Indian Journal of Experimental Biology
Vol. 63, June 2025, pp. 511-517
DOI: 10.56042/ijeb.v63i06.13066

Anticancer potential of L-asparaginase impregnated selenium-cyclodextrin nanobiocomposite against mouse B-cell lymphoma cells

G Baskar*, A Jessica, R Yuvassri, B Vanessa Doris, L A Aneesah & R Pravin

Department of Biotechnology, St. Joseph's College of Engineering, Chennai-600119, India

Received 10 August 2024; revised 13 March 2025

Lymphoma remains a significant challenge in cancer treatment due to its high prevalence and resistance to conventional therapies. There is a growing demand for innovative and targeted treatment strategies that can enhance therapeutic efficacy while minimizing side effects. The present work focuses on the synthesis of selenium-cyclodextrin (Se-CyD) nanobiocomposite of L-asparaginase using the co-precipitation method for drug delivery against lymphoma cells. The size of the synthesized Se-CyD nanobiocomposite was found to be 29.74 nm. Using a scanning electron microscope, the spherical shape of the nanobiocomposite was observed. The absorption of the nanocomposite was observed in the range of 200 to 600 nm using a double-beam UV-Vis spectrophotometer. The FTIR spectrum showed peaks of transmittance at specific wavenumbers, indicating regions of low and high absorption due to the involvement of functional groups in the nanobiocomposite. The X-ray diffraction analysis revealed the crystalline structure of the nanocomposite by representing sharp and prominent peaks. The Methyl thiazolyl diphenyl-tetrazolium bromide (MTT) assay on CH27 mouse B-cell lymphoma cell line loaded with Se-CyD nanobiocomposite showed 65.9% toxicity at a concentration of 100 µg/mL. This concentration represents the IC50 value of the Se-CyD nanobiocomposite for the CH27 mouse B-cell lymphoma cell line. Thus, a combination of selenium and cyclodextrin nanocomposite coated with L-asparaginase proves to have anticancer properties.

Keywords: Nanoparticles, β-cyclodextrin, Sodium selenite, Drug delivery, Enzyme-based cancer therapy

Lymphoma is a diverse group of cancers affecting the lymphatic system, which poses significant treatment challenges due to their complexity and varied presentation[1]. The precision of nano-drugs enhances the therapeutic efficacy and reduces the risk of side effects. Also, nanoparticles can penetrate tumor tissues more effectively[2]. By using nanoparticles as drug delivery systems, more effective and targeted therapies for lymphoma treatment can be achieved.

Asparagine aids in tumor-associated signaling[3]. Unlike normal cells, cancer cells cannot produce asparagine, which they require for proliferation. L-asparaginase breaks down the amino acid into L-aspartic acid and ammonia, thus causing the cancer cells to die[4]. Normal cells are less affected by this depletion since they can compensate for the loss by producing more asparagine[5]. However, cancer cells that rely on external sources of asparagine are unable to cope with the depletion and eventually undergo apoptosis[6].

Recent studies on selenium at its nano-level have proven to exhibit enhanced activity due to its higher surface area-to-volume ratio than in its natural form[7]. Three forms of selenium are involved in the destruction of cancer cells. L-selenomethionine induces apoptosis but only in cells that have the *p53* gene[8]. Selenium-methyl L-selenocysteine can induce apoptosis even in cells that lack the suicide gene[9]. Inorganic sodium selenite can effectively increase the genetic expression of a cell protector called glutathione, which is used in the therapeutic targeting of cancer cells. However, only sodium selenite has shown the direct activation of natural killer cells which have some antitumor abilities[10]. Additionally, the properties of β-cyclodextrins have been proven to be beneficial in their applications in the medical industry, food industry, and cosmetic industry[11]. The co-precipitation process facilitates the integration of nanoparticles with biocompatible materials and ensures the uniform distribution[12]. Moreover, it can be easily scaled up for large-scale production, making it an ideal choice for developing advanced materials in various applications, including drug delivery[13].

In the present study, the formulation of nanobiocomposite that seems to effectively combine the properties of selenium and cyclodextrin with the therapeutic action of L-asparaginase to disrupt lymphoma cancer cell growth has been studied. The synthesized selenium-cyclodextrin nanobiocomposite was subjected to SEM, EDAX, FTIR and XRD analysis for the physicochemical characterization. The anticancer activity of the nanobiocomposite was

*Correspondence:
Phone: +91-44-24501060
E-mail: basg2004@gmail.com

tested by performing an MTT assay on the CH27 mouse B-cell lymphoma cell line.

Materials and Methods

Chemicals used

β-cyclodextrin (98% pure) and sodium selenite (98% pure) were procured from SRL, Mumbai, India. *Aspergillus terreus* MTCC 1782 was acquired from CSIR-IMTECH, Chandigarh, India. Chemicals for Czapek-Dox agar slants, glutaraldehyde treatment and trichloroacetic acid were procured from Loba Chemie Pvt. Ltd., Mumbai, India. The necessary chemicals for Nessler's reagents were sourced from Chemspure, Chennai, India. All the chemicals were of laboratory grade and were used without any further purification.

Production of L-asparaginase

Aspergillus terreus strain's inoculum was cultured in Czapek agar slants at 37℃ for 4 days. Subsequently, *Aspergillus terreus* was introduced into a 250 mL Erlenmeyer flask containing 200 mL of modified Czapek-Dox Liquid medium. This medium comprised 4.0 g of L-proline, 2.0 g of L-asparaginase, 0.4 g of glucose, 2.0 g of sodium nitrate, 0.104 g of potassium chloride, 1.04 g of dipotassium hydrogen phosphate, 0.002 g of zinc sulphate, 0.002 g of ferrous sulphate and 0.104 g of magnesium sulphate and adjusted to *p*H 6.2. Fungus underwent aerobic cultivation with agitation in an orbital shaker at 160 rpm and a temperature of 32℃ for 3 days. Following the incubation period, the culture was filtered using a Whatman filter paperand enzyme activity of the resulting filtrate containing the crude L-asparaginase was estimated using Bradford's assay[14,15].

Synthesis of Se-CyD nanoparticles

To synthesize selenium nanoparticles, 0.11 g of β-Cyclodextrin was dissolved in 20 mL of 0.5 N acetic acid. Two solutions in equal volumes were prepared having 0.1 M sodium selenite and 0.05 M β-mercaptoethanol. β-mercaptoethanol solution was gradually added to the sodium selenite under continuous stirring. The shift in colour from deep orange to a lighter brown signified the successful synthesis of selenium nanoparticles[16]. The resulting selenium nanoparticles were blended with the prepared β-cyclodextrin solution. 6 mL of 1 mol/L NaOH was added to the solution to induce co-precipitation. Subsequently, the mixture underwent sonication and centrifugation. The pellet obtained was washed with 10 mL of 20 mM Tris-HCl buffer. Finally, the obtained pellet underwent lyophilisation through a freeze dryer operating at a temperature of -45ºC and a pressure of 0.150 kHz. It was stored in an air-tight container for further use.

Impregnation of Se-CyD nanoparticles with L-asparaginase

Nanobiocomposite were prepared using, 0.3 g of Se-CyD nanoparticles were added into 300 mL of 0.1 M phosphate buffer and the solution was adjusted to *p*H 8.0. 3 mL of 1 M glutaraldehyde was added and stirred for 2 h at 37℃. The solution underwent sonication for 35 min. After this, 300 mL of L-asparaginase was added and stirred for about 30 min at 4℃ in an ice bath. The solution was then stored at 4℃ for 6 h. Then the solution was subjected to centrifugation at 5000 rpm for 30 mins[17].

Characterization of the synthesized L-asparaginase impregnated Se-CyD nanobiocomposite

The synthesized L-asparaginase impregnated Se-CyD nanobiocomposite was subjected to various characterization such as UV-Vis, FTIR, XRD and SEM-EDAX analysis. UV-visible spectroscopy was performed using a Double beam spectrophotometer (Systronics, 2201) in 200-600 nm wavelength range to determine its absorption characteristics. High-resolution scanning electron microscopy (FEI Quanta FEG 200 instrument) was used to observe the particle size and morphology. Fourier transform infrared spectroscopy (FTIR) utilizing a BRUKER-ALPHA-Platinum-ATR-IR instrument was used to identify the functional groups in the nanobiocomposite. Additionally, Bruker D8 Discover powder XRD machine was used to obtain the 2θ value for the characterization of the nanobiocomposite.

Anticancer activity of the synthesized L-asparaginase impregnated Se-CyD nanobiocomposite

The anticancer activity of the synthesized L-asparaginase impregnated Se-CyD nanobiocomposite was studied on the CH27 mouse B-cell lymphoma cell lines. Cells were seeded in a 96-well tissue culture plate with 5×10^3 cells in 100 µL media per well. The cells were grown as a loose cluster in suspension and needed passaging when the cell density reached 1-1.5 million cells mg/mL. The lymphoma cell line CH27 was grown on a polystyrene-coated flask with an RPMI medium, and the media was replaced in 2 to 3 days. It was done by centrifuging the cell to extract pellets, resuspending it in the fresh medium and seeding it into the flask while incubating at 37℃. After 24 h, the cells were treated

with different concentrations of the lyophilized sample of Se-CyD nanobiocomposite such as 100 ng, 10 ng, 1 ng and 1 µg. After 24 h of incubation, MTT reagent was added followed by an additional incubation period of 2 to 4 h. The reaction concluded with media removal and the resulting formazan crystals were dissolved in DMSO. The absorbance directly correlating with cell viability was then measured at 570 nm. The % cytotoxicity of the extracts was determined using the following formula,

$$\% \text{ Cytotoxicity} = \frac{(1 - \text{OD control} - \text{OD test})}{\text{OD control}} \times 100$$

Results and Discussion

UV -Vis analysis of the synthesized L-asparaginase impregnated Se-CyD nanobiocomposite

The UV-Vis spectral analysis of the synthesized L-asparaginase impregnated Se-CyD nanobiocomposite was recorded in the range of 200 to 600 nm. As shown in Fig. 1, the absorption peak observed at 366 nm indicates the presence of selenium within the nanobiocomposite. This uniform distribution may be necessary for the stability of the nanobiocomposite[18]. Absorbance peak at 248 nm confirmed the impregnation of the L-asparaginase enzyme to the Se-CyD nanobiocomposite[19]. The results showed that the Se-CyD nanobiocomposite effectively binds with L-asparaginase, as confirmed by spectroscopic analysis. The dispersion (broad absorbance) observed in peaks could signify that the Se-Cyd nanobiocomposite is less aggregated in solution, an important property that determines the bioavailability of a nanoparticle. Less aggregation means that more particles are available for interaction with biological systems, enhancing their potential therapeutic effects[20].

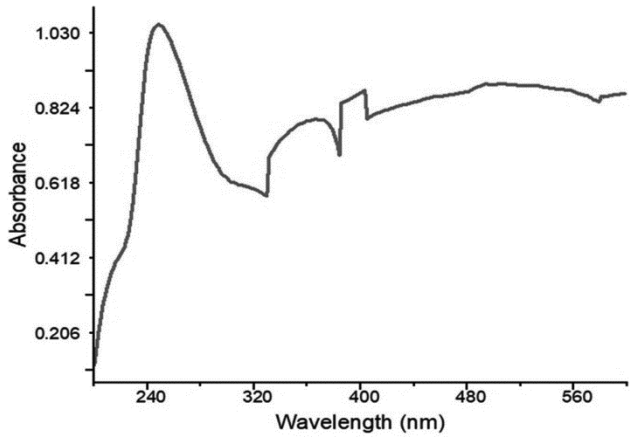

Fig. 1 — UV-Vis Analysis of Se-CyD nanobiocomposite of L-asparaginase

SEM-EDAX analysis of the synthesized L-asparaginase impregnated Se-CyD nanobiocomposite

Morphological characterization of the synthesized nanobiocomposite was analyzed using SEM. The EDAX analysis was done to study its elemental composition and confirm the presence of selenium and cyclodextrin. The nanobiocomposite sample was visualised at a SEM magnification of 10000× and 5000× with a power setting of 30 kV. The cyclodextrin formed aggregates, which indicated that the asparaginase had been incorporated into the nanoparticles and the surface of the nanobiocomposite was rugged and heterogeneous as shown in Fig. 2. Aggregation of the particles lead to the stabilization of nanobiocomposite[21]. The particle size of the nanobiocomposite was found to be in the range of 20 to 50 nm.

The position and intensity of the peaks formed by the nanobiocomposite under the EDAX spectrum were used to identify specific elements and estimate their concentration. The spectrum showed the presence of selenium and cyclodextrin. As shown in Fig. 3, the weight % of selenium and β-cyclodextrin present in the synthesized nanobiocomposite was found to be 23.31% and 30.05%, respectively. A high selenium content (23.31%) ensures that the nanobiocomposite has a therapeutic effect. The high composition (30.05%) of cyclodextrin acts as a biocompatible carrier. Moreover, cyclodextrin enhances water solubility and cellular uptake, improving absorption and drug delivery to cancer cells, in this case[22].

X-ray diffraction analysis of L-asparaginase impregnated Se-CyD nanobiocomposite

The observed chromatogram as shown in Fig. 4, depicts the sharp and distinct peaks which confirms the synthesized nanobiocomposite was in its

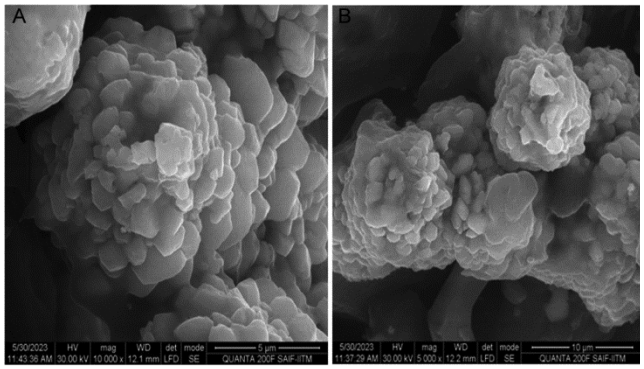

Fig. 2 — SEM Analysis of Se-CyD nanobiocomposite of L- asparaginase (A) at 5 µm resolution (B) at 10 µm resolution

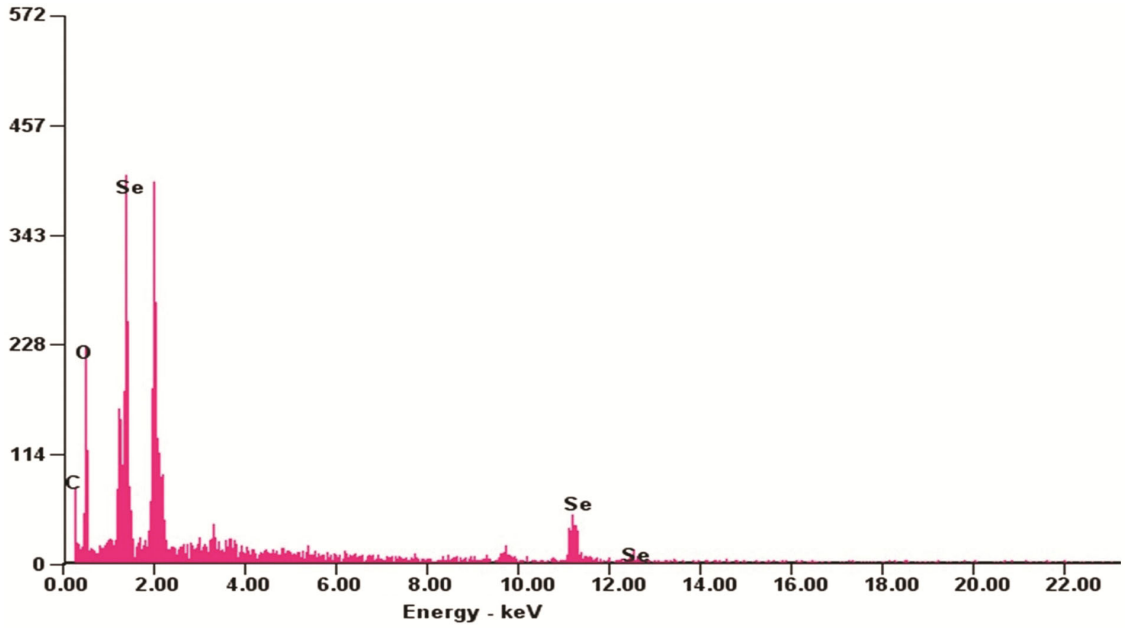

Fig. 3 — EDAX Analysis of Se-CyD nanobiocomposite of L- asparaginase

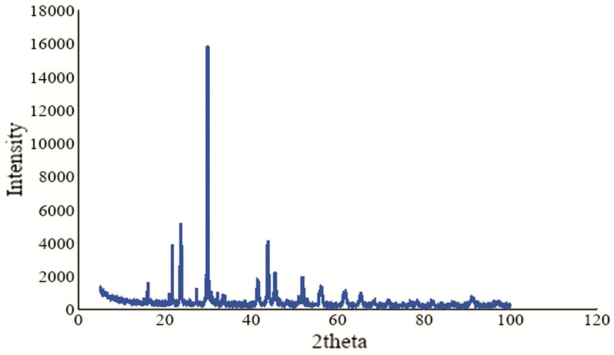

Fig. 4 — XRD Analysis of Se-CyD nanobiocomposite of L-asparaginase

crystalline form. As per JCPDS card 06-0362, selenium nanoparticles exhibited the peaks listed as tabulated in Table 1. Cyclodextrin showed less prominent peaks, within the 2θ range of 5 to 25°, showing amorphous characteristics[23].

The average size (D) of the nanobiocomposite was determined to be 29.74 nm by employing the Debye–Scherer's formula:

$$D = 0.94 * \lambda / (\beta * \cos(\theta))$$

[D represents the average crystalline size, with λ denoting the wavelength of the Cu Kα line (1.5406 nm), θ represents the Bragg angle, while β denotes the full width at half-maximum (FWHM) of the diffraction peak expressed in radians]

Since the particles are in the nanoscale range, they have a high surface area, which is known to improve interaction with biological fluids and enhance dissolution[24,25].

Table 1 — Detected XRD Peaks and Corresponding Miller Indices for Se-CyD Nanobiocomposite of L-asparaginase

2θ Value (°)	Miller Index
23.54	(1,0,0)
29.77	(1,0,1)
41.26	(1,1,0)
45.13	(2,1,0)
50.29	(2,1,1)
53.74	(2,0,2)
61.77	(2,0,3)
65.12	(3,0,1)
72.85	(2,2,0)

FTIR analysis of L-asparaginase impregnated Se-CyD nanobiocomposite

The synthesized L-asparaginase impregnated Se-CyD nanobiocomposite was subjected to FTIR analysis to identify the functional groups in the sample by measuring the absorption of infrared light at different wavelengths. As shown in Fig. 5, the peaks observed at 3752.34 cm^{-1} and 3711.04 cm^{-1} depict the presence of broad O-H stretching of hydroxyl groups. The peak confirmed the C-H alkane bond at 2921.15 cm^{-1}. C-O-C ether linkage from cyclodextrin rings was confirmed at peak position 979.41 cm^{-1}. The interaction between cyclodextrin and selenium may be responsible for the formation of these peaks[26,27]. The presence of amide bonds at 1624.31 cm^{-1} and 1544.54 cm^{-1} depicts the interaction of L-asparaginase within the nanobiocomposite[28]. Vibrations observed at 734.70 cm^{-1}, 673.41 cm^{-1} and

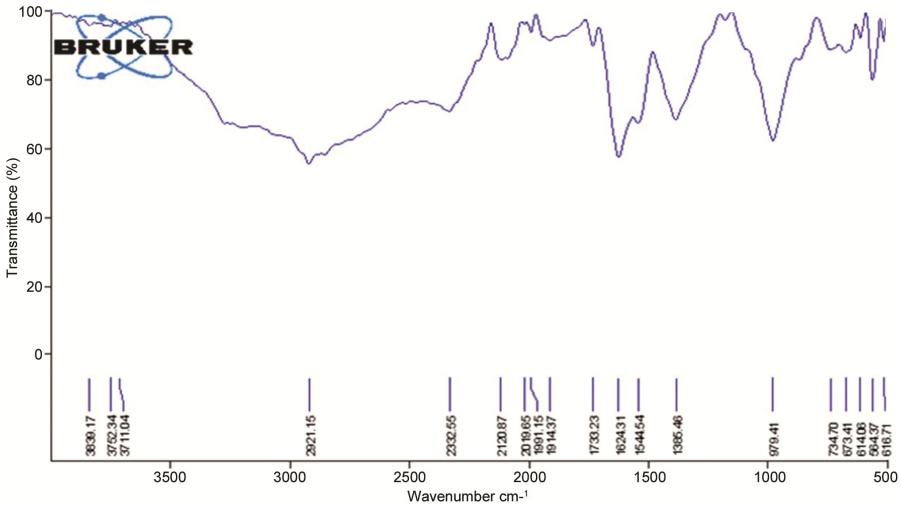

Fig. 5 — FTIR Analysis of Se-CyD nanobiocomposite of L- asparaginase

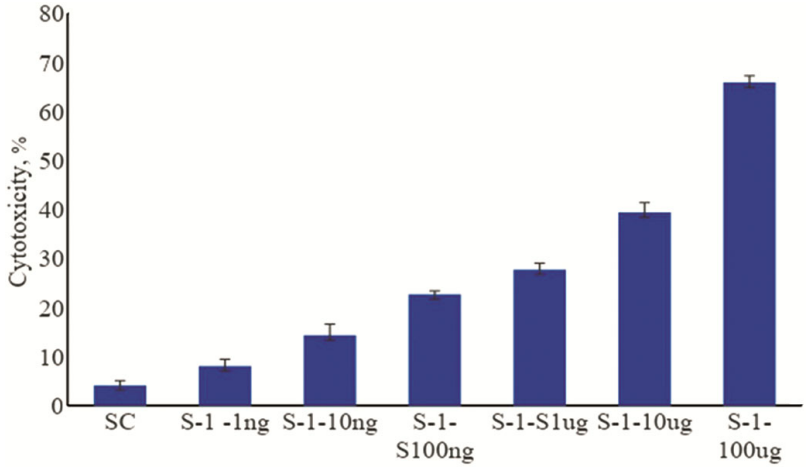

Fig. 6 — Cytotoxicity of Se-CyD nanobiocomposite of L- asparaginase on CH27 mouse B cell lymphoma cancer cell line

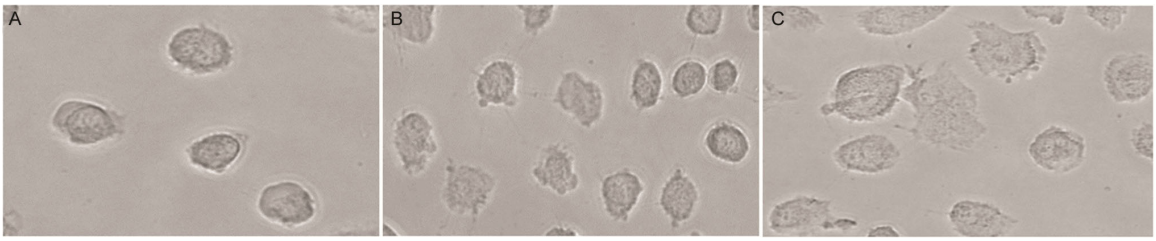

Fig. 7 — Microscopic images of cytotoxicity of Se-CyD nanobiocomposite of L- asparaginase on CH27 mouse B cell lymphoma cancer cell line. (A) Control CA27, (B) Low concentration (1 ng), (c) High concentration (100 µg)

614.06 cm^{-1} correspond to the interactions with selenium[29,30].

MTT Assay analysis of L-asparaginase impregnated Se-CyD nanobiocomposite

The synthesized L-asparaginase impregnated Se-CyD nanobiocomposite exhibited a stronger effect on the CH27 lymphoma cell line at 100 µg/mL, while its effect was minimal at 1 ng/mL as shown in Fig. 6. The impact of the L-asparaginase impregnated Se-CyD nanobiocomposite on the CH27 mouse B-cell lymphoma cell line was evaluated using the MTT assay, which revealed a toxicity rate of 65.9% at a concentration of 100 µg/mL. This concentration corresponds to the IC50 value of the nanobiocomposite for the CH27 cell line as depicted in Fig. 7. The results confirmed a dose-dependent cytotoxic effect, with cytotoxicity increasing as the concentration of the nanobiocomposite increased. At

lower concentrations (1 ng, 10 ng), the cytotoxic effect was minimal whereas higher concentrations (10 µg, 100 µg) significantly increased toxicity. These findings suggest that the synthesized L-asparaginase impregnated Se-CyD nanobiocomposite exhibits a concentration-dependent toxic effect on CH27 mouse B-cell lymphoma cells.

Conclusion

The study aimed to assess the anticancer potential of the synthesized L-asparaginase impregnated Se-CyD nanobiocomposite against lymphoma cells. UV spectrophotometric analysis confirmed nanobiocomposite formation with characteristic peaks at 248 and 366 nm. SEM and XRD analyses revealed its aggregated crystalline morphology, while FTIR analysis confirmed the presence of key functional groups, including amide, alkane, hydroxyl and ether groups which are essential for nanobiocomposite formation. The MTT assay demonstrated a dose-dependent cytotoxic effect against the CH27 mouse B-cell lymphoma cell line, with an IC50 value of 100 µg/mL and 65.9% toxicity at this concentration. These findings highlight the therapeutic potential of the synthesized L-asparaginase impregnated Se-CyD nanobiocomposite. By integrating the encapsulating ability of cyclodextrin, the therapeutic properties of selenium and the enzymatic activity of L-asparaginase, this study suggests that the L-asparaginase impregnated Se-CyD nanobiocomposite is a promising anticancer agent for lymphoma treatment.

Conflict of interest

The authors declare no potential competing interests.

References

1 Huang J, Chan SC, Lok V, Zhang L, Lucero-Prisno DE 3rd, Xu W, Zheng ZJ, Elcarte E, Withers M & Wong MCS, Global Burden, Risk Factors, and Trends of Non-Hodgkin Lymphoma: A Worldwide Analysis of Cancer Registries. *Cancer Med*, 13 (2024) 1.

2 Nirmala MJ, Kizhuveetil U, Johnson A, Balaji G, Nagarajan R & Muthuvijayan V, Cancer nanomedicine: a review of nano-therapeutics and challenges ahead. *RSC Adv*, 13 (2023) 12345.

3 Pal S, Sharma A, Mathew SP & Jaganathan BG, Targeting cancer-specific metabolic pathways for developing novel cancer therapeutics. *Front Immunol*, 13 (2022) 955476.

4 Hope HC & Salmond RJ, The Role of Non-essential Amino Acids in T Cell Function and Anti-tumour Immunity. *Arch Immunol Ther Exp*, 69 (2021) 29.

5 Fallati A, Di Marzo N, D'Amico G & Dander E, Mesenchymal Stromal Cells: An Ally of B-Cell Acute Lymphoblastic Leukemia (B-ALL) Cells in Disease Maintenance and Progression within the Bone Marrow Hematopoietic Niche. *Cancers*, 14 (2022) 3303.

6 Yuan Q, Yin L, He J, Zeng Q, Liang Y, Shen Y & Zu X, Metabolism of Asparagine in the Physiological State and Cancer. *Cell Commun Signal*, 22 (2024) 163.

7 Perks P, Huynh E, Kaluza K & Boullata JI, Advances in Trace Element Supplementation for Parenteral Nutrition. *Nutrients*, 14 (2022) 1770.

8 Garbo S, Di Giacomo S, Łażewska D, Honkisz-Orzechowska E, Di Sotto A, Fioravanti R, Zwergel C & Battistelli C, Selenium-Containing Agents Acting on Cancer-A New Hope? *Pharmaceutics*, 15 (2022) 104.

9 Radomska D, Czarnomysy R, Radomski D & Bielawski K, Selenium Compounds as Novel Potential Anticancer Agents. *Int J Mol Sci*, 22 (2021) 1009.

10 Xia X, Zhang X, Liu M, Duan M, Zhang S, Wei X & Liu X, Toward improved human health: efficacy of dietary selenium on immunity at the cellular level. *Food Funct*, 12 (2021) 976.

11 Christaki S, Spanidi E, Panagiotidou E, Athanasopoulou S, Kyriakoudi A, Mourtzinos I & Gardikis K, Cyclodextrins for the Delivery of Bioactive Compounds from Natural Sources: Medicinal, Food and Cosmetics Applications. *Pharm*, 16 (2023) 1274.

12 AboGabal R, Shokeir D & Oraby AH, Design and Synthesis of Biologically Inspired Biocompatible Various Polymeric Magnetic Nanoparticles for Imaging and Biomedical Applications. *Nano-Struct Nano-Objects*, 36 (2023) 101048.

13 Alqahtani MS, Syed R, Shahid M & Shaik JP, Synthesis and characterization of ZnO/β-cyclodextrin/nicotinic acid nanocomposite and its biological and environmental application. *Green Process Synth*, 12 (2023) 20230050.

14 Baskar G, Abinesh AR, Sheik Mohammed Raja A, Keerthana K, Supriya A & Pravin R, Green synthesis, characterization and anticancer activity of fungal asparaginase from *Aspergillus terreus* conjugated on MgO-ZnO nanocomposite against liver cancer cells. *Indian J Exp Biol*, 61 (2023) 1642.

15 Juluri KR, Siu C & Cassaday RD, Asparaginase in the Treatment of Acute Lymphoblastic Leukemia in Adults: Current Evidence and Place in Therapy. *Blood Lymphat Cancer*, 12 (2022) 55.

16 Spyridopoulou K, Aindelis G, Pappa A & Chlichlia K, Anticancer Activity of Biogenic Selenium Nanoparticles: Apoptotic and Immunogenic Cell Death Markers in Colon Cancer Cells. *Cancers*, 13 (2021) 5335.

17 Jia R, Wan X, Geng X, Xue D, Xie Z & Chen C, Microbial L-asparaginase for Application in Acrylamide Mitigation from Food: Current Research Status and Future Perspectives. *Microorganisms*, 9 (2021) 1659.

18 Puri A, Mohite P, Ansari Y, Mukerjee N, Alharbi HM, Upaganlawar A & Thorat N, Plant-derived selenium nanoparticles: Investigating unique morphologies, enhancing therapeutic uses, and leading the way in tailored medical treatments. *Mater Adv*, 5 (2024) 3602.

19 Lubkowski J & Wlodawer A, Structural and biochemical properties of L-asparaginase. *FEBS J*, 288 (2021) 4183.

20 Khalid Q, Ahmad M, Minhas MU, Batool F, Malik NS & Rehman M, Novel β-cyclodextrin nanosponges by chain growth condensation for solubility enhancement of

dexibuprofen: Characterization and acute oral toxicity studies. *J Drug Deliv Sci Technol*, 61 (2021) 102089.

21 Lavania K & Garg A, Inclusion complex of chrysin with hydroxypropyl-β-cyclodextrin (HP-β-CD): Preparation, characterization, and dissolution study. *BioNanoSci*, 13 (2023) 616.

22 Alam S, Nagpal T, Singhal R & Kumar Khare S, Immobilization of L-asparaginase on magnetic nanoparticles: Kinetics and functional characterization and applications. *Bioresour Technol*, 339 (2021) 125599.

23 Ramos-Inza S, Morán-Serradilla C, Gaviria-Soteras L, Sharma AK, Plano D, Sanmartín C & Font M, Formulation studies with cyclodextrins for novel selenium NSAID derivatives. *Int J Mol Sci*, 25 (2024) 1532.

24 Kumari L, Choudhari Y, Patel P, Gupta GD, Singh D, Rosenholm JM, Bansal KK & Kurmi BD, Advancement in solubilization approaches: A step towards bioavailability enhancement of poorly soluble drugs. *Life*, 13 (2023) 1099.

25 Yusuf A, Almotairy ARZ, Henidi H, Alshehri OY & Aldughaim MS, Nanoparticles as drug delivery systems: A review of the implication of nanoparticles' physicochemical properties on responses in biological systems. *Polymers*, 15 (2023) 1596.

26 Hassan H, Adam SK, Alias E, Affandi MMRMM, Shamsuddin AF & Basir R, Central composite design for formulation and optimization of solid lipid nanoparticles to enhance oral bioavailability of acyclovir. *Molecules*, 26 (2021) 5432.

27 Sangeetha M, Siri U, Venkat Sai Kumar G, Gajendar M & Rama Rao T, Self-Destructive Nanoparticles of Drug Delivery. *J Nanomed*, 7 (2024) 1069.

28 Bose R, Jayawant M, Raut R, Lakkakula J, Roy A, Alghamdi S, Qusty NF, Sharma R, Verma D, Khandaker MU, Almujally A, Tamam N & Sulieman A, Cyclodextrin nanoparticles in targeted cancer theranostics. *Front Pharmacol*, 14 (2023) 1218867.

29 Morán-Serradilla C, Plano D, Sharma AK & Sanmartín C, Following the trace of cyclodextrins on the selenium and tellurium odyssey. *Int J Mol Sci*, 25 (2024) 7799.

30 Zhou J, Jia J, He J, Li J & Cai J. Cyclodextrin Inclusion Complexes and Their Application in Food Safety Analysis: Recent Developments and Future Prospects. *Foods*, 11 (2022) 3871.