O P I N I O N OF R E V I E W E R

from Prof. Zara Cherkezova-Zheleva, Institute of Catalysis - Bulgarian Academy of Sciences (member of the Scientific Jury)

on the competition for occupying the academic position **associate professor** in the professional field 4.2. "Chemical sciences", scientific specialty "Chemical kinetics and catalysis" for the needs of Laboratory "Design and characterization of catalytic materials" in the thematic field "Application of EPR spectroscopy for the investigation of radical processes" for the needs of the Institute of Catalysis at the Bulgarian Academy of Sciences,

announced in the State Gazette 47/04.06.2024

According to the Order № РД-09-54/29.06.2024, issued by the Director of the Institute of Catalysis-BAS (IC-BAS), I was appointed as a member of the Scientific Jury for accomplishing the procedure in the competition for occupation of the academic position „Assoc. professor" in IC-BAS in the professional field 4.2 „Chemical Sciences", scientific research area "Chemical kinetics and catalysis", for the needs of the Laboratory "Design and characterization of catalytic materials" in the thematic field "Application of EPR spectroscopy for the investigation of radical processes" in IC-BAS, announced in the State Gazette 47/04.06.2024.

1. Attitude on the obtained materials:

Assist. Prof. PhD Ralitsa Mladenova is the only candidate, applying for the academic position “Associated Professor” in the competition, announced by the IC-BAS for the needs of the Laboratory "Design and characterization of catalytic materials", scientific group “Center for EPR Spectroscopy”. She has submitted a full set of application documents according to the requirements of the Regulation for the Terms and Procedure for Acquisition of Academic Degrees and for Occupation of Academic Positions in the Institute of Catalysis of BAS. Assist. Prof. PhD Ralitsa Mladenova fulfils all the relevant law requirements for occupation of the academic position “Assoc. Professor”. She has submitted 22 scientific research publications in total. All of them were published after receiving of PhD degree and are an object of the current review. Based on the relevant summary submitted by the applicant it is obvious that she fulfils and even exceeds both minimal National requirements and specific requirements of IC, BAS. It should be noted that her score for group Д, В and Г indicators is above the relevant requirements. The total score of the applicant is 506 points while the minimal required points are only 430.

2. Short biographical data about the applicant:

Assist. Prof. PhD Ralitsa Mladenova graduated the Sofia University - Faculty of Chemistry in the year 2001 acquiring master's degree in chemistry and specialization "Applied Chemistry and Management". After her graduation, she was appointed to the position of chemist at IC-BAS, where she started research investigations on paramagnetic objects using the Electron Paramagnetic Resonance (EPR) method. In 2008 she was awarded with a PhD title on the topic "EPR study of thermally generated free radicals in foods", diploma No.: 32047/21.01.2008 under the supervision of Prof. N. Yordanov. After winning a competition in 2008, she was employed as Assistant Professor at IC-BAS. Since 2011, the candidate Dr. Mladenova has been working at the position of Senior Assistant Professor at the same Institute, after winning a competition. As of 12.07.2024 she has an internship in the specialty, which is more than required in the regulatory documents for the competition for the occupation of the academic position of Assistant Professor at IC-BAS.

3. Analysis of the scientific and innovative research activities of the candidate and their applications in practice

Scientific research publications:

Dr. Ralitsa Mladenova submitted 22 publications in total for participation in the competition. These include 20 scientific articles that have been published in journals with an impact factor referenced by the ISI database (Scopus/Web of Science and Google Scholar), as well as 2 publications without impact factor. There is no evidence of plagiarism in all presented scientific works. The publications submitted for participation in the competition do not duplicate the ones presented for obtaining a PhD degree. It should be noted that Dr. Ralitsa Mladenova is the first or second author in most of the competition publications, that have been published after her PhD (9 out of 22, i.e. 41% and 3 out of 22, i.e. 14%, respectively). In 2 out of 22 (9%) she is the third author and in 8 of 22 articles (36%) is a fourth or subsequent author. This shows her leading contribution to the development of the presented scientific investigations and the related innovative contributions. Despite some differences in the published data on the distribution of these publications by quartiles according to the different databases (WoS/Scopus/Scimago Journal&Country Rank), it is clear that the results of Dr. Ralitsa Mladenova's research studies have been published in prestigious international journals. According to SJR data, these publications are as follows: 14% (3 out of 22) being in the Q1 area (WoS or Scopus): Molecules, Journal of Materials Research and Technology, Materials Characterization. 41% (9 out of 22) works were published in international journals in the field of Q2: Journal of Food Measurement and Characterization, Journal of Radioanalytical and Nuclear Chemistry (2), Catalysts, Radiation Physics and Chemistry (2), Applied Sciences, Comptes rendus de l'Académie bulgare des Sciences (2). 22% (5 out of 22) papers were published in international journals in Q3: Applied Radiation and Isotopes, Radiochimica Acta, Comptes rendus de l'Académie bulgare des Sciences, Journal of Chemical Technology and Metallurgy, Oxidation Communications. 14% (3 out of 22) papers were published in international journals in Q4: Bulgarian Chemical Communication (3).

The publications participating in the competition were divided into two groups, covering the B and Г indicators, according to the Rules of the conditions and order for acquiring academic degrees and for taking up academic positions at the IC - BAS. In the first group, indicator B - "Habilitation work - scientific publications in journals that are refered and indexed in recognised scientific information databases (WoS or Scopus)" are presented 8 publications. They are valued at 129 points. According to this indicator, the required 100 points were repeatedly exceeded by the received 129 points. It should be noted that in 5 of the 8 presented articles (i.e. 63%), Dr. Ralitsa Mladenova is the first author in the research team, and in 1 out of 8 (13%) is a second author. In 6 of these 8 publications, the candidate is a corresponding author (75%). In the second group, 14 articles covering indicator Г-7 are presented. This gives a total of 249 points for this indicator, with a minimum of 220 points.

Participation in national and international scientific events:

The investigation results of Dr. Ralitsa Mladenova were presented as a total of 27 scientific presentations at international (16 out of 27) and national (11 out of 27) scientific forums, of which 1 oral report and 26 poster presentations. The most of these presentations (21 out of 27) are on the research activities conducted after the defense of her PhD thesis. 15 out of 27 posters are presented by Dr. Ralitsa Mladenova. Participation at prestigious scientific forums and presentation of scientific papers as oral or poster reports has a significant impact on her carrier. The candidate is the project leader of one project at the World Federation of Scientists - 2005-2006, and a member of the working group of 2 international, 6 national scientific projects and 2 EBR projects. The presented scientific

investigations and research papers submitted to the competition are closely related to the objectives and deliverables of these projects, 11 in total.

International recognition and significance of the scientific results

The number of citations of Dr. Ralitsa Mladenova's research works is the evidence of the international recognition and significance of her scientific results. The total number of noticed citations of 22 publications with her participation at the date of submitting her documents is 64, according to Scopus and Web of Science database. Thus, under indicator Д the candidate receives 128 points, which exceed more than 2 times the required 60 points for the position of "associate professor" in accordance with the Rules for the conditions and the order for acquiring scientific degrees and for occupying academic positions at IC - BAS. The Hirsch index (h-index) in Scopus is 7.

Therefore, according to the presented materials and each of the mentioned indicators, the candidate for the current competition - Dr. Ralitsa Mladenova fulfils the requirements for the position of "associate professor" in accordance with the Rules for the conditions and the order for acquiring scientific degrees and for occupying academic positions at IC - BAS.

4. Contributions of the scientific and innovative research activities of the candidate

The main scientific contributions of fundamental and innovative scientific research of Dr. Ralitsa Mladenova are focused on important topics of European and national priorities – investigation of gamma irradiation effects on antioxidant capacity of natural products, foods and organic compounds, as well as study of free radicals and the effect of irradiation (high-energy radiation, etc.) in organic substances. A major focus of the research is the use of the EPR method as a highly sensitive technique for the characterisation of a wide range of materials, which detects paramagnetic particles (free radicals) induced by irradiation of organic and inorganic substances. EPR provides information on the amount, chemical composition, electronic structure and behaviour of paramagnetic particles. The research carried out is an extension of her PhD thesis entitled "EPR study of thermally generated free radicals in foods". The **habilitation work** of Dr. Ralitsa Mladenova includes the results of research in following thematic areas (Publications Nos. B1-B8):

1. **Evaluation of gamma irradiation effects on antioxidant capacity of natural honeybee products based on EPR investigation.**
2. **Evaluation of gamma irradiation effects on antioxidant capacity of fruits based on EPR investigation.**
3. **Evaluation of gamma irradiation effects on antioxidant capacity of nuts based on EPR investigation.**

- **The scientific achievements at the first thematic direction** are related to **evaluation of gamma irradiation effects on antioxidant capacity of natural honeybee products [B1, B3, B4, B5]**

- EPR based investigation on the effect of gamma irradiation on the anti-radical activity of propolis (publication B1), bee bread/perga (publications B4, B3) and pollen (publications B5, B3), was reported for the first time. This systematic study reported correlation of the polyphenolic content and the radical processes occurring. The decrease in EPR signal intensity of the stable 1,1-diphenyl-2-picrylhydrazyl (DPPH) radical (as a reactive hydrogen acceptor) was monitored upon addition of a certain amount of extracts of non-irradiated and irradiated samples: bee pollen (two harvests), bee bread and propolis. The dependence of the trapped DPPH radicals on the volume of the extract of the studied samples was evaluated. This is of great importance for the practice due to the increasing application of gamma radiation in the sterilization of honeybee products.

- Important correlations were established for the influence of gamma irradiation parameters of honeybee products on their antioxidant, antimicrobial, antibacterial activities, as well as their shelf-life extension. The optimum irradiation dose (5 kGy) was found to increase the antioxidant activity of bee bread and bee pollen.

- **Evaluation of gamma irradiation effects on antioxidant capacity of fruits based on EPR investigation** is **the second thematic direction** of the investigations of Dr. Ralitsa Mladenova**:**

- The scientific achievements of Dr. Ralitsa Mladenova are related to registration of new and original results on the process of free radicals generation and their antiradical activity as a result of irradiation with different doses of dry rosehip seeds - 10 and 25 kGy (publication B2).

- The observed radical processes were analyzed and explained using the results obtained with EPR and other characterization methods in regard to establishment of more effective, clean and optimized approach for their treatment

- Original scientific results have been obtained for the dependency of the trapped stable DPPH radicals on the amount of added Goji berry extracts, by varying the treatment dose, 0.05, 2 and 10 kGy, respectively (paper B6).

In **the third thematic direction**, the investigations of Dr. Ralitsa Mladenova are devoted to **evaluation of gamma irradiation effects on antioxidant capacity of nuts based on EPR investigation:**

- New and original results were obtained for the effect of gamma radiation treatment of nuts on their free radical-scavenging activity under medium (10 kGy) and high dose (25 kGy) irradiation;

- Relationships with significant practical importance for the radical-scavenging activity of peanuts and hazelnuts with changing dose and irradiation time have been derived (publications B7 and B8, respectively).

The fundamental and applied research presented by the applicant in **the papers outside the habilitation work** includes 14 publications. In these works, the research presented as habilitation thesis has been continued and extended by adding to the EPR analysis of the effect of gamma irradiation on the anti-radical properties of foods and organic compounds [Г3, Г4], the study of free radicals and irradiation (high-energy radiation, etc.) in organic substances [Г11, Г12, Г13, Г14]. Dr. Ralitsa Mladenova's scientific and applied contributions are also related to application of EPR spectroscopy for establishment of relationships between synthesis method, structure, physicochemical and functional characteristics of materials, and their improved catalytic properties [Г1, Г2, Г5, Г6, Г7, Г8, Г9, Г10]. The studies conducted on the effect of gamma irradiation on the anti-radical activity of almonds and some organic compounds, such as ascorbic acid (AA), cysteine (Cys) and diphenylamine (DPA), focused on the benefits and drawbacks of subjecting foods and natural products to radiation treatment for their disinfection and shelf-life extension.

Thus, the applicant's scientific contributions from out-of-habilitation studies add new thematic areas to the above-mentioned habilitation work. The following important scientific contributions of the candidate should be highlighted:

- Important relations on the effect of gamma irradiation on the anti-radical properties of foods and organic compounds have been established by application of EPR spectroscopy (publications Г3, Г4);

- Comparative analysis of free radicals and the effect of external influences such as high-energy radiation, etc. have been investigated. EPR spectroscopy of various organic substances (publications Г11, Г12, Г13, Г14), providing important information on the type

and stability of the generated paramagnetic particles in the samples. The effect of the preparation method of some foods, such as pasta products, and the storage conditions on the amount of induced free radicals was determined. The preservation of the primary structure of hyaluronic acid samples irradiated with X-rays and different laser radiation wavelengths (511, 578, 808 and 1540 nm) were studied by Fourier transform infrared spectroscopy (FT-IR) and Electron Paramagnetic Resonance (EPR) spectroscopy. Methodologically, EPR spectroscopy was applied as a sensitive and effective analytical technique to identify radiation treatment in green tea samples;

- EPR spectroscopic analysis has been successfully used to characterize catalytic materials and to explain their catalytic behaviour, as well as the influence of preparation method and doping effect. The oxidation and coordination state of paramagnetic ions have been investigated in details. Important information on the presented defects (such as surface defects, radicals, free and trapped charge carriers or clusters) on photocatalytic properties of the catalytic material have been established (publications Г1, Г2, Г5, Г6, Г7, Г8, Г9, Г10).

Based on the review of the submitted documents for the announced competition and my personal opinion, it can be concluded that Dr. Ralitsa Mladenova is a young and active scientist with great potential for systematic research and in-depth investigations, whose competence is very much appreciated. The discussed scientific contributions and the results achieved by Dr. Ralitsa Mladenova are a step forward for improvement of food treatment technology and new catalyst development. The author's contributions are significant and correctly presented. They logically follow the obtained results. Applicant's scientific papers submitted for participation in the competition are completely in the field of the area 4.2 "Chemical Sciences" and in particular are fully in line with the scientific specialty "Chemical kinetics and catalysis" with focus on the topic "Application of EPR spectroscopy for the investigation of radical processes".

CONCLUSION: The documents and the materials presented by Assist. Prof. Dr. Ralitsa Mladenova meet all the requirements of the Law for the Development of the Academic Staff in the Republic of Bulgaria, the Regulations for its implementation and the corresponding rules for the implementation of the law in the IC - BAS. The candidate submitted a sufficient number of scientific papers, published after the receiving the PhD degree. The obtained results based on the research activity of Dr. Ralitsa Mladenova are original and have significant scientific contribution to the studied area. They completely fulfilled the relevant requirements of IC for occupation of the academic position "Associate Professor" in the field of competition. I strongly support the application and also recommend to the members of the Scientific Jury and to the Scientific Council of the Institute of Catalysis to award to the Assist. Prof. Dr. Ralitsa Mladenova the academic position "Associated Professor" under the professional field 4.2. “Chemical Sciences”, scientific specialty "Chemical kinetics and catalysis".

17/09/2024
Sofia

Reviewer:

(Prof. Dr. Z. Cherkesova-Zheleva,
Member of the Scientific Jury)