

REVIEW

of the application(s) for the academic position "Professor" at the Institute of Microbiology "Stefan Angelov" at the Bulgarian Academy of Sciences. Professional field: 4.3. Biological Sciences; Specialty: Microbiology - Genomics and Regulation of Gene Expression in Prokaryotes

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By order № I-81 / 01.07.2020 of the Director of the Institute of Microbiology "Stefan Angelov" (IMicB) at the Bulgarian Academy of Sciences (BAS) I was appointed a member of the Scientific Jury in a competition for the academic position "Professor" in the same institute. The competition is in the area of higher education 4. Natural sciences, mathematics and informatics; professional field 4.3 Biological sciences; specialty "Microbiology - genomics and regulation of gene expression in prokaryotes". The competition was announced in State Gazette No. 47/22.05.2020 for the needs of the Department of General Microbiology, Laboratory of Microbial Genetics at IMicB. Only one candidate has submitted documents for participation in the competition – Dr. (DSc) Penka Mladenova Petrova, Associate Professor in the same institute who has professional experience in the specialty of the announced competition over 19 years. The candidate has submitted on paper and electronic media all the documents that are required by the Law for the Development of Academic Staff in the Republic of Bulgaria (LDASRB), the Regulations for its application and the respective regulations of BAS and IMicB-BAS.

Brief biographical data

Dr. P. Petrova graduated in Biotechnological Processes from the Faculty of Biology at Sofia University "Kl. Ohridski" in 1994 with a qualification (Master's degree) "Biotechnologist with a specialization in genetic and cell engineering". For a short time (from 1995 to 1996) she worked as a specialist in the Institute of Molecular Biology at the Bulgarian Academy of Sciences. In 1997 she entered the full-time doctoral program at IMicB-BAS, and in 2003 obtained a PhD degree with title of the defended dissertation "Creation of a gene cloning system for *Streptococcus thermophilus*". The entire scientific career of Dr. Petrova took place at IMicB, where in the period from 2003 to 2009 she walked the path from 3rd grade to the 1st grade Research Assistant, and from 2011 until now she holds the academic position "Associate Professor" at the same institute. In 2020 she defended a doctorate for acquisition of the degree "Doctor of Science" (DSc) on the topic "Molecular biology research on new bacterial glycoside hydrolases with industrial application." Dr. Petrova successfully combines research and administrative activities at IMicB. She was a member, secretary and chairman of the Scientific Council, chairman of the General Meeting of Scientists, head of the Laboratory for gene expression, chairman of the commission for work with genetically modified organisms, and in 2020 she was elected Director of IMicB.

Publications and citations

Dr. Petrova participates in the competition for the academic position "Professor" with a total number of 18 scientific publications, 5 of which are publications equivalent to a habilitation work (group of indicators B). These publications, not included in her scientific assets for previous degrees/positions, are equivalent to 105 points. From the remaining 13 publications (group of indicators G) she collects a total of 245 points at a required minimum of 220 points. Twelve of the 18 publications for participation in the competition are with impact factor (IF) (total IF = 31.078), 2 publications with SJR, 1 without IF/SJR, but with quartile (Q2), 2 book chapters and 1 patent. In more than a half (12/18) of the articles, Dr. Petrova is the first or last author, which emphasizes her leading role in the research she conducted after becoming an Associate Professor. The candidate has submitted for participation in the competition 12 additional articles in the group of indicators G that are without IF/SJR and quartiles. Such articles are not taken into consideration in the table of the minimum national requirements and for this reason will not be reviewed.

The independent citations of the papers, with which Dr. Petrova participates in this competition, are 156, and the total number of citations of all scientific papers for her entire scientific career is 731 (of them in Scopus 404). For participation in the competition, Dr. Petrova has selected 200 of the citations in Scopus for the period 2012 - 2020, *i. e.* after occupation of the academic position "Associate Professor". In this way she earns 400 points ($200 \times 2 = 400$) in the group of indicators D of Table 1 of the Regulations for application of LDASRB, thus exceeding approximately 4 times the required minimum of 100 points (120 points for BAS employees).

Review of publications

Dr. Petrova presented an extended habilitation report on her research activities, in which she outlined her scientific and applied contributions in three main directions: (1) verification of new enzyme activities through genomic, transcriptional and enzymological approaches, (2) sequencing of genomes and metagenomes, and (3) application of gene engineering methods to construct new bacterial producers of acids and fuels.

Through the approach of complete genomic sequencing, Dr. Petrova was the first scientist who published the entire genome of the strain *Bacillus velezensis* 5RB. She also found that this strain encodes enzymes for conversion of lignocellulose substrates into useful products (**№3**). She contributed further to this research area by demonstrating that *B. safensis* and *B. toyonensis* strains produce cellulose and hemicellulose hydrolyzing enzymes (**№1**). Dr. Petrova conducted a metagenome sequencing of a microbial community that degrades cellulose and thus is applicable for waste cleaning in manned space missions. This direction is new for IMicB and marks the start of metagenome studies on microbial communities for space purposes (**№2**, group of indicators B). The candidate has discovered a rare transferase activity of the enzyme β -galactosidase produced by the Bulgarian lactic acid bacteria (LAB) *Lactobacillus delbrueckii* *subsp. Bulgaricus*. Thanks to this activity these bacteria synthesize prebiotics from the group of galactooligosaccharides (GOS) and Dr. Petrova has measured the highest quantity of GOS

reported for yogurts thus far (№4). Next, in papers №4 and №1 of B group of indicators she has reported new genetic approaches for identification and distinction of LAB strains. The assimilation of prebiotics by the Bulgarian LAB is due to their ability to degrade various oligo- and polysaccharides, and Dr. Petrova discovered some of the first producers of amylase, β -fructosidase and β -galactosidase in the world (№5, 6, 9, 12). Publications №4 and №5 of B group of indicators describe the sequencing of the *inu* gene of a *Lactobacillus paracasei* strain, which encodes a new cell-associated fructan β -fructosidase. The relationship between the hydrophobicity of the LAB cell surface and their resistance to organic solvents was demonstrated for the first time (№2). Dr. Petrova's interest in enzymes that break down α -glucans is not limited to LAB. She constructed a *Klebsiella pneumoniae* strain (G31-A), in which she introduced the α -amylase gene from *Bacillus licheniformis* 44MB82/G. The productivity of that strain in the synthesis of 2,3-butanediol from starch is 3 times higher than that reported in the literature so far (№8). The strain can convert not only starch but also glycerol to 2,3-butanediol and this discovery has been patented (№13). In regard to the perspective for the production of alternative fuels from renewable raw materials, Dr. Petrova co-authored a review article dedicated to the production of 1-butanol from microbial producers (№3, group of indicators B). In strains of the genus *Bacillus*, Dr. Petrova also found enzymes that, in addition to hydrolase, also have transglycosylase activity. These enzymes, referred to as cyclodextrin-glucanotransferases (CGT-ases), catalyze the synthesis of cyclodextrins with valuable properties. Dr. Petrova sequenced the gene for hitherto non-described CGTase in *B. pseudocalophilus* (strain 8SB) (№10, 11). In addition, she reports the results of the first molecular biological study of neuraminidase from a non-pathogenic strain of *Vibrio cholera*, which enables the safe production of neuraminidase (№7) for scientific and practical purposes.

At the end of the habilitation report, the candidate presents a clear vision for her future research. Her prospective research will be based on the so far accumulated data, which show that in addition to the classic symbiotic partners *L. bulgaricus*/*Str. thermophilus* in the Bulgarian yoghurt there is an accompanying microflora with no less significant biological activity. Dr. Petrova plans to focus her research on this microflora in order to develop new synbiotic products and functional foods. Another direction of her future research will be the so-called "white" biotechnology for the production of valuable low molecular weight compounds and fuels, which have been so far chemically synthesized. Therefore, she plans to continue her experiments on cloning and heterologous expression of target genes in various microbial hosts.

Project activity

The research and applied activities of Dr. Petrova are reinforced by a number of research projects. She has been a team member or principal investigator (PI) of totally 23 research grants, seven of which are ongoing. This shows that the candidate not only has a clear vision for her future research, but has also ensured financial support for these studies in the next three years. In 7 of the projects, including one of the ongoing ones, she is PI on behalf of IMicB as an applicant organization. The projects are funded mainly by the Bulgarian Research Fund NSF (15 projects)

and by contracts with foreign companies (3 projects) as well. The remaining projects are funded by national and European scientific, framework and operational programs. The attracted funding by Dr. Petrova as a project manager amounts to a total of BGN 252,000, whereby most of the finances are coming from the “Lactobacilli” project, supported by the Chinese company Bright Dairy & Food Co. Ltd. (BGN 225,000).

Educational and expert activities

Dr. Petrova was the scientific supervisor of five graduates and 42 postgraduates in Bulgaria and abroad, as well as the holder of four courses and training programs in "Genetic Engineering and Gene Expression in Bacteria", "Genetic Engineering and Recombinant DNA Technologies", "Genetically modified microorganisms" and "Molecular studies on lactic acid bacteria". She was the independent supervisor of one and co-supervisor of another successfully defended PhD programs. Dr. Petrova is a preferred expert in her field. Her expert activities are linked to memberships in scientific councils and expert commissions (6). She also took part in a number of examination commissions (11) and scientific juries elected to evaluate applications for acquiring scientific degrees and occupation of academic positions (13).

Compliance with the criteria for occupying the academic position "Professor"

The following table presents the compliance of the group of indicators (A to E) of Dr. Petrova with the minimum national requirements, according to Table 1 of the Regulations for implementation of the LDASRB (for BAS employees, indicators D and E are elevated):

Group of Indicators	Minimum number of points	Candidate points
A	50	50
Б	-	100
B	100	105
Г	200 (220 for BAS)	245
Д	100 (120 for BAS)	400
E	150	575
Total	640	1375

It is clear from the table that Dr. Petrova covers and in most of the indicators exceeds the minimum national requirements. She also covers the criteria of the Regulations on the terms and conditions for acquiring scientific degrees and for occupying academic positions at BAS. Its total number of points is more than twice the required minimum. According to the additional requirements of IMicB, the candidate for "Professor" must have published at least 20 scientific papers (articles with IF, book chapters, reports from international conferences full text and patents) after becoming an associate professor (Docent) and in at least 16 of them to be a leading/corresponding author. Assoc. Prof. Petrova meets these criteria, as she has published a total of 24 scientific papers after her Docent election, including 19 articles with IF/SJR, 2 book chapters, 2 reports at international conferences, published in full and 1 patent. In 17 of these

publications she is the leading (first or last) author. At a required minimum of 400 citations for the entire scientific career, she has 731 citations, and her total IF for this period is 54,785 thus exceeding with *ca.* 15 points the minimum threshold of 40 IF. According to a reference in Scopus, the H-factor of Dr. Petrova for the period 2005-2020 is 11 at a required minimum of 10. Dr. Petrova also covers the requirements of IMicB for management of doctoral students and projects. She has supervised two successfully defended doctorates (minimum 2) and managed 6 projects (minimum 3), including 3 international ones.

CONCLUSION

The analysis made in this review shows that Dr. Petrova meets all the formal requirements of the LDASRB, the regulations for its application and the internal rules and requirements of BAS and IMicB for occupying the academic position "Professor". Her activities cover, and in some respects many times exceed the minimum national requirements for holding this position. For example, the citations of the papers, with which she participates in the competition, are four times higher than the required minimum. Dr. Petrova has participated (in) and managed scientific projects that have led to significant and original scientific contributions published in prestigious international journals. Strength of the candidate is her significant administrative experience and good national and international contacts, which are a prerequisite for her successful future career. That is why I find it completely justified to recommend to the respected Scientific Jury of the current competition to propose to the Scientific Council of IMicB at BAS to elect Assoc. Prof. Dr. Penka Mladenova Petrova at the academic position "Professor".

09/09/2020

Prof. R. Mironova