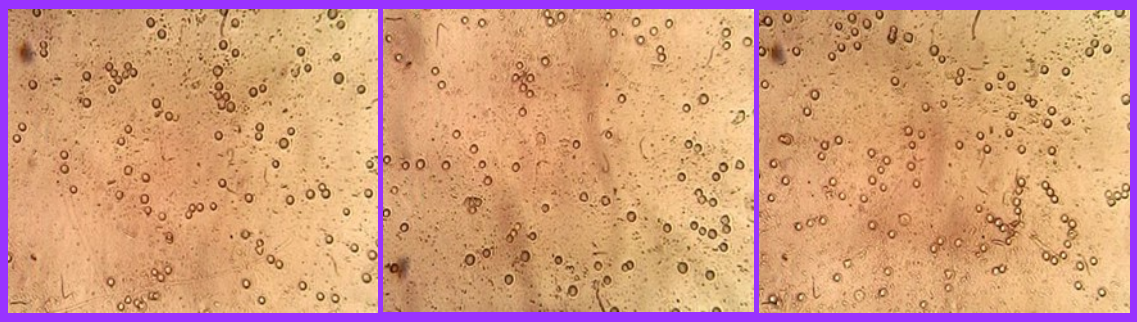

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In vitro antiproliferative activity of *Dracaena fragrans 'Lemon Lime'* on MCF-7 breast cancer cell lines

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Abstract

This study aimed to evaluate the *in vitro* antiproliferative activity of leaves of *Dracaena fragrans 'Lemon Lime'* on MCF-7 breast cancer cell lines. Phyto-constituents were extracted from leaves, and their total flavonoid contents were measured. Cell viability of cell lines was assessed by the MTT assay. The extract contained alkaloids, tannins, phenolics, and flavonoids, with a total flavonoid content of 161.7 mg QE/g. The IC_{50} of the extract on cell lines was 64.9 µg/mL. These findings indicate that *D. fragrans 'Lemon Lime'* possesses notable antioxidant and antiproliferative activity.

Introduction

Dracaena fragrans 'Lemon Lime' is a widely cultivated ornamental plant valued for its variegated foliage and adaptability to indoor environments, and it also contributes to indoor air quality improvement through partial removal of volatile organic compounds such as formaldehyde and benzene via phytoremediation mechanisms (Borzabadi Farahani et al., 2025; Peterson et al., 2023; Kumar et al., 2023).

Although the genus *Dracaena* has been extensively studied for its ornamental and ecological significance, its pharmacological potential remains relatively underexplored, particularly for horticultural cultivars like 'Lemon Lime'. This creates a research gap regarding its phytochemical composition and possible therapeutic applications.

Plants are known to be rich sources of secondary metabolites such as flavonoids, phenolics, alkaloids, and tannins, which exhibit strong antioxidant proper-ties (Dai and Mumper, 2010). Among these, flavonoids and phenolic compounds are widely recognized for their ability to scavenge free radicals and reduce oxidative stress through electron donation and hydrogen transfer mechanisms (Heim et al., 2002). Oxidative stress, caused by excessive reactive oxygen species (ROS), is strongly associated with aging and the progression of chronic diseases, including cancer, cardiovascular disorders, and neurodegenerative conditions (Qin et al., 2026).

Cancer continues to be a leading global health burden, characterized by uncontrolled cell proliferation, metastasis, and resistance to therapy. Despite advances in conventional treatments such as chemotherapy and radiotherapy, issues like toxicity and drug resistance persist, driving interest in plant-derived anticancer agents (Wu et al., 2024). Natural products such as paclitaxel and vincristine highlight the importance of

plants in anticancer drug discovery (Talib et al., 2020). *In vitro* assays, MTT is widely used to screen cytotoxic potential of plant extracts against cancer cell lines, including MCF-7 breast cancer cells (Bellamakondi et al., 2014).

The present study aimed to evaluate the pharmacognostic characteristics, total flavonoid content, and antiproliferative activity of *D. fragrans* leaf extract.

Materials and Methods

Plant materials

Healthy, disease-free specimens of D. fragrans 'Lemon Lime' were procured from Shubham Nursery (Kupwad) for use in the experimental studies. The collected plant materials were taxonomically authenticated and identified by Mr. S. M. Sabale in the Department of Botany of College P. V. P. Mahavidyalaya, Kavathe Mahankal. The identification was carried out based on detailed morphological characteristics, including leaf shape, variegation pattern, stem structure, and overall growth habit, and by comparing these features with standard taxonomic descriptions and floras.

Freshly harvested leaves were thoroughly cleaned under running water to remove dust and adhering particles, and subsequently rinsed with distilled water. The leaves were subsequently dried. Once completely dried, they were chopped and ground using a grinder to obtain a fine powder. The powdered material was passed through a 60-mesh sieve to ensure uniformity of particles. The fine powder was then stored in an air-tight, light-resistant container and kept in a cool, dry environment.

Approximately 50 g of powder of D. fragrans leaf was extracted using a Soxhlet apparatus. The powder of plant material was packed with a cellulose thimble, and continuous reflux extraction was carried out sequentially with solvents of increasing polarity, such as n-hexane, chloroform, ethyl acetate, and ethanol, to isolate phytoconstituents with a wide range of polar characteristics. Each solvent was used for an adequate period to ensure efficient extraction of the phytoconstituents, with multiple extraction cycles carried out when necessary. Following extraction, the solvents were evaporated using a rotary evaporator to obtain concentrated crude extracts, which were utilized for phytochemical analysis and biological activity studies (Abubakar and Haque, 2020).

Box 1: MTT Assay

Principle

This colorimetric assay is based on the capacity of mitochondria succinate dehydrogenase enzymes in living cell store reduce the yellow water-soluble substrate 3-(4,5-dimethylthiazol 2-yl)-2,5-diphenyl tetrazolium bromide (MTT) into an insoluble, purple colored formazan product is measured spectrophotometrically. As MTT reduction occurs only in metabolically active cells, the extent of this reduction reflects the viability of the cells.

Requirements

96-Well microplates (tissue culture grade); Aluminum foil; Biosafety cabinet (SAS filtration technologies Pvt. Ltd. Pune); CO_2 Incubator (Thermo Scientific BB150); DMSO; MCF-7 (Human mammary gland breast adenocarcinoma) cell line; MEM Medium supplemented with 10% fetal bovine serum; Microplate reader (Bioline BD 206); MTT reagent (5 mg/mL in PBS); Phosphate-buffered saline (PBS)

Procedure

Step 1: MCF-7 (human mammary gland breast adenocarcinoma) cells were taken from the National Centre for Cell Science (NCCS), Pune, and maintained in Minimum Essential Medium (MEM) with 10% fetal bovine serum.

Step 2: The cells were incubated at 37°C in a humidity containing 5% CO_2 and seeded at a density of 1×10^4 cells/mL for 24 hours.

Step 3: For the test assay, cells were plated in 96-well tissue culture plates at a conc of approximately 1×10^4 cells per well in 100 µL of culture medium, followed by the addition of 100 µL of test samples at concentrations from 10 to 100 µg/mL.

Step 4: Control wells contained cells treated with 0.2% DMSO in PBS.

Step 5: All treatments were performed in triplicate.

Step 6: Control experiments were maintained for baseline cell survival and to determine the percentage of viable cells following treatment.

Step 7: The cell cultures were incubated for 24 hours at temperature 37°C in a humidified atmosphere containing 5% CO_2 using a CO_2 incubator (Thermo Scientific BB150).

Step 8: After incubation, the culture medium was completely removed, and 20 µL of MTT reagent (5 mg/mL in PBS) was added to each well.

Step 9: The reduction, formazan crystal was observed under microscope, where these viable cells produced the yellow MTT to dark-color crystals.

Step 10: Subsequently, the medium was removed, and 200 µL of DMSO added to dissolve the formazan crystals, and incubated for 10 min at temperature 37°C under light-protected conditions.

Step 11: The absorbance of sample was measured in triplicate at 570 nm using a technique ELISA microplate reader (Bioline BD 206).

Reference

Sawant et al., 2023; Manikyam et al., 2021

Phytochemical screening

The extracts were examined for phytoconstituents such as tannins, flavonoids, alkaloids, glycosides, terpenoids, steroids, fats and oils, proteins, and saponins.

Total flavonoid content

The dried leaf powder was subjugated to ethanol extraction using a Soxhlet apparatus. One milliliter aliquot of the resulting extract was mixed with 0.3 mL of 5% sodium nitrite solution and incubated for 5 min. Subsequently, 0.3 mL of 10% aluminum chloride was added and allowed to stabilize for 6 min. This was followed by the addition of 2 mL of 1 M sodium hydroxide, and the final volume was marked up to the spectrophotometer (Shimadzu UV-1900i, Japan). A calibration curve was created using quercetin, and the total flavonoid content was calculated as milligrams of quercetin equivalents (Shraim et al., 2021).

Statistical analysis

Data were shown as mean ± SD. For data analysis, three replicates of the results were made. An analysis of variance (ANOVA) test was conducted in one direction to determine how the conditions differed. A p-value of less than 0.05 ($p<0.05$) was deemed significant.

Results

Extracts yield

The extraction yield varied considerably among the solvents, ranging from 1% to 8%. The ethanolic extract exhibited the highest yield (8%). The n-hexane extract showed a moderate yield (4%). Chloroform exhibited the lowest yield (1%).

Phytochemical screening

Initial phytochemical analysis of extracts obtained using different solvents indicated variations in the distribution of bioactive compounds (Table I).

The ethanol extract shows the most diverse phytochemical composition, with the presence of tannins, alkaloids, glycosides, flavonoids, and carbohydrates.

Table I

Phytochemical screening of *D. fragrans 'Lemon Lime'* leaves extracts in different solvents

Phytoconstituent	Ethyl acetate	Chloro-form	*n*-Hexane	Ethanol
Alkaloid	Absent	Absent	Absent	**Present**
Flavonoid	**Present**	**Present**	Absent	**Present**
Glycosides	**Present**	Absent	Absent	**Present**
Carbohydrate	Absent	Absent	Absent	**Present**
Saponin	Absent	Absent	Absent	Absent
Tannin	**Present**	Absent	Absent	**Present**

The ethyl acetate extract was found to contain tannins, flavonoids, and glycosides. The chloroform extract shows the presence of flavonoids alone. The *n*-hexane extract did not show the presence of any of the tested phytoconstituents. Saponins were absent in all extracts.

The plant extract (ethanolic) shows a total flavonoid content of 161.7 mg QE/g of extract.

Antiproliferative activity

Figure 1 shows the cell viability test of plant extract (ethanolic) against MCF-7 cells. 5-Fluorouracil (5-FU) was used as a standard.

The decrease in cell viability was concentration-dependent (in case of plant extract: 89.8% at 20 µg/mL to 40.0% at 100 µg/mL; in case of 5-fluorouracil: 52.8% at 20 µg/mL to 20.0% at 100 µg/mL) with IC_{50} of 64.9 µg/mL and 16.0 µg/mL, respectively (Table II).

Table II

Effects of plant extract on MCF-7 cell lines using MTT assay

	Cell viability (%)	
Concentration (µg/mL)	Extract	5-Fluorouracil
20	89.8	52.8
40	83.2	37.2
60	72.2	29.7
80	57.5	24.8
100	40.0	20.0

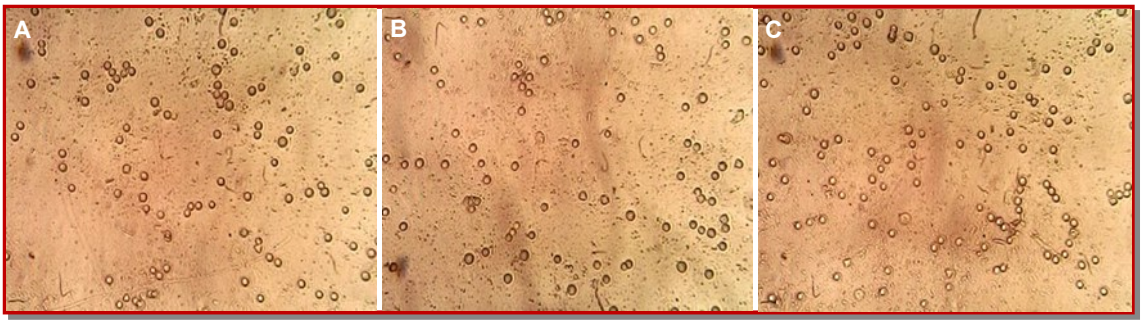

Figure 1: Microscopic view (100x) of MCF-7 cell in presence of none (A), 100 µg/mL of extract (B), or 100 µg/mL of 5-fluuorouracil (C)

Discussion

The present study provides a comprehensive evaluation of the phytochemical composition and biological activities of *D. fragrans* 'Lemon Lime', an ornamental plant that has not been previously explored for its pharmacological potential. The findings demonstrate that the plant possesses a diverse range of phytoconstituents along with notable antioxidant activity and moderate cytotoxic effects against MCF-7 breast cancer cells. While antioxidant activity was observed, it is widely recognized that such properties are common among plant extracts (Brglez Mojzer et al., 2016). Therefore, the principal significance of this study lies in the demonstrated anti-cancer activity.

The phytochemical analysis indicates that solvent polarity plays a vital role in extracting bioactive compounds. The ethanol extract displayed the greatest diversity of phytochemical constituents, likely due to its high polarity, which allows it to solubilize a broad spectrum of compounds, including alkaloids, flavonoids, glycosides, and tannins.

The flavonoids presence in extract of ethyl acetate and chloroform suggests that these compounds are moderately polar, allowing extraction in both intermediate polarity solvents. In contrast, the absence of phytoconstituents in the solvent *n*-hexane extract indicates that non-polar solvents are less effective for extracting these secondary metabolites.

Tannins and glycosides were predominantly extracted in polar and semi-polar solvents, supporting previous findings that these compounds are generally polar in nature. The absence of saponins across all extracts may indicate either their true absence in the plant material or their presence below detectable limits.

The amount of total flavonoids is within the range commonly reported for flavonoid rich plant extracts (Gidamo, 2023), suggesting a moderate to high presence of polyphenolic constituents. Furthermore, the flavonoids present in the extract may act synergistically with other phytoconstituents, enhancing the overall bioactivity. The findings of this study highlight the plant's potential as a promising source for natural antioxidants and provide a strong basis for further exploration in its pharmacological properties.

The phytochemical screening revealed the presence of flavonoids, alkaloids, glycosides, and tannins, particularly in the ethanolic extract (Agarwal et al., 2016). These classes of compounds have been extensively reported in the literature for their biological activities, including anti-cancer effects (Teodor et al., 2020). Previous studies on plant-derived compounds have shown that flavonoids and phenolic constituents can inhibit cancer cell proliferation and induce apoptosis (Abotaleb et al., 2018). Although *D. fragrans 'Lemon Lime'* has not been previously studied, similar findings have been reported in other plant species, supporting the role of these phytochemicals in cytotoxic activity (Sun et al., 2019).

The anti-cancer activity observed in this study may be attributed to the combined effect of multiple phytoconstituents (Wagner and Ulrich-Merzenich, 2009). Flavonoids and phenolic compounds are known to modulate oxidative stress and interfere with cellular signalling pathways involved in cancer progression (Kopustinskiene et al., 2020). In addition to their antioxidant properties, these compounds may induce apoptosis, inhibit cell cycle progression, and disrupt mitochondrial function in cancer cells (Wendlocha et al., 2024). The presence of alkaloids and glycosides may further enhance the cytotoxic potential of the extract, as these compounds are also associated with anti-tumour activity (Dhyani et al., 2022).

Although the extract demonstrated significant antioxidant activity, it is important to emphasize that antioxidant potential alone does not directly translate into anti-cancer efficacy. The cytotoxic effect observed against MCF-7 cells suggests that mechanisms beyond free radical scavenging are involved. The concentration-dependent decrease in cell viability indicates that the extract may interfere with cell survival pathways, possibly through induction of programmed cell death or inhibition of cell proliferation.

This study provides the first scientific evidence of the phytochemical composition and anti-cancer activity of *D. fragrans 'Lemon Lime'*. The observed cytotoxic effect against MCF-7 breast cancer cells highlights its potential as a novel source of bioactive compounds. While antioxidant activity was also detected, the primary contribution of this study is the demonstration of anti-proliferative activity, which warrants further investigation.

The present study has certain limitations, including the use of only a single cancer cell line (MCF-7) and the absence of toxicity evaluation on normal cells. In addition, the study was performed using crude extracts without isolation of specific bioactive compounds, and the underlying molecular mechanisms of cytotoxic activity were not investigated. Further *in vivo* and mechanistic studies are therefore required to validate the therapeutic potential of *D. fragrans 'Lemon Lime'*.

Conclusion

D. fragrans 'Lemon Lime' contains diverse phytoconstituents and exhibits concentration-dependent cytotoxic activity against MCF-7 breast cancer cells, along with antioxidant activity. The findings indicate that the plant possesses measurable anti-proliferative potential, with anti-cancer activity representing the primary observed biological effect.

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Ethical Issue

The development, acquisition, authentication, cryopreservation, and transfer of cell lines between laboratories were followed according to the guidelines published in British Journal of Cancer, 2014

Conflict of Interest

Authors declare no conflict of interest

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References

Abotaleb M, Samuel SM, Varghese E, Varghese S, Kubatka P, Liskova A, Busselberg D. Flavonoids in cancer and apoptosis. Cancers 2018; 11: 28.

Abubakar AR, Haque M. Preparation of medicinal plants: Basic extraction and fractionation procedures for experimental purposes. J Pharm Bioallied Sci. 2020; 12: 01-10.

Adedapo AA, Jimoh FO, Afolayan AJ, Masika PJ. Antioxidant activities and phenolic contents of the methanol extracts of the stems of *Acokanthera oppositifolia* and *Adenia gummifera*. BMC Complement Altern Med. 2008; 8: 54.

Agarwal A, Kumar A, Singh BK, Trivedi N, Jha KK. A review on extraction and phytochemical screening methods. Res Pharm Health Sci. 2016; 2: 130-37.

Apak R, Gorinstein S, Bohm V, Schaich KM, Ozyurek M, Guclu K. Methods of measurement and evaluation of natural antioxidant capacity/activity (IUPAC Technical Report). Pure Appl Chem. 2013; 85: 957-98.

Bellamakondi PK, Godavarthi A, Ibrahim M, Kulkarni S, Naik RM, Maradam S. *In vitro* cytotoxicity of Caralluma species by MTT and trypan blue dye exclusion. Asian J Pharm Clin Res. 2014; 7: 17-19.

Borzabadi Farahani F, Rahimi J, Khoramipour S, Dehghanifard E, Alimohammadi M. Environmental modulation enhances benzene phytoremediation by Aglaonema and Dracaena in indoor settings. Sci Rep. 2025; 15: 31559.

Brand-Williams W, Cuvelier ME, Berset CL. Use of a free radical method to evaluate antioxidant activity. LWT-Food Sci Technol. 1995; 28: 25-30.

Brglez Mojzer E, Knez Hrncic M, Skerget M, Knez Z, Bren U. Polyphenols: Extraction methods, antioxidative action, bioavailability and anticarcinogenic effects. Molecules. 2016; 21: 901.

Dai J, Mumper RJ. Plant phenolics: Extraction, analysis and their antioxidant. and anticancer properties. Molecules 2010; 15: 7313-52.

Dhyani P, Quispe C, Sharma E, Bahukhandi A, Sati P, Attri DC, Szopa A, Sharifi-Rad J, Docea AO, Mardare I, Calina D. Anticancer potential of alkaloids: A key emphasis to colchicine, vinblastine, vincristine, vindesine, vinorelbine and vincamine. Cancer Cell Int. 2022; 22: 206.

Gidamo GH. Antioxidant activity and mineral content of *Impatiens tinctoria* A. Rich (Ensosila) tuber, an Ethiopian medicinal plant. Sci Rep. 2023; 13: 14998.

Heim KE, Tagliaferro AR, Bobilya DJ. Flavonoid antioxidants: chemistry, metabolism and structure-activity relationships. J Nutr Biochem. 2002; 13: 572-84.

Kopustinskiene DM, Jakstas V, Savickas A, Bernatoniene J. Flavonoids as anticancer agents. Nutrients 2020; 12: 457.

Kumar R, Verma V, Thakur M, Singh G, Bhargava B. A systematic review on mitigation of common indoor air pollutants using plant-based methods: A phytoremediation approach. Air Qual Atmos Health. 2023; 16: 1501-27.

Majid N, Nissar S, Raja WY, Nawchoo IA, Bhat ZA. Pharmacognostic standardization of *Aralia cachemirica*: A comparative study. Future J Pharm Sci. 2021; 7: 33.

Manikyam HK, Joshi SK, Vakadi S, Patil SB. Anticancer activity of novel terpenoid, saponin of *Psidium guajavaon* MCF-7 cancer cell line using DAPI and MTT assays. Afr J Pharm Pharmacol. 2021; 15: 206-11.

Peterson G, Jones T, Rispoli D, Haddadi S, Niri V. Investigation of simultaneous volatile organic compound removal by indoor plants using solid phase microextraction-gas chromatography-mass spectrometry. RSC Adv. 2023; 13: 26896-06.

Qin Y, Qian C, Li W, Wang Q, Sheng Q, Chen Z, Zhang W, Li W, Ge G, Yan Z, Geng D. Oxidative stress: Molecular mechanisms, diseases, and therapeutic targets. Med Comm. 2026; 7: e70600.

Sawant VJ, Bamane SR, Shejwal RV, Patil SB. Comparison of drug delivery potentials of surface functionalized cobalt and zinc ferrite nanohybrids for curcumin in to MCF-7 breast cancer cells. J Magn Magn Mater. 2016; 417: 222-29.

Shraim AM, Ahmed TA, Rahman MM, Hijji YM. Determination of total flavonoid content by aluminum chloride assay: A critical evaluation. LWT. 2021; 150: 111932.

Sun J, Liu JN, Fan B, Chen XN, Pang DR, Zheng J, Zhang Q, Zhao YF, Xiao W, Tu PF, Song YL. Phenolic constituents, pharmacological activities, quality control, and metabolism of *Dracaena* species: A review. J Ethnopharmacol. 2019; 244: 112138.

Talib WH, Alsalahat I, Daoud S, Abutayeh RF, Mahmod AI. Plant-derived natural products in cancer research: extraction, mechanism of action, and drug formulation. Molecules 2020; 25: 5319.

Teodor ED, Ungureanu O, Gatea F, Radu GL. The potential of flavonoids and tannins from medicinal plants as anticancer agents. Anti-Cancer Agents Med Chem. 2020; 20: 2216-27.

Wagner H, Ulrich-Merzenich G. Synergy research: Approaching a new generation of phytopharmaceuticals. Phyto-

medicine 2009; 16: 97-110.

Wendlocha D, Kubina R, Krzykawski K, Mielczarek-Palacz A. Selected flavonols targeting cell death pathways in cancer therapy: The latest achievements in research on apoptosis, autophagy, necroptosis, pyroptosis, ferroptosis, and cuproptosis. Nutrients 2024; 16: 1201.

Wu Z, Xia F, Lin R. Global burden of cancer and associated risk factors in 204countries and territories, 1980–2021: A systematic analysis for the GBD 2021. J Hematol Oncol. 2024; 17: 119.

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