



REVIEW

by Prof. Yana Ilieva Topalova
Faculty of Biology, Sofia University "St. Kliment Ohridski"

of the documentation submitted for participation in a competition for the academic position PROFESSOR at the Faculty of Biology of Sofia University "St. Kliment Ohridski"

Department of Ecology and Environmental Protection,
4.3. Biological Sciences (Ecology and protection of ecosystems - Ecology of microorganisms)

1. General review of the competition documentation submitted by the candidate

In the State Gazette, issue 87 of 19.10.2021 and on the website of the Sofia University competition for PROFESSOR under 4.3. Biological Sciences (Ecology and Ecosystem Protection - Ecology of Microorganisms) for the needs of the Faculty of Biology have received the documents of one candidate - Assoc. Prof. Dr. Anelia Evgenieva Kenarova. It is evident from them that the participant in the competition meets the conditions under Section IV of the Law for the Development of The Academic Staff, resp. - of Art. 60 and 61 of the Rules for Implementation of the Law on the Development of the Academic Staff in the Republic of Bulgaria, as well as - on t.t. 1 - 5 of Section V of the Recommendations of Sofia University "St. Kliment Ohridski", Faculty of Biology. This review has been prepared in accordance with this legal framework, in accordance with academic and university practice. The reference for the minimum requirements under art. 26 of the Law on Scientific Research for the Scientific Field 4.3. Biological sciences, professional field "Ecology and protection of ecosystems" - Ecology of microorganisms is completed and is fully in accordance with regulatory requirements. ***The whole large volume of documentation for the competition, in addition to being in accordance with the requirements for the given academic position, is diligently, understandably, neatly arranged with reverence for the details and accuracy of the facts.***

2. Career development and thematic profile of the candidate

The only participant in the announced competition - Associate Professor Dr. Anelia Evgenieva Kenarova - is a lecturer at the Department of Ecology and Environmental Protection at the Faculty of Biology, Sofia University. She currently has 28 years of work experience, all of which have passed at Sofia University. From the mentioned work experience it can be seen that Assoc. Prof. Kenarova has consistently and systematically formed and grown simultaneously as a biologist-ecologist, as a

researcher, partner, and leader of teams for innovative and modern environmental research. In addition, she has gained valuable experience in the field of teaching, and organizational work at Sofia University. I can responsibly state here that the entire professional path of Associate Professor Kenarova is the path of a scientist and lecturer with **vocation, talent, and deep motivation** to create excellently trained biological and environmental personnel with modern environmental theoretical training and applied knowledge, skills, competencies, and qualification.

Associate Professor Kenarova has a Master's degree in Biotechnology and an excellent diploma in Biotechnology, a specialist in biotechnological processes and technologies. She made her doctoral dissertation at the Department of Biotechnology at the Faculty of Biology-SU. Initially, in 1994-1998 she worked as a biologist-specialist in the Department of Biotechnology of the Bulgarian Academy of Sciences, and from 1998-2010 after winning a competition she was successively senior and chief assistant in the Department of Ecology and Environmental Protection of the Bulgarian Academy of Sciences. From 2010 until today she is an associate professor in the scientific specialty 02.22.01 Ecology and Ecosystem Protection in the same department. Consequently, Associate Professor Kenarova develops her research and teaching potential and today she is already a prominent scientist nationally and internationally and one of the well-known professors at Sofia University in the field of environmental sciences. Thus, the overall development of the candidate leads to a **logical, reasonable, and compliant with the legal requirements participation in the competition for PROFESSOR**. Evidence of this in scientific and teaching terms, numerically and specifically in the contributions will be presented below.

3. Research activity of the candidate

3.1. Review and analysis of publications and scientometric data

The general impression of the documentation submitted at the competition is that several characteristics that can be brought to the fore before the detailed analysis: scale, large volume, orderliness and precision in the layout, diversity, high indicators of the required for the academic position "PROFESSOR" at Sofia University "St. Kliment Ohridski".

In the competition for PROFESSOR the candidate has presented a total of 63 papers / full list of publications /, 5 of them submitted for the scientific-educational degree - DOCTOR, 32 - presented in the competition for ASSOCIATE PROFESSOR, 24 in the competition for PROFESSOR, two are additionally presented the textbook, one of which is for students. Viewed from another angle, publications can be classified as: 61 articles and reports in full print, of which 33 in journals with impact factor or SJR, 24 in refereed journals without impact factor, 2 in popular science journals and 2 book chapters. Participation in scientific conferences and forums - 14 international and 17 national.

The other monitored scientometric indicators of the candidate are: Total impact factor -20,558, Impact factor for the competition period - 16,512, observed citations -225 / 160 referred to in Scopus * Web of Science and 65 in other databases /, H-index 7 (Scopus), 9 (Google - Scholar).

The scientometric indicators of the candidate associate professor Kenarova on the point system are filled in very precisely, I have reflected them below in a short table:

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Indicator group	Evidence presented	Number of points
A.	PhD Dissertation	50
B.	Habilitation work / 5 scientific publications with information on habilitation work publications B4.1. - B4.5./	102
C.	Scientific publications in ref. editions and indexed in the international databases Web of Science / Scopus - 15 articles - G7.1-G7.15, 2 book chapters, 2 publications without Q and SJR	289
D.	Citations in scientific journals, as required	320
E.	Successfully defended doctoral students - 1 Participation in the national projects - 5 Participation in international projects - 3 Management of nat. Projects - 3 Attracted funds	25 50 60 60 17.61
TOTAL		970.61

All these numerical data are evidence of two important intermediate conclusions: 1 / The candidate has a diverse and rich scientific output that fully meets the requirements for the position of "PROFESSOR"; 2 / He is a well-known researcher nationally and internationally with his developments in the field of ecology of microorganisms, judging by the citations of his scientific works.

3.2. Main scientific and applied contributions to the habilitation reference and as overall contributions to the publishing activity

I will appreciate the described scientific production and I will focus on the fact that I have dedicated more than 35 years to the Biological Sciences and the University Education in Biology and the various environmental fields in various aspects and scientific-educational degrees.

As mentioned above, the scientific contributions can be systematized in the following thematic areas, which are related and complementary in accordance with the theme of the announced competition for PROFESSOR.

Thematic area 1: Influence of the soil pollution with heavy metals and radionuclides on the state of soil microbial communities

In this thematic area, the key is to demonstrate with various methods a **direct link between the level of soil contamination with heavy metals and radionuclides and the abundance of soil bacterial communities (B4.1, B4.4, D7.13, and D0.1)**. This trend is confirmed by using different methods of analysis - cultivation (**B4.4 and G7.13**), metagenomic (**B4.4 and G7.13**), and epifluorescence microscopy (**B4.1 and D0.1**).

Phylogenetic analysis showed the change in the **structure** of bacterial soil communities in heavy metal and radionuclide contamination (**B4.1**), resulting in a decrease in the share of

Verrucomicrobia and *Acidobacteria* and an increase in *Bacteroidetes* with increasing pollution levels. *Alpha-* and *Beta-Proteobacteria* are also distributed according to the level of contamination. All registered representatives of *Verrucomicrobia* are parasites of protozoa and nematodes, which indirectly shows that high levels of pollution also affect their spread. Bacterial diversity decreases with the gradient of contamination (**B4.1 and G7.13**), but exceptions (**B4.1**) have been registered, probably due to local features of the environment.

Of original character is the contribution to phylogenetic analysis and the demonstration that **archaeal communities** in radionuclide and heavy metal contaminated substrates are represented only by the **order Nitrososphaerales** (kingdom *Crenarchaeota*, type *Thaumarchaeota*), which includes mainly ammonia-oxidizing archaea (**G7.5**). Soil contamination with heavy metals and radionuclides has been shown to adversely affect the activity of soil **dehydrogenases** and **phosphatases** (**B4.2, B4.3, D7.13, and D0.1**). The negative effect of contamination with radionuclides and heavy metals on the **catabolic activity** of soil (**B4.2, B4.5**) and sediments (**D0.1**) bacterial communities has been proven. The negative effect is expressed not only in the reduced bacterial activity (**B4.2, B4.5, and D0.1**) but also in the lag-phase which was extended in proportion to the pollution (**B4.5**) in the absorption of carbon compounds. The contribution moments with the established changes in the functional profiles of soil/sediment bacterial communities (**B4.2, B4.5, and D0.1**) are important, as limits of the inhibition and the stimulation and their relation to the microbial abundance in the habitats are registered. Correlation and ordination analyzes have shown that changes in bacterial abundance, species composition, functional profiles, and enzyme activities in radionuclide and heavy metal contamination are a function not only of the level of contamination (**B4.2, B4.3, B4.4, D7.12, D7.13, and D7.14**) but also on **major soil factors** such as organic substrate (**B4.2 and B4.3**), inorganic nitrogen (**B4.3, B4.4, D7.13, and D7.14**), inorganic phosphates (**G7.13 and G7.14**) and pH (**B4.4 and G7.13**).

Topic 2: Influence of soil pollution with Quadris^R on the state of soil microbial communities

The negative effect of the fungicide Quadris^R on the activity of **soil enzymes** has been proven (**D7.12**). - soil urease, beta-glucosidase, arylsulfatase, acidic and alkaline phosphatases to the soil preparation. It has been shown that all these enzymes, without urease, can play the role of indicators for assessing the impact of Quadris^R and other fungicides on soil biotransformation processes. The negative effect of Quadris^R (**G7.14**) on **catabolic activity, functional diversity**, and microbial abundance of soil bacterial communities has also been demonstrated. Correlation dependences for the correlation of azoxystrobin residues (the active ingredient of Quadris^R) with the change of soil habitat parameters related to soil fertility have been proposed. The role of **Biolog EcoPlateTM** as **suitable** for monitoring studies of the functional parameters of microbial communities and hence the connection with the assessment of soil characteristics has been proven (**B4.2, B4.5, D7.14, D0.1, and D8.1**). The use of Quadris^R has been shown to selectively enhance **antibiotic resistance** in soil bacterial communities (**G7.9 and G7.10**).

Topic 3: Ecosystem functions and ecosystem services

The candidate proves that the intensive development of agriculture in Bulgaria reduces the capacity of agroecosystems to perform a number of ecosystem functions and provide ecosystem services such as pollinator maintenance, natural control of crop pests, soil protection from erosion, retention, and accumulation of organic substances, protection of water against pollution, climate

regulation (D7.8). It has been proven that the maintenance of highland permanent meadows in the South-West Region (G7.11) as the main approach to land use preserves biodiversity in the region and maintains a high level of ecosystem services. Ecosystems (soil and aquatic) have been shown to have the capacity to self-purify petroleum hydrocarbons, thanks to their preserved ecosystem **functions (D7.6 and D0.3)**. This capacity correlates with the abundance and activity of oil-degrading bacteria and depends on the season and local environmental conditions. Methane-oxidizing bacterial strain MM1 (G7.7) has been isolated, which can be used in bioremediation programs to reduce methane emissions from old landfills. It is shown that the isolated strain has high ecological plasticity in relation to the temperature of the medium and the concentration of methane.

Subject area 4: Bacterial communities of extreme ecosystems

PCR amplification with subsequent restriction analysis (ARDRA) showed that the bacterial communities of the Tear and the Kidney lakes (Seven Rila Lakes) have a low level of **genetic similarity** both within one year and between the same months of two consecutive years. (D7.1 and D7.4). The low genetic similarity proves the existence of an ecological strategy for rapid growth and a sharp change in the composition of bacterial communities depending on the change in the values of environmental factors. The quick reaction to the changing

Rapid response to a changing environment means the dominance of a small number of species (r-strategists) that are best adapted to new environmental conditions. *The contribution is of a fundamental scientific nature and is original for the system of the Seven Rila Lakes and confirmatory for alpine lakes.*

Correlation analyzes have shown that the main **factors with a controlling effect** on the abundance and biodiversity of the pelagic bacterial communities of the Tear and the Kidney lakes are temperature and primary productivity (the Tear and the Kidney), predation (the Tear), phosphates, nitrates, amount of total suspended solids, pH (the Kidney) (G7.1 and G7.4). Probably, the more extreme environmental conditions and the simpler food connections in the Tear determine the smaller number of bacterioplankton controlling factors. *The contribution is of a fundamental scientific nature and is original.*

The soils on Livingston Island have been shown to be well-stocked with bacteria and in particular actinomycetes (G7.2 and G7.3). Bare gravelly soils are the richest in bacteria, but no linear relationship has been established between the habitat type (bare gravelly soils, subsoil: mosses, higher vegetation, and mixed vegetation) and the total bacterial abundance. *The contribution is of a fundamental scientific nature and is original.*

Actinomycete strains have been isolated from the soils of Livingston Island and have been identified as members of the **genus Streptomyces (D7.3)**. The isolates synthesize an antibiotic complex with activity against phytopathogenic bacteria and can be used as producers of plant protection products.

The contributions summarized in this way are distributed and evaluated as fundamental, original, applied, and methodological contributions. It is not insignificant that all scientific research and in the course of the formation and discussion of scientific conclusions, contributions, young people were involved along with Associate Professor Kenarova. These

young participants have acquired good research skills in the priority areas of the contributions of the habilitation reference - a classic and innovative assessment of the structure, functions, and potential metabolic capabilities of microbial soil and sediment communities. This potential is assessed in a model and real environment and is represented through 1 / creation and proposal of innovative indicator potential for monitoring and evaluation; 2 / assessment of the reaction of microbial communities to maintain soil fertility, development of self-purifying activity for bioremediation; 3 / role and potential of microbial communities in extreme conditions and habitats. These are all modern scientific and applied approaches with great content and methodological significance in the ecology of microorganisms. As a long-term researcher in these fields, I accept the described fundamental, original, applied and methodological contributions of Associate Professor Kenarova and I appreciate them HIGHLY. I believe that with her highly focused, positive, constructive approach and realistic, innovative attitude, she as a professor will translate and turn contributions into real results in practice and will continue to pass them on to young researchers and teachers, who undoubtedly grow and build in the department, which she currently leads. I can not fail to point out that these contributions as horizontal activities affect areas such as molecular biology of microbial soil communities, enzymology, and kinetics of transformation processes in polluted and extreme ecosystems, bioremediation, and self-purification - all integrated horizontal priorities and methodological approaches.

4. Research and educational projects

A significant part of the publications with the author or co-author Anelia Kenarova is a result of the realization of research and educational projects funded by various sources. The list of projects includes 5 national projects, three international projects with the key participation of Associate Professor Kenarova. She was the leader of three successfully completed projects. All projects / 26 in total / have provided the material and technical opportunities for teamwork and the creation of a group of researchers around the future professor. I believe that in the future this team will be sustainable and will continue to work in the above priority areas and will cooperate with others in the field.

5. Educational and pedagogical activity of the candidate

This component of the evaluation is no less important in the final decision before the vote, given that it is a matter of holding the academic position of PROFESSOR at a university. In the last five years of her activity, Associate Professor Kenarova has had an average of 466 hours of classroom employment and 578 total employment. Behind these figures are the development and implementation of the mandatory courses "Ecology and Environmental Protection" for the Bachelor's degree in Biology and Biomanagement and Sustainable Development. She also teaches the disciplines "Ecology" and "Environmental Protection" for the Bachelor's degree, Waste Management for the Bachelor's degree - Biomanagement and Sustainable Development. She teaches Ecology and Environmental Protection for FMI and has created and teaches several modern disciplines for Master programs - Ecology of Microorganisms, Ecology of Urban Ecosystems, Waste Management, Atmospheric Air Quality, and Control. She has supervised 32 master students and 1 Ph.D. student which had successfully graduated. She is responsible for one current Ph.D. student. She has been the head of the Master's program "Biobusiness". The textbook "Fundamentals of Ecology", co-authored with Associate Professor Bogoev, is one of the best in the field of ecology, which is widely used by students, researchers, and professionals working in the field of ecology.

This voluminous, highly meaningful, diverse pedagogical and creative-teaching activity places Associate Professor Kenarova among one of the best graduates, researchers, and lecturers at the Faculty of Biology, who will leave a recognizable mark in the field of ecology of microorganisms, waste management, and environmental protection in general.

I value the teaching contributions as significant and equal in future response in society with the research contributions. Especially taking into account that every discovered scientific novelty in the field of ecology of microorganisms is directly translated as educational content in the disciplines taught by Associate Professor Kenarova. I have a long-term and personal impression of this.

Expert activity

Associate Professor Kenarova is a respected, sought-after expert in the field in the preparation of environmental impact assessments, preparation of expert assessments of pollution, and organization of pollution treatment of municipalities, industrial enterprises, and others. Eight expert assessments and environmental impact assessments were presented as evidence.

6. Participation in the organization and administrative activity of the Faculty of Biology

In parallel with her active research and teaching activities, Associate Professor Kenarova has actively integrated and participated in the administrative activities of the Department of Ecology and Environmental Protection, Faculty of Biology, and Sofia University. She has been the Head of the Department of Ecology and Environmental Protection since 2016 until now. She is currently the Deputy Dean for the Master's Degree, she has been the Head of the Master's program "Biobusiness", she has worked as an active member of the Attestation Commission, in the commission of the elections of the Faculty of Biology, she is a member of the General Assembly of Sofia University and the Faculty Council of Sofia University. And in this direction - active citizenship, teaching position, high organizational activity, and organization are other kinds of contribution-merits that turn the high research and teaching potential of Associate Professor Kenarova in the real environmental and educational policies at the Faculty of Biology and Sofia University.

7. Summary comment, personal impressions, critical remarks, and recommendations

The analysis made so far of the professional development of Associate Professor Kenarova shows that during her 28 years of work she has formed as a lecturer and researcher at Sofia University with a clear profile and high qualification, fully consistent with the announced competition for PROFESSOR. The active publishing activity in terms of volume, content, and quality covers and exceeds the requirements for holding the position of PROFESSOR at the Faculty of Biology.

The research activity is implanted in the various teaching and teaching activities of the candidate, which is the main requirement of the research universities, such as Sofia University. From this point of view, I emphasize once again the value of such academic staff growing up at Sofia University. From the content point of view, I evaluate the research and teaching contributions of the candidate as extremely complex - ie. address in-depth key issues in the ecology of microorganisms, address these issues in many aspects and at different levels - molecular, functional, enzymological,

indicator, applied, related to the study of critically polluted regions, resources and ecosystems. From this point of view, I think that the team created and led by Associate Professor Kenarova is a national innovator, and the candidate was an "open recipient" of the latest aspects of studying microbial communities in a natural way and when the impact of extreme factors is involved.

I have had personal impressions of Associate Professor Kenarova since 1996. I have had the opportunity to work with her on projects and on the creation of disciplines and educational programs. She is a constructive, dialogical, result-oriented, desirable partner in research and educational projects, a good person who supports her colleagues and students, a realistic-minded but innovation-oriented teacher. In the long run, she has built an image of an open, modern, complex personality, with her own style and class, such as a PROFESSOR at Sofia University should be.

I am convinced that Associate Professor Kenarova can achieve much more in the field of ecology of microorganisms and with her teaching talent to pass the newly acquired knowledge and results to young researchers and experts from her own team. I have no critical remarks to the candidate, except for my wish that the reported results and contributions to the habilitation work be formed as a monographic work that can be used by students.

8. Conclusion

Based on the above analysis of the submitted competition documentation, and from my long-term impressions of Associate Professor Kenarova, I believe that she meets the requirements for PROFESSOR, formulated in the Law for Academic Staff Development and the Rules of Sofia University. Undoubtedly, she is an established specialist in the field of ecology of microorganisms, with a proven place and role in university education in ecology and protection of nature and the environment.

In my opinion, this is a sufficient argument to recommend to the esteemed Scientific Jury and the Faculty Council of the Faculty of Biology - in accordance with Art. 60 and Art. 61 of the Regulations for its implementation - **to vote for the acquisition by the associate professor. Dr. Anelia Kenarova of the academic position of PROFESSOR.**

8.02.2022

Reviewer:

/prof. Yana Topalova, DSc/