

## 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 “Associated Professor” in professional field: 4.3. Biological Sciences (General Microbiology and Biology of Extremophilic Microorganisms), presented to a Scientific Jury formed by order of the Rector of Sofia University "St. Kliment Ohridski" № RD-38-612/15.12.2021

The only candidate in the competition for "Associated Professor" announced in the State Gazette, issue 87 of October 19, 2021 is Assistant Professor Anna Atanasova Tomova, PhD from the Department of General and Industrial Microbiology at Faculty of Biology at Sofia University "St. Kliment Ohridski".

### **I. General presentation of the procedure and the applicant**

The set of materials and documents presented by Assistant Professor Dr. Anna Tomova 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 (LDASRB), and Rules of Sofia University.

Assistant Professor Anna Tomova graduated from the Faculty of Biology at Sofia University "St. Kliment Ohridski" in 1999. She has a master's degree in Molecular Biology with a specialization in Microbiology. In 2011 she received the educational and scientific degree "Doctor" at the Institute of Microbiology (IMicB), BAS. Her scientific career began in 2000 as a microbiologist at IMicB, where in 2012 she held the academic position of Assistant Professor. Since 2015 Dr. Tomova is Assistant Professor in NIS at Sofia University "St. Kliment Ohridski", and since 2016 - in the Department of General and Industrial Microbiology at the Faculty of Biology at Sofia University. Her scientific visits at Novozymes, Denmark and CNR, Italy have undoubtedly contributed to her growth as a scientist.

Dr. Tomova also has administrative experience, she actively participates in the administrative activity of the Department and the Faculty. Since 2017 she is a Secretary of the master's Program of Microbiology and Microbiological Control and a member of the Agrobiotechnologies Working Group of the Council of Specialties.

The scientific and pedagogical career of the applicant is entirely related to the topic of the competition and reflects current and promising areas of General Microbiology, Molecular Biology, Molecular Taxonomy and Microbiology of Extreme Microorganisms.

### **II. Characteristics of the applicant's activity**

#### **Overview of the applicant 's scientific works**

Assistant Professor Anna Tomova is the author of 27 scientific works, 23 of which are scientific publications, 1 chapter of a book and 3 textbooks. Of the articles, 20 have been published in journals with IF (total IF 26.055) and 3 - in Proceedings of scientific forums. The applicant's works have been cited 356 times and form an h-index of 10 (according to Scopus). The results of Dr. Tomova's research have been reported at 20 national and international scientific forums. Dr. Tomova's scientific output has been published in renowned scientific journals, a number of which have a high IF, such as Extremophiles, World J. Microbiol. Biotechnol., J. Mol. Catal., Int. J. Syst. Evol. Microbiol., J. Basic Microbiol., Lipids, Int. J. Speleol. etc. This is a characteristic of their relevance and high scientific level.

The impact of scientific activity of Assistant Professor Anna Tomova in fulfillment of the minimum national requirements under Art. 26 of the LDASRB for the scientific field 4.3. (Biological Sciences) are as follows:

- Group A indicators - PhD Autoreferat;
- Group B indicator - 5 scientific articles in IF journals with rank Q2;
- Group D indicator - 12 scientific articles with IF and rank Q2 (2), Q3 (10), and 1 chapter of a book;
- Group E indicator - 326 citations (SCOPUS);
- Group F indicator - although it is not obligatory for the academic position of Associate Professor, the applicant presents high activity. She is the author of three textbooks. Her scientific results have been widely disseminated through an active participation in 20 national and international forums. Dr. Tomova is a co-author of 3 articles published in Proceedings.

The report on the fulfillment of the minimum requirements for the academic position "Associate Professor" shows that the applicant covers and exceeds the required points on the individual indicators, gaining 803 instead of the required 400.

### ***Research activity and achievements***

The scientific works of Dr. Anna Tomova fully cover the topic of this competition, namely General Microbiology and Biology of Extreme Microorganisms. These areas include the applicant's activity in a very relevant field of microbiological science - biodiversity of extremophilic bacteria and their use as producers of valuable biologically active substances, as well as the molecular mechanisms of yeast cellular response under conditions of oxidative stress. Four scientific directions are outlined, in which important scientific and applied contributions have been formulated.

**1. Isolation and characterization of cultivated bacteria from extreme niches and description of new biological species.** Prokaryotic microorganisms, including extremophiles, have dominated the evolutionary history of our planet, occupying all ecological niches. They are the subject of research in a number of fields of science and especially in microbiology. Extremophiles take up a significant part of the applicant's scientific activity. The presented results are a contribution to clarifying their distribution and diversity. At the same time, new microbial species producing non-traditional biologically active substances with application in medicine and industry have been proposed. The most important contributions are the following:

1.1 The isolation of new species of extremophilic bacteria from extreme niches in Bulgaria is an original achievement of the fundamental and applied importance. These species were recognized by the International Committee on Systematics of Prokaryotes. *Anoxybacillus bogrovensis* sp. nov. (as a producer of amylase from a hot spring in the village of Dolni Bogrov) and *Myroides guanonis* sp. nov. (from prehistoric drawings in the Magurata cave) were identified and characterized. It should be emphasized that *Anoxybacillus bogrovensis* sp. nov was included in the latest edition of Burgie, which undoubtedly is a great achievement for Bulgarian microbiology.

1.2. In-depth study of the taxonomic affiliation and biological activity of the cultivated bacteria inhabiting the Gallery of Prehistoric Drawings in Magurata Cave, Bulgaria was realized for the first time. New information on the biodiversity of cultivated psychrophilic bacteria from the cave with a focus on their taxonomy and the sampling site, as well as the role of guano for their development has been obtained. Strains producing temperature-sensitive enzymes and bioactive metabolites have been selected.

1.3. The lipid profile of strains isolated from Bulgarian hot springs belonging to two newly described bacterial species, namely *Anoxybacillus bogrovensis* and *Anoxybacillus rupiensis* was characterized.

**2. Microbial enzymes and exopolysaccharides of biotechnological importance.** Modern biotechnology uses thermophilic bacteria to produce enzymes and biologically active substances with application in various fields of human activity. These technologies are not only a cost-effective alternative, but they are also a very important step in creating an environmental strategy in the industrial sphere. The development of methods for producing new microbial enzymes and polysaccharides is the main focus of the research in this area. Data on the mechanism of action are presented.

2.1. Producers of thermostable enzymes were isolated; the enzymes were purified, and their physicochemical properties and mechanism of action were characterized. The contribution has to be attributed to production of thermostable inulinase from a thermophilic strain of *Bacillus* sp. 11; thermostable gelatin lyase from thermophilic strain *Geobacillus stearothermophilus* 98; thermostable lipase from thermophilic *Bacillus stearothermophilus* MC7; extracellular collagenase from the mesophilic strain *Streptomyces* sp. 3B; thermostable  $\beta$ -amylase and  $\alpha$ -glucosidase from thermophilic strains of *B. stearothermophilus*

2.2. A thermophilic producer (*Brevibacillus thermoruber*) of exopolysaccharide has been isolated from a hot spring in the region of Rupite. A method for polysaccharide production by a short fermentation process (8 hours) at high temperature has been developed.

**3. Biodiversity of microbial communities in extreme niches.** The third area combines the microbiological studies of extreme habitats and the metagenomic analysis to detect the presence of non-cultivated microorganisms. This approach provides a broader view not only of biodiversity but also of the functional characteristics of the microbial community. Using metagenomic analysis in this section, original scientific and applied achievements have been formulated, which have received international recognition in renowned journals.

3.1. The contributions regarding the structure of the archaeal communities in the hot spring Vlasa, Velingrad and the hot spring Varvara, Bulgaria should be noted. The presence of five new phylogenetic units in the Vlasa spring has been proven. Here was identified a strain of species *Korarchaeum cryptofilum* belonging to the division *Korarchaeota*. A great biodiversity of archaea in the Varvara spring has been established. Moreover, a hypothesis for their metabolite status based on the metabolic features of closely related species has been formulated.

3.2. The biodiversity of the bacterial community in the Gallery with prehistoric paintings in the Magura cave has been characterized for the first time. The new information is undoubtedly a huge contribution to the microbiology of extremophilic microorganisms. Taxonomic affiliation of the found sequences belonging to 8 bacterial groups - *Proteobacteria*, *Nitrospirae*, *Acidobacteria*, *Actinobacteria*, *Chloroflexi*, *Planctomycetes*, *Firmicutes*, and *Gemmatimonadetes* has been established. It has been shown that about 1/3 of the isolated sequences show a weak relationship with the nearest bacterial sequences that suggests the existence of new taxonomic units.

3.3. Data on the biodiversity of bacteria and archaea in two Bulgarian hot springs - Levunovo and Vetren dol (geographically distant, with different tectonic origin and different water temperature) have been gained for the first time. Furthermore, a new thermophilic archaeal group in the order *Methanosarcinales* has been proposed. Phylogenetic analysis reveals the presence of a large number of new archaeal and bacterial sequences.

**4. The yeast *Saccharomyces cerevisiae* as a model system for studying the quiescent state.** Research activity in the field of System and Molecular Biology was conducted; mechanisms responsible for entering, experiencing, and exiting a quiescent state have been examined. Original

achievements have been formulated. New data can be applied to higher eukaryotes in theoretical and practical aspects. I would focus on developing new or improved immunosuppressive and anti-cancer therapies.

4.1. New data on the role of the antioxidant enzymes SOD and catalase in the entry and survival of quiescent cells through the use of two different cell lines - mouse and human fibroblasts have been gained. A 10-fold increase in the specific enzyme activities during the resting transition has been demonstrated. Evidence for their role in maintaining redox homeostasis in Go cells was presented. I greatly appreciate the developed *in silico* approach based on bioinformatics analysis of genes encoding SOD and catalase in human and mouse cells.

4.2. Information on the relationship between carbon source and cell differentiation (spores/Go cells) in diploid strains of *S. cerevisiae* is an original achievement. The investigation reveals that the resting yeast cells (Go) demonstrated stable redox homeostasis, and optimal balance between reactive oxygen species and reduced equivalents.

4.3. Results of adaptive cellular response of yeast cells from Go state against oxidative and toxic stress are of great interest. New data on the effect of four drugs on the viability of logarithmically growing and Go cell populations of *S. cerevisiae* BY4741 have been obtained. Using the proteomics, the changes in the protein profile of these cells under stress conditions have been proved. Seven protein compounds involved in the cellular response of Go cells to toxic substances have been identified.

### **Education activities**

Teaching work is one of the main activities of the applicant. This activity is entirely in the field of competition. For the last year Assistant Professor Anna Tomova has 640 teaching hours, 570 of which are classroom employment. She is a holder of lecture courses at the bachelor's degree (General and Soil Microbiology, Microbiology and Methods for Obtaining Superproductive Strains) and the master's degree (Microbiology and Microbiological Control and Food Quality and Safety). At the same time, Tomova actively participates in conducting practical exercises in both levels of education.

It should be noted the activity of the applicant as the author of new lectures and practical exercises. Dr. Tomova is an author of lecture courses on Biology of Extreme Microorganisms, Organoleptic Analysis and Fundamentals of Industrial Microbiology. Her work includes the developed exercises for the courses in Antibiotics and Antibiotic Resistance, Genetically Modified Organisms in Food, Genetic Engineering, Legislation and Control and General and Soil Microbiology. Apart from lecturing, Assist. Prof. Tomova also participates in the training of young staff. She has supervised 7 bachelor's and master's degree graduates. Her activity also includes 3 textbooks, which can be used by students at several universities, by teachers in secondary schools and specialists in microbiological practice.

### **III. Participation in research projects**

Dr. Tomova is a participant in 19 projects, 7 of which have been funded by international institutions and 12 by national ones, such as the Danish company Novozymes, bilateral agreement Bulgaria-Greece, CNR, Italy, EU, NSF, etc.

### **IV. Personal impressions of the candidate**

I have the pleasure to personally know Dr. Tomova since she joined IMicB. She is a serious scientist with in-depth theoretical training. I have excellent impressions from her research activity, from her energy invested in the work, from her ability to work collaboratively in interdisciplinary teams. The mentioned qualities will be very useful to her as an Associate Professor at Sofia University "St. Kliment Ohridski".

## **V. Conclusion**

Assistant Professor Dr. Anna Tomova is a well-known lecturer and promising scientist in the field of this competition distinguished by her own scientific profile and modern approach to research. Her teaching activity corresponds to the current requirements of higher education. She is the author and co-author of textbooks and works actively with graduates. The entire activity of Dr. Tomova in terms of scientometric indicators meets the requirements of the LDASRB, the Regulations to it, as well as the Regulations of Sofia University "St. Kliment Ohridski" concerning the academic position "Associate Professor".

In view of all mentioned above, I give confidently my positive assessment and strongly recommend to the members of the Scientific Jury, formed by order № RD-38-612/15.12.2021 of the Rector of Sofia University "St. Kliment Ohridski", to prepare a proposal to the Faculty Council for election of Assistant Professor Anna Atanasova Tomova, PhD, to the academic position of "ASSOCIATE PROFESSOR" in the professional field 4.3. Biological sciences (General Microbiology and Biology of extreme microorganisms).

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Sofia

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/Prof. Maria Angelova, DSc/