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REVIEW

By: Acad. Prof. Atanas Ivanov Atanasov, Head of the Joint Genomics Center at Sofia University "St. Kliment Ohridski"

Regarding: The announced competition for the academic position of *Associate Professor*, published in the State Gazette, Issue No. 110/31.12.2024, in the field of Higher Education Area 4: "Natural Sciences, Mathematics and Informatics"; Professional Field 4.3: "Biological Sciences"; Scientific Specialty: "Genetics", for the needs of the Environmental Mutagenesis Section, Department of Ecosystem Research, Ecological Risk, and Conservation Biology at the Institute of Biodiversity and Ecosystem Research (IBER) – Bulgarian Academy of Sciences. The sole applicant in this competition is Petya Nikolaeva Parvanova.

CANDIDATE'S CAREER DEVELOPMENT

Educational Background and Professional Career

Chief Assistant Professor Dr. Petya Parvanova was born on February 18, 1981. In 2003, she obtained a Bachelor's degree in "Ecology and Environmental Protection" from the Faculty of Natural Sciences and Mathematics at the South-West University "Neofit Rilski" in Blagoevgrad. In 2005, she earned a Master's degree in the same field from the Faculty of Biology at Sofia University "St. Kliment Ohridski."

In 2007, she commenced her doctoral studies at the Central Laboratory of General Ecology – BAS (CLGE-BAS), which in 2010 became part of the newly established Institute of Biodiversity and Ecosystem Research at the Bulgarian Academy of Sciences (IBER-BAS). In 2011, she was awarded the educational and scientific degree "Doctor" in the scientific specialty "Ecology and Ecosystem Conservation."

Dr. Petya Parvanova began her scientific career in 2005 as a biologist at the CLGE/IBER-BAS. In 2010, she was appointed as an ecologist, and in 2011, as an assistant at

CLGE/IBER-BAS. In 2012, she successfully competed for the position of Chief Assistant Professor at IBER-BAS.

Acquired Professional Skills

Throughout her professional development, Dr. Petya Parvanova has acquired practical competencies in laboratory maintenance, sterile technique, and the operation of various laboratory instruments and equipment, including centrifuges, autoclaves, growth chambers, gel electrophoresis systems, and digital platforms for gel imaging and analysis.

Over the years, she has independently mastered and successfully applied a broad array of methodologies, including:

1. **Biochemical techniques** – Quantification of malondialdehyde (MDA) levels, intracellular hydrogen peroxide (H_2O_2), proline (Pro), photosynthetic pigments, and reducing sugars; assessment of catalase and peroxidase enzymatic activity;
2. **Microbiological methods** – Spot testing; viability assays and identification of "visible mutations";
3. **Molecular approaches** – Determination of chaperone protein levels (HSP70B) and detection of double-strand DNA breaks.

In 2013, Dr. Parvanova was awarded a project under the BG051PO001-3.3.05-0001 program "SCIENCE AND BUSINESS," entitled *Bioinformatic Analysis of Genetic Polymorphism in Bulgarian and Portuguese Cultivars and Lines of Common Bean (Phaseolus vulgaris)*. The project was funded through the Operational Programme "Human Resources Development," co-financed by the European Social Fund of the European Union. The overarching goal of the initiative was to provide support for the development of doctoral students, postdoctoral researchers, fellows, and early-career scientists.

During the period from November 3 to December 1, 2013, Dr. Parvanova undertook a research specialization at the National Institute for Agrarian and Veterinarian Research I.P. (INIAV) in Oeiras, Portugal. There, she acquired expertise in DNA isolation methods, as well as PCR, AFLP, and SSR analyses.

Dr. Parvanova possesses strong skills in scientific writing and in the execution of research projects. She is also experienced in supervising undergraduate theses and providing scientific mentorship to doctoral candidates.

She is proficient in both English and Russian.

Primary Directions in Research Activity

The candidate's primary research interests are focused on *Chlamydomonas reinhardtii* [B4.1; B4.2; B4.3; B4.4; B4.6; B4.7; B4.8; G7.11; G7.12; G8.1; G8.2] and higher plant species [B4.5; G7.4; G7.11; G7.13; G8.1].

Unicellular green algae from the genera *Chlamydomonas* and *Chlorella* serve as convenient model organisms in the fields of genotoxicology, mutagenesis, and antimutagenesis due to several advantageous characteristics: they are photosynthetic organisms with a short life cycle, possess a haploid chromosome set (allowing mutations to be phenotypically expressed in the first generation), are relatively easy to culture in laboratory conditions, and exhibit a typical plant-like eukaryotic cell structure. These qualities make them particularly suitable for screening a wide range of anthropogenic pollutants using biochemical and molecular markers of induced oxidative stress and for investigating mechanisms of genotypic resistance [B4.1; B4.2; B4.3; B4.4; B4.6; B4.7; B4.8; G7.11; G7.12; G8.1; G8.2]. These algal models have traditionally been used in the research conducted within the Environmental Mutagenesis Section.

The candidate has also benefited from access to an extensive and well-maintained collection of algal strains from these genera, including highly radio- and chemo-resistant variants and strains deficient in various DNA repair mechanisms, maintained within the same research section.

In addition, Dr. Petya Parvanova is actively engaged in research using two additional model organisms: *Saccharomyces cerevisiae* [B4.8; G7.1; G7.6; G7.8; G7.9; G7.10; G7.11; G7.12] and *Myzus persicae* [B4.8; G8.1].

The selected plant species *Pisum sativum* L., *Phaseolus vulgaris* L., and *Solanum tuberosum* L. have also been utilized in studies on the mutagenic effects of environmental factors. These studies aim to elucidate the mechanisms and systems involved in stress response formation and genotypic resistance in higher plants [B4.5; G7.4; G7.11; G7.13; G8.1].

The articles listed under Section B "Habilitation Work" encompass the primary research directions outlined above. Publications are categorized under Sections B and G, all of which align with the research themes discussed. To avoid redundancy in phrasing, the scholarly contributions have been jointly presented for both indicators.

As a Chief Assistant Professor, the candidate has deepened her research into the following area:

- **Prevention of Induced Mutagenesis (Antimutagenesis) through the Exogenous Application of Natural Products**

The exogenous application of natural products derived from *Clinopodium vulgare* L., *Amorpha fruticosa*, *Ailanthus altissima*, and two major constituents of *Lilium candidum* extract – kaempferol and jatropham – on two test systems, *Chlamydomonas reinhardtii* [B4.1; B4.2; G8.2] and *Saccharomyces cerevisiae* [G7.6; G7.8], has yielded novel insights into key mechanisms of antimutagenesis. These contributions are reflected in the following findings:

- It has been established that the cellular response to oxidative stress can be significantly modulated depending on the mode of application of biologically active natural products — ranging from the absence of genotoxic, mutagenic, or DNA-damaging effects to clearly expressed cytotoxic properties [B4.1; G7.6; G7.8; G8.2]. These results represent a valuable contribution to understanding the mechanisms of antimutagenesis and highlight the critical role of experimental design.
- It has also been demonstrated that the DNA-protective potential of natural plant products is largely attributable to their antioxidant capacity and their promotion of accelerated repair of DNA double-strand breaks [B4.1; B4.2; G7.6; G8.2]. The data obtained confirm and advance current understanding of the interaction between the method of exogenous application, the biological activity of naturally derived substances, the experimental setup, and the resulting biological outcomes.

Nonetheless, the question of whether the biological activity of plant-derived extracts should be assessed on the basis of the total extract, or its principal constituents remains, in the candidate's view, an open and debated issue.

- **Assessment of the Genotoxic Potential of Environmental Xenobiotics Using a Complex of In Vivo Tests and Criteria with Varying Resolution Capabilities: Microbiological, Biochemical, and Molecular Approaches**

A comprehensive system has been developed for the evaluation of the genotoxic, mutagenic, carcinogenic, and DNA-damaging effects of environmental physical [B4.5; G7.4; G7.13] and chemical [B4.8; G7.11] agents, including plant-derived natural products [B4.3; B4.6; B4.7; G8.1]. A complex of test systems with varying resolution capabilities has been employed, involving *Chlamydomonas reinhardtii* [B4.3; B4.6; B4.7; B4.8; G7.11; G8.1], higher plants [B4.5; G7.4; G7.11; G7.13; G8.1], *Saccharomyces cerevisiae* [B4.8; G7.11], and *Myzus persicae* [B4.8; G8.1], along with a suite of chemical, microbiological, biochemical, and molecular markers.

- It has been established that the total leaf extract of *Narcissus cv. Hawera* and the essential oil of *Origanum vulgare* subsp. *hirtum* exhibit a clearly expressed genotoxic and DNA-damaging potential in the model system *Chlamydomonas reinhardtii*, though they do not demonstrate mutagenic activity [B4.3; B4.6; B4.7; G8.1]. This information may be considered a contribution to the field of "green technologies."
- Observed differences in the biological activity of the two fractions of the methanolic extract from *Origanum vulgare* subsp. *hirtum* are likely due to the primary constituent carvacrol, present in the non-polar fraction, which exhibits strong genotoxic and DNA-damaging effects in *Chlamydomonas reinhardtii*, in contrast to the polar fraction [B4.6]. These results offer a potential basis for future research related to green technologies.
- It has been demonstrated that elevated levels of lipid peroxidation and intracellular peroxides can serve as accessible and reliable early markers for assessing the extent of induced oxidative stress in plant test systems [B4.5; G7.4; G7.13; G8.1]. This information holds significance for the field of genotoxicology.

- For genotoxicological purposes, two complexes of test systems and assessment criteria have been developed to evaluate the damaging potential of xenobiotics present in the environment [B4.8; G7.11]:

  A) It has been established that chlorpyrifos is a broad-spectrum pesticide that, in addition to its pesticidal properties, exerts genotoxic, mutagenic, phytotoxic, aphicidal, DNA-damaging, recombinogenic, and clastogenic effects.

  B) Identified genotypic differences in the sensitivity of *Chlamydomonas reinhardtii*, *Saccharomyces cerevisiae*, and *Phaseolus vulgaris* L. ultimately allow for the selection of unicellular green algae as a sensitive test system for detecting the effects of low concentrations of $PbCl_2$.

  C) Novel findings indicate that $PbCl_2$ indirectly damages photosynthetic pigments and DNA through the induction of oxidative stress.

- **Mechanisms of Genotypic Resistance**

Based on morphometric, microbiological, physiological, biochemical, and molecular analyses performed on various test systems — *Chlamydomonas reinhardtii*, *Saccharomyces cerevisiae*, *Phaseolus vulgaris* L., *Pisum sativum* L., and *Myzus persicae* — original data have been obtained regarding the role and significance of developmental stage, mitotic cycle, and DNA repair capacity in the formation of genotypic resistance [B4.4; B4.5; G7.1; G7.4; G7.6; G7.9; G7.10; G7.12; G7.13].

- Using mutant and engineered unicellular organisms and a suite of microbiological, biochemical, and molecular approaches, novel data have been obtained on the role of physiological state, mitotic cycle phase, and cellular repair potential in stress response and genotypic resistance to chemically-induced oxidative stress of varying origin (extract of *Clinopodium vulgare* L., zeocin, menadione, bee venom). The results contribute to the hypothesis concerning the mechanisms involved in the formation of genotypic resistance [B4.4; G7.1; G7.6; G7.9; G7.10].
- Using varieties and mutant lines of *Phaseolus vulgaris* L., and a complex of markers — H_2O_2, MDA, Pro, and HSP70 — it was established that the severity of induced oxidative stress is highly genotype-dependent. The roles of Pro and HSP70 were

particularly emphasized. As a highly sensitive marker, Pro can be recommended for distinguishing the stress response even among closely related genotypes. Its early accumulation in specific organs indicates the onset of oxidative stress. On the other hand, overproduction of HSP70 serves both as an early signal of oxidative stress and as an indicator of ongoing plant adaptation. These findings are considered a contribution to genotoxicology with relevance for agriculture [B4.5; G7.4; G7.12; G7.13].

- **Assessment of the Effect of Anthropogenic Pollutants and Environmental Factors Using Higher Plant Test Systems, in Relation to Ecotoxicology and Agriculture**

Applying chemical, morphometric, physiological, and biochemical methods to various test systems — *Fraxinus excelsior* L., *Lactuca sativa* L., *Lepidium sativum* L., *Raphanus sativus* var. *radicula*, *Medicago sativa* L. (Plewen variety), *Zea mays* L., *Triticum vulgare* Host. (Sadovo variety) — valuable data were obtained regarding the stress response of test objects exposed to various anthropogenic pollutants and environmental factors, relevant to ecotoxicology and agriculture [G7.2; G7.3; G7.5; G7.7].

- Using a set of physiological parameters (photosynthesis intensity, transpiration, and stomatal conductance) and biochemical markers (levels of SOD and CAT) in a pot experiment with seedlings of *Fraxinus excelsior* L., it was found that increased antioxidant enzyme activity may serve as an indicator for assessing the effects of atmospheric pollution. The newly obtained original data contribute to the field of ecotoxicology.
- Using hydroponically cultivated maize plants and a combination of chemical (atomic absorption spectrophotometry), physiological (photosynthesis intensity, transpiration, and stomatal conductance), and biochemical (photosynthetic pigment content) parameters, the effects of cadmium ($CdCl_2$) and paraquat (PQ), applied individually or in combination, were assessed. The results provide insights into plant stress responses and accumulation properties toward $CdCl_2$, which are of immediate relevance for ecotoxicology and phytoremediation.
- Based on ecotoxicological assessment of the plant-soil-water system, it was recommended that wastewater from Radomir Metal Industries not be used for irrigating arable land. The developed model may be applied in ecotoxicological research for agroecological purposes.

- Based on research conducted with four *Lactuca sativa* L. cultivars and a set of physiological parameters (photosynthetic intensity, transpiration, and water use efficiency), it was found that leafy lettuce exhibits the highest adaptability to low temperatures and shading. This fact may be practically applied to extend the vegetative growth period [G7.7], thus benefiting agricultural production.

Project Activities and Leadership in Scientific Research Projects

Since beginning work in 2005 at the Central Laboratory of General Ecology (CLGE)/Institute of Biodiversity and Ecosystem Research (IBER) – Bulgarian Academy of Sciences (BAS), Chief Assistant Dr. Petya Parvanova has participated in 25 projects funded by various sources, including the National Science Fund (NSF), Ministry of Education and Science (MES), European Bank for Reconstruction and Development (EBRD), the Sixth Framework Programme, FP7, COST Action FP0903, the European LIFE+ Programme, among others.

Following her transition to the "Environmental Mutagenesis" Department at IBER-BAS, Chief Assistant Dr. Petya Parvanova has been involved in 16 research projects, serving as principal investigator in two of them:

- In 2013, she led the project **BG051PO001-3.3.05-0001 "SCIENCE AND BUSINESS"**, with the topic: *Bioinformatic Analysis of Genetic Polymorphism in Bulgarian and Portuguese Varieties and Lines of Common Bean (Phaseolus vulgaris)*. This project was awarded a specialization grant and funded under the **Operational Programme "Human Resources Development"**, co-financed by the **European Social Fund of the European Union**.
    - Type of grant: "Support for the development of PhD students, postdocs, specialists, and young scientists"
    - Host institution abroad: **National Institute for Agrarian and Veterinarian Research I. P. (INIAV) - Oeiras, Portugal**
    - Specialization period: **03.11.2013 – 01.12.2013**
- In 2016–2017, she was project leader under the **Programme for Support of Young Scientists at BAS**, project **DFNP-66/27.04.2016**, titled: *Potential Phytoncidal Effect*

of Plant Extracts from Amaryllidaceae Species on Chlamydomonas reinhardtii, funded by the Ministry of Education and Science.

Additionally:

- She served as a **task leader** in three projects under the **Budget Subsidy Mechanism**, according to intra-institutional agreements.
- In 2024–2027, she is **work package leader** in project **KP-06-N71/13**, titled: *Contribution and Interrelation Between the DNA Repair (DDR), Chaperone, and Antioxidant Systems in the Formation of Adaptive Response*, funded by the **National Science Fund**. Project coordinator: Associate Professor Dr. Teodora Todorova, IBER-BAS.

The projects developed within the department are funded by:

- National Science Fund (5 projects)
- Ministry of Education and Science (3 projects)
- European Bank for Reconstruction and Development (3 projects)
- Budget Subsidy (4 projects)
- Operational Programme "Human Resources Development", co-financed by the European Social Fund (1 project)

Of the 16 projects in which the applicant has participated, **three are international**, including bilateral cooperation with the **National Research Centre, Egypt**. One of the projects she led, funded by the **Operational Programme "Human Resources Development"**, enabled specialization at **INIAV - Oeiras, Portugal**.

Training of Young Scientists and Researchers

Chief Assistant Dr. Petya Parvanova has experience as a part-time lecturer at the **University of Forestry**, Faculty of Ecology and Landscape Architecture, Department of Plant Pathology and Chemistry. She conducted biochemistry practicals with second-year students in the *Ecology and Environmental Protection* program during the academic years **2009/2010 through 2014/2015**, with a total teaching workload of **342 hours**.

Additionally, she taught **34 hours of practicals in Ecology and Environmental Protection** as a part-time lecturer at the **Faculty of Biology of Sofia University**, for students majoring in *Molecular Biology*, *Biotechnology*, *Biology and Chemistry*, *Geography and Biology*, and *Biology and English* (Bachelor's degree level) during the **summer semester of the 2021/2022 academic year**.

Dr. Parvanova also served as a **supervisor of a Master's thesis** during the **2020–2021 academic year** in the Department of Genetics at **Sofia University "St. Kliment Ohridski"**. The Master's student, Elena Aleksandrova Zidarova, successfully defended her thesis in 2021, entitled:
"Biological Activity of Essential Oils on Two Test Organisms – Chlamydomonas reinhardtii and Saccharomyces cerevisiae", in the "Gene and Cell Engineering" Master's program.

She was also a **scientific consultant to PhD student Tsveta Vladimirova Angelova**, in the regular PhD program at IBER-BAS. The dissertation, titled *"Biochemical and Molecular Markers for Resistance to Oxidative Stress"*, was successfully defended in **2018** under the supervision of Prof. Dr. Stefka Chankova.

Dr. Petya Parvanova is co-author of **three textbook chapters** used in the Department of Ecology and Environmental Protection at the Faculty of Biology, Sofia University:

- Lyubenova M., P. Parvanova. *Legislation in the Field of Ecotoxicology.* In: *Ecotoxicology – A Short Practicum*, Lyubenova M., Kalchev R. AN-DI – Sofia, 2007, pp. 39–45.
- Lyubenova M., P. Parvanova. *Quantitative Structure-Activity Relationship (QSAR).* In: *Ecotoxicology – A Short Practicum*, Lyubenova M., Kalchev R. AN-DI – Sofia, 2007, pp. 53–55.
- Lyubenova M., P. Parvanova. *Growth Test with Lepidium sativum L.* In: *Ecotoxicology – A Short Practicum*, Lyubenova M., Kalchev R. AN-DI – Sofia, 2007, pp. 202–212.

As an author and co-author, Dr. Parvanova has participated in **54 national and international scientific forums**, where she presented **2 plenary lectures**, **41 oral presentations**, and **11 posters**.

Her **expert activities** include serving since **2014** as:

- **Secretary of the Organizing Committee of the "Ecology Seminar"**;
- **Secretary of the Biology Section** at the Union of Scientists in Bulgaria (USB).

From **2015 to 2019**, she held the position of **Acting Head of the "Environmental Mutagenesis" Department** and **Representative of Young Scientists** in the Scientific Council of IBER-BAS.

Her peer-review activity includes preparing **5 anonymous reviews**. She is also **editor of six collections of scientific papers** presented at the "Ecology Seminar" in **2014 through 2019**, and **co-editor and compiler of four Abstract Booklets** for the **International Ecology Seminar** held in **2021, 2022, 2023, and 2024**.

Scientometric Indicators and Compliance with the Minimum Requirements under the Regulations for the Implementation of the Act on the Development of Academic Staff in the Republic of Bulgaria

According to the **Regulations for the Implementation of the Act on the Development of Academic Staff in the Republic of Bulgaria**, the **minimum national requirements for appointment to the academic position of Associate Professor** in professional field **4.3. Biological Sciences** are as follows:

1. **Indicator A** – PhD Dissertation: **50 points**
2. Chief Assistant Dr. Petya Parvanova has successfully defended a doctoral dissertation titled *"The Influence of Tropospheric Ozone on the Physiological Activity and Certain Biochemical Parameters of Seedlings from Sensitive and Tolerant Tree Species,"* thereby fully meeting the requirements for this indicator.
3. **Indicator B** – Habilitation Work: **100 points**
   Dr. Parvanova presents **eight scientific publications** in peer-reviewed journals indexed in **Web of Science** and **Scopus**, including:

- 1 article in a **Q2 quartile journal** (20 points)
- 4 articles in **Q3 journals** (4 x 15 = 60 points)
- 3 articles in journals with **SJR ranking** but without impact factor (3 x 10 = 30 points)
  Total: **110 points**, exceeding the minimum required threshold.

3. **Indicator G** – Scientific Publications and Contributions: **200 points** (or **220 points**, based on the elevated internal criteria of BAS)
   3.1.1. **Section 7** – Scientific publications in internationally indexed journals (excluding the habilitation work):
   Dr. Parvanova lists **13 publications**, of which:

- 3 are in **Q1 journals** (3 x 25 = 75 points)
- 1 in a **Q2 journal** (1 x 20 = 20 points)
- 2 in **Q3 journals** (2 x 15 = 30 points)
- 7 in **SJR-ranked journals without impact factor** (7 x 10 = 70 points)

Subtotal: **195 points**

3.2. **Section 8** – Published book chapters or contributions to collective monographs: Dr. Parvanova is co-author of **two book chapters** (2 x 15 = 30 points)
Total for Indicator G: **225 points**, surpassing both the national and BAS internal requirements.

4. **Indicator D** – Citations in scientific journals, monographs, collected volumes, and patents indexed in Web of Science and Scopus:
   The minimum requirement is **50 citations** (or **60** according to BAS).
   Dr. Parvanova has documented **52 citations**, each carrying **2 points**, totaling **104 points**, which far exceeds the required minimum.

Additional Achievements:

- Dr. Parvanova is **co-author of 48 articles and short communications**, surpassing the required minimum of 20.
- She has submitted **23 scientific publications** for the current competition, with a **total impact factor (IF) of 11.449** and **SJR of 2.163**.
- Her **h-index** is **3** according to both **Scopus** and **Web of Science**.
- She has **11 publications with an impact factor**, exceeding the minimum requirement of 10.
- **80 citations** are registered, with **52** in **international impact factor journals**, exceeding the minimum requirement of 10.

Therefore, Dr. Petya Parvanova **fully satisfies** both the **national** and **BAS-specific requirements** under the Regulations for obtaining academic positions, including the position of **Associate Professor** at IBER-BAS.

Personal Impressions

I have known Dr. Petya Parvanova through the annual seminars with international participation organized by the Institute of Biodiversity and Ecosystem Research (IBER) of the Bulgarian Academy of Sciences, in which I have regularly participated. As a long-standing member of the organizing committee, she has consistently demonstrated commendable organizational and professional skills, contributing to the effective implementation of these important scientific events, both for the institute and the country.

Conclusion

Based on her educational background, professional career, and acquired competencies; her significant scientific achievements and contributions; her involvement in research projects; her ability to mentor and support young researchers; her personal qualities; as well as the proven compliance of her scientometric indicators with the requirements outlined in the **Regulations for the Implementation of the Act on the Development of Academic Staff in the Republic of Bulgaria** and the **Internal Rules for Attaining Academic Degrees and Positions at IBER-BAS**, I **confidently recommend** to the academic committee to prepare a report-proposal to the **Scientific Council of IBER-BAS** for the **appointment of Chief Assistant Dr. Petya Nikolaeva Parvanova** to the **academic position of Associate Professor** in the **Professional Field 4.3. Biological Sciences**, with **Scientific Specialty: Genetics**, for the needs of the **"Environmental Mutagenesis" Section**, Department of **Ecosystem Research, Ecological Risk and Conservation Biology at IBER-BAS**.

Sofia,

April 25, 2025 /Acad. Prof. Atanas Atanasov/