Appendix 12a

REVIEW

of dissertation for the acquisition of:

educational and scientific degree " **doctor** "	**X**
scientific degree **"Doctor of Science"**	
	the true is indicated by the sign "X"

Author of the dissertation:

assistant		Yoana	Dinkova	Stoyanova	Department of Biotechnology, Faculty of chemical and system engineering department of biotechnology, University of chemical technology and metallurgy
academic position	scientific degree	name	middle name	last name	workplace

Topic of the dissertation:

Waste products from the essential oil industry – utilization and biological activity

Scientific area:

5	Engineering sciences
code	name

Professional area:

5.11	Biotechnology
code	name

Scientific specialty:

Technology of Biologically Active Substances

The review was written by:

Assoc. prof.	PhD	Zlatka	Miltcheva	Alexieva	retired
academic position	scientific degree	name	middle name	last name	workplace

1. Completion of the provided documents:

A) The dissertation and the competition documents are in full compliance with the Regulations.	4 points	**X**
B) The documents are complete but do not fully comply with the requirements of the Regulations.	2 points	
C) The documents are not completed in accordance with the requirements of the Regulations.	0 points	
		one of the answers given is marked with the sign "X"

Missing documents and violated standards must be described if response C is marked.

2. Meeting the minimum requirements under the Regulations:

A) The candidate meets the minimum requirements	20 points	**X**
B) The candidate doesn't meet the minimum requirements	0 points	
		one of the answers given is marked with the sign "X"

It must be filled in if answer B is marked. The publication activity of the candidate is analyzed. The response of the results achieved (quoted) is analyzed.

3. The relevance of the topic of the dissertation:

A) The topic is relevant and new (there are no known results on the topic by other authors)	8 points	**X**
B) The topic is relevant and results from other authors are known	6 points	
C) The topic is not relevant, but results from other authors are known	2 points	
D) The topic is not relevant and no results from other authors are known	1 point	
E) The topic does not correspond to the level of dissertation	0 points	
		one of the answers given is marked with the sign "X"

The evaluation of the relevance of the dissertation must be substantiated
Over time, the issue of removing dangerous industrial pollutants from the environment remains relevant. Waste products build up as a result of processing essential oil crops, which might lead to environmental issues. However, there are several beneficial biologically active compounds in waste biomass that may be put to use. Because there aren't enough successful scientific advancements in

this field, it's currently difficult to develop technologies that enable the breakdown of waste plant biomass and the extraction of useful BAC. Secondly, its reuse aligns with the principles of circular waste-free technology.

4. Knowledge of the problems, subject of research in the dissertation:

A) The doctoral student knows in detail the achievements of other authors on the topic of the dissertation	8 points	**X**
B) The doctoral student is partially familiar with the achieved results on the topic of the dissertation	4 points	
C) The doctoral student has no prior knowledge of the status of the problems in the dissertation	0 points	
		one of the answers given is marked with the sign "X"

The evaluation must be substantiated if answer C is marked.
The literature review of the dissertation provides detailed information on the available achievements of science and practice in the field of extraction of essential oils, their importance and application in the field of various industries - pharmaceutical, cosmetic, food, agricultural, etc. The review presents information on waste products obtained in the production of essential oils. Considerable attention is paid to technological approaches for studying the efficiency of the processes of membrane filtration, spray drying and precipitation. The possibilities for their application in studying the substances contained in waste materials, with important biological activity, which opens up the prospects for their utilization are indicated. The importance of research in efforts to protect the environment is also emphasized. The doctoral student, Eng. Yoana Stoyanova shows complete knowledge of the topic related to the subject of the dissertation, as a result of which she clearly identified the unresolved problems and substantiated the scientific and applied significance of the presented work.

5. Type of research:

A) Theoretical	4 points	
B) Applied	4 points	
C) Theoretical with application elements	4 points	**X**
D) It does not correspond to the level of dissertation	0 points	
		one of the answers given is marked with the sign "X"

The level of research must be substantiated if answer D is marked.

6. Objectives of the research:

A) Realistic and of scientific and / or applied interest	8 points	**X**
B) Realistic, but not of scientific and / or applied interest	3 points	
C) Unattainable (unrealistic)	0 points	
		one of the answers given is marked with the sign "X"

Objectives must be specified. The type of the set objectives must be justified.
The goal set to study the biological activity of waste products from the production of essential oils of rose, lavender and clove and to study the effectiveness of the processes of membrane filtration, spray drying and precipitation as methods for their utilization is realistic and defines research of a scientific nature, which also has applied significance. To achieve the goal, 5 tasks have been formulated, which define the scientific nature of the planned research.

7.Methods of research:

A) Adequate to research and set objectives	8 points	
B) Partially appropriate, enabling part of the scientific objectives and / or applications to be achieved	4 points	
C) Inappropriate methods	0 points	
		one of the answers given is marked with the sign "X"

Methods must be specified. The type of methods used is justified.
In the experimental part of the dissertation, classical and modern approaches are used, such as hydrodistillation, extraction of waste plant material (solid-liquid extraction), batch membrane filtration, spray drying. The spray drying experiments are carried out at the Institute for Solid State Processes and Particle Technology, Hamburg-Harburg University of Technology (TUHH), Germany. The work carried out in the process include cultivation and determination of antibacterial activity of waste products from the production of essential oils (disk - diffusion method and broth microdilution method), determination of antioxidant activity of waste fractions (DPPH method, UV/Vis Spectrophotometer), study of the chemical composition of waste fractions by High Performance Liquid Chromatography (HPLC) and Gas Chromatography (GC), determination of dry matter in liquid samples of the waste fractions (Rotary Vacuum Evaporator). Membrane selectivity has defined by determining membrane retention coefficients. The methods used are appropriately selected to achieve the scientific goals of the dissertation.

8. Contributions of the dissertation:

A) With lasting scientific and / or applied response, they form the basis for new research and applications	20 points	**X**
B) They are of significant scientific and / or applied interest, complete and / or summarize previous research	16 points	
C) They are of scientific and / or applied interest	12 points	
D) Lack of significant contributions	8 points	
E) Lack of contributions	0 points	
		one of the answers given is marked with the sign "X"

Contributions must be specified. The type of results achieved must be justified.
The contributions of this dissertation can be grouped into several main areas: Study of the biological activity of waste fractions from the production of essential oils, which includes studies related to the antibacterial activity and antioxidant activity of waste fractions from the production of essential oils; Development of effective methods for extraction and concentration of bioactive compounds from these

waste fractions using membrane technologies; The influence of the spray drying method and precipitation of waste fractions on the antioxidant activity of the studied samples. The object of analysis in the different parts of the dissertation were waste products from the production of lavender, carnation and rose oils, which are key crops in the production of essential oils in Bulgaria. The most serious and comprehensive attention is paid to the waste mass from the processing of lavender. All contributions formulated in the final part of the dissertation are of an original scientific nature and constitute the basis for new areas of research and applications.

9. Evaluation of the compliance of the dissertation summary with the dissertation:

A) Full compliance	4 points	**X**
B) Compliance of the main parts	2 points	
C) Lack of compliance of the main parts	0 points	
		one of the answers given is marked with the sign "X"

The evaluation must be substantiated if answer C is marked.
The Abstract fully reflects the processes, the results obtained, and the formulation of the conclusions and contributions of the dissertation work. It also demonstrates a large part of the figures and tables that perfectly illustrate the experimental results.

10. Participation of the doctoral student in the achievement of the results of the dissertation:

A) The doctoral student has at least an equal participation	8 points	**X**
B) The doctoral student has secondary participation	5 points	
C) The participation of the doctoral student is unnoticeable	0 points	
		one of the answers given is marked with the sign "X"

Critical notes must be provided if one of the items B or C is marked.
The presented dissertation work and the author's report on the results, presented by Asst. Prof. Yoanna Stoyanova, prove personal contribution to the experimental development, analysis and interpretation of the majority of the scientific results. 3 scientific publications on the topic of the dissertation are presented, in two of which doctoral student Yoanna Stoyanova is the first author, which shows her equivalent participation in the research work, scientific contributions and publication of the scientific results.

11. Critical notes:

A) Lack of critical notes	8 points	
B) Critical notes of a technical nature	7 points	
C) Critical notes that would partially improve the results achieved	4 points	
D) Significant critical notes	0 points	

		one of the answers given is marked with the sign "X"

Critical notes must be provided if one of the answers C or D is marked.
In some parts of the manuscript, textual errors occur when citing experiments carried out by other authors. The list of references contains sources that do not contain all the necessary data for citation, e.g. 11, 12, 13, 17, 33, 40, 52, 54, 62, 65, 69, 81, 91, 119, 120, 121. Assuming that “the bacteriostatic effect of growth inhibitors and subsequent adaptation to them, and on the other hand, of spores that have entered and sprouted from the distillate” (p. 68), may be the reason for the lack of reduction in the effect of lavender distillate, it should be noted that E. coli does not sporulate. The errors identified are of a technical nature and do not have a real impact on the high value of the dissertation work.

12. Conclusion

A) The evaluation of the dissertation is **POSITIVE**	This evaluation is assigned to a total number of at least 65 points	**X**
B) The evaluation of the dissertation is **NEGATIVE**	This evaluation is assigned to a total number below 65 points	
		one of the answers given is marked with the sign "X"

To be filled in at the request of the reviewer
The topic of processing and utilization of waste products from the essential oil industry is an interesting and promising direction for research, with the aim of solving a number of biotechnological and environmental problems. A very large volume of work has been carried out, which provides sufficiently original results for the successful completion and defense of the dissertation. On the other hand, the development provides opportunities and perspectives for continuing the topic and solving additional and new problems arising from the conclusions made. The presented dissertation work formulates 9 conclusions reflecting the obtained results and 9 original scientific and scientific-applied contributions. A large part of the results have been published in authoritative scientific journals, referenced in the Scopus and Web of Science databases. The development of doctoral student Yoana Stoyanova as a highly qualified, methodologically prepared specialist is demonstrated both by the logical connection of the obtained results and their interpretation, and by the mastery of a rich arsenal of classical and modern analytical and engineering methods applied in the research. The dissertation submitted for official defense on the topic "Waste products from the essential oil industry - utilization and biological activity", by doctoral student Yoana Stoyanova, fully complies with all the criteria reflected in the Law on the Development of the Academic Staff in the Republic of Bulgaria and the Regulations for its implementation. Based on everything mentioned so far, I strongly suggest that my colleagues on the Scientific Jury vote to award the scientific and educational degree "Doctor" to Yoana Dinkova Stoyanova in the professional field 5.11. Biotechnology.

17.03.2025	The review was written by:	
date		signature