PHD FINAL EXAMINATION 2025 - REVIEW

Valutazione/Review Id: **2182708**

1 VALUTAZIONE/REVIEW

1.1 Dati del candidato per cui si sta eseguendo la valutazione / PhD student Personal Data

Cognome /
Surname

KRAUTFORST

Nome /
Name

KAROLINA

Titolo della tesi / Title of the
Thesis

Extraction of Algal Pigments and Their Encapsulation in Lyotropic Liquid Crystalline Nanoparticles for Anticancer Applications

1.2 Dati del valutatore / Evaluator's data

Nome/Name	Vitalij	**Cognome/Surname**	Novickij

E-mail

vitalij.novickij@vilniustech.lt

Università di afferenza/Reviewer's
University

Vilnius Gediminas Technical University

Indirizzo dell'Università di afferenza/Reviewer's University full postal
address

Plytines g. 27, P1-424, LT-10105, Vilnius, Lithuania

Aree di ricerca/competenza / Areas of
research/expertise

Anticancer therapies, pulsed electromagnetic field effects, drug-resistance

✔ Si dichiara di aver preso visione della informativa sul trattamento dei dati personali
I declare I have read the information notice on personal data treatment

1.3 Qualità scientifica / Scientific quality

Originalità dei risultati ottenuti / Originality of thesis
results

Ottimo / Excellent

Rilevanza dei risultati nel contesto scientifico / Relevance of results in the scientific context

Ottimo / Excellent

Rigore metodologico / Methodological accuracy

Molto buono / Very good

Descrizione delle procedure sperimentali / Description of the experimental procedures

Molto buono / Very good

1.4 Chiarezza e sintesi della tesi / Clearness and synthesis of the thesis

Chiarezza complessiva della tesi / Overall thesis clearness

Ottimo / Excellent

Chiarezza nella presentazione dei risultati, inclusa la completezza dei dati presentati / Clearness of results presentation including completeness of figures presented

Ottimo / Excellent

Completezza delle fonti / Completeness of references

Ottimo / Excellent

1.5 Valutazione complessiva della tesi / Overall evaluation of the thesis

Valutazione complessiva della tesi / Overall evaluation of the thesis

Ottimo / Excellent

1.6 Valutazione / Review

Valutazione finale / Overall evaluation

Il/La dottorando/a può essere ammesso/a all'esame finale
The candidate can be admitted to the final examination.

Commenti generali sulla tesi e suggerimenti - Esplicitare con chiarezza le modifiche/integrazioni richieste

General remarks on the thesis and suggestions - Clarify the corrections/additions requested

This thesis presents a compelling exploration of innovative strategies to address the limitations of traditional anticancer therapies, focusing on the synergistic potential of photodynamic therapy (PDT), nanomedicine, and sustainable marine biomass-derived compounds. The actuality is supported by the pressing challenges in oncology, such as drug resistance, side effects, and metastasis risk.

The rationale for utilizing marine algae as a source of bioactive compounds is well-justified, emphasizing both environmental sustainability and therapeutic potential. The incorporation of microwave-assisted extraction (MAE) as an eco-friendly technique further strengthens the study's alignment with sustainable practices. As a model pancreatic cancer (BxPC-3 cells) was specifically chosen, given its notorious resistance to conventional therapies.

A key strength of the dissertation lies in use of nanoparticles (cubosomes) to overcome the hydrophobicity and instability of algal pigments (e.g., chlorophylls and caulerpin). The comparison between Pluronic-free (TS-CUB) and Pluronic-based (CUB) cubosomes is intriguing, suggesting potential advancements in biocompatibility and drug delivery efficiency. The methodology used in the thesis, including scattering/microscopic techniques and in vitro assays is a wholesome and finished work.

The conclusions are important, match the work to broader implications for sustainable nanomedicine and marine biomass valorization. The statistical methods employed in the work are adequate.

Overall, the thesis is well-structured, involves interdisciplinary approach to anticancer therapy, merging nanotechnology, PDT, and green chemistry. It succeeds in framing the novelty and relevance. The work holds significant promise for both oncology and environmental sustainability, warranting attention from researchers in drug delivery and marine bioresources.

The thesis is well-published in high impact journals, where the PhD thesis author is first or second author confirming her contribution. The chapters are detailed enough and sufficiently published in CA WOS journals.

I also have several open questions:

1. The study focuses on in vitro assays (BxPC-3 cells). Does the formulation retain efficacy in in vivo models (e.g., pharmacokinetics, tumor penetration)?
2. Are there immune responses or off-target effects not captured in monolayer cell cultures?
3. Are there degradation issues with hydrophobic compounds (e.g., chlorophylls) during long-term storage?
4. How do TS-CUB formulations compare to other nanoplatforms (e.g., liposomes, polymeric NPs) in terms of cost, efficacy, and scalability?
5. Is the superiority of TS-CUB over TS-HEX consistent across other cancer types, or is it melanoma/pancreatic-specific?
6. Are algal-derived compounds amenable to Good Manufacturing Practice (GMP) standards and bioethical issues?
7. Could batch variability in natural extracts affect reproducibility in clinical trials?
8. What are the in vitro model limitations? How stable are the cubosomes under physiological conditions (e.g., in serum)?
9. Does the nanocarrier improve tumor targeting, or is uptake enhancement non-specific (e.g., also affecting healthy cells)?
10. Does light penetration depth limit the therapeutic efficacy in deep-seated pancreatic tumors?
11. Are there resistance mechanisms that could limit its long-term efficacy?

Even though the thesis raised several open questions, the thesis itself, the dissemination and the results are of high quality. In my opinion it is a finished work, meeting the international standards for PhD works and the candidate can proceed to further procedures for attaining her PhD degree.