

SCIENTIFIC OPINION

by Assoc. Prof. Eng. Georgi Evgeniev Chernev, PhD, University of Chemical Technology and Metallurgy, Sofia, elected to the Scientific Jury Order № I-108/31.07.2024. of the Director of the Institute of Microbiology "Stefan Angelov" - BAS, on a PhD thesis **on the topic “New photosensitizers and carbon composites as antimicrobial agents”**, with author Marieta Dimitrova Belcheva for the acquisition of the educational and scientific degree “doctor” in the field of higher education: 4. Natural sciences, scientific specialty 4.3. “Microbiology” with scientific supervisors prof. Lyudmila Kabaivanova, PhD and prof. Boyko Cintsarski, PhD.

As a member of the scientific jury, I have received all the necessary documents for the disclosure procedure for the defence of the PhD thesis by the student Marieta Dimitrova Belcheva according to the ZRASRB and the regulations for its application.

1. General presentation of the procedure and the dissertation

Marieta Dimitrova Belcheva completed her higher education in 2001 at the Medical University of Sofia with the qualification - Master of Medicine, as well as at the SU "St. Kliment Ohridski" with the qualification "Master of Chemistry and Physics". In 2023, he was enrolled as a free doctoral student at the Stefan Angelov Institute of Microbiology.

2. Relevance of the topic

The topic of the PhD thesis is related to research on new therapeutic agents, methods and techniques with a mechanism of action different from that of the widely used antibiotics and chemotherapeutics, which are gaining more and more importance due to the rate of growth of drug resistance. In recent years, available treatment methods for bacterial reduction in periodontology and cardiology have become increasingly effective. In order to further optimize the fight against bacterial infections in the oral cavity and their prevention and to obtain a better bacterial reduction while minimizing the negative consequences of the methods used today, the effect of photodynamic inactivation of new metal-containing phthalocyanine photosensitizers against some of the most common microorganisms. This is also the basis for the motivation of the PhD student and her supervisors for choosing the topic, its relevance and practical importance.

The content of the dissertation fully covers the announced nomenclature specialty in professional direction 4.3 Biological Sciences, scientific specialty "Microbiology" for the award of the ONS "Doctor".

3. Knowing the problem

The PhD thesis is constructed in a traditional form including introduction, literature review, aim and objectives, materials, methods, results and discussion, conclusions and contributions. It is written on 148 typewritten pages, includes 4 tables and 56 figures. The literature review is based on 304 publications corresponding to the set tasks. All aspects of the problem are discussed in detail, including research from recent years, but without neglecting the historical reference.

4. Research methodology, characterization and evaluation of the PhD thesis and contributions

For the purposes of the development in the provided dissertation, according to the literature review, microorganisms relevant to health and suitable for the topic of the study were selected. The experiments were made based on a selection of different collections of cell cultures from Bulgaria and abroad. In the process of work, clinical isolates of interest were also selected. For the experiments with metal-containing phthalocyanine photosensitizers, *in vitro* biofilm models were also performed. The dissertation is written in a good scientific style, with accurate use of terminology, which shows that the doctoral student knows the subject matter professionally. The literature review is structured correctly with direct reference to the purpose of the dissertation and the tasks set. The overview of the dissertation work presents microbiological characteristics of clinically significant microorganisms; clinical manifestations of selected pathogens; existing problems in the administration of antimicrobials to treat infections or kill organisms; the essence of the photodynamic therapy method, as well as the main types of activated carbon composites, their methods of impact and application in practice are described in detail. The aim of the dissertation work is formulated precisely and clearly, including testing the antimicrobial action of newly synthesized, metal-containing phthalocyanine photosensitizers and carbon composites, with a view to their application, respectively, as an alternative in the fight against infections in the maxillofacial region and as antibacterial agents in the purification of air. To achieve the goal, 2 main tasks have been formulated, each of which includes four sub-tasks that complete the set goal. The main results are presented according to the set tasks and the selected methodical approaches and in their essence are a thorough characterization of the antimicrobial potential of newly synthesized metal-containing phthalocyanine photosensitizers and carbon composites.

The main contributions of the dissertation can be formulated as follows:

- New carbon composites were synthesized using a new ecological technology from waste products as precursors.
- The enhancement of the qualities of metal-containing carbon composites and the expansion of their applications as antibacterial components, by combining the properties of metals and activated carbon, have been proven.
- The results obtained in the *in vitro* experiments can serve to prepare a protocol for further *in vivo* experiments.

- It has been proven that the use of photosensitizers and newly synthesized activated carbon composites is a new approach to reduce the excessive use of antibiotics in line with the modern trend of overcoming antibiotic resistance.

5. Assessment of the publications and personal contribution of the doctoral student

The data obtained because of the development of the dissertation work have been presented in 3 scientific publications and have been presented at 5 scientific forums. Articles published in Diamond & Related Materials journals with Q2 quartile; Proceedings of the SPIE with SJR 0.24 and Problems of Dental Medicine. One citation was noted on the publication in Proceedings of the SPIE. Reports have been presented at 2 international and 3 national forums. This gives me reason to believe that the results of PhD student Marieta Belcheva have become available to our and the international scientific community. In most of the presented publications and participation in scientific forums, the doctoral student is in the first place, which is proof of her personal contribution to the development of the dissertation work.

6. Conclusion

In conclusion, I consider that the PhD student has fulfilled the requirements of the ZRASRB, as well as those in the Rules for it of the Institute of Microbiology, BAS for the acquisition of the educational and scientific degree "doctor". The material presented by PhD student Marieta Belcheva is dissertation able, the topic is current and offers a modern level of an important issue for theory and practice. The conducted experiments are set methodically correctly, the obtained results are reliable and are a solid basis for further scientific and applied developments. A huge amount of experimental work has been carried out, and the problem has been multifaceted and studied in detail at a modern level, and significant contributions have been made. Based on the opinion made and the proven growth of the PhD student, I propose to the respected members of the scientific jury to award Marieta Belcheva the educational and scientific degree "Doctor" in the field of science 4.3 Biological Sciences (Microbiology).

20.09.2024

Prepared the opinion:

/assoc. prof. eng. Georgi Chernev, PhD/