

Abstract

Synthesis and Preliminary Investigation of Metal Nanoparticles from the Stem Extract of *Bacopa* sp. for the Treatment of Lung Cancer[†]

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Abstract: Lung cancer is the third most common cancer in women and the most common cancer in males. Chemotherapy, allopathy, hormone therapy, radiation therapy, surgery, immune system, and targeted therapies are frequently used to treat lung cancer. These medications induce other diseases and have a variety of negative effects. Thus, we used a different strategy and sought to treat lung cancer with medicinal herbs. We selected the perennial creeping herb *Bacopa monnieri*, which belongs to the Scrophulariaceae family, among other medicinal herbs. It contains several active phytoconstituents, including sterols, alkaloids, flavanoids, terpenoids, and saponins. The primary component with anti-lung cancer efficacy is phytosterol, according to the components. According to the phytochemical investigation, this plant contained it. The literature review indicates that the problem is lessened by nanoparticle production. Thus, the novelty of our work is the manufacture of zinc oxide nanoparticles for the treatment of lung cancer using BM stem extracts. Researchers have been interested in ZnO material because of its huge band gap (3.37 eV) with n-type semi-conductivity and high excitonic binding energy (60 meV) with regards to the different semiconductor nanomaterials, such as TiO₂, SnO₂, GaN, CuO, GaAs, Si, and ZnO. Zinc oxide in bulk is economical and can be used for many different industrial processes, such as the creation of nanoparticles. Zinc acetate serves as the precursor and stem extract serves as the reducing agent in the synthesis. The absorbance peak between 300 and 400 nm in UV spectroscopy was used to characterize the ZnO nanoparticles that were produced from hydromethanolic BM stem extract. In later research, lung cancer treatment might be considered. Given that lung (A549) cell lines will be treated with phytosterol-containing hydromethanolic BM stem extract in the form of ZnO nanoparticles, which will cause cell death by reducing cell proliferation, DNA damage and apoptosis may occur.

Keywords: metal nanoparticles; medicinal plant; lung cancer; zinc oxide



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1. Introduction

One of the main causes of illness and mortality worldwide is cancer. Among non-communicable diseases, cancer ranks second in terms of mortality, after cardiovascular disease. Globally, cancer is responsible for one in eight fatalities, which is more than the combined deaths from AIDS, TB, and malaria. Treatment options for this complex, multifactorial, heterogeneous disease include chemotherapy, hormone therapy, surgery, radiation, immune system, and targeted therapies. The disease's defining feature is the unchecked growth and spread of abnormal cells, which can be brought on by a variety of internal, external, genetic, and environmental factors.

Lung cancer is the second most common cancer in both men and women, and is a highly metastatic disease. When compared to other tumor types, lung carcinoma is the

most common cause of cancer-related death and has the lowest economic impact. Lung cancer accounts for 1.6 million cancer deaths annually (roughly 20% of all cancer deaths) and an additional 1.8 million new cases worldwide each year, making it the leading cause of cancer mortality worldwide in both high-income and low- and middle-income countries.

2. *Bacopa* Species

A genus of 70–100 aquatic plants is called *Bacopa*. The term “water hyssop” is commonly used, although it is misleading because *Bacopa* is not closely related to hyssop despite having a very similar look. These have upright or decaying stems, and they can be annual or perennial. The leaves are sessile and twisted in the opposite direction. The leaf has a regular, round-to-linear blade with a palmate or pinnate vein. The stems might be smooth or hairy. Seeds and broken stems are dispersed throughout the area. The scent of crushed leaves strongly resembles lemon. Herbs have been shown in preliminary clinical work to improve memory. Some of these plants are commonly utilized in warmer climates in freshwater ponds and aquariums.

3. Zinc Oxide Nanoparticles

In the industrial setting, bulk zinc oxide is inexpensive and useful for several processes, such as the creation of nanoparticles. As a result, it can withstand strong electrical fields, elevated temperatures, and high power usage. Wurtzite architecture is a predominant feature of ZnO nanocrystals, with lattice parameters of $a = 0.3296$ nm and $c = 0.52065$ nm. In its most basic form, ZnO exhibits tetrahedron geometry, where each ion is surrounded by four counterions that point in the direction of the tetrahedron’s corners. Three main mechanisms have been identified by NPs to improve food and package consistency: the release of antimicrobial ions, the disruption of bacterial cell integrity, and the generation of reactive oxygen species (ROS) as a result of light exposure.

4. Aim

To prepare and investigate the ZnO nanoparticles with the stem extract of *Bacopa monnieri* for the treatment of Lung cancer.

5. Objectives

- To extract the components from the dried and powdered stem.
- To synthesize the ZnO nanoparticles.
- To screen the phytochemical components of the BM stem extract.
- To characterize the extracts and nanoparticles.
- To analyse the components present in it.

6. Results and Discussion

Cancer treatment has benefited greatly from the discovery of drugs derived from medicinal plants. Additionally, throughout the past 50 years, the majority of new therapeutic uses of plant derivatives and secondary metabolites have been developed to combat cancer. After that, the project research was conducted to examine the phytochemistry and anticancer potential of stem extract from *Bacopa monnieri* (L.).

7. Phytochemical Screening Test

Using established procedures, the phytochemical screening test was performed to verify that the stem extract included flavonoids, alkaloids, proteins, phytosterols, and carbs.

8. Characterisation of Zinc Oxide Nanoparticles

The creation of zinc oxide nanoparticles is confirmed by the absorbance peak seen between 300 and 400 nm. The optical characteristics of the produced ZnO NPs have been examined using UV—visible spectroscopy. Moreover, the heavy absorption band seen

between 300 and 400 nm can be attributed to the intrinsic band gap absorption of ZnO due to the electron transitions from the valence band to the conduction band.

9. Conclusions

According to the aforementioned study, ZnO nanoparticles containing *Bacopa monnieri* stem extract contain phytosterols, which are used to cure lung cancer.

Following a battery of phytochemical screening assays, the hydromethanolic BM stem extract revealed the absence of quinoids, saponins, and phenols but the presence of proteins, carbohydrates, phytosterols, and flavonoids.

The next step is to create zinc oxide nanoparticles using a magnetic stirrer and a NaOH solution to modify the pH. The solution for white precipitate was made. Following centrifugation and drying, 23.2 mg of zinc oxide nanoparticles was produced.

UV—visible spectroscopy was used to describe the optical characteristics of the zinc oxide nanoparticles. In this case, the presence of zinc oxide nanoparticles was confirmed by the absorbance peak seen between 300 and 400 nm. We were unable to conduct FTIR analysis and detect the *in vitro* anti-cancerous activities of the synthesized ZnO NPs because of the pandemic conditions.

Supplementary Materials: The following supporting information can be downloaded at: <https://www.mdpi.com/article/10.3390/proceedings2024100008/s1>, Conference Poster: Synthesis and Preliminary Investigation of Metal Nanoparticles from the Stem Extract of *Bacopa* sp. for the Treatment of Lung Cancer.

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