REVIEW

by Assoc. Prof. Dr. Zlatka Miltcheva Aleksieva

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Subject: The scientific production of Assoc. Prof. Dr. Milen Georgiev for participation in a competition for the academic position "Professor" for the needs of the Laboratory "Metabolomics", Department of Biotechnology, IMicB-BAS in professional field 5.11. Biotechnology. The competition was announced in State Gazette no. 47 of 22.05.2020.

Assoc. Prof. Dr. Milen Georgiev is the only candidate who submitted documents for participation in the announced competition. All necessary documents are presented in accordance with the requirements of the Law on the Development of the Academic Staff in the Republic of Bulgaria and the Rules for its implementation in the Institute of Microbiology - BAS.

PROFESSIONAL BIOGRAPHY

Milen Georgiev graduated as MS in Biotechnology from the University of Food Technology, Plovdiv, Bulgaria, where he has studied from 1996 to 2001. M. Georgiev became a full-time doctoral student at the Stefan Angelov Institute of Microbiology (IMiKB) of the Bulgarian Academy of Sciences at 2002. After a successful defense in 2005 he became a postdoctoral student in the Marie Curie Program at the Institute of Food Technology and Bioprocessor Engineering at the Technical University of Dresden, Germany. In 2007 he was appointed as a Research Associate I degree at the Institute of Microbiology - BAS. From 2010 to 2012 he was a postdoctoral fellow in the Marie Curie program at the Institute of Biology, University of Leiden, the Netherlands. Since 2010 he has held the scientific position of "Associate Professor" at the Institute of Microbiology - BAS, which he currently occupy. Since 2020 he has been appointed Head of the Metabolomics Laboratory. Assoc. Prof. M. Georgiev was a guest researcher at the Institute of Botany, Technical University of Dresden, Germany (2014). Hi is a project manager of the project SuSMAPWaste at the University of Agronomy and Veterinary Medicine, Bucharest, Romania (since 2016). He is the Head of the Department of Plant System Biology and Biotechnology Center, Plovdiv, Bulgaria (from 2017 to the present). He is fluent in English at a high level, written and spoken, and Russian at a basic level. Assoc. Prof. M. Georgiev has been a member of the Scientific Council of the Institute of Microbiology - BAS since 2019.

His extensive expert work should also be noted: Co-editor of the journals Phytomedicine (Elsevier), Food and Chemical Toxicology (Elsevier) and Food Frontiers (Wiley); Member of the editorial board of the journals Biotechnology Letters (Springer), Chinese Medicine (Springer) and Molecules (MDPI); Ad hoc reviewer / rapporteur for the European Commission, the Austrian, Polish, Romanian and Latvian Research Funds; Reviewer of dissertations for Universities in France, Bulgaria, Pakistan, India and Malaysia; Reviewer for a number of peer-reviewed scientific journals. He is a member of the European Federation of Biotechnology, the Bulgarian Phytochemical Association, the Association of Medicinal and Aromatic Plants of the countries of Southeast Europe (AMAPSEEC) and the Phytochemical Society of Europe (PSE).

TEACHING ACTIVITY

Assoc. Prof. M. Georgiev leads and gives lectures in a Specialized Lecture Course in Metabolomics, Faculty of Biology, The University of Plovdiv. He is the supervisor of 3 doctoral students, 5 MS graduates and 9 trainees.

MAIN SCIENTIFIC INDICATORS

Assoc. Prof. M. Georgiev has delivered for the current competition his scientific production, which can be systematized according to the Minimal National Requirements to the scientific activities of the candidates for the academic position "professor". Milen Georgiev presented the Abstract of his PhD thesis on the topic: "Opportunities to increase the yield of rosmarinic acid from cell culture *Lavandula vera* MM" which covers the requirements of group "A" indicators.

To the requirements of group "B", the candidate has submitted 28 scientific publications, pulished after taking the scientific position "Associate Professor". They are published in prestigious international scientific journals, referenced and indexed in world databases Scopus and Web of Science (19 - Q1; 7 - Q2; 2 - Q4) with total IF 90,287. This results in 639 points, with a required minimum of 100 points in the Regulations for implementation of the Law in the Republic of Bulgaria at the Institute of Microbiology - BAS.

In the group of indicators "Г" 26 journal publications are presented (21 issues - Q1; 4 issues - Q2; and 1 issue - Q3; Total IF = 142.363) and 3 chapters of books, edited, referenced and indexed in a world-known database data. The candidate scores 665 points as a final result, with a minimum of 200 points required in the Rules of the Institute. As can be seen, Assoc. Prof. Milen Georgiev distinguished by a significant excess of the national minimum requirements regarding the criterion that directly reflects his active research.

A list of 45 cited articles from the submitted for evaluation in the competition, with a total of 1057 citations is presented to indicator D11 "Cited in scientific publications, monographs, collective volumes and patents, referenced and indexed in world-famous databases with scientific information (Web of Science and Scopus)", group of indicators "**Д**". The calculations show that Assoc. Prof. Georgiev scores 2114 points, with a required minimum of 100 points. This result clearly proves the wide international prominence and significance of the author's scientific results and achievements.

The data on the indicators from group E exceed the minimum national requirements to the highest degree. Assoc. Prof. Georgiev is a leader of 2 international and 3 national research projects, and he is a participant in 3 national and 3 international research projects. The amount of funds for the basic organization as a result of these projects is impressive - BGN 6,770,000. Only this indicator brings 1354 points, with a required minimum of 150 tons.

In conclusion, it can be seen that the amount of the minimum required according to ZRASRB 600 points is more than 8 times exceeded. The total number of points scored by Assoc. Prof. M. Georgiev is 5072 points.

For his overall scientific activity, Assoc. Prof. Georgiev has published a total of 130 scientific publications, participated in 12 projects and managed 5 projects. He has participated in 67 national and international scientific forums, in 30 of which as an invited speaker. He was a member of 13 organizing committees of international conferences, chairman of the Org. Committee of the International Scientific Conference (ICNPU), co-editor of 3 and a member of 3 foreign editorial boards, discussed above. He has reviewed numerous articles for various international scientific journals and dissertations. According to data from the Scopus information database, Dr. M. Georgiev has over 2500 citations and respectively H-index - 25, and Impact factor over 390.

I should note that the applicant has submitted a Report for fulfillment of the requirements according to the Rules of the IMicB - BAS, where the required set of points, both for Area 4

Natural Sciences (4.3. Biological Sciences), and for Area 5 Technical sciences (5.11. Biotechnologies) are unified. If the points of the information submitted in the documents of this competition are recalculated according to the requirements of the Law on Technical Sciences (where the coefficient for the articles is divided equally between the co-authors), then their sum is even higher, videlicet: Indicator B - 278.57 points; indicator G -273.74 points; indicator D - 10570 points and indicator E - 1584 points, or a total of 12 756.31 points.

The presented data prove convincingly enough that Assoc. Prof. M. Georgiev significantly exceeds the national requirements for holding the scientific position of "professor".

Regarding "Additional criteria for the development of the academic staff in IMicB" it can also be noted that the criteria are over fulfilled. For example, the requirement in the criterion "Number of publications in journals with IF, monographs, chapters of monographs, collections published in full text, patents" is 20 pcs. (published after "Associate Professor"), and in 16 of them leading or corresponding author. The candidate has presented in full text 57 relevant scientific publications, in 6 of which he is the first author and in 27 publications - the corresponding author. The next criterion "Citations" requires 400 citations for the entire scientific career, and the candidate submits over 2500 citations, the requirement for H factor is 10 for the entire scientific experience, and the total h - factor of M. Georgiev is 25. Regarding the number of supervised scientific research projects, as well as participation in such it is described in detail above, and the exceeded requirements are indisputable. Assoc. Prof. Georgiev is the supervisor of 3 doctoral students, one of whom has successfully passed preliminary internal defense. This is the only conditional discrepancy with the requirements of the institute's additional criteria, which is to be fully met. In this regard, I can point out what is noted in the Notes to the Rules under item 7 – “The system allows for the summation of the coefficients within a group of indicators, so that internal compensation is made and the missing points of one indicator are supplemented with points of another”. In this case, the impressive over fulfillment of many other indicators does not allow for fluctuations in the compliance of the candidate with the requirements for the scientific position "Professor" in the Department of Microbiology of BAS. During the attestation of all scientists held this year on indicators determining their scientific contribution to the so-called Component 2 for the budget financing of the Institute by BAS, Assoc. Prof. Georgiev took the first place which is another clear confirmation of what has been said.

All three Pythagoras awards (2011, 2015 and 2020), Marin Drinov Award of the Bulgarian Academy of Sciences for Young Scientists (2009) and the Diploma for High Scientific Achievements from the Management Board of the Bulgarian Academy of Sciences (2018), as well as and 7 awards under the SusMAPWaste Project are strong confirmation, as well. Since 2013, as Chairman of the Organizing Committee, Assoc. Prof. Georgiev has participated in the organization of the International Conference on Rational Utilization of Related Products: From the plant to the pharmaceutical shelf. The last edition of the conference (4th International Conference on Natural Products Utilization) held in 2019 in the resort. Albena, gathers 330 scientists from 50 countries.

SCIENTIFIC CONTRIBUTIONS

Assoc. Prof. Georgiev's research is focused on the biosynthesis of pharmaceutically important molecules of plant origin and their sustainable biotechnological production. In recent years, for the first time in Bulgaria, the modern platform for metabolomics and metabolic profiling with nuclear magnetic resonance (NMR) has been introduced. The NMR-metabolic platform is currently successfully applied in real biotechnological developments, in the field of

natural sciences and pharmacy. Not only the use of the most modern methodological approaches should be considered, but also the wide range of plant objects, as well as medical problems are the subject of metabolic research.

The most significant place in the presented scientific production is occupied by the researches with a number of medicinal plants and herbs. A large volume of research has been conducted with representatives of the genus Rhodiola and mainly *Rhodiola rosea*. This species has highly recognized adaptogenic properties and is intensively used in traditional medicine as well as in clinical practice.

In order to determine the phytochemical variations of the main secondary metabolites from different morphological parts of *R. rosea* Wildgrown in Bulgaria, 1H NMR-based metabolomics was performed, combined with multivariate data analyzes, followed by the sensitive HPLC method. The aromatic compounds salidroside and rosavin are identified only in the rhizomes and roots and are absent in the aerial parts.

The use of a combined platform based on HPLC-UV and one-dimensional (1D) and two-dimensional (2D) NMR-based metabolomics has enabled integrated analysis of extracts of different types of rhodiola, known and unique molecules, commercial products and the identification of impurities as well as the major metabolic differences, especially between *R. rosea* and *R. crenulata*. The HPLC method has used to detect and quantify phenylethanoids and phenylpropanoids. The results of the HPLC analyzes of the products show large discrepancies between the amounts declared by the manufacturer of salidroside and rosavin and the quantities reported in this study. These results show the need to develop methods for quality control of herbal preparations. The developed analytical approach can be applied at any stage of production of commercial products, starting with authentication and evaluation of raw materials to the finished product.

The potential of *R. rosea* extract and its main components salidroside, rosarin, rosavin and rosin to alter cell growth of human Jurkat T cells, apoptosis of CD3 T cells in the spleen and expression of surface markers and phosphorylation of extracellular signal-regulated kinase (ERK) was also investigated. To identify the main components in the methanol extract of rhizomes of R. rosea, NMR based fingerprinting was performed. Two-dimensional NMR analysis of 1H-13C heteronuclear single quantum spectrum spectroscopy (HSQC) showed the dominant components in the rhizomes, such as salidroside and rosavin (ie rosarin, rosavin and rosin). The exact amounts of the compounds were determined by HPLC. Flow cytometry was used to determine phosphorylated ERK. Initial screening for cell viability and growth in the Jurkat T cell line revealed the strongest biological activity of rosarin and rosavin and the mildest of salidroside and rosin. Rosavin inhibits the regulation of TRAIL, while rosarin has the opposite effect. The data suggest that the different effects of rosarin and rosavin on TRAIL expression may include a clear effect on ERK signaling, highlighting their potential to manipulate TRAIL, which is important for the resistance to apoptosis in autoimmune diseases and cancer. Chemical fingerprinting of a standardized commercial Rhodiola extract by NMR was performed. The studied Rhodiola extract was found to have a beneficial effect on learning and memory processes in naive rats and rats with memory impairment caused by scopolamine. The observed effect is likely due to a number of major mechanisms, including its modulating effect on brain acetylcholine levels and MAO inhibitory activity leading to stimulation of neuroamine neurotransmission. In addition to the pronounced stress-protective properties of *Rhodiola rosea* L. may also play a role in improving cognitive function (**5, 32, 34, 37, 39**).

The effect of pure salidroside, curcumin and their combination on the immunoreactivity of rats exposed to chronic mild stress (CMS) followed by lipopolysaccharide (LPS) -induced inflammation was studied. Repeated administration of salidroside and curcumin, alone and in combination, results in a pronounced antidepressant-like effect. Treatment with salidroside, curcumin, and their combination reduces the levels of IL-6 and TNF-α, suggesting a potentially synergistic interaction of the two plant compounds in their immunomodulatory, anti-inflammatory, and anti-stress activities (**21, 45**).

Other in-depth studies have focused on important components of secondary metabolism in members of the genus Verbascum (mulleins), as well as other plant species producing phenylethanoglycosides such as verbascoside.

Muleins have been used in traditional folk medicine for centuries to treat a wide range of human ailments, including bronchitis, tuberculosis, asthma and various inflammations. Metabolic differentiation and classification of five different species of Verbascum (mulleins) were performed according to NMR -based metabolic data. Based on the obtained results, the muleins were divided into two groups: group A (*V. phlomoides* and *V. densiflorum*) and group B (*V. xanthophoeniceum*, *V. nigrum* and *V. phoeniceum*). Higher amounts of bioactive iridoid and phenylethanoid glycosides have been found to accumulate in group B plants. V. xanthophoeniceum and *V. nigrum* accumulate significant amounts of the pharmaceutically important harpagoside, verbascoside, forsytoside B and leukoskeptoside B, which emphasizes their potential for use in the pharmaceutical industry. This is the first report on the analysis of leaf metabolism of Verbascum sp.

Verbascoside is hydrophilic in nature and has pharmacologically beneficial activities for human health, including antioxidant, anti-inflammatory and antineoplastic properties in addition to its numerous wound healing and neuroprotective properties. The influence of verbascoside and its positional derivative isoverbascoside, isolated from plants *V.olympicum* and *Sibthorpia africana* was studied. The potency and selectivity of both compounds have been found to depend on the degree of activation and functional status of neutrophils and have the potential to affect neutrophil-related pathologies e.g. in sepsis or sterile inflammation without causing debilitating or life-threatening effects of complete neutrophil and the innate immune system blocking. Metabolic profiling by application of 1H and 2D-NMR to extracts from another plant *Clinopodium vulgare* L. reveals the presence of some distinctive phenolic compounds. The most common of the group of secondary metabolites among them are cafenates, chlorogenic acid and catechin. The data obtained show that *C. vulgare* has a good potential for manipulating neutrophilic functions under certain conditions, such as cell status, inflammatory environment and the relative content of caffeic and chlorogenic acid in the extract.

Transformed with *Agrobacterium rhizogenes* hairy root cultures of the plant *Harpagophytum procumbens* and its cell suspension were cultured in aeration flasks. Their main active components (phenylethanoid glycosides verbascoside, leukoskeptoside A, b-OH-verbascoside and martinoside) were isolated and structurally identified by NMR and LC-MS chromatography. After separation by HPLC, their concentrations were determined by UV spectrometry. Preparations, extracts and isolated phenylethanoid glycosides from *H.procumbens in vitro* systems were tested on mouse macrophages and human serum to investigate their effects on the classical complement activation pathway. The results show that extracts and preparations from *in vitro* systems and pure verbascoside (their main active ingredient) have strong anti-inflammatory properties, comparable or even higher than those of pure harpagoside (main anti-

inflammatory ingredient of intact tubercles of *H.procumbens*). In this way, their potential for new anti-inflammatory drugs has been proven.

The *H. procumbens* suspension cell culture experiments aimed at transferring the production of anti-inflammatory phenylethanoid glycosides to a 3-L stirred tank reactor or to a 1-L glass column bioreactor with pulsed aeration. The production of verbascoside in the glass column reactor significantly exceeds that in mother plants and flask-grown crops. (**19, 20, 44, 52, 54, 55, 56**).

Sambucus plants have a prominent place in folk medicine of people in Europe and the Middle East. *Sambucus ebulus* preparations have shown antineoplastic, antimicrobial (including antiviral) and anti-inflammatory properties. Two new tetraacetylated iridoid glycosides, together with 3 known flavonol glycosides isolated from the leaf of *S. ebulus* L. Their structures were determined using 1D and 2D-NMR and UPLC-TOF MS (ultra high performance liquid chromatography - quadrupole time-of-flight mass spectrometry). One of the new compounds is a rare representative of iridoid diglycosides containing an unusual ribohexo-3-ulopyranosyl sugar moiety.

Other bioactive ingredients that have been reported for the first time within species *S. ebulus* have also been isolated, and some of which quercetin-3-O-laminaribioside and isoramhamnetin-3-O-laminaribioside have antioxidant properties. Fravonoid-enriched fractions obtained by single-step chromatographic separation also exhibited mighty antioxidant activity, while crude methanol extract showed antiherpes simplex virus (HSV-1) activity. It can be concluded that *S. ebulus* can serve as a promising source of forcrful bioactive molecules for various purposes. 1H NMR fingerprint in combination with multivariate data analysis revealed the main metabolic differences of Sambucus mature and immature fruits, and leaves. Immature fruits and leaves of *S. ebulus* have been found to have a similar metabolism, which undergoes significant changes during fruit ripening. The cyanogenic glycoside sambunigrin was not detected in any of the samples (33, 42, 43).

Much attention in research has been paid to transformed root crops (hairy roots HR) obtained by infection with *Agrobacterium rhizogenes* and is characterized by the propagation of excessively branched roots. A. rhizogenes provides a valuable platform for studying the pathways of biosynthesis in plants. Genetically transformed root crops, also called hairy roots (HR), provide an approach to the production of valuable secondary metabolites. Hairy roots with huge potential for use in phytoremediation are also shown, i.e. decontamination of contaminated plant media.

Interesting is the work about adapting the metabolism of hairy roots of tobacco for the production of stilbene (t-resveratrol (t-R) in t-piceatanol (t-Pn) and t-pterostilbelen (t-Pt)). A metabolically engineered biotechnology system including a gene encoding stilbene synthase (STS) and / or transcription factor (TF) AtMYB12 was used to generate a complete response in the phenylpropanoid synthesis pathway and coordinate the regulation of multiple metabolic steps. An artificial microRNA for chalcone synthase (amiRNA CHS) was used to stop normal fuchsia by the endogenous enzyme chalcone synthase (CHS). Transgenic HR is able to biosynthesize target stilbenes, but significant metabolic disturbances caused by TF AtMYB12 have been identified, confirming the complexity of in vitro plant-based biotechnological systems for heterologous production of high-value molecules.

The leaves of *V. xanthophoeniceum* are not susceptible to transformation with three *A. rhizogenes* strains when co-cultivation and direct infection methods are applied. For this reason, an effective system for induction of hair root culture has been created. Verbascoside is the most

common secondary metabolite and its amounts in the hairy branches of the roots are several times higher than in the plant tissue of the mother plant. These results indicate the possibility of large-scale production of this bioactive metabolite (**28, 51, 53**).

The use of transgenic hair root crops of *Fagopyrum tataricum* reveals the role of various transcription factors and genetic families in the production and biosynthesis of bioactive flavonoids, such as rutin and quercetin. Jasmonate (plant hormones) MYB transcription factors have been shown to act as repressors of phenylpropanoid biosynthesis in *F. tataricum*. Detailed molecular studies lead to results that are promising for further engineering and regulation of plant secondary metabolism (**9, 14, 23**).

The synthesis of nanoparticles from precious metals using either microorganisms or plant extracts is a modern approach, alternative to classical (physical or chemical) methods. Phytosynthesized are silver (Ag), gold (Au) and bimetallic nanoparticles obtained by mediating the ethanol extract of *Melissa ofcinalis* L. by metal reduction, which according to the present study is caused by phenolic compounds, which in addition to reducing have a stabilizing function.

Phytosynthesized nanoparticles inhibit the mitodepressant effect of *M. ofcinalis* extract. Different samples of *M. oficinalis* ethanol extract with or without nanoparticles induce different specific chromosomal aberrations. Microscopic analysis revealed a protective effect of M. ofcinalis extracts containing Au or Ag / Au nanoparticles on nuclear DNA damage expressed in the absence of micronuclei. The high incidence of C-mitosis observed in *A. cepa* root tip cells incubated, in particular, with 10% Ag / Au nanoparticle extract is a sign that they may be a potential antitumor agent.

Antimicrobial activity has been tested against common strains of bacterial species such as *Staphylococcus aureus*, *Bacillus cereus*, *Pseudomonas aeruginosa*, *Escherichia coli*, yeasts of the genus Candida and molds - *Aspergillus niger* and *Trichoderma viride*. *A. niger* is known to be the most resistant pathogen among fungi. The results revealed that silver nanoparticles were active against most of the tested strains (except *C. glabrata*, *A. niger*, *T. viride*). For *B. cereus*, not only the silver nanoparticles show a strong effect, but also the extract itself. Golden nanoparticles are active against a limited number of strains (*B. cereus*, *P. aeruginosa* and *C. krusei*). Bimetallic nanoparticles (gold / silver) usually show an intermediate effect (with the exception of *S. aureus*), similar to the values obtained with silver nanoparticles (**29**).

Interesting metabolic studies have been conducted with a number of other medicinal plants: Aqueous extract of *Nepetanuda ssp. nuda* L. affects the replication of human herpes alpha virus (HHV) (**10**). From the fruits of Chinese mulberry (*Cudrania tricuspidata*) is isolated isoflavone Scandenolone, which shows anti-cancer potential by suppressing the viability of MCF-7 cells in breast cancer. Similar studies have been performed with flaxseed extract, which induces apoptosis in human MCF-7 cancer cells (**15, 17**). Methanol extracts of *Dianthus calocephalus* have a high antioxidant capacity, and ethyl acetate extracts show inhibitory activity on cholinesterases, tyrosinase, α-amylase and α-glucosidase. Routine has been shown to be a competitive tyrosinase inhibitor (**25**). The composition of hydroethanol extracts from the roots of *Arctium lappa* L. and the aerial parts of *Veronica persica* Poiret was studied. They have been tested to determine their antioxidant potential and their effect on *A. niger* and *P. hirsutum* fungi. Microemulsions containing extracts of *V. persica* and *A. lappa* exert anti-inflammatory effects in experimental models (**24, 27**). Preservation of the Bulgarian endemic plant *Achillea thracica* Velen is achieved by in vitro cultivation of mono-nodal segments and subsequent transfer and leaf biomass accumulation. Different growth conditions have been shown to affect the

composition of essential oils, suggesting their participation in the process of adaptation and survival in changing environmental conditions (**31**). Changes in mitragynin content in *Mitragyna speciosa* were studied. Mitraginine levels have been shown to increase in stems, consistent with higher expression levels of the alpha subunit of anthranilate synthase (ASA) and tryptophan decarboxylase (TDC) (**50**). An efficient protocol for the isolation of cimifugin from the plant *Peucedanum schottii* has been developed and the enzyme inhibitory activity has been evaluated. Cimifugin has shown low to moderate inhibition of cholinesterases (AChE and BChE) and tyrosinase (TYR), which are key enzymes for the treatment of some neurodegenerative diseases (**38**). In a study of agrimonolide and desmethylagrimolide isolated from *Agrimona pilosa*, it was demonstrated for the first time that these compounds stimulate the expression of phase II detoxifying enzymes via the Nrf2-dependent signaling pathway (**35**).

The analyzed numerous developments are combined not only with the characteristic direct connection between basic and applied research but also with the skillful application and logical combination of a number of state-of-the-art research methods: NMR, GC-MS, LH-MS countercurrent chromatography (HPCCC), HPLC, UV-VIS spectrometry, X-ray fluorescence, transmission electron microscopy, RT-qPCR, etc.

In the presented information about the research work of Assoc. Prof. Dr. Milen Georgiev, the contributions are organized in 7 main paragraphs and really reflect the achievements in the scientific developments that he has led or participated in. They can be summarized in three main conclusions:

1. The achieved significant results of fundamental and applied importance have an exceptional contribution to the world plant biotechnology, in the study of the metabolic regulation of the secondary metabolism of plants on the basis of complex molecular research and creating a real opportunity for qualitative and quantitative control of complex pharmaceuticals and food supplements.
2. Isolation, purification and study of the biotechnological and pharmacological potential and mechanism of action of plant extracts and biologically active molecules.
3. Creation of transformed root cell cultures of medicinal plants and systems for scaling the production of biologically active substances. Development of methods for obtaining new materials based on the principles of "green" chemistry.

The works included for evaluation in this competition were carried out after the acquisition of the scientific position "Associate Professor". All works of the candidate are considered peer-reviewed. Research and results are characterized by originality, relevance, fundamental and applied significance, fully consistent with the scientific field and scientific direction of this competition. It is also relevant and important for other scientific fields from other scientific areas, such as Biological Sciences, Chemical Sciences and Pharmacy. In this context, the scientific activity of Assoc. Prof. Georgiev can be defined as interdisciplinary, which is confirmed by the high number of publications in quartiles Q1 and Q2.

IN CONCLUSION, assessing comprehensively the scientific activity of Assoc. Prof. Dr. Milen I. Georgiev, it can be argued that his work results in significant fundamental scientific and scientific-applied contributions and reveals opportunities and prospects for new research on current issues aimed at the needs of real biotechnological productions. We are presented with a btight example of a direct connection between achievements of a theoretical and applied nature. It should be noted that all studies are performed at a high scientific level and are distinguished by

the most modern research approaches used for analysis: molecular genetics, chemical, physicochemical, microbiological, and bioinformatics.

The achievements of Assoc. Prof. M. Georgiev have been published in various authoritative scientific journals, have been reflected in numerous and highly funded research projects and have found a very wide positive response in the scientific community in Bulgaria and around the world, which undoubtedly confirms the importance of the tasks, and the applicability of the results obtained. The scientific production and the scientific indicators of Assoc. Prof. M. Georgiev many times exceed the requirements of the Law on the Development of the Academic Staff in the Republic of Bulgaria, and the respective Rules of IMicB for occupying the academic position “Professor” in the Professional field 5.11. Biotechnology.

All this gives me a reason to support the candidate and convincingly recommend to the esteemed members of the Scientific Jury to evaluate positively and to propose to the Scientific council of IMicB to award Assoc. Prof. Dr. M. Georgiev, the academic position "Professor".

Sofia, August 26, 2020.

REVIEWER:

(Assoc. Prof. Dr. Zlatka Alexieva)