

## REVIEW

By Prof. Ivan Georgiev Ivanov, D.Sc., IMB-BAS

Evaluation of candidates for Full Professor position in the area of higher education: 4. Natural sciences, mathematics and informatics; professional field 4.3. Biological Sciences; Genetics (molecular genetics, bioinformatics, and synthetic biology)

### 1. Common part

The competition for "Professor" in higher education 4. Natural sciences, mathematics and informatics, professional field 4.3. Genetics (Molecular Genetics, Bioinformatics, and Synthetic Biology) was declared for the needs of the Department of Genetics at the Faculty of Biology at the University of Sofia "St. Kl. Ohridski" in the State Gazette no. 93/ 26.11.2019. The only candidate is Assoc. Prof. Dr. Robert Dimitrov Penchovsky of the same department. The examination of the documents shows that the procedure for opening and announcing the competition has been followed and the documents have been prepared in accordance with the requirements of the Law on Development of the Academic Staff in the Republic of Bulgaria (LDASRB), the Rules for its implementation and the internal rules of Sofia University "St. Kl. Ohridski".

### 2. Brief biographical information

Assoc. Prof. Robert Dimitrov Penchovsky was born on 19.06.1971 in Sofia. In 1989 he enrolled as a full-time student at the Sofia University "St. Kl. Ohridski", who graduated in 1994 with a master's degree in Biochemistry and Microbiology, majoring in Genetics. In 1995 he received a diploma for an additional qualification in Applied Informatics from the Free Faculty of Sofia University. After completing his full-time military service, he worked shortly at the Institute of Molecular Biology, BAS and subsequently held various positions at a number of research institutes and universities abroad such as the Institute of Molecular Biotechnology (Jena, Germany); Fraunhofer Gesellschaft (St. Augustine, Germany); Department of Molecular, Cellular and Developmental Biology (Yale University, USA) and Institute of Genetics at the University of Cologne (Germany). In the latter, he developed his doctoral thesis (2000-2003) and obtained a Ph.D. ("Doctorate"). Since 2010 he has been a full-time employee of the Faculty of Biology at Sofia University. Acts as Assistant Professor in the Department of Genetics, and in 2013 he was hired as Associate Professor in Genetics, Synthetic Biology, and Molecular Evolution. Since 2018 he leads the Molecular Biology Laboratory at the Center of Competence at Sofia University of Clean Technologies and Environment.

### 3. Scientific works

#### 3.1. An overview of the applicant's scientific work

Prof. R. Penchovsky is the author of 48 scientific papers, 27 of which have been published in high ranked journals in the field of competition, 1 book, 7 chapters in monographs, 8 reports from scientific forums, 4 patents and 1 dissertation. In 46 of them he is the leading (first or last) author. According to Scopus, his papers have been cited 349 times. They have a total IF of

126.49 and h-index = 10. The applicant has participated in 27 national and international scientific forums.

According to the presented list of papers, Dr. Penchovsky participates in the "Professor" competition with 25 scientific papers (the ones included in the doctoral dissertation and his habilitation for Associate Professor are not included in this count), of which 14 are in periodicals, 1 book, 4 chapters in monographs, 4 reports from scientific forums and 2 patents (1 Bulgarian and 1 international). In all of them he is the leading (first or last) author.

A detailed review of the papers however, shows that 5 of them (№ 3, 20-23) are actually abstracts (or photocopies) of posters and do not meet the criteria for scientific publication. That is why I am correcting and accepting that Assoc. Prof. Penchovsky participated in the competition with 20 papers, of which 13 in scientific journals, 1 book, 4 in monographs and 2 patents. Of these, 15 (including the international patent under No. 25) have been published, 4 articles are in press, and the Bulgarian patent application (No. 24) is with a decision for issueing.

According to Scopus, the above papers have a total IF = 39. They are cited (after habilitation) 319 times. Four of the articles in IF journals (№ 1, 4, 6, 9) are grouped as "articles equivalent to habilitation work", whereby Dr. Penchovski covers the criteria for indicators in Group B of the Implementing Regulations of the ZRARB.

The impact of scientific activity of Assoc. Prof. Penchovski in fulfilling the minimum national requirements under Art. 26 of the LDASRB for the scientific field 4.3. (Biological Sciences) are as follows:

Indicators of group A: dissertation - 50 p.

Group B indicators: habilitation work - 100 p.

Group D indicators (in points): Q1 publications - 75; Q4 publications - 24; published book based on dissertation - 20; book chapters - 60; inventions - 50. Total: 229 points.

Group D indicators: Citations - 638 points.

According to the above correction, 20 scientific items/papers are related to the present competition for Professor. Of these, No. 15 (representing a book written on the basis of the applicant's PhD thesis) is not a subject of peer review, as it has already been reviewed in connection with obtaining the candidate's doctorate degree. The abstracts of the talks and posters presented at scientific forums will not be reviewed as well, but they will be taken into consideration when making my final assessment.

In this review, I will refer to the papers with their original numbering (from 1 to 25) according to the attached list of papers.

### **3.2. Evaluation of the scientific papers**

The papers to be reviewed can be divided into two categories: *a) Original*, i.e. containing own (autors') results (Nos. 1, 2, 4-7, 13, 17, 24, 25) and *(b) Review articles* (Nos. 8-14, 16, 18, 19).

#### *a) Original scientific papers*

Bioinformatics is an integral part of modern molecular genetics, and in particular of genomics. Due to this, the candidate has focused his attention and efforts in this direction. In this field he is facilitated by his specialization in Applied Informatics, which complements his other specialties in Microbiology, Biochemistry, and Genetics.

Assoc. Prof. Penchovsky successfully adapts basic nucleic acid research databases to a PHP-based server, providing useful tools for a variety of analyzes with a user-friendly interface. It

creates an RSwitch database containing complete descriptions of 215 bacterial riboswitches of 16 different species found in 50 pathogenic bacterial species. The bank also contains information on RNA aptamers, the thermodynamic stability of RNA structures, free energy, centroid structures, positional entropy and more. It can trace the biochemical pathways in which the fish switches described are involved, as well as their consensus motives in relation to drug resistance, etc. The RSwitch database is freely available online (1). Using this and other available databases, Dr. Penchovsky investigates the distribution, structure, and function of 28 different classes of fish switches in bacteria that regulate gene expression by four different mechanisms of a limited number of genes important for the synthesis of major metabolites. The purpose of his research is to support the development of new antibacterial agents applicable to drug (antibiotic) resistance (6).

As a specialist in bacterial genetics and genomics, Assoc. Prof. Penchovsky is interested in the antibiotic resistance of pathogenic bacteria and the search for new antibacterial agents with a mechanism of action other than antibiotics. Such agents might be the bacterial riboswitches, most of which are allosteric cis-acting gene elements located in the 5'-untranslated region of mRNA. Their activity depends on the presence of specific metabolites through which they regulate the synthesis of other major cellular constituents. In order to identify reliable riboswitches that could serve as a basis for the creation of new antibacterial drugs, Dr. Penchovsky conducted a comprehensive *in silico* analysis of eight riboswitches in the genomes of pathogenic bacteria. Based on their suitability to be used as antibacterial drugs, they are classified into four groups. The results show that FMN, SAM-I, glmS, TPP, as well as the lysine riboswitches, are promising from the point of view of the above goal (5). This work has been awarded an international patent (25) and a decision for granting a BG patent (24).

Dr. Penchovsky has created 6 new web-based molecular biology research platforms, including DNA / RNA translation, amino-codon transformer (one-letter to three-letter coding and vice versa), virtual PCR analyzer, determination of protein hydrophobicity, reverse translator protein search engine for open reading frames in eukaryotic genomes (4). It also offers a variety of computational methods for designing allosteric ribozymes with logical functions based on oligonucleotides or small RNA molecules. Through these tools, optimal ribozyme constructs can be identified in minutes, i.e. much faster than the experimental selection methods that take weeks (13).

Paper No. 7 presents the results of the study of the NC protein gene family in *Arabidopsis thaliana*. These genes show homology to the genomes of almost all living organisms (from viruses to humans), which is an indication of their vital biological functions. Their EGL-26 homolog in *C. elegans* is involved in the regulation of morphogenesis, and human homologs resemble tumor suppressors and regulators of apoptosis. The author believes that the results these studies will contribute to clarify the functions of both HC proteins in *Arabidopsis* and to design appropriate molecules targeting plant tumors.

Assoc. Prof. Penchovsky is also an author of a brilliant methodical work (2), published in the prestigious international journal *Biosensors and Bioelectronics*, with IF = 8.17. It creates an automated system for transferring DNA with mobile superparamagnetic microbeads between two spatially separated solutions with different pH values. It is used in the production of DNA microarrays, functional screening of nucleic acids, screening of chemical libraries, amplification and sequencing of DNA and more.

*b) Review articles (Nos. 8-14, 16, 18, 19)*

Prof. Penchovsky is the author of a series of review articles published in reputable scientific journals such as IEEE Transactions on Computational Biology and Bioinformatics; Expert Opinion on Drug Discovery; Biotechnology Advances; Journal of Clinical & Medical Genomics; Biomedical Journal of Scientific and Technical Research, as well as in the monographs of Springer, Elsevier, and IGI Global. The articles were written on the basis of current literature sources at the time of publication, including own publications, which is a good approach for promoting his own scientific achievements.

Most of the review articles focuses on antibiotic resistance in bacteria and the search for new antibacterial agents based on RNA regulatory elements such as RNA aptamers, antisense oligonucleotides, small interfering (si) RNAs and ribozymes (8). The author also reviews specific RNA molecules with antibacterial activity (11), examines the mechanisms of drug resistance (16) and strategies for its prevention (12, 18).

Some of the review articles are devoted to bioinformatics. Paper № 9 discusses the capabilities of the new web-based PHP server and its 9 web-based applets for DNA, RNA, and protein analysis. The application aspects of modern software products are presented in No. 14. It discusses designing of ribozymes and approaches for their creation, as well as RNA-based approaches for molecular monitoring, diagnosis, and discovery of new antibacterial drugs. The specific features of clinical trials of therapeutic nucleic acids such as antisense oligonucleotides, aptamers, small interfering (si) RNAs and ribozymes, mainly intended for topical application, have been extensively discussed (8).

A futuristic piece of work is paper № 19, entitled "*Synthetic Approaches to Biology: Engineering Gene Control Circuits, Synthesizing, and Editing Genomes*", which outlines the technical aspects of creating new genomes and the limitations that exist on their implementation today.

The candidate's diverse interests are also illustrated by paper № 10, which discusses the potential of plant biotechnology and the plants as a future source of recombinant pharmaceutical proteins.

#### **4. Pedagogical activity**

According to the information provided by the administrative department of Sofia University, Assoc. Prof. Penchovsky has 14 years 4 months and 22 days of work experience, of which 13 years 3 months and 19 days in the field of genetics.

As a full-time lecturer at the Sofia University, he is the holder of the obligatory lecture courses (in Bulgarian and English) for full-time and part-time students of the Master's degree program (with a total annual course of 315/315 hours) in the courses "Bioinformatics and molecular evolution", "Synthetic Biology" and "Genomics" for the master programs "Genetics and Genomics" and "Genetic and Cell Engineering", as well as in the disciplines "Molecular Genetics"(30/30 hours) and "Bioinformatics"(30/15 hours) for Bachelors in the Molecular Biology and Agrobiotechnology majors. Assoc. Prof. Penchovsky also lectures on Ph.D. students in the subjects Bioinformatics and Molecular Evolution, Synthetic Biology and Genomics with a 90/90 General Curriculum. He also participates in the "Contemporary Aspects of Biology: Bioinformatics, Genomics and Synthetic biology" with a total of 90/90 hours. Thus, the applicant's total annual school employment amounts to 555/540 hours.

In addition to lecturing, Assoc. Prof. Penchovsky also participates in the training of Ph.D. students and graduates. He has supervised 16 successfully defended undergraduate students from the Sofia University, as well as 7 Ph.D. students, of which 2 defended, 2 in preparation and 3 current. He is also a supervisor of 4 after diploma qualification students in the Modern Aspects of Biology.

The contribution of this activity to the fulfillment of the minimum national requirements under Art. 2b of LDASRB, indicators of group E, is 100 points (for successfully defended doctoral students).

## 5. Scientific projects

Assoc. Prof. Penchovsky participated in the development of 16 scientific projects funded by national and European sources, of 8 of which he has been a principle investigator. The total value of the attracted funds under the projects managed by Dr. Penchovsky amounts to BGN 326,000, which brings him a total of 165.2 points (indicators of group E) according to Art. 2b of the LDASRB.

## 6. Expert, organizational and representative activity

Prof. R. Penchovsky is a member of the editorial board of the international scientific journal EC Microbiology. He has been a reviewer of scientific papers submitted to the journals ACS Synthetic Biology, Lab on a Chip, Biomacromolecules, EC Microbiology, etc. He has been a member of 2 scientific juries for Assistant Professor and 2 for Associate Professor.

## 7. Summary assessment

The summarized assessment in accordance with the Regulations for the application of the LDASRB in the field of Natural Sciences for the academic position of Professor is presented in the table below.

Indicator	Required minimum	Presented number of points
A	50	50
B	100	100
C	200	229
D	100	638
E	150	265
<b>Total</b>	<b>600</b>	<b>1282</b>

**Conclusion:** Assoc. Prof. Dr. Robert Dimitrov Penchovsky is an established researcher and lecturer in the field of genetics and genomics of microorganisms. Since the beginning of his scientific career, he has published 49 scientific papers in some of the most renowned

international journals in the fields of genetics, genomics, and bioinformatics. An indicator for the quality of his scientific output is the high IF of the published papers (IF 129), the numerous citations (349) and the high h-index (h 10). A measure of its independence is the leading place in his scientific publications (in 94% of the papers he is correspondent author). In his professional career, he has grown both as a researcher, university lecturer and research organizer. The assessment according to the criteria of the LDASRB shows (see table above) that it exceeds twice the official minimum state requirements for the academic position of Professor in the field of Natural Sciences. All of this gives me a reason to recommend to the distinguished Scientific Jury appointed to hold this competition as well as to the Faculty Board of the Faculty of Biology at the Sofia University "St. Kl. Ohridski" to award to Associate Professor Robert Penchovsky the Academic Position "Professor" in "Genetics" (molecular genetics, bioinformatics, and synthetic biology).

Sofia

27.02.2020

Referee:

/Acad. Ivan Ivanov/