

## OPINION

Regarding the acquisition of the academic position "professor", in a professional field 4.3. Biological Sciences /Microbiology/ for the needs of the Department of Biotechnology, Laboratory "Bioremediation and biofuels, "Stephan Angeloff" Institute of Microbiology"-BAS

**Candidate:** Assoc. prof. Lyudmila Kabaivanova, PhD

**Opinion was prepared by:** Prof. Todor Kantardjiev, DSc

The candidate Lyudmila Kabaivanova graduated as a Master in "Biochemistry and Microbiology" in 1992 at Sofia University "St. Kliment Ohridski", Faculty of Biology, after which in 1993 she started working at the Institute of Microbiology - BAS. In 2006, Assoc. prof. Kabaivanova defended successfully at IMikB her dissertation work on "Degradation of nitrile compounds with cells immobilized in different carriers by *Bacillus sp.*-UG-5B, producer of thermostable nitrilase". In the same Institute, in 2011, she won a competition for the academic position of "associate professor". For the period from 2016 to 2020, she is the scientific secretary of the Institute, she was elected as the head of the "Applied Microbiology" department, which she leads until now, and at the same time she is the deputy director of the "Stefan Angelov" Institute of Microbiology at the BAS.

The upward career growth of Associate Professor Kabaivanova is the result of in-depth and active research activities in important areas - microbiology, biochemistry, biotechnology, including aerobic biodegradation processes, such as microbial detoxification, biodegradation and biosorption to solve a number of environmental problems, as well as anaerobic ones, concerning the utilization of various wastes in order to obtain renewable energy with the participation of specific microbial communities as an alternative to fossil fuels, using the activities of bacteria and fungi in biodegradation processes to obtain nutrient-rich composts in order to improve soil fertility, for sustainable agriculture and clean food. Undeniably relevant are the topics related to studying the nutritional and therapeutic applications of microalgae - obtaining new biologically active substances from algae in order to test their potential as antitumor agents for use in biomedicine and biologically active substances from bacteria, characterizing their properties and testing of their cytotoxic action, potentially applicable as an alternative to conventional drugs. Biotechnological approaches offer alternatives for the sustainable production of such natural molecules that hold enormous potential.

The diversity of applied methods is formed by microbiological and biochemical, biotechnological and nanotechnological procedures, immobilization, morphology and immunofluorescence visualization, scanning electron microscopy.

The scientific activity of Lyudmila Kabaivanova can be highly evaluated, based on her high scientometric indicators. She is the author/co-author of 115 scientific publications, in 66 of which she is the lead author, which have been cited 450 times. The results of the experimental work have been presented at 69 significant international scientific forums. She participated as manager (3) and executor in 19 national and international scientific research projects with the attraction of many funds for their implementation.

In the present competition, the publications of L. Kabaivanova are distributed as follows: according to indicator A - Abstract for obtaining the educational and scientific degree "Doctor" - 1 piece; List B includes 6 scientific publications (3xQ2, 2xQ3 and 1xQ4), and List G - 15 scientific publications (1xQ1, 11xQ3 and 3xQ4).

According to the submitted report on the fulfillment of the minimum requirements for the academic position of "professor" based on the Regulations for the Application of the ZRASRB of the Republic of Bulgaria and of the BAS, as well as according to the Additional Requirements of the IMikB, it can be seen that the candidate fully meets all the requirements - she has submitted materials, corresponding to 814.6 points out of the required 640, as well as the additional requirements of the IMikB.

I cannot fail to note some important contributions reflected in the published scientific works of Assoc. prof. Lyudmila Kabaivanova:

1. New immobilized systems were obtained - with cells of *Aspergillus awamori*, which degrades xenobiotic phenol, applicable for detoxification of industrial polluted sites, with toxic aromatic compounds, for the first time immobilized in cryogel cells of *Pseudomonas aeruginosa* with increased yield of rhamnolipid biosurfactants, which mediate the biodegradation of poorly soluble environmental pollutants.
2. The ability of *Rhodococcus wratislawiensis* strain to simultaneously mineralize aromatic and aliphatic xenobiotics has been demonstrated, and immobilized cells of *Pseudomonas aeruginosa* degrade n-hexadecane, which can be used in real conditions to treat polluted industrial wastewater.
3. A new strain, genetically identified as *Bacillus cereus*, capable of degrading hydrocarbons from crude oil has been isolated and for the first time immobilized in a cryogel carrier applicable in the bioremediation of oil-contaminated sites.

4. Hybrid materials synthesized by the sol-gel method have been used to immobilize bacterial cells from *Bacillus sp.*, producers of the nitrilase enzyme that converts nitriles into the corresponding acid and ammonia and can be applied to remove toxic nitriles.
5. New hybrid biosorbents have been created, with the inclusion of biomass or heteropolysaccharides from the red microalgae *Porphyridium cruentum*, which remove heavy metal ions from aqueous solutions.
6. Maize stalks, as a renewable energy source, have been used in an anaerobic biodegradation process, and pre-treatment with ultrasound leads to an increase in the yield of biomethane as an energy carrier.
7. A small closed-loop system was implemented, starting from anaerobic biodegradation of lignocellulosic substrates, followed by cultivation of microalgae in the waste digestate, their low-cost cultivation having great potential for many applications, and subsequent return of microalgae biomass back to the bioreactor as co-substrate, leads to increased yield and promotes the circular economy.
8. Two-stage anaerobic systems have been used to biodegrade waste wheat straw and biohydrogen and biomethane production have been achieved, with the real hope of solving some of humanity's environmental problems and overcoming the fuel energy crisis, as the microbiomes found in the reactors have been identified using metagenomics and simple non-linear models were obtained to serve to determine the optimal ratio of working volumes of the bioreactors in the system, with a view to maximizing energy production.
9. With the addition of a microbial suspension of isolated fungi and bacteria from plant waste as a substrate for improved enzyme activity, biodegradability and quality of compost, a significant increase in the populations of all physiological groups of microorganisms and an increase in soil fertility for the cultivation of clean foods, and from there and pure nature.
10. A cell-specific effect of newly isolated extracellular polysaccharides from the microalgae *Porphyridium sordidum*, *Porphyridium cruentum* and *Rhodella reticulata* on tumor cell lines was demonstrated, with a dose-dependent decrease in tumor cell viability and changes in cell morphology, while control cells remained with normal morphology and retain their viability, and the possible adverse effects of naturally derived substances, including the effect on the vasculature, were investigated, with trehalosolipid obtained from *Nocardia farcinica* reducing cancer

cell viability but not affecting isometric contraction of rat mesenteric arteries in vitro.

11. The high potential for adaptability of the green microalgae *Chlorella vulgaris* under unfavorable conditions is shown, with an assessment of the influence of oxidative stress - changes in the photosynthetic apparatus and antioxidant enzymes, and the highest percentage of polyunsaturated eicosapentaenoic acid was reached in the red microalgae *Rhodella reticulata* under optimal conditions - suitable for addition in various diets and with other applications in the food industry.
12. A trehalose lipid was isolated from a strain of *Rhodococcus wratislaviensis* and tested for its effect on cell viability and migration of tumor and normal human breast cell lines along with colony formation assays, demonstrating its antitumor activity and potential for biomedical application.

Assoc. prof. Kabaivanova has undoubtedly proven herself as an established scientist and specialist. She also presented a vision for her future research, stepping on the conclusions and contributions so far, with a view to the challenges related to the depletion of fossil energy resources and the need for alternative ways to obtain biofuels with a new emphasis - obtaining hydrogen, considered the fuel of the future . The modern concept of using the abilities of microorganisms for bioremediation of contaminated environments, as well as in the production of biologically active substances relevant to pharmacy and biomedicine, is carried out with the hope that their biological and medical applications will be widely used in the next decade with the most important common goal - increasing the quality of life of people.

## CONCLUSION

Based on my acquaintance with the submitted documents, scientometric data and works, with their undeniable significance, the scientific and scientific-applied contributions contained in them, as well as the candidate's active research, expert and project activity, I find it reasonable to state, that my opinion, regarding the acquisition of the academic position "Professor" in Professional direction 4.3. Biological Sciences /Microbiology/ is positive.

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