

**REVIEW**

of dissertation for the acquisition of:

educational and scientific degree " <b>doctor</b> "	X
scientific degree " <b>Doctor of Science</b> "	
	the true is indicated by the sign "X"

**Author of the dissertation:**

	Masters	Maria	Tsvetanova	Mondashka	
academic position	scientific degree	name	middle name	last name	workplace

**Topic of the dissertation:**

COMBINED METHODS FOR THE SEPARATION AND CONCENTRATION OF EXTRACTS FROM NATURAL RAW MATERIALS USING GREEN SOLVENTS
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**Scientific area:**

5	Technical sciences
code	name

**Professional area:**

5.10	Chemical technologies
code	name

**Scientific specialty:**

Unit operation in Chemical and Biochemical Engineering
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**The review was written by:**

Assoc. Prof.	Dr.	Chavdar	Petrov	Chilev	UCTM
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"
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Missing documents and violated standards must be described if response C is marked.

The PhD candidate Maria Tsvetanova Mondashka has submitted the complete set of documents required for the initiation of a PhD defence procedure, in accordance with the regulations of the University of Chemical Technology and Metallurgy, Sofia.

It is noteworthy that the submitted documents are well organised and arranged in chronological order, reflecting the progression of the doctoral research, which facilitates easy access to the required information.

The PhD candidate Maria Mondashka has successfully passed all required examinations specified in the individual study plan with excellent results and has been granted the right to proceed to defence.

## 2. 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	
B) The topic is relevant and results from other authors are known	6 points	X
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

The topic of extracting bioactive compounds from plant materials is highly relevant, as it combines fundamental scientific research with practical applications of significant potential. In the present study, a comprehensive approach to the development of extraction methods is defined, based on the integration of appropriately selected extraction solvents, adequate pre-treatment of the raw material, and well-controlled operating conditions.

The study explores the potential for broader utilization of one of the well-established medicinal plants—*Hypericum perforatum* (St. John's Wort)—as a source for the production of both traditional and novel products for various applications. Nevertheless, this research area is not entirely new. Numerous studies have been published on the characterization of parameters influencing the extraction process of bioactive compounds from plant materials. In addition, there are scientific works specifically focused on the use of *Hypericum perforatum* for the production of various medicinal products.

Considering the importance of the challenges related to environmental aspects and sustainable development, the relevance of the present dissertation can be regarded as indisputable. The stated relevance is appropriately reflected in the defined research objectives and tasks.

## 3. 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
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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.

In the development of the theoretical and methodological framework of the doctoral thesis, the PhD candidate has utilised a broad range of scientific sources. The literature review includes 173 references, a significant proportion of which have been published within the last five years. The cited sources cover the main theoretical and applied areas relevant to the subject of the dissertation. A systematic analysis of the available information is presented, clearly demonstrating the candidate's strong interpretative skills and critical approach to the existing knowledge and established findings in the field.

#### 4. Type of research:

A) Theoretical	4 points	
B) Applied	4 points	
C) Theoretical with application elements	4 points	<b>X</b>
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.

The presented doctoral thesis includes substantial theoretical calculations related to the recovery of biologically active compounds from waste biomass generated by the essential oil industry. Mathematical models are proposed to describe the extraction of residual biologically active substances using different types of nanomembranes. In addition, a series of biological studies have been conducted on the concentrated extracts, including assessments of their antibacterial and antioxidant activity.

#### 5. Objectives of the research:

A) Realistic and of scientific and / or applied interest	8 points	<b>X</b>
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 object and subject of the research, as well as the aim, objectives, and research hypothesis, are appropriately defined. An overall outline of the methodology and the information base of the doctoral study is also provided.

The primary aim of the dissertation is to expand the methodology for studying the extraction of medicinal plants using both conventional and non-conventional plant-based solvents, incorporating environmental indicators as well as parameters related to the quality and safety of the obtained extracts.

The stated aim is realistic, well justified, and clearly motivated, representing significant scientific and practical interest. The specific objectives formulated to achieve this aim are likewise realistic and have been fully accomplished within the scope of the study.

#### 6. Methods of research:

A) Adequate to research and set objectives	8 points	<b>X</b>
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, both classical and modern approaches have been employed for the preparation and analysis of the target samples:

1. Classical extraction methods, namely maceration (without agitation) and Soxhlet extraction, were used for the isolation of the main groups of extractable compounds. These were carried out in two variants: an initial extraction with volatile non-polar solvents (hexane, petroleum ether, chloroform), followed by extraction with aqueous–alcoholic solvents. As an alternative approach for process intensification, ultrasound-assisted extraction was applied, either independently or in combination with agitation and heating. The influence of key parameters on extraction yield and kinetics was investigated, including the solid-to-liquid ratio, number of successive extraction steps, temperature, agitation method, and particle size distribution of the plant material.
2. Phytochemical analyses were conducted in accordance with standard methods described in the European Pharmacopoeia (Ph. Eur. 9.0, 2017) and the monographs of the Committee on Herbal Medicinal Products of the European Medicines Agency (EMA, 2019). These included:
  - Gravimetric methods for determining moisture content (loss on drying) of plant samples (dw) and total extractable matter (dE);
  - Spectrophotometric methods for the quantitative determination of major classes of compounds:
    - total hypericins (HYPs), expressed as hypericin and its derivatives (mg/g dw);
    - total polyphenols (TPC), determined by the Folin–Ciocalteu method and expressed as gallic acid equivalents (mg GAE/100 g dw);
    - total flavonoids (TFC), determined by a colourimetric method using AlCl<sub>3</sub> and expressed as quercetin equivalents (mg QE/100 g dw);
    - total chlorophyll and carotenoid pigments (TChr and TCar), determined by direct spectrophotometric measurement (mg/g dw).

Infrared spectroscopy (IR) was employed for the identification of functional groups of the main components, supporting the theoretical investigation of the influence of molecular structure on solubility. A combined IR and UV–Vis methodology was further applied to assess the stability of active compounds and solvents under sunlight exposure (photo-oxidation), thermal treatment (thermo-oxidation), and ultrasonic conditions. In addition, MTT assays were performed to evaluate potential cytotoxic activity.

The experimental methods employed represent a well-balanced combination of classical and modern approaches and have been appropriately applied to obtain reliable and meaningful results. The quality of the data, as well as their analysis and interpretation, is highly commendable. In conclusion, the selected experimental methods are appropriate and enable the successful achievement of the objectives set in the doctoral thesis.

#### 7. Contributions of the dissertation:

A) With lasting scientific and / or applied response, they form the basis for new research and applications	20 points	
B) They are of significant scientific and / or applied interest, complete and / or summarize previous research	16 points	<b>X</b>
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 structure and content of the doctoral thesis presented by Eng. Mondashka provide sufficient grounds to conclude that this research work contains a number of significant and well-defined contributions.

From a theoretical and applied perspective, the contributions are associated with the development of an original methodology for the preliminary assessment of solvent suitability for the extraction of biologically active compounds from plant raw materials. This methodology is based on the combined use of Hansen solubility parameters and (eco)toxicological indicators. The limitations of the Hansen model in predicting solvent suitability for specific processes in binary and multicomponent systems over a wide polarity range are also clearly demonstrated.

The applied aspects are reflected in the proposed scheme for the integrated utilisation of raw materials and the stepwise production of three types of extracts with different properties and intended applications. These extracts may be used either independently or as components in natural cosmetics and pharmaceutical products.

Accordingly, I fully accept the five contributions defined by the PhD candidate. These contributions are of an original scientific nature, build upon previous research, and provide a solid basis for further developments and applications.

#### 8. Evaluation of the compliance of the dissertation summary with the dissertation:

A) Full compliance	4 points	<b>X</b>
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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 of Maria Tsvetanova Mondashka has been prepared in a concise 48-page format and follows the structure and content of the doctoral dissertation. It is written in a clear and precise manner, with accurate and well-articulated language. The content of the abstract fully corresponds to the description of the experiments, obtained results, analyses, and conclusions presented in the dissertation, providing a coherent and logical synthesis that naturally leads to the stated conclusions and contributions. The abstract fully meets the requirements of the applicable regulations (PPZRAS).

#### 9. 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	<b>X</b>
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.

I have known the PhD candidate Maria Mondashka since her enrolment in the Department of Chemical Engineering and have had the pleasure of working with her and participating in discussions regarding the results she has achieved. I have had the opportunity to personally observe her unquestionably positive qualities, her dedication to work, and her commitment to professional development, both in the subject matter of her dissertation and in related areas concerning the study of biologically active compounds and their activity.

I consider that the candidate has made a significant contribution to the execution of experiments and the presentation of the research results included in the dissertation. In one of the publications, she is listed as the first author, and in another as the third. Although both publications are co-authored, I regard this as evidence that the candidate has at least an equivalent level of participation. No detailed protocol indicating the percentage of contribution among authors has been provided, which suggests equal involvement of the co-authors.

The dissertation itself, combined with my direct impressions of Eng. Maria Mondashka's participation in scientific forums presenting results related to her dissertation, leaves me with no doubt regarding her substantial and equitable contribution to achieving the described results.

#### 10. Critical notes:

A) Lack of critical notes	8 points	
B) Critical notes of a technical nature	7 points	<b>X</b>

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.

As a point of criticism, I could highlight the poor visual quality of some of the presented figures, which may render them difficult to read. There is also the use of inadequately defined terms, such as “plant-based medicines – p.154” and “the BAC complex – p.154,” which require either further clarification or redefinition.

Overall, my assessment is that the dissertation does not contain any significant omissions or evident errors that would diminish the evaluation of its scholarly quality.

## 11. Conclusion

A) The evaluation of the dissertation is <b>POSITIVE</b>	This evaluation is assigned to a total number of at least 65 points	<b>X</b>
B) The evaluation of the dissertation is <b>NEGATIVE</b>	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 proposed doctoral dissertation by Eng. Maria Tsvetanova Mondashka, entitled “COMBINED METHODS FOR THE SEPARATION AND CONCENTRATION OF EXTRACTS FROM NATURAL RAW MATERIALS USING GREEN SOLVENTS”, fully complies with the requirements of the Act on the Development of the Academic Staff in the Republic of Bulgaria, its implementing regulations, and the Rules for the Conditions and Procedures for Awarding Scientific Degrees and Holding Academic Positions at the University of Chemical Technology and Metallurgy – Sofia, for the award of the educational and scientific degree of Doctor.

Taking into account the scientific contributions of the dissertation, as well as the professional and research qualities of the author, I am of the opinion that the thesis constitutes a complete, original, and significant piece of scholarly work. On this basis, I confidently express my **positive evaluation** and strongly recommend the awarding of the educational and scientific degree “Doctor” (PhD) to Eng. Maria Tsvetanova Mondashka in the professional field 5.10 Chemical Technologies.

Date	The review was written by:	Signature
07.04.2026	Assoc. Prof. Dr Eng. Chavdar Petrov Chilev	