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Phytogenic Synthesis of Beta vulgaris-Derived Silver Nanoparticles Against A549 Lung Cancer Cells and Anticancer Activity

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Abstract: Cancer is a one type of diseases characterized by the uncontrolled growth and spread of abnormal cells, which can invade nearby tissues and spread to other parts of the body. Lung cancer is a specific type of cancer due to the abnormal cells are formed in the lung. It is mainly formed by the drinking of alcohol and smoking of cigarette. Lung cancer is a malignant neoplasm that arises from the cells of the lung tissue Beta vulgarizes is a rich source of nitrogenous pigments to treatment of anticancer drug. These are natural pigment and non-toxic biodegradable and non-allergenic. The plant based nano particles to treatment of the lung cancer by using the beta vulgarizes extract and silver oxide (Ago) nano particles with the temperature 90℃ -100℃ to precipitate is formed. These synthesized bio particles is having anticancer activity to decrease the cell growth by using the SEM& UV methods. To develop and evaluate biosynthesized nanoparticles as a targeted and eco-friendly therapeutic approach for the treatment of lung cancer, focusing on their synthesis, characterization, cytotoxic efficacy, and potential to enhance drug delivery with minimal side effects.

Keywords: Noise Reduction, DL, U-Net, Cross- Domain Denoising (Audio & Image), GUI.

1. Introduction

Cancer is a one type of diseases characterized by the uncontrolled growth and spread of abnormal cells, which can invade nearby tissues and spread to other parts of the body. There are many different types of cancer, each originating in a specific part of the body, such as breast, lung, or colon cancer. Cancer can be caused by a variety of factors, including genetics, lifestyle choices, and environmental factors. It is a specific type of cancer due to the abnormal cells are formed in the lung. It is mainly formed by the drinking of alcohol and smoking of cigarette. Lung cancer is a malignant neoplasm that arises from the cells of the lung tissue [1].

In 2024, lung cancer remains the leading cause of cancer death worldwide, with an estimated 1.8 million deaths, representing about 1 in 5 cancer deaths globally. There are two main types of lung cancer: non-small cell lung cancer (NSCLC) and small cell lung cancer (SCLC). NSCLC is the most common type and accounts for about 85 % of all cases, while SCLC accounts for the remaining 15% [1]. This study focuses on the green synthesis of nanoparticles using biological sources such as plant extracts, microorganisms, or biomolecules, aiming for an eco-friendly and cost-effective alternative to conventional methods.

The scope includes the synthesis, characterization (e.g., size, shape, surface properties), and evaluation of the therapeutic potential of these biosynthesized nanoparticles against lung cancer cells. It also covers their cytotoxic effects, drug-loading efficiency, and potential for targeted delivery. The research is limited to in vitro (and optionally in vivo) studies and does not include clinical trials.

1.1. Why beta vulgaris is selected for this experiment

(a). Rich in Phytochemicals

Beta vulgaris contains a variety of bioactive compounds such as:

- Betalains
- Flavonoids
- Phenolic acids
- Ascorbic acid (Vitamin C)

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These compounds act as natural reducing and stabilizing agents, facilitating the conversion of Ag^{+} ions into Ag^{0} (metallic silver nanoparticles) without the need for toxic chemicals.

(b). Eco-Friendly and Non-Toxic

Using beetroot extract supports green chemistry principles, it avoids harmful reagents and is safer for both the environment and human health compared to chemical synthesis methods.

(c). Cost-Effective and Readily Available

Beetroot is cheap, easily available, and renewable, making it an ideal candidate for scalable nanoparticle synthesis in developing and academic settings.

(d). Strong Reducing Capacity

The pigmented betalains in beetroot are strong antioxidants that can effectively reduce metal ions to nanoparticles, enhancing synthesis efficiency.

(e). Dual Functionality

The extract serves both as a reducing agent (converts silver ions to silver nanoparticles) and a capping/stabilizing agent (prevents agglomeration of nanoparticles), simplifying the synthesis process.

(f). Biocompatibility

Nanoparticles synthesized using Beta vulgaris are generally more biocompatible and show lower toxicity, which is important for biomedical applications such as anticancer treatments, including lung cancer therapy.

2. Related Work

2.1. Synthesis Method:

Wash fresh beetroot thoroughly with distilled water. Peel and chop into small pieces. Weigh about 50 grams and boil in 100 mL of distilled water for 10–15 minutes. Cool the mixture and filter it using filter paper. Store the beetroot aqueous extract in the refrigerator until use. (1)

(a). Preparation of Silver Nitrate Solution

Prepare 1 mM $AgNO_3$ solution by dissolving 0.017 grams of silver nitrate in 100 mL of distilled water. Mix the Beta vulgaris extract with the $AgNO_3$ solution in a 1:9 ratio (e.g., 10 mL extract + 90 mL $AgNO_3$).Stir the solution continuously on a magnetic stirrer at room temperature or heat gently (around 50–60°C) for better reaction speed. A color change from light pink to dark brown/reddish-brown indicates the formation of AgNPs.

(b). Collection and Purification

Centrifuge the solution at 10,000 rpm for 15 minutes to collect the nanoparticles. Wash the pellet with distilled water 2–3 times to remove impurities. Dry the nanoparticles in an oven or lyophilize (freeze-dry) for storage.

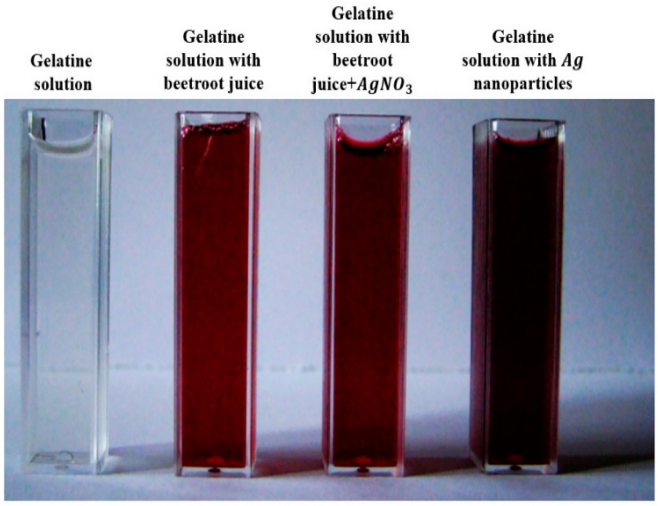

Figure.1 Beetroot extract with silver nanoparticles

(c). Characterization (Optional but Standard)

UV-Vis Spectroscopy to confirm nanoparticle formation (typical peak ~420–450 nm).

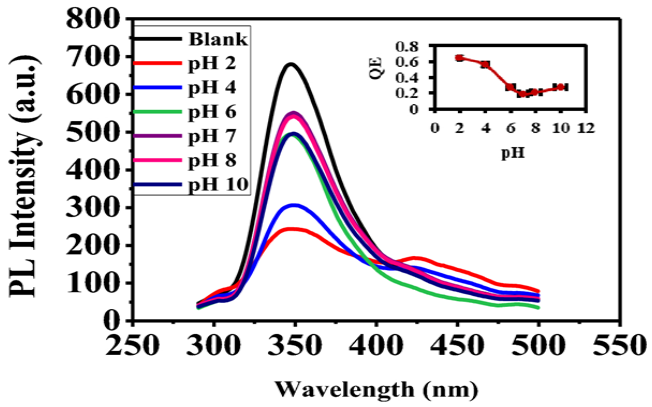

Figure.2. UV-Visible Spectra of Beet root extract with silver nano particles at different Ph levels

3. Results

The cytotoxic effects of the synthesized AgNPs were assessed using the MTT assay on A549 lung cancer cells.

The results demonstrated a dose-dependent inhibition of cell proliferation, indicating the potential of Beta vulgaris-

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derived AgNPs as an effective anticancer agent.

Additional analyses, such as AO/EtBr staining, suggested that the mechanism of cell death induced by AgNPs was due to apoptosis in cancer cells. This apoptotic effect was further supported by the presence of characteristic apoptotic features observed under fluorescence microscopy.

4. Conclusion

The study concluded that Beta vulgaris-derived silver nanoparticles exhibit significant anticancer activity against A549 lung cancer cells.

The green synthesis method employed is eco-friendly and cost-effective, making it a promising approach for developing novel anticancer agents.

However, the study also emphasized the need for in vivo studies to further understand the therapeutic potential and safety profile of these nanoparticles.

This research contributes to the growing body of evidence supporting the use of plant-derived silver nanoparticles in cancer therapy and highlights the potential of Beta vulgaris as a source for such biogenic nanomaterials.

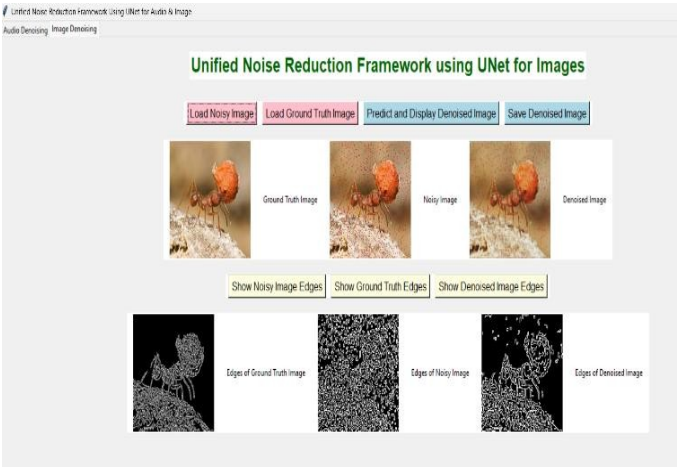

Figure.1 Beetroot Extract With Silver Nanoparticles

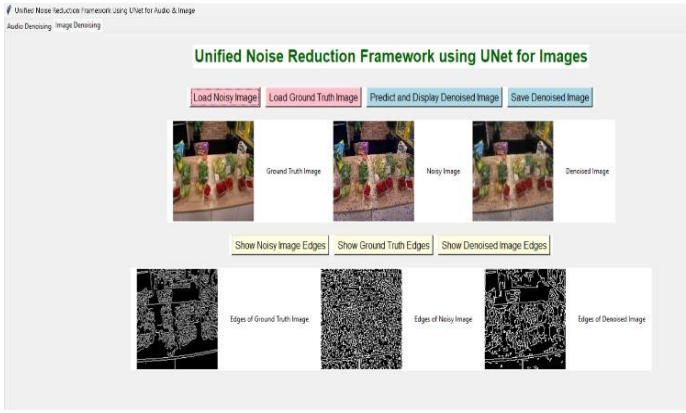

Figure.2 UV-Visible Spectra of Beet root extract with silver nano particles at different Ph levels

5. Conclusions

This presents a unified framework for noise reduction in audio and image domains, demonstrating the versatility and effectiveness of the U-Net architecture. By integrating deep learning with traditional signal processing techniques, the framework offers a robust solution for enhancing multimedia data quality. Future work will focus on optimizing the framework for real- time applications and exploring its potential in other domains, such as video denoising.

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