

Research Article

Enhanced Cytotoxic Activity of *Corallocarpus epigaeus* Tuber-mediated Gold Nanoparticles Against Human Epidermoid Carcinoma A-431 Cells

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Abstract

Background: Plant-derived nanomedicine has emerged as a promising strategy for enhancing anticancer efficacy while reducing toxicity. *Corallocarpus epigaeus* is a medicinal plant rich in bioactive phytochemicals with reported pharmacological properties.

Objective: The present study aimed to compare the cytotoxic effects of acetone extract of *Corallocarpus epigaeus* tuber and gold nanoparticles (AuNPs) synthesized using the same extract against the human epidermoid carcinoma A-431 cell line.

Methods: Cytotoxicity was evaluated using the MTT assay across a range of concentrations (1-500 µg/ml). IC₅₀ values were determined by linear regression analysis using a Log(inhibitor) versus normalized response model with variable slope.

Results: The acetone extract exhibited moderate cytotoxicity with an IC₅₀ value of 84.67 µg/ml. In contrast *Corallocarpus* mediated AuNPs showed significant enhanced cytotoxic activity, with a reduced IC₅₀ value of 57.97 µg/ml. Gold nanoparticles demonstrated greatest growth inhibition at higher concentrations, reducing cell viability to 12.94% at 500 µg/ml compared to 27.45% for the crude extract.

Conclusion: Incorporation of *Corallocarpus epigaeus* bioactive components into gold nanoparticles significantly enhanced anticancer efficacy, highlighting the potential of plant-mediated AuNPs as a promising nanomedicine approach for epidermoid carcinoma therapy.

Keywords: *Corallocarpus epigaeus*, Gold nanoparticles, Nanomedicine, Cytotoxicity, A-431 cell line, IC₅₀

Introduction

Cancer remains one of the leading causes of mortality worldwide, necessitating the development of novel therapeutic strategies with improved efficacy and reduced side effects. Nanomedicine has emerged as a transformative approach in cancer treatment by enabling targeted delivery, enhanced cellular uptake and controlled release of therapeutic agents [1,2]. Gold nanoparticles (AuNPs) are particularly attractive in nanomedicine due to their biocompatibility, ease of synthesis, tunable size, and surface functionalization capability [3]. Recently, green synthesis of nanoparticles using plant extracts has gained considerable attention as an eco-friendly and cost-effective alternative to conventional chemical methods [4]. Plant-derived phytochemicals act as both reducing and stabilizing agents, often conferring additional biological activity to the nanoparticles. *Corallocarpus epigaeus* (family: Cucurbitaceae) is a traditional medicinal plant known for its antioxidant, anti-inflammatory and antimicrobial properties [5]. However, its anticancer potential, particularly in nanoparticle form, remains unexplored. Epidermoid carcinoma A-431 cells serve as a well-established in-vitro model for studying skin cancer therapeutics [6]. The present study was designed

to compare the cytotoxic efficacy of acetone extract of *Corallocarpus epigaeus* tuber and gold nanoparticles synthesized using the same extract, with the focus on evaluating the nanomedicine advantage through IC₅₀ analysis.

Materials and Methods

Plant Collection and Identification

C. epigaeus plant species was obtained from Solavanthan village, Madurai in December 2023. The plant specimens (ARIBASKBI-1) were identified by Plant Taxonomist Dr. Karuppusamy at Department of Botany, The Madura College, Madurai, Tamil Nadu, India. The specimen is stored at Botany department under a herbarium voucher LSID-2PNI-20013498. Only the healthy and disease-free leaves of the plant were taken for testing. Fresh tubers of *Corallocarpus epigaeus* were collected, shade dried and powdered. The powdered material was extracted using acetone by standard solvent extraction methods. The extract was filtered and concentrated under reduced pressure.

Green Synthesis of Gold Nanoparticles

Gold nanoparticles were synthesized using the acetone extracts

of *Corallocaepus epigaeus* tuber as a reducing and stabilizing agent. Formation of AuNPs was confirmed visually by colour change

Cell Culture

The human epidermoid carcinoma A-431 cell line was obtained from a certified repository and maintained in DEME supplemented with 10% feta bovine serum and antibiotics at 37°C in a humified 5% CO₂ incubator.

MTT Cytotoxicity Assay

The sample was tested for in vitro cytotoxicity, using Cells by MTT assay. Briefly, the cultured Vero Cells were harvested by trypsinization, pooled in a 15 ml tube. Then, the cells were plated at a density of 1×10⁵ cells/ml cells/well (200 µL) into the 96-well tissue culture plate in DMEM medium containing 10 % FBS and 1% antibiotic solution for 24-48 hour at 37°C. The wells were washed with sterile PBS and treated with various concentrations of the sample in a serum-free DMEM medium. Each sample was replicated three times and the cells were incubated at 37°C in a humidified 5% CO₂ incubator for 24 h. After the incubation period, 20 µL of 5 mg/mL MTT was added to each well. The cells were then incubated for an additional 2–4 hours, until purple precipitates were clearly visible under an inverted microscope. Finally, the medium was removed from the wells and the wells were washed with 1X PBS (200 µL). Additionally, to dissolve the formazan crystals, 100 µL of DMSO was added, followed by 5 min of shaking. The absorbance for each well was measured at 570 nm using a microplate reader and the percentage cell viability and IC₅₀ value was calculated using Graph Pad Prism 6.0 software (USA).

$$\text{Formula Cell viability \%} = \frac{\text{Test OD}}{\text{Control OD}} \times 100$$

IC₅₀ Determination

Dose-response curves were generated using non-linear regression analysis with a variable slope model IC₅₀ values were calculated along with standard errors and 95% confidence intervals.

Results and Discussion

Cytotoxic Activity of Acetone Extract of *Corallocaepus epigaeus* on A-431 Cells

The cytotoxic activity of the acetone extract of *Corallocaepus epigaeus* was evaluated against human epidermoid carcinoma (A-431). The acetone extract of *Corallocaepus epigaeus* tuber exhibited a concentration dependent cytotoxic effect against the human epidermoid carcinoma A-431 cell line. A significant reduction in cell viability was observed with increasing concentration of the extract (Tables 1, 2 and Figure 1).

The highest concentration (500 µl/ml) showed 83.1% growth inhibition indicating the extract exhibited pronounced cytotoxicity, with a mean cell viability of 27.45% while 500 µl/ml showed 33.32% viability. A gradual increase in cell viability was observed with decreasing concentrations, reaching 76.59% at 1 µl/ml, indicating reduced cytotoxicity at lower doses, Control cells exhibited 100% viability, confirming assay reliability and normal cellular metabolism.

The decrease in optical density at 570 nm reflects a reduction in mitochondrial dehydrogenase activity, suggesting impaired

Table 1: Cytotoxic property of acetone extract of *Corallocaepus epigaeus* on A-431 cell line.

S. No	Tested sample concentration (µg/ml)	Cell viability (%) (in triplicates)			Mean Value (%)
1.	Control	100	100	100	100
2.	500 µg/ml	25.8278	25.76	30.756	27.447943
3.	400 µg/ml	29.9669	31.68	38.3162	33.321013
4.	300 µg/ml	41.8874	41.92	41.5808	41.796058
5.	200 µg/ml	45.5298	44.96	51.2027	47.23085
6.	100 µg/ml	58.1126	52.96	56.5292	55.867264
7.	50 µg/ml	61.755	57.92	67.354	62.342973
8.	25 µg/ml	82.4503	75.36	69.244	75.684772
9.	10 µg/ml	68.3775	72.8	75.945	72.374167
10.	5 µg/ml	77.9801	79.68	79.3814	79.013859
11.	1 µg/ml	82.4503	66.4	80.9278	76.592722

Table 2: Percentage Viability acetone extract of *Corallocaepus epigaeus* on A-431 cell line.

S. No	Tested sample concentration (µg/ml)	Cell viability (%) (in triplicates)			Mean Value (%)
1.	Control	100	100	100	100
2.	500 µg/ml	13.9738	8.11639	16.7192	12.936476
3.	400 µg/ml	29.5488	27.1057	26.6562	27.770193
4.	300 µg/ml	34.3523	39.3568	39.2744	37.661173
5.	200 µg/ml	48.4716	45.3292	45.5836	46.461487
6.	100 µg/ml	43.2314	50.3828	48.5804	47.398244
7.	50 µg/ml	50.655	52.8331	55.6782	53.055444
8.	25 µg/ml	57.3508	65.3905	64.0379	62.25972
9.	10 µg/ml	65.3566	71.0567	75.3943	70.602535
10.	5 µg/ml	75.2547	80.5513	84.858	80.221359
11.	1 µg/ml	91.4119	91.1179	94.3218	92.283873

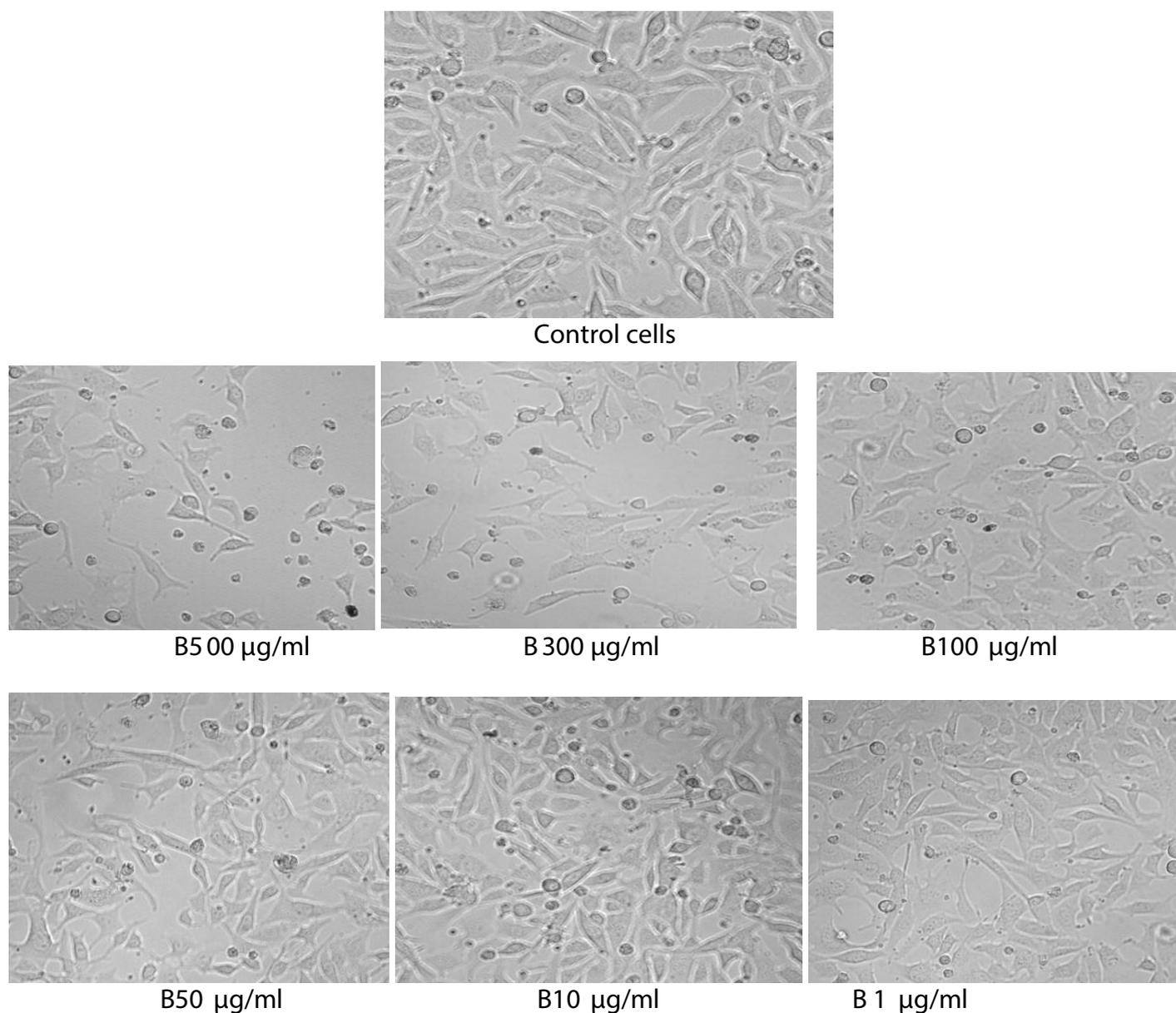


Figure 1: Images of control cells and Acetone extract of *C. epigaeus* treated cells.

metabolic function and reduced proliferation of cancer cells. Similar dose-dependent cytotoxic effects of plant acetone extracts against epidermoid carcinoma cell lines have been previously reported and attributed to the presence of bioactive secondary metabolites [7-9]

Cytotoxic Activity of *Corallocarpus epigaeus* Tuber Mediated AuNPs on A-431 Cells

The cytotoxic activity of gold nanoparticles synthesized using the acetone extract of *Corallocarpus epigaeus* tuber extract was evaluated against the human epidermoid carcinoma cell line (A-431) using MTT assay. The results demonstrated a dose-dependent reduction in cell viability, confirming the antiproliferative efficacy of the biosynthesized AuNPs. (Tables 3, 4 and Figure 2).

The highest concentration (500 µl/ml) the AuNPs induced

pronounced cytotoxicity, with mean cell viability of 12.94% and 27.77% respectively. A gradual increase in cell viability was observed with decreasing concentrations reaching 92.28% viability at 1 µl/ml, indicating minimal cytotoxicity at lower doses. The untreated control cell maintained 100% viability, confirming the reliability of the assay conditions.

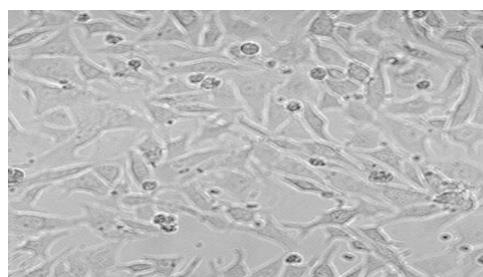
The observed reduction in optical density values at 570 nm directly correlates with decreased mitochondrial activity, reflecting compromised cellular metabolism and loss of viable cells. Similar concentration dependent cytotoxic effects have been reported for plant-based AuNPs against various cancer cell lines, including, skin, breast and cervical cancer, attributed to the enhanced nanoparticle- cell interactions and intracellular accumulation [9,10]

Table 3: Cytotoxic property of gold nanoparticle synthesized from *C. epigaeus* tuber acetone extract.

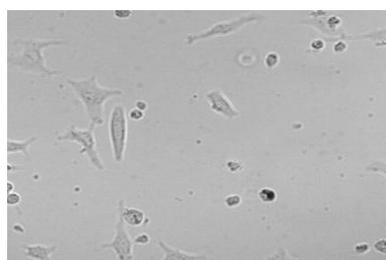
S. No	Tested sample concentration (µg/ml)	OD Value at 570 nm (in triplicates)		
1.	Control	0.687	0.653	0.634
2.	500 µg/ml	0.096	0.053	0.106
3.	400 µg/ml	0.203	0.177	0.169
4.	300 µg/ml	0.236	0.257	0.249
5.	200 µg/ml	0.333	0.296	0.289
6.	100 µg/ml	0.297	0.329	0.308
7.	50 µg/ml	0.348	0.345	0.353
8.	25 µg/ml	0.394	0.427	0.406
9.	10 µg/ml	0.449	0.464	0.478
10.	5 µg/ml	0.517	0.526	0.538
11.	1 µg/ml	0.628	0.595	0.598

Table 4: Percentage Viability acetone extract mediated AuNPs on A-431 cell line.

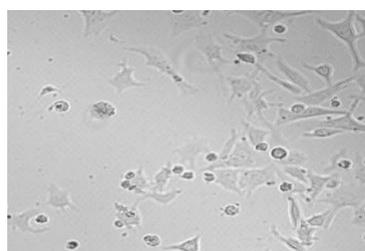
S. No	Tested sample concentration (µg/ml)	Cell viability (%) (in triplicates)			Mean Value (%)
1.	Control	100	100	100	100
2.	500 µg/ml	13.9738	8.11639	16.7192	12.936476
3.	400 µg/ml	29.5488	27.1057	26.6562	27.770193
4.	300 µg/ml	34.3523	39.3568	39.2744	37.661173
5.	200 µg/ml	48.4716	45.3292	45.5836	46.461487
6.	100 µg/ml	43.2314	50.3828	48.5804	47.398244
7.	50 µg/ml	50.655	52.8331	55.6782	53.055444
8.	25 µg/ml	57.3508	65.3905	64.0379	62.25972
9.	10 µg/ml	65.3566	71.0567	75.3943	70.602535
10.	5 µg/ml	75.2547	80.5513	84.858	80.221359
11.	1 µg/ml	91.4119	91.1179	94.3218	92.283873



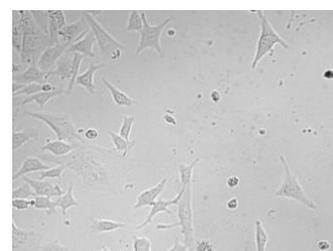
Control cells



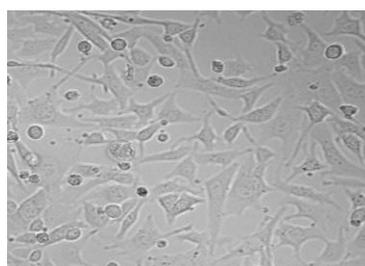
A500 µg/ml



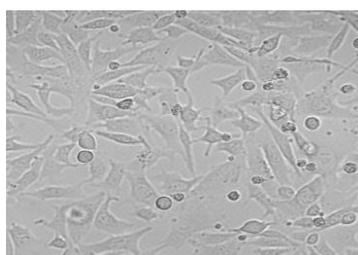
A300 µg/ml



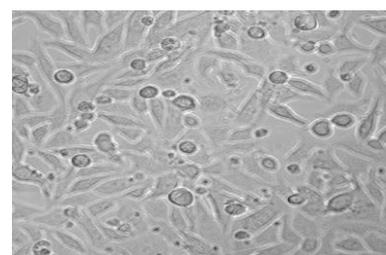
A100 µg/ml



A50 µg/ml



A10 µg/ml



A1 µg/ml

Figure 2: Images of control cells and gold nanoparticles synthesized from *C. epigaeus* against treated cells.

IC₅₀ Determination of *Corallocarpus epigaeus* Acetone Extract and *Corallocarpus epigaeus* – Mediated Gold Nanoparticles on A-431 Cells

The cytotoxic activity of acetone extract and gold nanoparticles synthesized using *Corallocarpus epigaeus* tuber was quantified against the human epidermoid carcinoma A-431 cell line using MTT assay. Dose- response data were analyzed by non-linear regression of log(inhibitor) versus normalized response using a variable-slope model.

The analysis revealed that *Corallocarpus epigaeus* mediated AuNPs exhibited IC₅₀ value of 57.97 µl/ml, whereas the acetone extract showed a higher IC₅₀ value of 84.67 µg/ml, indicating greater potency of the nanoparticle formulation (Table 5). The AuNPs showed a moderate negative Hill slope (-0.6962) suggesting a gradual inhibitory effect, while the acetone extract showed a steeper slope (-0.9403), reflecting a sharper but less potent response. Both exhibited high goodness-of-fit values (R²>0.9177), confirming the reliability of the concentration dependent inhibitory response. The 95% confidence interval for the IC₅₀ ranged from 45.15 to 74.43 µl/ml (AuNPs) and IC₅₀ ranged from 70.00-102.4 µl/ml, confirming the accuracy of tailored model. Gold nanoparticle reduced the IC₅₀ by ~32% indicating enhanced cytotoxic efficacy compared to the crude acetone extract. Compared to the reports on crude plant extracts, the IC₅₀ value obtained in the present study within the biologically relevant range and comparable to acetone extract of medicinal plants reported to exert anticancer activity against skin cancer cell lines [11,12].

The comparative results of the study clearly demonstrate the nanomedicine advantage of *Corallocarpus epigaeus* mediated gold nanoparticles over the acetone extract alone. While the crude extract exhibited notable cytotoxic activity against A-431 cells, incorporation into gold nanoparticles significantly enhanced efficacy, as evidenced

by a lower IC₅₀ values and greater maximal growth inhibition. The enhancement can be attributed to several factors intrinsic to nanoparticles-based delivery systems. In contrast crude acetone extract rely on passive diffusion and may undergo metabolic degradation, limiting their intracellular bioavailability. Gold nanoparticles offer increased surface area for phytochemical adsorption, improved cellular uptake through endocytosis and prolonged intracellular retention, all of which contribute to enhanced anticancer activity [12-14]. Moreover, AuNPs are known to induce oxidative stress and mitochondrial dysfunction in cancer cells, thereby amplifying apoptosis-related signaling pathways [15]. Importantly the observed dose-dependent response and acceptable goodness-of-fit values indicate reliable and reproducible cytotoxic effects. The higher cell viability observed at lower concentrations further suggests a favorable therapeutic opening, an essential consideration for translational nanomedicine. Rather replacing plant-based therapeutics, this study demonstrates that nano structuring of traditional medicinal plant extracts can significantly improve their biological performance, thereby bridging ethnopharmacology and modern medicine. The comparative evaluation clearly demonstrates that the acetone extract of *Corallocarpus epigaeus* exhibits intrinsic anticancer activity its nano formulation as gold nanoparticles significantly enhances cytotoxic potency, reduces the effective dose (IC₅₀) and improves biological activity against A-431 cells. These findings support the use of *Corallocarpus epigaeus* as a valuable bioresource for green nano-medicine based cancer therapeutics.

Conclusion

The present study provides convincing evidence that gold nanoparticles synthesized using *Corallocarpus epigaeus* tuber acetone extract exhibit significantly enhanced cytotoxic activity against human epidermoid carcinoma A-431 cells compared to the crude extract. The reduction in IC₅₀ value and increased growth inhibition highlight the

Table 5: Comparative IC₅₀ analysis.

log(inhibitor) vs. normalized response -- Variable slope				
	Acetone Extract of <i>Corallocarpus epigaeus</i> tuber		Acetone Extract mediated AuNPs	
Best-fit values				
LogIC ₅₀		1.928		1.763
HillSlope		-0.9403		-0.6962
IC ₅₀		84.67		57.97
Std. Error				
LogIC ₅₀		0.04036		0.05301
HillSlope		0.07893		0.06188
95% Confidence Intervals				
LogIC ₅₀		1.845 to 2.010		1.655 to 1.872
HillSlope		-1.102 to -0.7787		-0.8229 to -0.5695
IC ₅₀		70.00 to 102.4		45.15 to 74.43
Goodness of Fit				
Degrees of Freedom		28		28
R square		0.9420		0.9177
Absolute Sum of Squares		1770		2064
Sy.x		7.950		8.585
Number of points				
Analyzed	3	30	3	30

potential of Plant-mediated AuNPs as a promising nanomedicine platform for cancer therapy. More experimental work similar to In-vivo studies are necessary to support clinical translation.

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Data Availability Statement

The data supporting the findings of this study are available from the corresponding author upon reasonable request.

Conflicts of Interest

The authors declare no conflicts of interest.

References

1. Ferrari M (2005) Cancer nanotechnology: opportunities and challenges. *Nature Reviews Cancer* 5: 161-171. [[crossref](#)]
2. Peer D, Karp JM, Hong S, Farokhzad OC, Margalit R, et al. (2020) Nanocarriers as an emerging platform for cancer therapy. *Nano-Enabled Medical Applications* 23: 61-91. [[crossref](#)]
3. Dykman LA, Khlebtsov NG (2011) Gold nanoparticles in biology and medicine: recent advances and prospects. *Acta Naturae* (англоязычная версия) 3: 34-55. [[crossref](#)]
4. Iravani S (2011) Green synthesis of metal nanoparticles using plants. *Green Chemistry* 13: 2638-2650.
5. Singh H, Du J, Singh P, Yi TH (2018) Ecofriendly synthesis of silver and gold nanoparticles by *Euphrasia officinalis* leaf extract and its biomedical applications. *Artificial Cells, Nanomedicine, and Biotechnology* 46: 1163-1170. [[crossref](#)]
6. Nadkarni AK (2007) Dr. KM Nadkarni's Indian materia medica: with Ayurvedic, Unani-tibbi, Siddha, allopathic, homeopathic, naturopathic & home remedies, appendices & indexes. Popular Prakashan.
7. Fulda S, Debatin KM (2004) Targeting apoptosis pathways in cancer therapy. *Current Cancer Drug Targets* 4: 569-576. [[crossref](#)]
8. Greenwell M, Rahman PK (2015) Medicinal plants: their use in anticancer treatment. *International Journal of Pharmaceutical Sciences and Research* 6.
9. Rajeshkumar S, Bharath LV (2017) Mechanism of plant-mediated synthesis of silver nanoparticles—a review on biomolecules involved, characterisation and antibacterial activity. *Chemico-Biological Interactions* 273: 219-27. [[crossref](#)]
10. Ahmed S, Ahmad M, Swami BL, Ikram S (2016) A review on plants extract mediated synthesis of silver nanoparticles for antimicrobial applications: a green expertise. *Journal of Advanced Research* 7: 17-28. [[crossref](#)]
11. Cragg GM, Newman DJ (2013) Natural products: a continuing source of novel drug leads. *Biochimica et Biophysica Acta (BBA)-General Subjects* 1830: 3670-3695. [[crossref](#)]
12. Kuppusamy P, Ichwan SJ, Al-Zikri PN, Suriyah WH, Soundharrajan I (2016) et al. In vitro anticancer activity of Au, Ag nanoparticles synthesized using *Commelina nudiflora* L. aqueous extract against HCT-116 colon cancer cells. *Biological Trace Element Research* 173: 297-305. [[crossref](#)]
13. Yeh YC, Creran B, Rotello VM (2012) Gold nanoparticles: preparation, properties, and applications in bionanotechnology. *Nanoscale* 4: 1871-1880.
14. Arvizo RR, Rana S, Miranda OR, Bhattacharya R, Rotello VM, et al. (2025) Mechanism of anti-angiogenic property of gold nanoparticles: role of nanoparticle size and surface charge. *Nanomedicine: Nanotechnology, Biology and Medicine* 7: 580-587. [[crossref](#)]
15. Khlebtsov N, Dykman L (2011) Biodistribution and toxicity of engineered gold nanoparticles: a review of in vitro and in vivo studies. *Chemical Society Reviews* 40: 1647-1671. [[crossref](#)]

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