Opinion

by **Prof. Milena Petkova Popova, PhD,**
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on the materials submitted in a competition for the academic position of **Professor** in the Area of Higher Education 5. Technical science, Professional filed 5.11. Biotechnology (Technology of biologically active compounds), for the needs of Department of Biotechnology, Metabolomics Laboratory at the Stephan Angeloff Institute of Microbiology-BAS (IMicB-BAS)

Assoc. Prof. Dr. Milen Ivanov Georgiev from IMicB-BAS, Department of Biotechnology, Metabolomics Laboratory is the only candidate in the competition for the academic position of Professor, announced in the State Gasette, issue 47 dated 22 May 2020, and on the website of IMicB-BAS.

1. General presentation of the procedure and the candidate

The set of materials submitted by Assoc. Prof. Dr. Milen I. Georgiev is in accordance with the Regulations of the Development of the Academic staff of the Stephan Angeloff Institute of Microbiology-BAS, and meets the criteria of the Institute for the academic position "Professor".

The candidate participates in the competition with 57 scientific papers, of which 54 are published in indexed and refereed journals, and 3 are book chapters. The distribution of the publications according to the journals' quartiles is as follow: 40 - Q1, 11 - Q2, 1 - Q3 and 2 - Q4. The publications enclosed have a total impact factor of 247.1 and 1057 citations (refer to Scopus). The candidate's h-index is 25 (Scopus) and 31 (Google scholar). Dr. Georgiev has been a leader of 5 national and international research projects with nearly BGN 7 million of funding, two of them on-going, and participant in another six projects. Materials and data for participation in scientific forums and program committees, scientific organizations and editorial boards of scientific journals, specializations, awards received, teaching activities and peer reviews are also provided.

Assoc. Prof. Dr. Milen I. Georgiev graduated from the University of Food Technologies, Plovdiv, in 2001 as a Master of Biotechnologies. His scientific career began a year later as a PhD student at IMicB-BAS (2002-2005), where he holded successively the academic positions of Research fellow I degree (2007) and Assoc. Professor (2010 – at present). During the period 2005-2012, Dr. Georgiev realized two long-term specializations at the Institute of Food Technology and Bioprocessor Engineering, Technical University of Dresden, Germany and the Institute of Biology, Leiden University, The Netherlands as a Marie Curie Postdoctoral Fellow. He is currently Head of the Laboratory of Metabolomics at IMicB-BAS and Head of Department at the Center of Plant Systems Biology and Biotechnology, Plovdiv, Bulgaria. He also coordinates the project SuSMAPWaste at the University of Agronomy and Veterinary Medicine, Bucharest, Romania. The candidate is a supervisor of three PhD students and gives lectures on Metabolomics at the Faculty of Biology, University of Plovdiv, Bulgaria. Assoc. Prof. Dr. M. I. Georgiev has published 130 publications (total IF over 390), which attracted over 2 500 citations.

2. General characteristics of the candidate's activities

Dr. Georgiev's research is in modern and promising scientific area, covering multidisciplinary studies in the field of plant biotechnology, chemistry of natural compounds, and pharmacology. The studies are focused mainly on initiation of transformed root cultures of medicinal plants, based on knowledge of their chemical composition and pharmacological activity, with a view to bioproduction of valuable secondary metabolites and as model systems to study plant metabolic processes. The candidate demonstrates interest in biosynthesis of iridoid and phenylethanoid glycosides, and their plant sources, representatives of which are traditional remedies. Dr. Georgiev' scientific work is characterized by distinguishable scientific and scientifically applied contributions, with an original, confirmatory, and methodical character.

Evaluation of the contributions and their significance

The research in the field of plant biotechnologies adds new data and knowledge to manage plant metabolism through genetic transformation and manipulating biosynthetic pathways. A sustainable bioproduction of pharmaceutically important secondary metabolites in *in vitro* systems has been achieved, and conditions, and factors influencing their biosynthesis have been determined. Among them is the accumulation of phenylethanoid glycosides, mainly verbascoside, in induced, for the first time, hairy root culture of *Verbascum* plants and in cell suspension culture of *Harpagophytum procumbens*, cultivated in a glass-column bioreactor with pulsed aeration (the results obtained have a potential for a large-scale bioproduction of verbascoside); *trans* stilbenes (resveratrol and its derivatives) in transgenic Tobacco root cultures; the indole-based alkaloid mitragynine in *Mitragyna speciosa* stems that correlates with expression of anthranilate synthase and tryptophan decarboxylase; jasmonate-responsive MYB transcription factors directly repressing rutin biosynthesis in *Fagopyrum tataricum* have been identified and a coherent model of the spatial repression has been proposed.

The studies performed are preceded and accompanied by complex chemical analysis of the corresponding plants and their *in vitro* cultures. Modern approaches and methods (NMR, GC/MS, LC/MS) have been applied, mainly NMR-based metabolomics (1D and 2D), which is a powerful tool for qualitative and quantitative analysis of complex mixtures. It should be noticed that the candidate Dr. Georgiev is the person who introduced, for the first time, NMR-based metabolomic studies in Bulgaria. A number of medicinal and endemic plant species: *Rhodiola* spp. (inc. their commercial products), *Verbascum* spp., *Achillea thracica* (incl. *in situ*, *in vitro* and *ex vitro* samples), *Sambucus ebulus*, *Peucedanum schottii*, *Clinopodium vulgare*, *Nepeta nuda*, *Veronica persica*, etc., has been also chemically characterized, based on metabolic profiling, metabolomics, and/or isolation of individual compounds. A reliable and practical analytical approach for quality and quantity assessment of *Rhodiola*-based commercial products and method for green synthesis of silver and gold nanoparticles *via* ethanolic extraction of *Melissa officinalis* have been developed. The studies in the field of chemistry of natural compounds contribute to revealing biosynthetic potential of the plants and its dereplication, along with evaluation of the authenticity of plant-based commercial products and selection of plants for biotechnological purposes by using modern analytical platforms.

The studies in the field of pharmacology and evaluation of biological activity are another step of the integrated scientific approach of the candidate. The contribution are related to the potential application of chemically characterized plant extracts and isolated individual compounds for prevention and treatment of socially significant diseases, with emphasis on the chronic inflammation and malignant tumors. Some of the results achieved (*in vitro*/*in vivo*) include: an antineoplastic effect for extracts of flaxseed (*Linum usitatissimum*) and the isoflavone scandenolone, purified from *Cudrania tricuspidata* fruit; significant anti-inflammatory and immunoregulatory activity for extracts and pure compounds of plant species mentioned above; antidepressant-like effect for salidroside and curcumin.

Significant contribution to the work of Assoc. Prof. Dr. Milen Georgiev is the summary of literature data and outlining future directions, challenges, and perspectives for the plant biotechnologies development and monitoring of the plant metabolome. The data are published as review articles in scientific journals and books.

The results achieved and contributions are reflection of critical and creative thinking as well as of the high level and precise implementation of the studies. This is supported by the fact that the papers have been published in journals with a high impact factor (total IF 247.1; average IF 4.6), such as *Trends in Biotechnology* (IF_{2019} 14.343; IF_{2012} 9.66), *Trends in Plant Science* (IF_{2019} 14.416; IF_{2012} 9.66), *Biotechnology Advances* (IF_{2019} 10.744; IF_{2014} 9.015), *Critical Reviews in Biotechnology* (IF_{2019} 8.108), *Pharmacological Research* (IF_{2019} 5.893), *Biomolecules* (IF_{2019} 4.082), *Food and Chemical Toxicology* (IF_{2019} 4.679; IF_{2018} 3.775; IF_{2017} 3.977) and *Food Chemistry* (IF_{2019} 6.306; IF_{2015} 4.052; IF_{2011} 3.655; IF_{2010} 3.458; IF_{2006} 2.433), and have received a

remarkably high recognition among the scientific community - over 1000 citations (only refer to Scopus). The results have been presented at 67 international conferences, symposiums, and congresses.

Assoc. Prof. Dr. M. Georgiev is undoubtedly a researcher with a recognized authority in Bulgaria and abroad. He has been an invited/plenary/keynote speaker at more than 40 scientific events, serves as an Associate Editor and on the editorial board of impact international scientific journals, and, last but not the least, he has been awarded three times the prestigious national prize "Pythagoras". It should be underlined that the candidate is the Founder and a Chairman of the International Conference on Natural Product Utilization: from Plant to Pharmacy Shelf (ICNPU), which is a leading scientific event in Bulgaria in the field of natural products.

The scientific qualification, the leading and personal contribution of Assoc. Prof. Dr. M. Georgiev in the articles submitted is indisputable. He is the author of correspondence of a significant part of the papers. He is also a leader of research projects with significant funding as well as a supervisor of a total 15 PhD students, master students, and trainees from the country and abroad.

3. Personal impressions

I have known Assoc. Prof. Milen Georgiev personally for several years. From my personal impression, supported also by his overall activity and future research plans, I can state that he is a researcher with a personal scientific style and an indisputable sense, competence, scientific curiosity, and striving for innovations in science and practice for overcoming important social problems.

CONCLUSION

The research work and scientometric indicators of Assoc. Prof. Dr. Milen Ivanov Georgiev, reflected in the documents and materials submitted for the competition cover and significantly exceed the requirements for holding the academic position of Professor. The documents and materials enclosed unequivocally correspond to the requirements of the Development of the Academic Staff in the Republic of Bulgaria Act, the Regulations of BAS for the Implementation of the Act, and the Regulations of IMicB-BAS.

The candidate has presented a significant number of scientific papers, not presented in other competitions, with original scientific and scientifically applied contributions, which have been published in high impact international journals and have received international recognition.

After the analysis of the research output of Assoc. Prof. Dr. Milen Georgiev, its importance and the scientific contributions reflected therein, I give my **positive assessment** and recommend to the Scientific Jury to prepare a report-proposal to the Scientific Board of IMicB-BAS for election of **Assoc. Prof. Dr. Milen Ivanov Georgiev to the academic position "Professor" at IMicB-BAS** in the Area of Higher Education 5. Technical science, Professional field 5.11. Biotechnology (Technology of biologically active substances) for the needs of the Department of Biotechnology, Laboratory of Metabolomics.

Sofia, 15 September 2020 .....

/Prof. Dr. Milena Popova/