

External Thesis Reviews

MSc Defenses 2025

Student Details

Profile: Pharmaceutical ecology
Student Bensaada Hichem

Reviewer Details

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MSc Thesis Review and Evaluation

1. Brief Summary of the Thesis

MSc thesis is aimed to conduct a side-by-side comparison of BSA- and KK46-functionalized CNTs as vectors for siRNA delivery, and to develop a simple approach for harvesting plant-derived exosome-like nanoparticles (PELNs), in particular from ginger, as a natural siRNA delivery alternative. This thesis is clearly written and well organized.

2. Strengths

The strengths of this MSc thesis are connected with high quality of review part as well as results of experimental part related to CNTs functionalization and comprehensive analysis.

3. Weaknesses

It would be useful to add results of simulation and compare with experimental data for BSA- and KK46-functionalized CNTs.

4. Questions

Did you evaluate the quantum yield of photoluminescence? Would be useful to compare the typical value of quantum yield with literature data.

Why does siRNA attach better to KK46 than to BSA according to ζ -potential?

Why does the intensity of PL signal and binding to siRNA change depending on the ratio of SWCNT and BSA, KK46 (1:5, 1:2.5, etc.)?

5. Recommended grade

A

Signature facsimile



Dr. Anastasia E. Goldt

Manizales, June 16, 2025

To whom it may concern:

Evaluation report of the thesis entitled: siRNA DELIVERY USING SINGLE-WALLED CARBON NANOTUBES (SWCNTS) AND PLANT-DERIVED EXOSOME-LIKE NANOPARTICLES (PELNS): DESIGN, CHARACTERIZATION, AND IN VITRO EVALUATION

Thesis by student Bensaada Hichem:

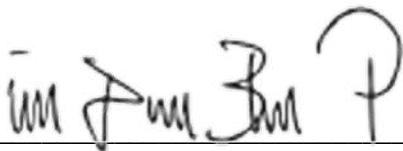
Evaluative Report

Theoretical Contribution: The thesis demonstrates a well-founded and up-to-date understanding of siRNA-based gene therapy, particularly regarding the challenges of intracellular delivery. The literature review is extensive, detailed, and covers both clinical developments and technological innovations in non-viral delivery systems. The student effectively contextualizes the role of carbon nanotubes and plant-derived exosome-like nanoparticles as emerging tools, highlighting their physicochemical properties, comparative advantages, and regulatory challenges. The theoretical approaches provide sufficient background, helping to engage the reader and frame the object of study clearly.

Methodological Contribution: The methodology is well-structured and aligns coherently with the proposed objectives. Advanced techniques such as UV–Vis–NIR spectroscopy, Z-potential analysis, AFM, cell viability assays (MTT), and methods for isolating ginger-derived exosomes are integrated. The comparison between two delivery platforms (SWCNTs and GELNs) represents an innovative and complementary design. However, some procedures in the experimental section could benefit from better standardization of controls and more detailed information regarding replicability.

Contribution in Results and Discussion: The results obtained are relevant and appropriately interpreted based on the applied techniques. The characterization of siRNA-CNT and GELN complexes demonstrates experimental rigor and technical proficiency. The analysis of cytotoxicity and siRNA loading efficiency provides valuable preliminary evidence regarding the feasibility of both platforms. The discussion effectively connects the findings with current literature, supporting the proposed hypotheses. Nonetheless, the absence of conclusive results in the functional in vitro evaluation section (STAT3 knockdown) currently limits the biological impact of the study.

Overall Assessment: This thesis presents a research proposal with high academic value, due to its relevance in the field of pharmaceutical biotechnology and its innovative approach combining nanotechnology with natural plant-derived vesicles for siRNA delivery. The student demonstrates advanced research skills, critical thinking, and proficiency in scientific writing. It is recommended to complete the pending functional assays to strengthen the contribution to applied knowledge and its potential for publication.



Jhon Fredy Betancur P. (Ph.D).

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Manizales – Caldas – Colombia

Manizales (Colombia), June 13, 2025

Dear and Respectful Medvedev Yuri Vladimirovich

Federal State Autonomous Educational Institution of Higher Education

I.M. Sechenov First Moscow State Medical University

of the Ministry of Health of the Russian Federation

Sechenov University, A.P. Nelyubin Institute of Pharmacy

Ref.: Thesis work, Master Qualification, Bensaada Hichem (2nd year master, group 729-04)
Specialty 19.04.01 – Biotechnology, Profile: Pharmaceutical ecology

I, Juan Carlos Carmona-Hernandez, full professor for the Medical School in Universidad de Manizales (Colombia) want to give an evaluating concept concerning the titled work: **siRNA DELIVERY USING SINGLE-WALLED CARBON NANOTUBES (SWCNTS) AND PLANT-DERIVED EXOSOME-LIKE NANOPARTICLES (PELNS): DESIGN, CHARACTERIZATION, AND IN VITRO**, as part of the Master Qualification requirement for the student Bensaada Hichem.

In this thesis work, a clear and well supported comparative approach for two types of single-walled carbon nanotubes (SWCNT) using High-Pressure Carbon Monoxide Process (HiPCO) Cobalt-molybdenum catalytic method (CoMoCAT) is solidly presented and executed. All literature approaches and sources (152 bibliographical references with approximately 90% of highly updated sources – from 2022 to the present) contribute strong theoretical and methodological background. I consider that the methodology and laboratory assays are very assertively selected and all practical processes and assays are very complete and include plenty of details for reproducibility purposes and future validation of findings.

The main goal of comparing directly a method that has been used for a good while, Bovine Serum Albumin (BSA) with the innovative KK46-functionalized (peptide approach) CNTs as vectors for siRNA delivery, describes a novel technique in search a more effective system looking to offer a better safety profile and better siRNA retention. This approach reflects a notorious trial for systems that in the future, although not widely consider at the moment, could become an international and affordable reference worldwide.



The current findings, based on the multiple laboratory and analytical techniques such as quantity of dispersion, optical properties (through UV–Vis–NIR spectroscopy and photoluminescence mapping), surface charge (zeta potential), and siRNA binding aptitude (through agarose electrophoresis), and in vitro cytotoxicity profiles determined through MTT assays, are a strong trial foundation to test and verify the hypothetical approach. The proposed hypothesis relies on the fact that although BSA functionalization can produce more ideal optical performance through well-controlled protein adsorption, the KK46 peptide with its high cationic and dendrimeric nature will provide a better safety profile and better siRNA retention.

This dissertation work further incorporates a thoroughly integrated investigation of plant-derived exosome-like nanoparticles (PELNs), which have been isolated from ginger through PEG precipitation and subsequently purified utilizing two distinct methodologies, thereby presenting a natural and biocompatible alternative for the delivery of siRNA. Through the investigation of PELNs in conjunction with CNTs, the candidate has further expanded the context beyond synthetic vectors, thereby situating these natural nanovesicles within the present-day siRNA therapeutics landscape and accentuating their potential for translation.

Overall, and with the coming *in vitro* testing, my concept the present thesis is for a complete, well thought and strongly supported thesis work, considering the completeness of his methodological approach, the in depth findings and the future application the whole process can have.

Please feel free to contact me for further details with respect to this general concept.

Juan Carlos Carmona-Hernandez

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