

## **Review**

by prof. Dr. Petya Koycheva Hristova,  
Faculty of Biology, Sofia University “St. Kliment Ohridski”

**Regarding:** The materials presented in a competition for the academic position “ASSOCIATE PROFESSOR” in a Professional area 4.3. Biological sciences (General microbiology and biology of extreme microorganisms).

The competition for the academic position of "Associate Professor" has been launched for the needs of the Department of General and Industrial Microbiology in the higher education area 4.3. Biological Sciences (General Microbiology and Biology of Extreme Microorganisms) and published in State gazette issue 87/19.10.2021. This review is presented to a scientific jury formed by order № RD-38-612/15.12.2021 of the Rector of Sofia University “St. Kliment Ohridski”.

According the deadline regulated by the HEL, an application for participation in this competition was submitted by only applicant - assist. prof. PhD **Anna Atanasova Tomova**. She currently works on a permanent position at the Department of General and Industrial Microbiology, BF.

In accordance with the meaning of para 1, p. 3 and p. 5 of ZRASRB I declare that as a member of this jury I have no common publications with the evaluated candidate in the competition.

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

For participation in the competition assist. prof. Anna Tomova presented the documents that are in compliance with the requirements of the Act for the Development of the Academic Staff in the Republic of Bulgaria, the Regulations for its implementation, and the Regulations for the conditions and the order for acquiring scientific degrees and holding academic positions in Sofia University “St. Kl. Ohridski”. All documents, available online on the website of the Faculty of Biology, meet the recommended criteria for holding the academic position of "Associate Professor" in Professional area 4.3. Biological sciences. The documentation for the competition is well structured and contains all the data necessary for the evaluation of the educational-pedagogical, scientific-applied and administrative activity of the applicant.

Assistant Anna Tomova graduated from Faculty of Biology at Sofia University "St. Kliment Ohridski" in 1999 as a Master in Molecular Biology with a specialization in Microbiology. In 2011 she defended her doctoral dissertation on "*Characteristics of thermophilic aerobic spore-forming bacteria with carbohydrate degrading activities isolated from Bulgarian thermal waters* (diploma № 34838 / 17.01.2011) for obtaining the educational and scientific degree "PhD".

Tomova's scientific career in the area of microbiology began in 2000 as a specialist at IMicB, BAS in the laboratory of "Extremophilic bacteria". From 2002 to 2011, she successively held the positions of research associate III degree, II degree and I degree. In 2012 she held the academic position of assistant professor at IMicB at BAS. In 2015, Anna Tomova began her teaching career as an assistant at Sofia University "St. Kliment Ohridski" NIS, under a project funded by the educational program Erasmus +, and since 2017 won a competition for assistant prof. in the Department of General and Industrial Microbiology at the Faculty of Biology. The total work experience of the applicant in the specialization is more than 19 years.

During the period 2001-2009 the applicant participated in two short-term specializations: in the company Novozymes (Denmark), with a scholarship from FEMS and in Italy in the field of bilateral cooperation between the laboratory of "Extremophilic Bacteria", BAS and Institute of Biomolecule Chemistry, CNR (Italy).

Anna Tomova actively participates in the administrative activities of the Department of General and Industrial Microbiology and the Faculty of Biology. Since 2017 she is the Secretary of the Master program "Microbiology and Microbiological Control", a member of the Agro biotechnologies Working Group of the Council of Specialties and Secretary of the Department.

The applicant's research interests are in the field of molecular biology and some of them are related to the characterization of industrially important biologically active substances such as thermostable enzymes and polysaccharides, as well as the study of microbial diversity in extreme habitats. Another part focuses on yeast as a model system for studying the mechanisms of adaptive cellular response in conditions of oxidative stress and rest.

## **II. General assessment of the applicant activity**

### **1. Assessment of educational-pedagogical activity**

As a tutor at the Faculty of Biology at Sofia University, assistant Anna Tomova realizes significant educational and pedagogical activities in the two educational and qualification degrees: "Bachelor" and "Master". On average, the total and auditorial employment in the last

5 years are 540 and 400 hours, respectively, which is many times higher than the hours adopted in the Regulations of Sofia University. During the last two years she has been assigned to give lectures in two compulsory courses in the Bachelor's Degree - *General and Soil Microbiology* (Agrobiotechnology), *Microbiology* (BMUR) and one elective - *Methods for obtaining super productive strains* (Biotechnology). In the Master's Degree, she leads by herself two elective courses in the two master's programs of the department: *Biology of Extreme Microorganisms* (MBMBC) and *Organoleptic Analysis* (FQS). At the same time, for the last five years, Tomova has been actively involved in conducting practical classes in nine courses in both levels of education. In the Bachelor's Degree, she conducts practical classes in *General and Soil Microbiology* (Agrobiotechnology), *Microbiology* (Biotechnology), *Methods for Obtaining Super Productive Strains* (Biotechnology) and *Genetic Engineering, Legislation and Control* (Agrobiotechnology). In the "Master's Degree she conducts practical classes in *Molecular Biology of Prokaryotes and Eukaryotes* (MP "MBMBC"), *Antibiotics and Antibiotic Resistance* (MP "MBMBC"), *Biology of Extreme Microorganisms* (MP "MBMBC"), *Organoleptic analysis* (MP "FQS"), *Genetically modified organisms in food* (MP "Microbiology and microbiological control" and MP "Food quality and safety"). In order to deliver the assigned compulsory and elective courses, the applicant independently develops new materials for conducting lectures and practical exercises. In this context, Anna Tomova has prepared two new lecture courses - *Biology of Extreme Microorganisms* and *Organoleptic Analysis for master's programs*. The practical classes in the courses on *Fundamentals of Industrial Microbiology*, *Antibiotics and Antibiotic Resistance*, *Genetically Modified Organisms in Food*, *Genetic Engineering, Legislation and Control* and *General and Soil Microbiology* have been extremely precisely developed and updated.

Every academic year Tomova participates intensively in the scientific and applied training of students, and for the last five years has been the research supervisor of 7 graduates in bachelor's and master's degrees. She has been appointed a scientific consultant for a new doctoral student in the department. To this activity can be added the 3 textbooks presented by the applicant, developed under the Erasmus + educational programs, which can be used by students at various universities in the country and abroad, by secondary school teachers and specialists in microbiological practice.

## **2. Assessment of scientific and applied research activities**

### **2.1. Scientific papers**

Assistant Anna Tomova is the author of 27 scientific and educational publications, in seven of which she was the first author. Of the articles, 20 have been published in journals with IF (total

IF 26.055), 3 are full-text reports in proceedings of scientific forums, 1 chapter in a book and 3 educational aids. Scientific publications are cited 382 times and form the h-index 11 according to Scopus and 206 times in others date base. Tomova reports her results at 20 national and international scientific forums. Tomova's scientific output has been published in renowned scientific journals, most of which have high IFs such as Int. J. Syst. Evol. Microbiol., Extremophiles, Lipids World J. Microbiol. Biotechnol., J. Mol. Catal., J. Basic Microbiol., Int. J. Speleol. etc., which is proof of the high scientific value of the results.

For participation in the competition for the academic position "Associate Professor" Assistant Anna Tomova presents a report on the implementation of the minimum national requirements under Art. 26 of the LDASRB, which fully meets the set criteria.

- Indicators from group A - dissertation for "PhD" - **50** points;
- Indicators from group B - 5 scientific articles in IF journals and with rank Q2; which thematically correspond to the competition - **100** points.
- Indicators from group C - 12 scientific articles with IF and rank Q2 (2), Q3 (10), 1 chapter of a book; - **205** points.
- Indicators from group D - citations - **448** points.

The indicators from group E are not obligatory for the academic position "associate professor", but the applicant presents significant activity on this indicator. Information for participation in 18 projects is presented, of which 15 are research and 3 are international educational. Of the research projects, 10 are national and 5 are international. Also, Anna Tomova is the author of three textbooks in Bulgarian and English (1. *Biotechnology as a means of creating environmentally friendly industrial processes*; 2. *Generally accepted in practice biofertilizers as an alternative to organic farming*; 3. *Modern achievements in in the field of systems biology and omix technologies*).

These data show that the report on the fulfilment of the minimum requirements for the academic position of "Associate Professor" ***covers and exceeds*** the required points on the individual indicators, gaining **803** points instead of the required 450.

## ***2.2. Scientific and applied contributions***

The scientific works of d-r Tomova fully cover the topic of this competition (General Microbiology and Biology of Extreme Microorganisms) and can be systematized in four main areas.

### **2.2.1. Isolation and characterization of cultivated bacteria from extreme niches and description of new biological species.**

The intensive research work of the applicant, aimed at isolating and characterizing extremophilic cultured bacteria and archaea from extreme niches, occupies a significant part in d-r. Tomova's publications. The presented results of theoretical and applied nature are the following:

➤ Original scientific and theoretical contributions are the determination for the first time of the biodiversity in the microbial profile of extreme niches in Bulgaria and the characterization of two new bacterial species (*Anoxybacillus bogrovensis* sp. Nov. And *Myroides guanonis* sp. Nov.), One of which is recognized by *International Committee on Systematics of Prokaryotes* and is included in the latest edition of Bergey.

➤ Contributions of scientific and applied nature are related to determining the potential of isolated thermophilic and psychrophilic bacteria as promising producers of new enzymes and non-traditional bioactive compounds with applications in medicine and industry. Also of original application is the study of the role of lipid profiles in the chemotaxonomy of members of the genus *Anoxybacillus*.

#### **2.2.2. Microbial enzymes and exopolysaccharides of biotechnological importance.**

The properties of microbial exopolysaccharides and enzymes determine the industrial interest in the search for new producers, especially from the group of thermophilic microorganisms. In this direction, d-r Tomova's research is aimed at isolating and characterizing producers of thermostable biologically active substances, developing methods for their production and studying the mechanisms of their action.

➤ Original scientific and theoretical contributions are the isolation of thermophilic producers of thermostable enzymes and exopolysaccharides, and especially promising are the obtained thermostable inulinase from thermophilic strain *Bacillus* sp. 11; thermostable gelatin lyase from thermophilic strain *Geobacillus stearothermophilus* 98; thermostable lipase from thermophilic *Bacillus stearothermophilus* MC7; extracellular thermostable collagenase from the mesophilic strain *Streptomyces* sp. 3B; thermostable  $\beta$ -amylase and  $\alpha$ -glucosidase from thermophilic strains of *B. stearothermophilus* and exopolysaccharide from *Brevibacillus thermoruber*.

➤ Research on the properties and kinetics of partially purified enzymes and exopolysaccharides, optimization of the conditions for their production, as well as research on the mechanisms of their action have a scientific and applied aspect in this direction.

#### **2.2.3. Biodiversity of microbial communities in extreme niches**

In this area are included publications in which the study of the biodiversity of microbial communities in extreme niches applies metagenomics. This cultivation-

independent approach allows taxonomic, phylogenetic and functional characterization of microbial populations of a habitat. The addition of metabolic genes as a marker for assessing community biodiversity provides important scientific and practical information on the evolution of gene families and the variety of metabolic strategies for resource utilization. This section contains original scientific and applied contributions that have received international recognition.

➤ An original scientific and theoretical contribution in this direction is the study of the biodiversity of archaeal communities in the hot springs of Vlasa, (Velingrad) and Varvara. The Vlasa samples are dominated by representatives of hyperthermophilic, anaerobic heterotrophic species, belonging to two orders of the *Creanarcheota* division (86.9%) - *Desulfurococcales* and *Thermoproteales*, and the presence of five new phylogenetic units has been proven. In the Varvara hot spring, a total of 35 archaeal operational taxonomic units (OTUs) belonging to three divisions of the *Archaea* domain - *Crenarchaeota*, *Euryarchaeota* and *Korarchaeota* - have been discovered. The studied archeal community is dominated by representatives of non-cultivable groups and new phylotypes, which are described for the first time in the applicant's publications. A large number of sequences are grouped into four heterogeneous groups belonging to the *Crenarchaeota* division, three of which show no association with cultured organisms.

➤ An important scientific contribution is the establishment of the great biodiversity of the bacterial community in the Gallery of Prehistoric Paintings in the Magurata Cave. Using molecular methods, 68 bacterial taxa were identified, which are assigned to 8 bacterial groups - *Proteobacteria* (40%), *Nitrospirae* (22.5%), *Acidobacteria* (21.5%), *Actinobacteria* (6.4%), *Chloroflexi* (3.2%), *Planctomycetes* (2.2%), *Firmicutes* (2.2%), and *Gemmatimonadetes* (2.2%).

➤ Significant scientific and theoretical contribution is the data obtained for the first time on the biodiversity of bacteria and archaea in two Bulgarian hot springs - Levunovo and Vetren dol, which are geographically distant, have different tectonic origins and different water temperatures. In these hot springs, 28 different phylotypes have been identified, which belong to five archaeal groups (I.1b, *Methanosarcinales*, *MCG*, *Methanobacteriales* and I.3b) of the *Crenarchaeota* and *Euryarchaeota* divisions. Of particular interest is the proposal to form a thermophilic archaeal group in the order *Methanosarcinales*. In the group of bacteria belong to the representatives of *Bacteroidetes*, *Proteobacteria*, *Cyanobacteria* and *Chloroflexi*. The combination of two molecular markers - 16S rDNA and the metabolic gene for glycoside

hydrolases allows a more in-depth assessment of microbial diversity and the detection of specific taxonomic groups.

#### **2.2.4. The yeast *Saccharomyces cerevisiae* as a model system for studying the quiescent state.**

In their characteristics, yeast cells resemble cells in tissues and organs in mammals and humans, making them a suitable model system for studying the conservative mechanisms underlying the entry, survival and quiescent state of these eukaryotes. The following original contributions are outlined in this direction:

- The role of cellular antioxidant enzymes in the entry and survival of cells at quiescent state based on biochemical methods and *in silico* analysis of genes encoding SOD and catalase is outlined.
- The influence of the carbon source on cell differentiation (spores / Go cells) in diploid strains of the yeast *S. cerevisiae* was studied.
- The adaptive cellular response of yeast Go cells to oxidative and toxic stress was studied.

### **III. Assessment of the personal contribution of the candidate**

The evaluation of all the submitted documentation gives me reason to assume that all scientific papers and developed curricula are work of the candidate. I add with conviction my positive assessment of the educational-pedagogical and administrative work, which d-r Tomova successfully balances with her research activity. I have known Anna Tomova for 26 years as an extremely responsible, serious and motivated student with a strong interest in science. Her successful development at IMicB proved the excellent training received at the Faculty of Biology. Involving d-r Tomova as an assistant in BF is essential for forming a successful and working team in the Department of General and Industrial Microbiology.

### **IV. Conclusion**

In conclusion, it can be stated that the Assistant Professor Anna Tomova, applicant in this competition, meets all scientometric indicators 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". The documentation for the competition presents convincing evidence of its scientific, scientific-applied and educational-pedagogical activities. Anna Tomova is already a well-established lecturer, successful scientist and extremely ethical and tolerant colleague.

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 of the Faculty of Biology **for election of Assistant professor Anna Atanasova Tomova PhD, to the academic position of "ASSOCIATE PROFESSOR"** in the professional area 4.3. Biological sciences (General microbiology and biology of extreme microorganisms).

04.02.2022

Reviewer:

Prof. Petya Hristova