ISETC2025

UNIVERSITI TEKNOLOGI MARA

ISETC2025

2 ND INTERNATIONAL SCIENCE, ENGINEERING AND TECHNOLOGY COLLOQUIUM



THE POWER OF SCIENTIFIC INNOVATION

INTELLIGENT SOLUTIONS FOR A SUSTAINABLE WORLD

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PREFACE

Welcome to the 2nd International Science, Engineering and Technology Colloquium 2025 (ISETC 2025)!

It is with great pleasure that we present this year's colloquium, a distinguished gathering of scholars, researchers, and professionals dedicated to the advancement of applied sciences. Held virtually on 9th July 2025, ISETC 2025 serves as a platform to highlight cutting-edge research, foster meaningful networking, encourage collaborations, and explore innovative solutions to global challenges.

This year's theme, "The Power of Scientific Innovation: Intelligent Solutions for a Sustainable World" highlights our shared goal to solve global challenges through applied science. It celebrates innovation as a key to building a more sustainable and resilient future. We're proud to feature keynote speakers and presenters who bring fresh insights, bold ideas, and breakthroughs shaping tomorrow's world.

We would like to extend our heartfelt appreciation to the Faculty of Applied Sciences, Universiti Teknologi MARA, Perak Branch, Tapah Campus, for their outstanding support and assistance throughout the planning and execution of the event. Their dedication has been instrumental to the success of this colloquium. We would like to sincerely thank all participants and researchers for their valuable contributions. We also appreciate the reviewers for their careful evaluations and helpful feedback. Your hard work and support mean a lot to us.

As editors, we are proud to present this collection of proceedings. It is an honour to bring together the interesting and meaningful work of our speakers and authors. We hope the ideas shared will lead to new discoveries, encourage more research, and help solve global challenges through science and innovation.

Warm regards,

Dr. Emi Norzehan Mohamad Mahbob
Dr. Saiyidah Nafisah Hashim
Ms. Lili Widarti Zainuddin
Ms. Nurul Nazwa Mohammad
Ms. Rozaina Saleh

ISETC 2025 Proceedings Editors

UNDERSTANDING THE EFFECT OF ANTIOXIDANT PROPERTIES IN *Chlorella sorokiniana* AND *Chlorella zofingiensis*-BASED LIQUID CRYSTALLINE NANOPARTICLES

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Abstract: Liquid crystalline nanoparticles (LCNPs) are an effective delivery vehicle and known with its ability to increase the bioavailability and stability of the bioactive compounds upon administration. This study focused on the formulation of liquid crystalline nanoparticles utilizing a binary lipid mixture of *C. sorokiniana* and *C. zofingiensis* microalgae based on soy phosphatidylcholine (SPC) and citric acid ester of monoglyceride (citrem). In this study, the particular microalgae(s) were selected based on its expeditious growth, cost-effectiveness, and intrinsic antioxidant attributes. The formulations were meticulously crafted employing a high-energy emulsification methodology, subsequently subjected to scrutiny through Fourier Transform Infrared spectroscopy (FTIR) and Ultra-Violet-Visible (UV-Vis) spectroscopy for comprehensive characterization. The outcomes derived from the FTIR spectra unveiled the presence of phenolic substances, proteins, and polysaccharides, indicating that the utilized algae in these formulations harbor significant inherent value. This potential can be harnessed for the development of formulations that naturally possess antioxidant properties. Furthermore, the antioxidant efficacy of liquid crystalline nanoparticles (LCNPs) derived from algae was compared with that of pure algae and atorvastatin-loaded formulations through DPPH free radical scavenging assay. The IC_{80} values for extracts from *C. sorokiniana* and *C. zofingiensis* were 48.99 µg/mL and 14.76 µg/mL, respectively. In contrast, the IC_{80} values for LCNPs based on *C. sorokiniana* and *C. zofingiensis* were 9.71 µg/ml and 3.25 µg/ml, respectively. The IC_{80} for drug-loaded LCNPs was recorded at 11.45 µg/ml. The lowest IC_{80} value from *C. zofingiensis* based LCNPs indicates the better antioxidant activity compared to pure algae extract, *C. sorokiniana* and ATV loaded LCNPs.

Keywords**:** *Liquid crystalline nanoparticles, microalgae, antioxidants, drug delivery*

INTRODUCTION

Poorly water-soluble drugs create a significant problem for pharmaceutical drug delivery systems because they have low bioavailability and absorption rates and are more likely to be broken down by enzymes and eliminated through the liver and kidney. Despite the widespread usage of synthetic antioxidants, security concerns have emerged over time. Numerous studies that have been published suggest a connection between long-term consumption of synthetic antioxidants and certain health concerns, including skin allergies, gastrointestinal disorders, and in some circumstances, an increased risk of cancer (Olasehinde et al., 2019). The number of such drug prospects has significantly expanded in recent years, and about 70% of the new therapeutic candidates have demonstrated poor water solubility (Martin & Sinko, 2011). Since the average human body contains 65% water, a medicine needs to be sufficiently water soluble and have a respectable level of bioavailability (Martin & Sinko, 2011). These poor water-soluble medications frequently have a digestive tract elimination before they are completely dissolved and blood circulation absorption. This effect could result in poor dose proportionality and inadequate bioavailability, which would be more detrimental to clinical translations. Due to customers' increased preference for safer and cleaner-label products, there is an increase in demand for natural antioxidant components. A promising but understudied research topic is the green synthesis of nanoparticles from microalgae, in addition to the established uses of microalgae biomass as a powerful antibacterial and antioxidant agent (Safafar et al., 2015). Silver, gold, platinum, and cadmium are just a few of the metal ions that microalgae can use as precursors to create nanoparticles (Shinde et al., 2025). Due to the potential uses of these algal-mediated nanoparticles, phyco-nanotechnology, which uses algae as a bioagent to synthesise nanoparticles, is gaining popularity.

MATERIALS AND METHODS

Citric acid ester of monoglyceride, grinsted citrem LR 10 extra kosher were bought from Danisco, L-α-phosphatidylcholine from soybean, Type II-S, 14-23% choline basis were purchased from Sigma Aldrich. 99% purity of atorvastatin calcium (ATV) were purchased from Sigma Aldrich, microalgae culture was obtained from laboratory of Institute Bioscience from University Putra Malaysia (UPM). Healthy microalgae were harvested and centrifuged at 5000 rpm for 15 minutes. Following the removal of supernatant, the biomass was washed three times with distilled water to remove the culture medium elements. Next, in 4.0 ml of distilled water, the biomass was resuspended. The biomass was left for 3 days until dried in room temperature. Then, those components SPC, citrem and algae are weighed using the ratio of 5:5:4. While, 45.0wt% deionized water was added to the lipid mixtures. To get uniform milky solutions and well-dispersed solutions, the emulsification process was carried out utilizing an ultrasonication probe by UP400S ultrasonic processor Hielscher ultrasound technology for 10 minutes in pulse mode of 5 seconds on, 2 seconds off 30% amplitude. The formulation is repeated for atorvastatin using a similar ratio. FTIR (IRTracer-100, SHIMADZU, Japan) was used to investigate the viable chemical interaction between microalgae, atorvastatin and LLCNPs.

Free radical scavenging activity was measured using 2,2-diphenyl-1- picrylhydrazyl (DPPH) according to the method described by Cox, Abu-Ghannam & Gupta (2010). 3.15 mg DPPH was weighed and dissolved in 50 ml of methanol solution in order to gain 0.16mM methanolic DPPH concentration. Next, 2 ml of this solution was added with 2 ml of fresh algae extract at different concentration which are 50, 100, 200, 300, 500 and 1000 µg/ml. The mixture was vortexed for 1 min and incubated at room temperature for 30 minutes in the dark. The absorbance of the sample solution was measured at 517 nm using a UV-Vis spectrophotometer.

RESULTS AND DISCUSSION

The FTIR results (Figure 1) exhibited distinctive peaks for pure algae, algae-based LCNPs, and LCNPs loaded with atorvastatin drugs. The physical interactions would take place between binary mixture SPC, citrem and algae since it has different reactive functional group and most likely caused by the weak hydrogen bond, dipole-dipole interaction and Van der Waals forces. For the antioxidant activity of pure microalgae, algae-based formulations and atorvastatin-loaded LCNPs, the DPPH method was performed using UV-vis measurement at absorbance value of 517 nm. The IC_{80} is the concentration of an antioxidant-containing substance required to scavenge 80% of the initial DPPH radicals. The highest IC_{80} value was found in atorvastation-loaded LCNPs which was 57.42 µg/ml, followed by LCNPs with algae *C. sorokiniana* based that was 14.17 µg/ml, and *C. zofingiensis* with the lowest IC_{80} value of 3.25 µg/ml. The IC_{80} values were calculated based on the percentage DPPH curve with a series dilutions concentration of the formulation of liquid crystalline. The lower the IC_{80} values (Figure 2), the more potent the substance at scavenging DPPH and this implies a higher antioxidant activity. Notably, the *C. zofingiensis* based LCNPs displayed the most favorable IC_{80} value, indicating higher antioxidant activity.

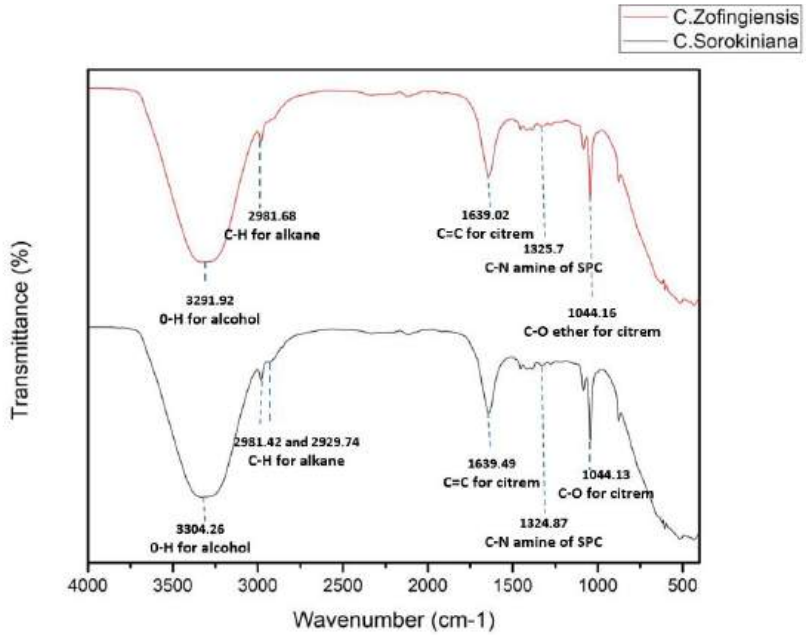


Figure 1. FTIR spectra of formulation algae *C. sorokiniana* and *C. zofingiensis* based LCNPs

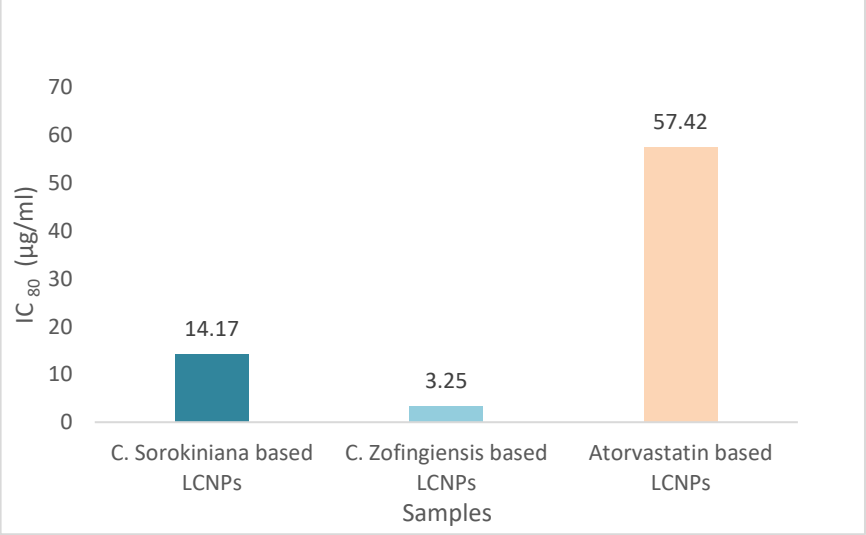


Figure 2. IC_{80} values of formulation LCNPs with algae based and atorvastatin-loaded LCNPs

CONCLUSIONS

Liquid crystalline nanoparticles incorporating algae and atorvastatin were effectively formulated utilizing a binary blend of soy phosphatidylcholine (SPC) and citric acid ester of monoglyceride (citrem) through ultrasonication. *C. zofingiensis* based LCNPs displayed the lowest IC_{80} value, indicating higher antioxidant activity in comparison with other algae and atorvastatin-loaded LCNPs.

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Sekian, terima kasih.

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