgarian Academy of Sciences.

In connection with the competition requirements, Rashkov has submitted documents in accordance with the regulations of the Institute of Biomedical Engineering, Bulgarian Academy of Sciences, including: Application for participation in the competition; Curriculum vitae according to the European model; Certificate of internship in the specialty; Diploma for the acquired educational and scientific degree "PhD" (copy); Abstract of the dissertation for obtaining the educational and scientific degree PhD; List of publications for the PhD and associate professor; Habilitation certificate and list of articles participating in the habilitation work; Certificate for meeting the minimum requirements for associate professor; Regulations for the implementation of the Law on the Development of Academic Staff in the Republic of Bulgaria; Abstracts in English and Bulgarian; Copy of all publications participating in the habilitation work; Copy of the State Gazette issue 69/16.08.2024; List of participation in scientific events; List of projects; Electronic media with all the above-listed documents, as well as a copy of these Regulations. Based on the submitted documents, in my opinion, the candidate Georgi Dimitrov Rashkov meets and exceeds the requirements of the Institute of Biomedical Engineering, Bulgarian Academy of Sciences for the position of Associate Professor.

3. Analysis of the main directions and research work and personal contributions of Georgi Dimitrov Rashkov.

For indicators from group A, Georgi Rashkov, out of a required 50 points, has 50 points based on the fact that he defended a dissertation for the award of the educational and scientific degree "doctor" on the topic "Possibility of application of photosynthetic membranes as a bioreceptor for pesticide registration";

For indicators from group B, indicators 3 and 4, Georgi Dimitrov Rashkov has 100 points out of a required 100 points from 4 publications with quartile Q1, General JCR IF: 19.36. From group D, indicators 5 to 9, has 254 points out of a required 200 points. The distribution of publications by quartiles is as follows: Q1 - 7 publications; Q2 - 2 publications; Q3 - 1 publication Q4 - 2 publications. **General JCR IF: 32.54**.

According to the application from group **D** (i.e. number of citations in scientific publications, monographs, collective volumes and patents, referenced and indexed in Web of Science and Scopus), the candidate presents a list of only selected citations in publications indexed in Web of Science or Scopus 42 citations. The points for this indicator are **84 points**.

According to group **E**, Georgi Dimitrov Rashkov was assessed with **120 points** out of the required 70 points and are based on his participation in 9 scientific projects, of which 6 national and 3 international.

In my opinion, the candidate Georgi Dimitrov Rashkov meets the national requirements under Art. 26 of the Law on the Development of Academic Staff in the Republic of Bulgaria for scientific field 4. "Natural sciences, mathematics and informatics", professional field 4.1. "Biological sciences" and, respectively, the requirements of the IBFBMI, BAS for occupying the academic position of "associate professor" in the scientific field and the relevant professional field of the competition.

4. Overall assessment of the significance of scientific achievements Georgi Dimitrov Rashkov

The main part of Georgi Rashkov's research is devoted to the influence of abiotic stress factors on the photosynthetic apparatus and the mechanisms of protection and adaptation of photosynthesis to such factors. The research is conducted in a wide range of organisms with varying degrees of complexity of the photosynthetic apparatus - cyanobacteria, green algae and plants. In addition, the role of exogenously applied signaling molecules and nanoparticles under physiological conditions and under

abiotic stress in various plant species has been studied in order to reduce the harmful effects of stresses.

An important part of Rashkov's research is related to the influence of salinity and drought on the photosynthetic apparatus, which I will discuss in more detail in my opinion. Drought and soil salinization are stresses that seriously limit plant productivity. Often, salinity as a stress factor occurs together with another abiotic stress such as drought, and some of the mechanisms of damage and protection from these stresses are very difficult to distinguish them. Drought and salt stress usually occur simultaneously or sequentially in heavily irrigated fields in arid and semi-arid regions. The effects of these stresses range from morphological adaptations to molecular responses. Recent studies have shown that plant responses to drought and salinity cannot be directly predicted by simply studying only one of these stresses at a given time. Therefore, the effects of single and combined drought and salinity stresses on the photosynthetic, stomatal, mesophyllic and hydraulic characteristics of plant leaves and their coordination need to be considered. Strategies to mitigate and manage the effects of these stresses also need to be developed, including screening for tolerant varieties, inducing stress resistance/tolerance, and adding bacteria and fungi to improve water use efficiency and yields under combined stress. In this regard, I should note that for this type of research, it is important to conduct experiments with intact objects such as leaves. Therefore, the study of leaf characteristics under the action of these stresses and the strategies for avoiding or mitigating their harmful effects requires a careful selection of research techniques, especially in cases where *in vivo* conditions are used. In this regard, in my opinion, Rashkov makes a good choice to study the effects of these stresses using the very sensitive method of chlorophyll fluorescence. Based on this method, many diverse parameters have been introduced, assessing very subtle changes in photosynthetic activity, such as 1) assessment of the quantum yield of photosynthesis; 2) study of specific protection mechanisms, assessed by changes in the heat dissipation of light energy captured by photosynthetic pigments; 3) indirect estimates of the proton motive force (pmf) across the thylakoid membrane associated with the efficiency of photosynthetic electron transport and ATP synthesis, as well as the participation of the pmf component such as the proton gradient accumulated across the thylakoid membrane, in protecting the photosynthetic apparatus from excess light energy (superoptimal excitation), which would lead to secondary effects of photodamage to photosynthesis, etc. Fluorescence studies allow for the study of stress effects at the level of photosystem 2. As an additional method, which fortunately can be used together with chlorophyll fluorescence, is the measurement of the degree of photooxidation of the primary acceptor of the reaction center of photosystem 1 (P700) assessed by absorption changes in the oxidized form of P700 at 820 nm. This allows Georgi Rashkov, for example, to study the functional activity of the photosynthetic apparatus of C3 pea (*Pisum sativum* L.) and C4 maize (*Zea mays* L.) plants under physiological conditions and after treatment with different concentrations of NaCl (0–200 mM) using chlorophyll fluorescence and changes in the photooxidation of P700, and an important conclusion was made that the effects of drought and salinity can be distinguished. It was found that the effects of salt stress are more significant in pea than in corn. On the other hand, the influence of different levels of drought on the photosynthetic characteristics of two species with C4 type of photosynthesis, maize (*Zea mays* L.) and sorghum (*Sorghum bicolor* L.), was studied, and it turned out that sorghum is more sensitive to drought.

Rashkov is also doing, in my opinion, very interesting research devoted to the influence of nitric oxide and brassinosteroids on the efficiency of photosynthesis under physiological conditions. Brassinosteroids (BR) are known as a type of plant hormone involved in various physiological and biochemical processes in plants. Small molecule compounds such as nitric oxide, ethylene, hydrogen peroxide, etc. are involved in the growth and development of plants, and their participation in BR-induced growth and stress responses are often considered in plants, including seed germination,

specific types of rooting, stem elongation, fruit ripening, etc. The relationship between BR and nitric oxide leads to accelerated plant development and reduces stress damage by modulating the antioxidant system, photosynthetic capacity and carbohydrate metabolism. Here I would recommend Rashkov to enter into even more detailed research in this area.

Among Rashkov's other scientific interests, I also highlight the studied impact of synthesized different types of zinc oxide nanoparticles on *Pisum sativum* L., in which case their influence on the structure of the stomata and changes in photosynthetic electron transport was studied in detail.

Finally, among Georgi Rashkov's personal contributions, I highlight the successful use of various non-invasive techniques for assessing changes in photosynthesis induced by various stress factors and the introduction of experimental approaches to limit the harmful consequences of these stresses.

5. Organizational and educational activities

Georgi Dimitrov Rashkov is involved in numerous projects, which is an important part of the organization of the scientific activity of the team of which he is a member. Due to the specifics of the scientific organization where Rashkov works and the fact that he is not habilitated, the lack of active educational activity is understandable.

6. Critical remarks and recommendations

I would like to make one remark to Georgi Rashkov related to the presented number of citations. I do not understand the reason why the candidate Rashkov makes a list of only selected citations according to the required reference for his scientific activity.

7. Conclusion on the candidacy

Based on the submitted materials, I confirm that they meet and exceed the requirements of the the Law on the State of the Republic of Bulgaria, the Regulations for its implementation and the Regulations of the IBPBMI, BAS for the candidate to occupy the academic position of "Associate Professor" in the scientific field and professional direction of the competition. I give my positive assessment and, based on the above, I recommend that the scientific jury propose to the competent body for the selection of the IBPBM, BAS to select **Senior Assistant Professor Dr. Georgi Dimitrov Rashkov to occupy the academic position of "Associate Professor"** in the professional field 4.3. Biological Sciences, scientific specialty "Biophysics".

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Sofia

Prepared the opinion:

/Assoc. Prof. Detelin Stefanov, PhD/