

## **REVIEW**

**by professor Ginka Atanasova Antova, PhD,**

**University of Plovdiv "Paisii Hilendarski"**

on the materials submitted for the competition for the academic position of "**Associate Professor**"

**at University of Plovdiv "Paisii Hilendarski"**

in area of higher education: 4. Natural sciences, Mathematics and Informatics

professional field: 4.2. Chemical Sciences, specialty "Analytical Chemistry"

In the competition for "Associate professor", announced in the State Gazette, issue 98 of 19.11.2024 and on the website of University of Plovdiv "Paisii Hilendarski" for the needs of the Department of Analytical Chemistry and Computer Chemistry at the Faculty of Chemistry, the candidate is Chief assistant professor Deyana Lyubomirova Georgieva, PhD from the Department of Analytical Chemistry and Computer Chemistry.

### **1. General presentation of the received materials**

By order No. RD-22-82/17.01.2025 of the Rector of University of Plovdiv "Paisii Hilendarski" (PU), I have been appointed as a member of the scientific jury of a competition for the academic position of 'Associate professor' at PU in the field of higher education 4. Natural Sciences, Mathematics and Informatics, professional field 4.2. Chemical Sciences (Analytical Chemistry), announced for the needs of the Department of Analytical Chemistry and Computer Chemistry at the Faculty of Chemistry.

One candidate has submitted documents to participate in the announced competition: Chief assistant professor Deyana Lyubomirova Georgieva, PhD from the Department of Analytical Chemistry and Computer Chemistry at the Faculty of Chemistry at University of Plovdiv "Paisii Hilendarski".

The set of materials on paper and in electronic format presented by Chief assistant professor Deyana Lyubomirova Georgieva, PhD is in accordance with the Regulations for the Development of the Academic Staff of the University of Plovdiv (RDASPU), and includes the following documents:

1. application form to the Rector for admission to the competition;
2. CV in European format;
3. diploma of higher education with acquired educational and qualification degree "Master" with appendix (original and copy) or notarized copy;
4. diploma of educational and scientific degree "Doctor" (original and copy) or notarized copy;
5. list of scientific works;
6. scientific works (copies of publications);
- 6.1 list of citations;
7. certificate of compliance with the minimum national and additional faculty requirements;

8. annotations of the materials under Art. 65. of the RDASPU (in Bulgarian and a foreign language) with an extended habilitation certificate, if a monograph is not submitted;
9. self-assessment of the contributions;
10. declaration of originality and authenticity of the attached documents;
11. certificate of work experience;
12. documents for academic work;
13. documents for scientific research work;
14. documents in accordance with the additional requirements of the respective faculty.

Chief assistant professor Deyana Lyubomirova Georgieva, PhD is co-author of 26 scientific publications and 1 chapter of a collective monograph. Sixteen of the publications are in journals referenced and indexed in the world databases of scientific information (10 publications in journals with quartile Q1; 1 publication in a journal with quartile Q2; 1 publication in a journal with quartile Q3; 4 publications in journals with quartile Q4) and 10 of the publications are in journals without impact factor and impact rank. The candidate chief assistant professor Deyana Georgieva, PhD participated in the competition for the academic position of "Associate professor" with a total of **15** scientific papers, **14** of which are publications in journals, refereed and indexed in *Web of Science* and/or *Scopus* and **1** chapter of a collective monograph. Four publications and a chapter of a monograph are presented as an equivalent number of articles for a habilitation thesis (indicator C), and the remaining 10 are in a group of indicator D. The distribution of scientific publications submitted for the competition by the respective Q factors is as follows: articles with Q1 – a total of 9 papers, with Q2 – 1 paper, with Q3 – 1 paper, with Q4 – 3 papers. The scientific paper submitted for the competition do not repeat those used for previous procedures for acquiring the educational and scientific degree "Doctor". At the time of submission of the documents for participation in the competition, over 140 citations (refereed and indexed in *Scopus* and *Web of Science*) have been noted. The scientific results have been presented in a total of 53 communications (9 oral reports and 44 poster presentations) at 42 scientific forums held in Bulgaria and 11 abroad. She has participated in 22 scientific projects – 4 international, 11 national and 7 university projects.

## **2. Brief biographical information about the candidate**

Chief assistant professor Deyana Georgieva completed her higher education at University of Plovdiv "Paisii Hilendarski" in 1995. She obtained a Master's degree in Chemistry and Physics (a five-year program) with qualifications as a chemistry teacher and a physics teacher. Initially, after finishing her secondary education, she worked at the "Nedelcho Nikolov" factory in Stara Zagora. Since 1994, she has been working at the Department of Analytical Chemistry and Computer Chemistry at University of Plovdiv "Paisii Hilendarski" as a chemist. She has consecutively held the positions of "assistant" (2004 - 2008), "senior assistant" (2008 - 2010), and "chief assistant professor" (from 2010 to present) in the same department. In 2015, she defended a dissertation to obtain the educational and scientific degree "Doctor" under the doctoral program "Analytical Chemistry" (dissertation topic: "*Solid phase extraction with magnetic nanoparticles for trace elements analysis by plasma spectrometry*").

Chief assist. prof. Deyana Georgieva has completed 3 specializations abroad on international projects (in 2005 at the University of Alicante - Spain, under Project CTQ2005-09079-C03-01, 2005-2008; in 2010 at the University of Alicante - Spain, under Project FP7-REGPOT-2009 and in 2023 at the University of Alicante - Spain, under Project BG05M2OP001-2.016-0018 MODERN-A).

### **3. General description of the candidate's activities**

#### *Assessment of Teaching and Pedagogical Activity*

Chief assist. prof. Georgieva has significant experience as a lecturer. Since 2004, she has been an assistant professor on a permanent contract in the Department of Analytical Chemistry and Computer Chemistry at University of Plovdiv "Paisii Hilendarski," and her work experience in the academic position of Chief assistant professor exceeds 10 years. She is a lecturer for 7 academic disciplines, of which 6 are with students in the Bachelor's degree program (Methods for Separation and Concentration in Chemical Analysis; Analytical Chemistry Part I; Analytical Chemistry Part II; Analytical Chemistry; Analytical Chemistry with Instrumental Methods for Analysis; and Analytical Chemistry with Instrumental Methods for Analysis at the branch "Lyuben Karavelov" in Kardzhali (in the last two years)) and 1 course for Master's degree students (Analytical Chemistry for non-specialist Master's students). She has also conducted laboratory exercises for Bachelor's students from various majors in the Chemical and Biological Faculties on the following courses: Analytical Chemistry Part I, Analytical Chemistry Part II, Analytical Chemistry, Sample Selection, Storage, and Preparation for Analysis, Methods for Separation and Concentration in Chemical Analysis, as well as for Master's students in the following courses: Modern Trends in Sample Preparation, Modern Methods and Trends in Elemental Spectral Analysis, Mass Spectrometry with Inductively Coupled Plasma (specialty Spectrochemical Analysis and Chromatographic and Spectral Analytical Control), and Environmental Object Analysis (specialty Chemistry and Ecology).

Between 2019 and 2024, a total of 2571 hours of classroom teaching were conducted with Bachelor's students and 490 hours with Master's students (a total of 3061 hours), meaning the average annual classroom workload is 612 hours. The candidate's classroom workload significantly exceeds the additional faculty requirements for teaching activities (1080 hours) for the academic position of "Associate professor".

An indicator of her qualities as a lecturer is her active work with students. From 2019 to 2024, she supervised 3 students who successfully defended their theses: Elitsa Dimitrova Dimitrova (specialty Biology and Chemistry), Mihaela Stefanova Peneva (specialty Analysis and Control), and Ekaterina Georgieva Georgieva (specialty Chemistry).

Dr. Georgieva was also a co-supervisor of doctoral student Lidia Ivanova Kainarova during the development of her dissertation, which was defended on October 21, 2022.

#### *Assessment of the Candidate's Scientific and Scientific-Applied Research Activity*

In the competition for the position of "Associate professor," Chief Assistant Professor Deyana Georgieva participated with a total of **15** scientific works, grouped as follows:

- *Publications in scientific journals that are refereed and indexed in world-renowned scientific databases (Web of Science and Scopus), equivalent to a habilitation thesis (Indicator C4) – 5 publications, of which 3 are in journals with an impact factor and impact rank (1 publication in Journal of Analytical Atomic Spectrometry - SJR<sub>2022</sub>=0.702; JCI<sub>2022</sub>=1.07; IF=3.4, quartile Q1, and 2 publications in Biomedicines - SJR<sub>2023</sub>=0.962; JCI<sub>2023</sub>=0.88; IF=3.9, quartile Q1), 1 in a journal with an impact rank (Bulgarian Chemical Communications - SJR<sub>2019</sub>=0.142, quartile Q4), and 1 chapter in a collective monograph (Analytical Nebulizers – Fundamentals and Applications, 2023, ed. A. Canals, Chapter 10).*

- *Scientific publications in journals that are refereed and indexed in world-renowned databases (Web of Science and Scopus), outside the habilitation thesis (Indicator D7) – 10 publications, of which 6 are in journals with an impact factor and impact rank (Talanta (SJR<sub>2003</sub>=0.989; IF<sub>2003</sub>=2.199; Q1); Analytica Chimica Acta (SJR<sub>2004</sub>=1.248; IF<sub>2004</sub>=2.588; Q1); Spectrochimica Acta Part B (SJR<sub>2012</sub>=1.353; IF=3.144; Q1); Water (SJR<sub>2020</sub>=0.718; JCI=0.66; IF=3.103; Q1); Plants (SJR<sub>2023</sub>=0.795; JCI<sub>2023</sub>=1.08; IF=4.0; Q1); Environments (SJR<sub>2023</sub>=0.744; JCI<sub>2023</sub>=0.60; IF=3.5; Q1)), and 4 in journals with an impact rank (Land (SJR<sub>2022</sub>=0.647; JCI<sub>2022</sub>=0.83; Q2), Bulgarian Journal of Agricultural Science (SJR<sub>2016</sub>=0.229; Q3), Bulgarian Chemical Communications (SJR<sub>2019</sub>=0.142; Q4), Scientific Papers. Series A. Agronomy (JCI<sub>2020</sub>=0.08; Q4)).*

All the publications submitted for the competition and the chapter from the collective monograph are in English and are in refereed and indexed journals in world-renowned databases (Web of Science and Scopus) – 9 publications in journals with quartile Q1; 1 publication in a journal with Q2; 1 publication in a journal with Q3; 3 publications in journals with Q4.

- *Citation of scientific production*

The candidate has worked purposefully, accumulated significant results, which she has made available to a broad audience, and has received recognition from numerous scientists abroad. The total number of citations presented at the time of submitting the documents for participation in the competition is 140 citations in publications in journals refereed and indexed in Scopus and Web of Science, with 97.2% of them being from foreign authors. Dr. Georgieva has a Hirsch index (h-index) of 7.

Chief assist. prof. Deyana Georgieva has met the national minimum requirements and the requirements of the Regulations for the Development of Academic Staff at University of Plovdiv "Paisii Hilendarski," and, under indicator E, she has exceeded the required points from the national minimum requirements of the Regulations for the Implementation of the Law on the Development of Academic Staff in the Republic of Bulgaria. Although the national minimum requirements for the academic position of "Associate professor" do not require points under indicator F, Dr. Georgieva has presented data for co-supervising a successfully defended doctoral student (25 points). The points indicated for each indicator are described and supported by evidence.

Achievement of the national minimum requirements  
in professional field 4.2. Chemical sciences

<b>Indicators</b>	<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>	<b>E</b>	<b>F</b>	<b>total</b>
National minimum requirements	50	–	100	200	50	-	400
Achievement of the candidate	<b>50</b>	–	<b>102</b>	<b>209</b>	<b>280</b>	<b>25</b>	<b>666</b>

*Contributions (scientific and scientific-applied) and citations*

The scientific activity of Chief assistant professor Deyana Georgieva is in the field of the development and application of modern instrumental methods of analysis in analytical practice. According to the candidate's presented scientific works, it is evident that the main contributions have both scientific and applied scientific character. The contributions from the scientific activity are mainly grouped into the following two main areas:

- ✓ Development and application of inductively coupled plasma mass spectrometry for the characterization of nanoscale materials (publications under indicator C);
- ✓ Development and evaluation of sample preparation approaches and spectrochemical analysis methods for the determination of essential and potentially toxic elements in environmental objects (publications under indicator D).

The developments in the application of inductively coupled plasma mass spectrometry (spICP-MS) for the characterization of silver nanoparticles (AgNPs) represent a significant contribution to the field of nanomaterial analysis. New approaches have been included for evaluating parameters such as size, concentration, and size distribution of nanoparticles. A theoretical model has been developed, allowing for a statistically based selection of the appropriate dilution factor for nanoparticles of different composition and sizes, which is crucial for ensuring the consistent entry of nanoparticles into the plasma discharge. A second module of this model has also been developed, which allows for the calculation of the concentrations of homogeneous ionic standards and provides the possibility to assess the probability of particle coincidence in already experimentally registered peaks. For the first time, the influence of the type of dispersion medium on the stability of Ag nanocolloidal suspensions, as well as the influence of the introduced mass on the signals during spICP-MS analysis, has been investigated. It has been proven for the first time that the noise of the registered signal when introducing an ionic standard depends only on the mass of the introduced amount of Ag, but is independent of the chosen integration time. An approach for calculating the uncertainty interval of the diameters of nanoparticles with different composition and sizes has been proposed. An assessment of the influence of the sample introduction system on the analytical characteristics of the spICP-MS method has been made. An approach for the experimental determination of the resolution of the spICP-MS method for a specific type of nanoparticles, based on the mean value of the uncertainty intervals in the studied size range, has been proposed. The conducted studies allow the evaluation of the resolution of the spICP-MS method in terms of characterizing the sizes of individual nanoparticles, as well as making a statistically justified selection of cluster sizes in the size distribution.

The research on the development of the application of inductively coupled plasma mass spectrometry (spICP-MS) for nanoparticle characterization, which finds practical applications in medicine, pharmacy, and nanotechnology, is distinguished by its scientific and applied contributions.

The developed spICP-MS method has found applications in nanomedicine, in the characterization of Ag nanoparticles loaded with drug forms, and accordingly in the study of their effectiveness in delivering the active drug substance and delaying coagulation. The results obtained for the size of the Ag core obtained by spICP-MS are comparable to those obtained by electron microscopy and other spectral methods. For the first time, density functional theory (DFT) has been applied to indicate the nature of the interaction between the drug component and nanostructures. It has been found that for both studied drug forms carried by nanoparticles, the results obtained for the release of the drug component are above 80%. The spICP-MS method has also been applied to analyze AgNPs in a commercial pharmaceutical product.

The scientific and applied contributions in the second main direction are in the area of development and evaluation of sample preparation approaches for elemental analysis purposes and in the application of spectrochemical methods for the analysis of essential and potentially toxic elements in environmental objects (soil and plant samples).

Research in spectrochemical analysis is mainly focused on improving sample preparation methods. The influence of different energy input mechanisms and the reaction mixture composition during acid mineralization of samples have been studied. A method for prepare samples for elemental analysis using ICP-OES with the help of ultrasound-assisted extraction has been developed, and the method has been compared to microwave-assisted extraction of the same elements. The optimal conditions for the preparation of soil samples for the determination of the total and plant-extractable phosphorus content have been established. When comparing the approaches for phosphorus extraction from the studied samples (method BDS ISO 11263:2002 and Egner-Riehm method), it has been found that the amount of phosphorus in the extract using the Egner-Riehm method is higher than that using the BDS ISO method. This demonstrates the importance of choosing the appropriate methodology according to the analytical goal.

A two-step modification approach for manganese ferrite nanoparticles ( $\text{MnFe}_2\text{O}_4$ ) has been proposed, involving coating them with a protective layer of  $\text{SiO}_2$  and impregnating them with a complexing agent - ammonium pyrrolidine dithiocarbamate (APDC). The synthesis approach leads to differences in the size and size distribution of the nanoparticles, which affects both the effectiveness of the surface modification of the magnetic core and their sorption properties. It has been proven that ligand-impregnated silicified manganese ferrite nanoparticles ( $\text{MnFe}_2\text{O}_4@ \text{SiO}_2\text{-APDC}$ ) are suitable as a sorbent for solid-phase extraction of Co, Cu, Zn, Mo, Cd, Tl, Pb, and Bi. It has been found that the optimized procedure for magnetic-assisted dispersive solid-phase extraction is suitable for application in the determination of target analytes in water samples in combination with the ICP-MS detection method.

To determine the content of essential and potentially toxic elements in soil, water, and biological samples, various spectrochemical methods have been used, such as Flame Atomic Absorption

Spectrometry (FAAS), electronic spectrometry in the ultraviolet and visible spectrum (UV-Vis), Inductively Coupled Plasma Optical Emission Spectrometry (ICP-OES), and Inductively Coupled Plasma Mass Spectrometry (ICP-MS), which provide high sensitivity and precision in the detection of target analytes. Each of these methods has been used with regard to specific analytical requirements - sensitivity, selectivity, and concentration range.

UV-Vis and ICP-MS methods have been applied as detection methods for the total and plant-extractable phosphorus content in soil samples with different compositions and phosphorus content. It has been proven that the results obtained for phosphorus content by both methods are statistically comparable. The content of macro- (N, P, K) and microelements (Co, Cu, Mn, Zn) in urban soils in the upper soil horizon of samples from large park areas and main boulevards in Plovdiv has been studied using plasma spectrochemical methods - ICP-OES and ICP-MS. The obtained results allow for the assessment of the sources leading to the accumulation of the studied elements in the samples.

For the first time, the possibility of soil remediation in urban areas through the planting of various plant crops has been investigated. The results obtained from characterizing of the elemental composition of soils and plants allow for the evaluation of a plant's suitability for phytoremediation through bioaccumulation and translocation.

For the first time, an automated, fast, and reliable method for the analysis of Ca, Fe, and Mn in mosses using flame atomic absorption spectrometry has been proposed. An integrated system for discrete introduction of the sample solution operating in the "solvent-air-sample-air-solvent" mode in combination with the flame atomic absorption detection method (ASDI-FAAS) has been successfully applied. The developed ASDI-FAAS method for moss analysis demonstrated an advantage over the ICP-MS method.

An assessment of the ecological status of mountain river water basins in Bulgaria has been made based on the accumulation of Al, As, Cd, Co, Cr, Cu, Fe, Hg, Mn, Ni, Pb, Zn in aquatic plants. Based on the obtained results for the elemental composition, contamination factors and metal pollution indices have been calculated, which have been applied to assess the ecological state of the studied river basins.

For the first time, the potential of transplants with moss and mussel bags for monitoring water quality in standing water basins, potentially exposed to anthropogenic pollution, has been tested by monitoring the change in the content of 12 elements and priority organic substances in the biota before and after their exposure in potentially polluted basins. A high level of accumulation of the studied substances in the applied combined transplants has been found at all investigated sites, demonstrating a different accumulation pattern in mosses and mussels with respect to elements and organic pollutants.

The composition of the fruits of four species of wild forest plants has been characterized in terms of moisture, carbohydrates, and some essential and potentially toxic elements. Determining the elemental profile of forest fruits found in Bulgaria allows for an assessment of their contribution to the recommended daily intake of Fe, Zn, Cu, and Mn, as well as the risk to human health from the levels of toxic elements in them. The established statistically significant difference in the con-

tent of the target analytes allows distinguishing them into separate groups on the basis of the determined elemental profile by the application of discriminant analysis.

An assessment of the influence of the urban environment on the elemental profile of linden blossom, as well as an assessment of the risk to human health from the consumption of herbal teas prepared from them, has been made. It has been found that despite the short flowering period, the average concentration of Al, Fe, Pb, V, Cr, Co, Ni, and Cd in samples from more congested areas can increase up to two times compared to those from clean areas. The study showed that the consumption of tea prepared from linden blossom has an insignificant contribution to the allowable daily intake of the studied elements, as determined by the European Food Safety Authority (EFSA), which minimizes the health risk.

The conducted analyses demonstrate the strength of spectrochemical methods for assessing pollution and monitoring the ecological state, including the impact of the urban environment on soils, waters, and vegetation. The assessment of bioaccumulation and translocation allows for the development of remediation strategies.

#### **4. Evaluation of the candidate's personal contribution**

The publication of research results in specialized reputable journals, their promotion at international and national conferences, and the participation of Chief assistant professor Deyana Georgieva in international and national projects are a testament to the candidate's professional qualities as a researcher. The research in which the candidate has participated has significant scientific and applied contributions and the recognition of Chief assistant professor Georgieva among the scientific community both in Bulgaria and abroad is evidenced by the significant number of citations from foreign authors (97.2%). The articles are co-authored with other colleagues, but Chief assistant professor Georgieva is the first author in two publications, the second author in 2, the third author in 1, the fourth author in 2, the fifth author in 3, the sixth author in 2, and the eighth, ninth, and thirteenth author in 1 publication each. The scientific activity and teaching qualifications of Deyana Georgieva demonstrate that she is an established university lecturer and researcher. The achieved results in her teaching and research activities fully meet and exceed the mandatory national minimum quantitative scientometric criteria for holding the academic position of "Associate professor".

#### **5. Critical remarks and recommendations**

I have no critical remarks or recommendations regarding the materials presented by the candidate. I was very impressed by the excellent arrangement and formatting of the documents submitted for her participation in the competition for the academic position of "Associate professor". My recommendation to Chief assistant professor Deyana Georgieva is to continue working persistently and thoroughly in the field of developing new approaches for sample preparation and the application of various plasma spectrochemical methods in the analysis of target analytes.



## 6. Personal impressions

Chief assistant professor Deyana Georgieva stands out her high competence in her field of work and demonstrates significant engagement in both academic and administrative activities. I have been greatly impressed by her excellent organizational skills, which she exhibited during her participation in the organizing committees of the 10<sup>th</sup> and 11<sup>th</sup> scientific conferences on chemistry at the Faculty of Chemistry. She has also been highly active in organizing the eight scientific seminars of the Faculty of Chemistry in partnership with the company ASM2.

## CONCLUSION

Scientometric data and materials presented by Chief assistant professor Deyana Lyubomirova Georgieva, PhD **fully meet all** the requirements of the Academic Staff Development Act in the Republic of Bulgaria (ASDARB), the Regulations for application of ASDARB, and the Regulations of University of Plovdiv "Paisii Hilendarski".

The candidate in the competition **has presented a sufficient number** of scientific works published after the materials used in the defense of her PhD. The candidate's works contain original scientific and scientific-applied contributions that have received international recognition, and all of them have been published in scientific journals that are referenced and indexed in world-renowned scientific information databases (*Web of Science* and *Scopus*). Her theoretical developments have practical applications in medicine, pharmacy, and nanotechnology. The scientific and teaching qualifications of Chief assistant professor Deyana Lyubomirova Georgieva **are unquestionable**.

The results achieved by Chief assistant professor Deyana Lyubomirova Georgieva, PhD in her teaching and research activities **fully** meet the minimum national and additional requirements of the Faculty of Chemistry, adopted in connection with the regulations of PU for the application of ASDARB.

After reviewing the materials and scientific works presented in the competition, analyzing of their significance and the scientific and scientific-applied contributions contained in them, I find it reasonable to give my **positive** evaluation and **recommend** that the Scientific Jury prepare a report-proposal to the Faculty Council of the Faculty of Chemistry for the appointment of **Chief assistant professor Deyana Lyubomirova Georgieva, PhD** to the academic position of "**Associate professor**" at PU "Paisii Hilendarski" in the field of higher education 4. Natural Sciences, Mathematics, and Informatics, professional field 4.2. Chemical Sciences (Analytical Chemistry).

March 15 2025

**Reviewer:** .....  
**Prof. Ginka Antova, PhD**