



Green Synthesis of Fe₂O₃ Mn₂O₃ and Mn₂O₃ with Cynoglossum Zeylanicum and Their Anticancer Activity

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Abstract: Fe₂O₃ Mn₂O₃ and Mn₂O₃ added cynoglossum zeylanicum the green synthesis of cynoglossum zeylanicum plant extracts the plant extracts with economical and environmentally friendly methods for this study. Secrets collected from nature have led biotechnology to produce advanced nanomaterials. This study revealed the important medical Fe₂O₃ Mn₂O₃ And Mn₂O₃ nanoparticle biosynthetic potential of fast, cost-effective, one-step synthetic method has been achieved. New Fe₂O₃ Mn₂O₃ And Mn₂O₃ nanoparticles were produced by UV-Vis spectroscopy, FTIR, XRD, SEM, DSI, PL analyses. Nanoparticles have good anti-inflammatory and anti-cancer properties. Interestingly, as a result of screening information on newly synthesized Fe₂O₃ Mn₂O And Mn₂O₃ nanoparticles, their anticancer abilities can be found using MTT assay. The technology can be effective with minimal impact. Nanoparticles have great energy and can be used for certain applications in biomedical media purification and catalysis.

IndexTerms - Cynoglossum zeylanicum, Fe₂O₃ Mn₂O₃ and Mn₂O₃, anticancer activity

I. INTRODUCTION

Green synthesis has gained increasing interest in recent years due to its potential to provide a safer, more sustainable alternative to traditional synthesis methods. This approach offers the possibility of producing materials with improved biocompatibility and biodegradability, which is of great interest in various fields such as biomedical applications, agriculture, and environmental remediation. Fe₂O₃ Mn₂O₃ And Mn₂O₃ alloys are known for their high strength and toughness, as well as their magnetic properties, which make them useful in a variety of applications. Manganese is an essential mineral that plays a crucial role in various biological processes such as metabolism, bone development, and wound healing. It is also a cofactor for several enzymes involved in antioxidant defense, carbohydrate metabolism, and neurotransmitter synthesis. Manganese is found in many foods such as whole grains, nuts, and leafy vegetables. Iron is another essential mineral that is required for the formation of hemoglobin, a protein in red blood cells that carries oxygen throughout the body. Iron also plays a role in energy production and immune function. Iron deficiency can lead to anemia, fatigue, and impaired cognitive function. Iron is found in many foods such as red meat, poultry, and legumes. In present study a simple biosynthesis method using plant extract of cynoglossum zeylanicum synthesize here Fe₂O₃ Mn₂O₃ And Mn₂O₃ nanoparticles the plant cynoglossum zeylanicum also called the ceylon hounds tongue there are countless medical applications cough burn wound ear infection antibiotic sometimes used as veterinary medicine. cancer of the blood forms tissue that affects the body's ability to fight disease leukemia is cancer of the blood-forming tissues including the bone marrow there are many types such as acute lymphoblastic leukemia acute myeloid leukemia and acute lymphocytic leukemia. Clinical studies evaluating new agents and clinical models are researched and implemented. However current treatments have many limitations regarding side effects and infection development. Therefore, new drugs need to be more potent and produce fewer side effects and be made by different mechanisms than cytotoxic drugs currently in use.

II. METHODOLOGY

2.1 Preparation of Cynoglossum zeylanicum extract

After combining 20 grammes of *Cynoglossum zeylanicum* (both the leaves and the stem) with 250 millilitres of double-distilled water, the mixture was heated to a temperature of 80 degrees Celsius for 20 minutes. After filtering the obtained extraction with Whatman No. 1 filter paper, the resulting filtrate was collected in a 500 mL Erlenmeyer flask and kept at room temperature until it was ready for use.

2.2 Synthesis of Mn₂O₃ nanoparticles

Green methods were used to prepare the Mn₂O₃ nanoparticles. For the preparation of Mn₂O₃NPs, 90 mL of 0.1M manganese (II) nitrate hexahydrate (Mn(NO₃)₂ · 6 H₂O) solution was added with 10 mL of *Cynoglossum zeylanicum* extract. From the extract, we get a block-coloured homogeneous precipitation solution. This solution was stirred constantly at a temperature of 80 °C for 5 hours. Thereafter, the solution was washed several times with double distilled water and ethanol. The precipitate was then dried at 120 °C. Thus, Mn₂O₃ nanopowder was obtained. The Mn₂O₃ NPs were annealed at 800 °C for 5 h because the energy from the heat would enhance the vibration and diffusion of lattice atoms for atomic rearrangement. Also, the annealing helped to remove the residual impurities.

2.3 Synthesis of Fe₂O₃ Mn₂O₃ nanoparticles

Green methods were used to prepare the Mn₂O₃ nanoparticles. For the preparation of Mn₂O₃NPs, 90 mL of 0.095M manganese (II) nitrate hexahydrate (Mn(NO₃)₂ · 6 H₂O) solution was added with 10 mL of *Cynoglossum zeylanicum* extract. 0.005M ferrous (II) nitrate hexahydrate Fe₂O₃ solution. From the extract, we get a block-coloured homogeneous precipitation solution. This solution was stirred constantly at a temperature of 80 °C for 5 hours. Thereafter, the solution was washed several times with double distilled water and ethanol. The precipitate was then dried at 120 °C. Thus, Fe₂O₃ Mn₂O₃ nanopowder was obtained. The Fe₂O₃ Mn₂O₃ NPs were annealed at 800 °C for 5 h because the energy from the heat would enhance the vibration and diffusion of lattice atoms for atomic rearrangement. Also, the annealing helped to remove the residual impurities.

2.4 Characterization of Fe₂O₃ Mn₂O₃ And Mn₂O₃ nanoparticles

XRD, In order to investigate the crystalline structure of the Mn₂O₃ and Fe₂O₃Mn₂O₃ nanoparticles, a technique known as X-ray powder diffraction (XRD) was applied.

The morphologies of Fe₂O₃Mn₂O₃ were analyzed using scanning electron microscopy (SEM).

The Dynamic Light Scattering (DLS) method was utilised so that the particle size distribution in an aqueous solution could be determined.

The FTIR analysis results indicate the existence of bio-components on the NPs' surface, such as alkaloids, tannins, and glycosides. The optical properties of Mn₂O₃ and Fe₂O₃ Mn₂O₃ NPs are directly proportional to the size of Mn₂O₃ and Fe₂O₃ Mn₂O₃ NPs, a UV-Vis spectrophotometer is a helpful instrument for evaluating these properties.

2.4.1 Assessment of cell morphology

the hematology molt-4 embryo edge was purchased from the embryo store of nccs national cell science centre pune india. Dulbecco's modified eagle medium dmem was used to force cell lines build up with 10 fbs penicillin 100 I and streptomycin 100 gml carry over added in order to prevent contamination the medium containing bacteria and the medium of insects were kept at 37 c in a humid atmosphere of 5 co 2.

2.4.2 Effect of Fe₂O₃ Mn₂O₃ And Mn₂O₃ nanoparticles on cytotoxicity

For analysis of cell viability, live MOLT-4 cells were harvested and counted using a hemocytometer diluted to 1 x 10⁴ cells/ml in DMEM medium, each well seeded in a 96-well plate and incubated for 24 hours. allow adding. . MOLT-4 cells were treated with control and xxx ranging from 2.5 to 15 µg/ml and applied to each well. MOLT-4 cells were cultured for 24 hours at 37°C in a 95% humidity and 5% CO₂ incubator. After incubation, the solution containing the cells was washed with fresh medium and the dye MTT (5 mg/ml in PBS) was added to each well, followed by incubation at 37 °C for a further 4 hours. Dissolve blood precipitate formazan in 100 µl of concentrated DMSO and cell viability is based on absorbance and measured at 540 nm using a multi-well plate reader. Results are expressed as the percentage of stable cells relative to controls. Calculate the half maximum inhibitory concentration (IC₅₀) values and analyze the effective dose for different time periods.

III. RESULTS AND DISCUSSION

3.1 XRD:

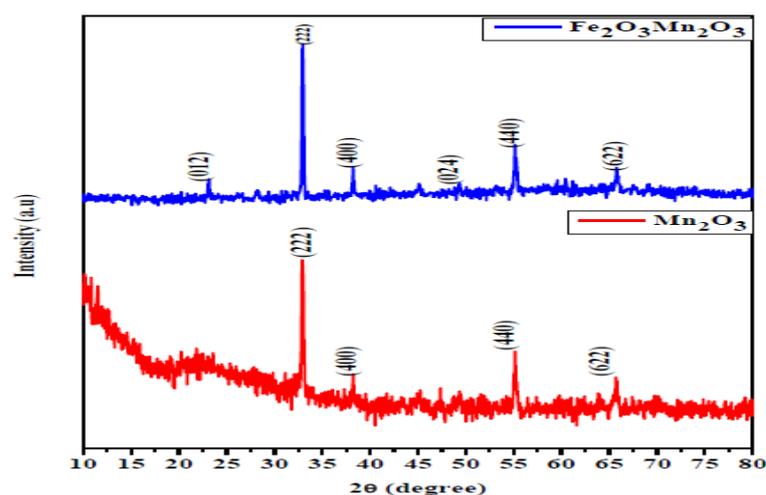


Fig 3.1: Shows the XRD pattern of Mn₂O₃ and Fe₂O₃Mn₂O₃ nanoparticles

The creation and development of nanomaterials with different physicochemical and optoelectronic properties is the basis of nanoscience. This report presents the properties of the ethnopharmacologically important *Cynoglossum zeylanicum* plant extract for the bioreduction of Fe_2O_3 Mn_2O_3 And Mn_2O_3 ions into mFe_2O_3 Mn_2O_3 And Mn_2O_3 nanoparticles. Fe_2O_3 Mn_2O_3 And Mn_2O_3 nanoparticles can be used for mixing, heating, pH changing, etc. It can be mixed with each other in 30 minutes by methods. Reduction and coating of new Fe_2O_3 Mn_2O_3 And Mn_2O_3 nanoparticles were achieved with *Cynoglossum zeylanicum* plant extract. The synthesis was carried out due to screening with different concentrations of Fe_2O_3 Mn_2O_3 And Mn_2O_3 and plant extracts. structural analysis. The obtained diffraction pattern (Fig: 3.1) shows Bragg reflections with 2θ values of 32.93° , 38.16° , 55.14° and 65.73° for the Mn_2O_3 nanoparticle and 23.12° , 32.95° , 38.20° , 49.29° , 55.16° and 65.81° for the $\text{Fe}_2\text{O}_3\text{Mn}_2\text{O}_3$ nanoparticle corresponding to the (012), (222), (400), (431), (440) and (622) (hkl) planes Fe_2O_3 (JCPDS NO.33-0664) and Mn_2O_3 (JCPDS NO.33-0900) which indicate the formation of a highly ordered two-dimensional hexagonal mesoscopic structure.

3.2 SEM:

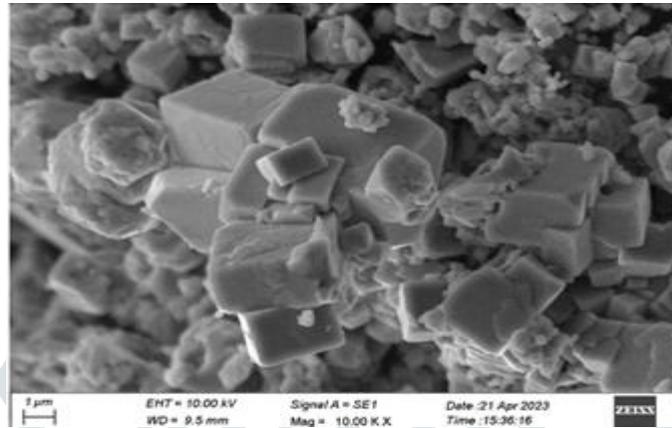


Fig : 3.2 Scanning electron microscopy (SEM) images of $\text{Fe}_2\text{O}_3\text{Mn}_2\text{O}_3$

The low-magnification SEM image in Fig.3.2 reveals that the $\text{Fe}_2\text{O}_3\text{Mn}_2\text{O}_3$ is made up of particles with a Rhombohedral (pseudocubic) structure and a diameter of 19-29 nm. In order to better comprehend the structural characteristics of $\text{Fe}_2\text{O}_3\text{Mn}_2\text{O}_3$, high-magnification SEM images were analyzed Fig.3.2. $\text{Fe}_2\text{O}_3\text{Mn}_2\text{O}_3$ particles have nanoparticles on their surface that range in size from several nanometers to one nanometer.

3.3 DSL:

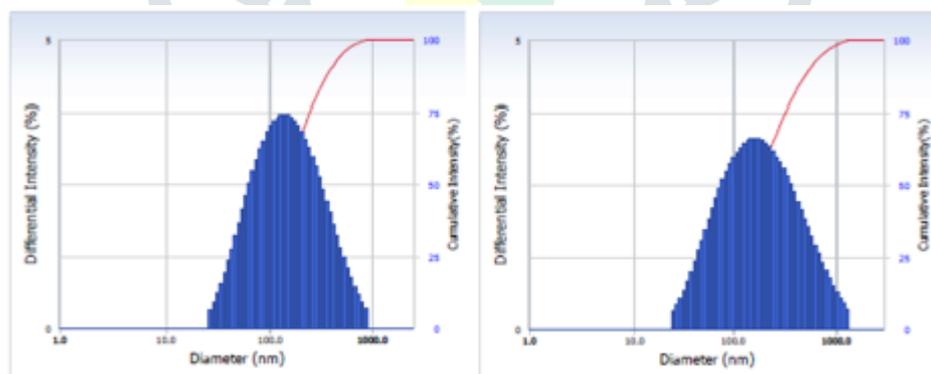


Figure 3.3: Shows DLS spectrum of Mn_2O_3 and $\text{Fe}_2\text{O}_3\text{Mn}_2\text{O}_3$ nanoparticles

The Dynamic Light Scattering (DLS) method was utilised so that the particle size distribution in an aqueous solution could be determined. We measured Mn_2O_3 and Fe_2O_3 NPs, and the nanoparticles themselves were found to be 166.5 and 141.20 nm.

3.4 FTIR:

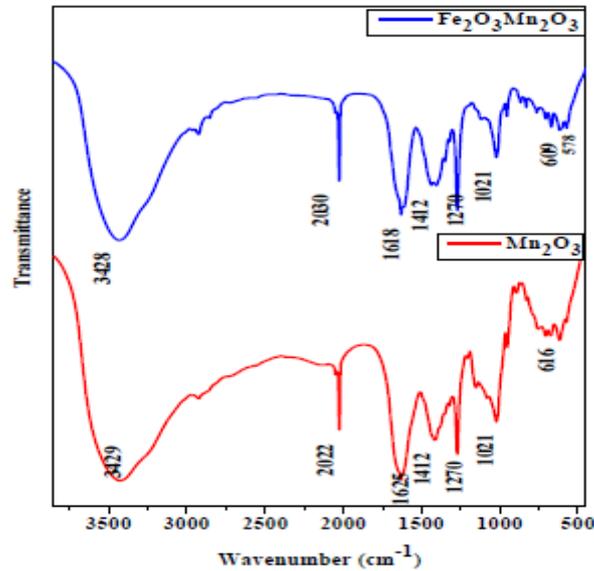


Figure 3.4: Shows the FTIR spectrum of Mn₂O₃ and Fe₂O₃Mn₂O₃ nanoparticles

Two strong peaks at 616 and 609 cm^{-1} arise from the stretching vibrations of the Mn–O and Mn–O–Mn bonds. In addition, the strong absorptions at 3428 cm^{-1} and 3429 cm^{-1} peaks arising at 1021 cm^{-1} are due to the C–OH stretching modes. A low intensity peak observed in 1618 cm^{-1} could be related to the bending mode of adsorbed water molecules. The band corresponding to Fe–O stretching mode of Fe₂O₃ is seen at 578 cm^{-1} .

3.5 UV-Vis:

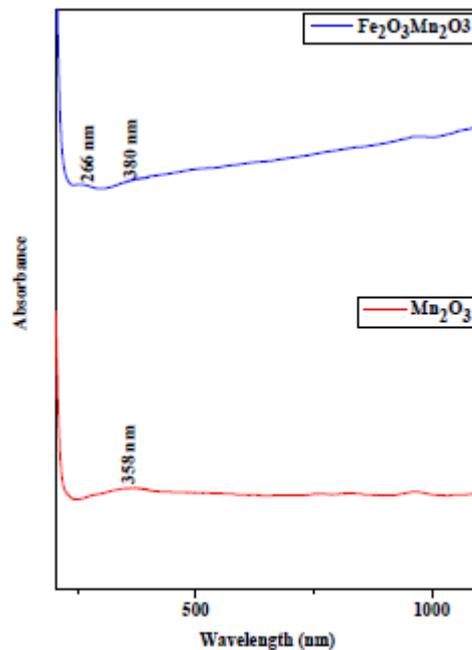


Fig 3.5: Shows UV-Vis absorbance spectrum of Mn₂O₃ and Fe₂O₃Mn₂O₃ nanoparticles

Strong absorption peak can be seen in the Mn₂O₃ NPs at a wavelength of 358 nm. Strong absorption peaks can be seen in the Fe₂O₃Mn₂O₃ NPs at wavelengths of around 266 and 380 nm.

3.6 PL:

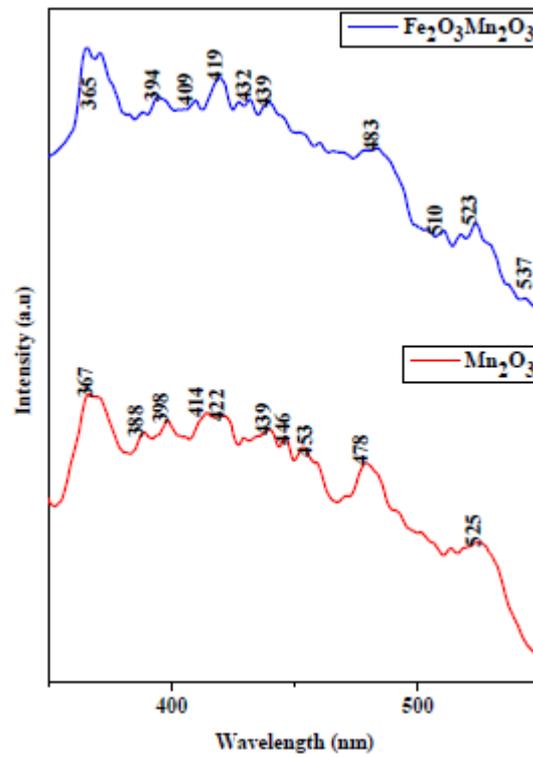


Figure 3.6 : Shows the PL spectrum of Mn₂O₃ and Fe₂O₃Mn₂O₃ nanoparticles

Both Mn₂O₃ and Fe₂O₃Mn₂O₃ NPs are subjected to excitation at a wavelength of 325 nm. In the case of Mn₂O₃, the PL emission levels that were measured were as follows: 367,388,398,414,422,439,446,453,478 and 525.

3.7 ANTICANCER ACTIVITY AND CYTOTOXICITY:

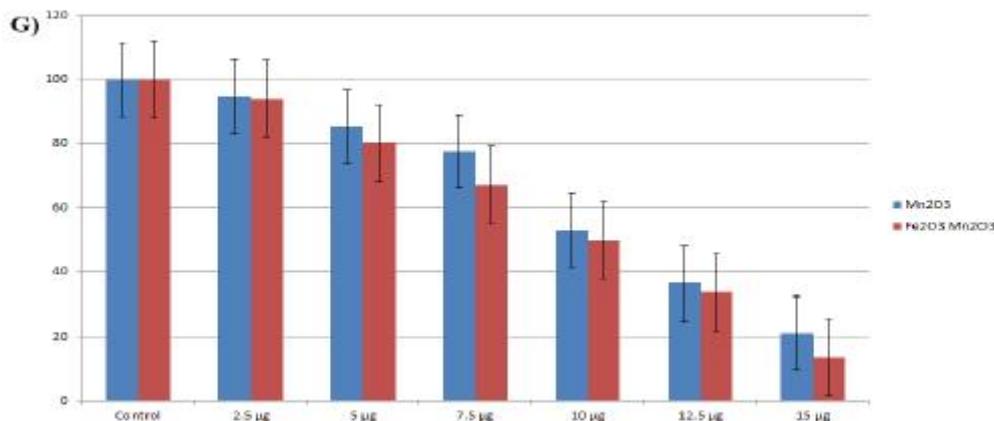
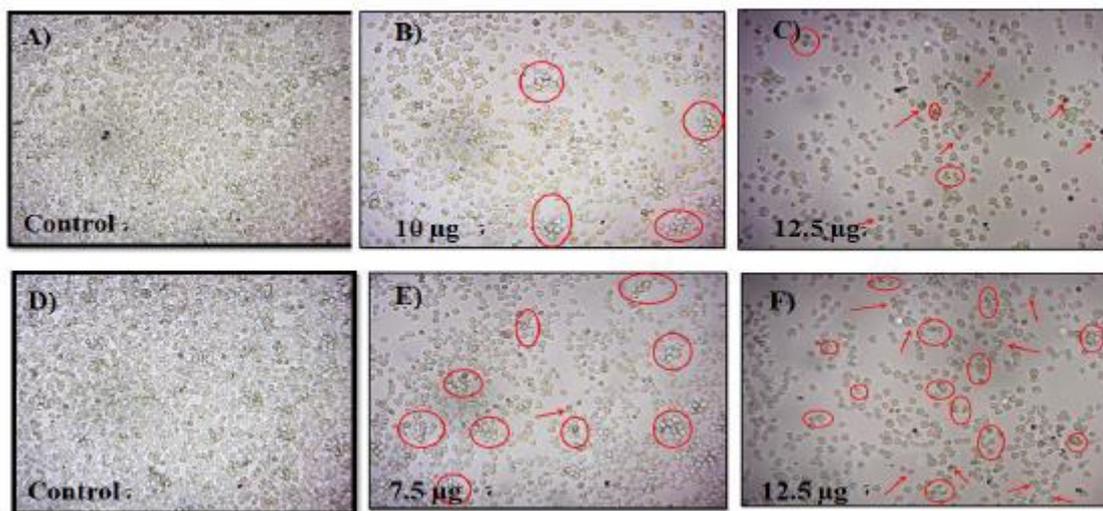


Fig 3.7: Shows the morphological alterations in human blood cancer cells (MOLT-4) cells are depicted in photomicrograph (40x) (A-C) Mn₂O₃ NPs (D-F) Fe₂O₃Mn₂O₃ NPs (G) Anticancer cell line of Mn₂O₃ and Fe₂O₃Mn₂O₃ NPs

MTT (50 mg) dye was dissolved in 10 mL of PBS. After vortexing for 1 min, it was filtered through 0.45 micro filters. The bottle was wrapped with aluminium foil to prevent light, as MTT was light sensitive. The preparation was stored at 4°C.

The below facts show such the use of phytochemicals in every fusion of nanoparticles is an important symbiotic relationship between nanoscience and green chemistry. As we performed a comprehensive analysis for the application of the new Fe₂O₃ Mn₂O₃ And Mn₂O₃ nanoparticle analysis, we investigated the treatment of anti-leukemic active MOLT-4 cells with distinct concentrations of Fe₂O₃ Mn₂O₃ And Mn₂O₃ nanoparticles as the time difference. The results shown in Figures 2a and b demonstrate that the physiological state of dying MOLT-4 cells is induced by Fe₂O₃ Mn₂O₃ And Mn₂O₃ nanoparticles treatment and that these effects are dose dependent.

Most current R and D into every development of malignancy cure has focused on the atomic tool by which drugs cause cytotoxicity as well as apoptosis in malignant cells. An ethnopharmacological approach to the production of Fe₂O₃ Mn₂O₃ And Mn₂O₃ nanoparticles would be useful in establishing a relationship between nanoscience and medicine. apoptosis and apoptosis, this study provides insight into the development of cancer-fighting nanotherapeutic drugs. This study shows that the production of Fe₂O₃ Mn₂O₃ And Mn₂O₃ nanoparticles by ethnopharmacological method will greatly help to establish an important link between nanoscience and medicine symbiotic relationship.

IV.CONCLUSION:

In the current research, cancer-causing cells were utilized as a means of assessing the cytotoxicity of Mn₂O₃ and Fe₂O₃Mn₂O₃ nanoparticles. The green precipitation method was used to prepare Mn₂O₃ and Fe₂O₃Mn₂O₃ nanoparticles, and *Cynoglossum zeylanicum* extract was used in the process. The results of an X-ray diffraction study showed that the particles that were produced have a hexagonal mesoscopic structure. The particles' average size was determined to be between ~38 and ~28 nanometers, depending on the study. According to the FT-IR spectra, the formation of a powerful higher intermolecular hydrogen bond occurs concurrently with the formation of ferric oxide from Mn₂O₃ nanoparticles. According to the results of PL analyses, a change in the band emission was brought about by manganese and ferric vacancies, oxygen vacancies, and surface defects in the Fe₂O₃Mn₂O₃. A human blood cancer cell line was tested with Mn₂O₃ and Fe₂O₃Mn₂O₃ nanoparticles, and both were found to exhibit cytotoxic activities. When contrasted with Mn₂O₃ NPs, Fe₂O₃Mn₂O₃ NPs exhibit a significantly higher level of anti-cancer activity. This finding, which indicates that this would be an improved method of treating cancer, can also be put to use in clinical settings.

REFERENCES

- [1] Anitha, Maruthiah, E. Daffodil, Sabapathy Muthukumarasamy, and Veerabahu Ramasamy Mohan. "Antitumor activity of *Cynoglossum zeylanicum* (vahl ex hornem) thunb. Ex. Lehm. against dalton ascites lymphoma in Swiss albino mice." *International Journal of Applied Biology and Pharmaceutical Technology* 3, no. 4 (2012): 457-462.
- [2] 2. Anitha, Maruthiah, Edison Dalmeida Daffodil, Sabapathy Muthukumarasamy, and VeerabahuRamasamyMohan. "Anti-Inflammatory activity of whole plant of *Cynoglossum Zeylanicum* (VAHL Ex Hornem) Thunb. Ex. Lehm." *Journal of Advanced Pharmacy Education & Research* Jan-Mar 3, no. 1 (2013).
- [3] 3. Ranabhat, Keshav, Kamal Prasad Regmi, Sarwesh Parajuli, Ranjita Thapa, Arjun Prasad Timilsina, Saurav Katuwal, Shantel Fleming, Akkal Dev Mishra, Khaga Raj Sharma, and Bishnu P. Regmi. "Evaluation of Antioxidant, Antimicrobial, and Cytotoxic Activities and Correlation with Phytoconstituents in Some Medicinal Plants of Nepal." *Journal of Chemistry* 2022 (2022).
- [4] 4. Joshi, Bishnu, Sujogya Kumar Panda, Ramin Saleh Jouneghani, Maoxuan Liu, Niranjana Parajuli, Pieter Leyssen, Johan Neyts, and Walter Luyten. "Antibacterial, antifungal, antiviral, and anthelmintic activities of medicinal plants of Nepal selected based on ethnobotanical evidence." *Evidence-Based Complementary and Alternative Medicine* 2020 (2020)