SCIENTIFIC STATEMENT

from **Prof. Maria Angelova, DSc,** The Stephan Angeloff Institute of Microbiology, Bulgarian Academy of Sciences

on the competition for the occupation of the academic position "Professor" in professional field: 4.3. Biological Sciences, scientific specialty (Microbiology – genomics and regulation of gene expression in prokaryotes) at the Department of General Microbiology, Laboratory "Microbial Genetics", presented to a Scientific Jury formed by order of the Head of SAIM № I-81/01.07.2020

The only candidate in the competition for "Professor" announced in the State Gazette, issue 47 of May 22, 2020 and on the website of The Stephan Angeloff Institute of Microbiology (SAIM), BAS, is Associate Professor Dr. Penka Mladenova Petrova, DSc from the same Institute.

1. General presentation of the procedure and the applicant

The set of materials and documents presented by Assoc. Prof. DSc. Penka Petrova in paper and electronic form for participation in the competition, fully complies with the requirements of the Law on the Development of the Academic Staff in the Republic of Bulgaria (ZRASRB), and Rules of SAIM, BAS. The documents also meet the additional criteria of the Institute.

Assoc. Prof. P. Petrova, DSc has 25 years of experience in the speciality (23 in SAIM and 2 in the Institute of Molecular Biology at BAS). Of these, 20 years are scientific experience. In 2003 she obtained the Doctor degree in Microbiology, after which she held the positions of Research Fellow (2003-2009) and Associate Professor (since 2011). In 2020 she defended the dissertation and received the degree "Doctor of Science".

Assoc. Prof. Petrova also has executive experience participating in the administrative activities of the Institute and BAS. Since 2013 she is the Head of the Laboratory of Gene Expression, and since 2018 - the Head of the Department of General Microbiology at SAIM. She has been Chairman of the General Meeting of Scientists and Chairman of the Scientific Council of SAIM. Since 2020 Assoc. Prof. Petrova is a Director of SAIM. She is currently a member of the General Assembly of BAS and a member of the Scientific Council of the Institute.

At the same time, Petrova is Chairman of the Commission for Work with GMOs (in SAIM) at the Ministry of Environment and Water and Head of the Working Group of BAS for Control of the Coronavirus. Assoc. Prof. Petrova is a member of the Union of Scientists in Bulgaria (Microbiology Section) and the European Federation of Microbiological Societies (FEMS), she is a member of the editorial board of the Journal of Investigative Genomics, MedCrave Group, USA.

Assoc. Prof. Petrova speaks three foreign languages, including exellent English and Russian and very good in French. She has excellent computer skills, which she has successfully applied in a wide range of studies in molecular biology.

The scientific career of the applicant is entirely related to the topic of the competition and reflects current and promising areas of general microbiology, molecular biology with omix approaches and biotechnology.

2. Characteristics of the applicant's activity

Research activity and achievements

Assoc. Prof. Petrova is a co-author of 68 publications with a total IF of 54.785, of which 40 papers have been indexed and referenced in journals in global databases, including 2 chapters of books (abroad); 27 in journals without impact factor and reports printed in full text; 1 patent. The results of the applicant have received a wide response among the international scientific community, these results have been cited 731 times (SCOPUS: 404) and have formed an *h*-index 12 (Scopus - 11).

The report on the fulfilment of the minimum requirements for the academic position "Professor" shows that the applicant covers and exceeds the required points on the individual indicators, gaining 1375 instead of the required 600. Regarding the additional requirements of SAIM, Assoc. Prof. Petrova presents production above the required one.

Thirty-seven papers are outside the competitions for acquisition of the scientific and educational degree "Doctor" and the academic position "Associate Professor" that can be distributed in accordance with the criteria for the minimum national requirements of ZRASRB, as follows:

- Group A indicators – PhD Autoreferat
- Group B indicators – DSc Autoreferat and 5 scientific papers in IF journals and rank Q2;
- Group C indicators - 5 scientific papers in IF journals (Q1 - 3, Q2 – 1, and Q4 - 1;
- Group D indicators - 10 scientific papers (Q1 - 3, Q2 - 3, Q3 - 3 and Q4 - 1), 2 chapters of books, 1 patent, 12 papers in journals without IF.
- Group E indicators - 404 citations (SCOPUS).
- Group F indicators - Assoc. Prof. Petrova is a supervisor of 2 successfully defended doctoral students (one of them - as a co-supervisor), she has obtained the scientific degree "Doctor of Science", and presents participation in projects and scientific forums.

Results from the research of Assoc. Prof. Petrova have been widely disseminated through her active participation in national and international forums. She is the author and co-author of 46 communications, most of which are oral reports.

In her career as a scientist, Assoc. Prof. Petrova participated in 23 research projects funded by national and international institutions, such as COPERNICUS, COST, FP7 EU, Center International de Recherche Daniel Carasso, France, ESF-OP “Human Resources Development”, Chr. Hansen A/S, Denmark, Bright Dairy&Food, China, NP "Healthy foods for a strong bioeconomy and quality of life", ESA, NSF and others. The applicant is a coordinator of 6 projects, leader of the partner organization in 3, and participant - in 14.

Regarding the additional criteria of SAIM, Assoc. Prof. Petrova presents scientific production above the required one. Twenty-five scientific papers with IF are presented, as in 13 publications she is the first author, and in 12 - author for correspondence, which determines her leading role in the research. Most of the papers have been published in reputable scientific journals, a number of which with high IF such as Nutrients (4.546), Biores. Technol. (4.917), Appll. Microbiol. Biotechnol. (3.42), Microbiol. Res. (2.616), Process Biochem. (2.497), etc. This is a characteristic of their relevance and high scientific level.

Scientific activity of Assoc. Prof. Petrova can be evaluated as highly innovative and implemented at a modern methodological level. Major part of this activity is a pioneering for SAIM. All scientific papers presented for the competition prove contribution of the applicant to understanding of the molecular mechanisms of degradation and conversion of various substrates by microorganisms. Her activity on the basis of modern omix approaches formulates important scientific and applied achievements in the following three directions:

1. Application of omix approaches to studying new enzymatic activities in microorganisms. The topic focuses on enzymes responsible for the metabolism of prebiotics by lactic acid bacteria (LAB).

- First producers of amylase, β-fructosidase and β-galactosidase in LAB has been identified; the expression of respective genes has been proven on the basis of phylogenetic and bioinformatics analysis; new data on the regulation of this expression has been obtained, as well as information on the antimicrobial efficacy of newly isolated LAB strains has been collected.
- The presence of an enzyme with fructosidase action in *Lactobacillus paracasei* has been proven for the first time; LAB strains capable of degrading inulin have been identified; gene encoding

a new cell-associated fructan-β-fructosidase has been identified, and the enzyme has been purified and characterized.

- Strains of *L. delbrueckii* ssp. *bulgaricus* from Rhodope yoghurts, producing galactooligosaccharides with bifidogenic effect has been characterized in details.
- The ability of strains belonging to the genus *Bacillus* to produce lignocellulolytic enzymes has been proven for the first time.
- Strains of species *B. velezensis*, *B. toyonensis* and *B. safensis* have been identified for the first time as producers of 2,3-butanediol on glucose and sugars from the lignocellulose.
- Gene encoding neuraminidase in a non-toxic producer has been sequenced for the first time.
- New information on the relationship between the ploidy of the species *Ogataea polymorpha* and β-glucuronidase expression has been obtained.

2. Genomic and metagenomic sequencing. This topic includes in-depth studies on the identification and characterization of microbial genomes, which outline new directions for SAIM.

- For the first time a Bulgarian team has published a complete genomic sequence of a microorganism - *Bacillus velezensis* 5RB. Genes associated with the direct conversion of cellulose, lignocellulose, starch and inulin into valuable products and genes responsible for production of antibiotics have been identified. The potential of *B. velezensis* 5RB as biopesticide has been evaluated.
- A new direction regarding metagenomic studies of microbial communities used to improve conditions for life during space flight has been placed in SAIM. The conducted metagenomic analysis has provided information on the composition of the cellulolytic community used for degrading of hygienic materials in long-term space missions.

3. Construction of new strain-producers by the methods of genetic engineering. This direction is focused on the use of modern genetic methods to create more efficient enzyme producers.

- One of the first recombinant enzymes with cyclodextrin-glucanotransferase activity suitable for dextrin production from starch has been constructed on the basis of heterologous expression of a gene from *Bacillus pseudakaliphilus* 8SB in *E. coli.*
- By cloning of amylase gene from *B. licheniformis* 44MB82/G, a strain *of Klebsiella pneumoniae* producing 2,3-butanediol from starch has been constructed.
- A scheme for cloning of amylase gene in the shuttle vector *E. coli*/*Zymomonas mobilis*, appropriate for direct biotechnological conversion of starch to ethanol, has been developed.
- Through the successful expression of a gene encoding β-glucuronidase in *Ogataea polymorpha*, an increase in expression of diploids and meiotic segregants has been achieved. This method offers successful use of the biotechnological potential of methylotrophic yeast.
- A new biotechnological process for microbial production of fructose from inulin has been developed.

I estimate the contributions received by Assoc. Prof. Petrova as original scientific results and those with emphasized applied significance. They provide new information about the mechanisms responsible for microbial metabolism as well as generate new, more efficient biotechnological processes. Undoubtedly, the achieved results constitute a solid scientific basis for future research. The same direction will be the focus on the next stage of her career. Assoc. Prof. P. Petrova intends the use of modern methods such as e.g. Next Generation Sequencing, bioinformatics, cloning and heterologous expression of target genes, development of new functional foods and symbiotic products, as well as construction of new and effective microbial producers of valuable metabolites.

Educational activity

Assoc. Prof. P. Petrova actively participates in the training of young scientists. Besides the successfully defending 2 PhD students, she has supervised 5 diploma theses from the Master's program and has trained 42 graduates from Bulgaria and abroad. Petrova has developed 4 courses that also relate to the topic of the competition, namely "Genetic engineering and gene expression in

bacteria", "Genetic engineering and recombinant DNA technologies", "Genetically modified microorganisms - GMM", and "Molecular studies of lactic acid bacteria".

Applied research and patent activity

The overall activity of the applicant impresses by its applied significance. She presents new efficient producers and new schemes for production of compounds useful for industry and medicine. Assoc. Prof. Petrova is co-author of the patent for the production of 2,3-butanediol registered in 2014.

3. Personal impressions of the applicant

I have known Assoc. Prof. Petrova since her appointment at the SAIM. I have always been impressed by her aspiration to enlarge a traditional topic for the Institute, such as Microbial Genetics with modern methods and approaches, to place new directions in the research. She is a highly competent scientist, recognizable among the scientific community and a sought-after partner in the field of molecular biology as well as of cell and genetic engineering. The mentioned qualities will be very useful for the activity of SAIM in the implementation of national and international projects.

4. Conclusion

Assoc. Prof. Penka Petrova, DSc, is an approved and promising scientist in the field of this competition (Microbiology - Genomics and regulation of gene expression in prokaryotes), which is distinguished by its own scientific profile and in-depth approach to research. Undoubtedly, she has the ability to address her research to current scientific and practical direction such as the control over the microbiome that contribute to improving the quality of life and health. Petrova is an active member of the research teams, she provides methodological guidance, scientific collaboration and project funding. The results of Assoc. Prof. Petrova have been published in renowned international journals and have become known to the both Bulgarian and international scientific community. Her scientific and applied achievements contribute to the increase of knowledge in microbiology, molecular biology and biotechnology and could be an important basis for new studies.

Generally, I give an excellent assessment of the overall activity of Assoc. Prof. Petrova, DSc. Furthermore, her application is fully compliant with requirements of the ZRASRB and requirements specified in the Rules of SAIM, BAS concerning the academic position "Professor".

In view of all mentioned above, I strongly recommend to the Scientific Jury, formed by order № I-81/01.07.2020 of the Director of SAIM to prepare a report-proposal to the Scientific Council for the selection of **Assoc. Prof. PENKA MLADENOVA PETROVA, DSc**, at the academic position of "**Professo**r" at SAIM-BAS in the field of higher education: 4. Natural Sciences, Mathematics and Informatics, Professional Degree: 4.3. Biological Sciences, scientific specialty "Microbiology – genomics and regulation of gene expression in prokaryotes" at the Department of General Microbiology, Laboratory "Microbial Genetics".

10.09.2020
Sofia

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/Prof. Maria Angelova, DSc/