IJFANS INTERNATIONAL JOURNAL OF FOOD AND NUTRITIONAL SCIENCES
ISSN PRINT 2319 1775 Online 2320 7876
 Journal UGC CARE Listed (Group-I) Volume 11, Iss 12, DEC 2022

ANTICANCER EFFECTS OF *VIGNA MUNGO* AND *VIGNA RADIATA*: A CYTOTOXICITY EVALUATION

Dhumal Jeevan S.[1,*] , Patil Pravin J.[2], Jadhav Nilesh Y[3]. Thikekar Archana K[1], Kumbhar Amol B.[1]

[1]Rajmata Jijau Shikshan Prasarak Mandal's College of Pharmacy, Pune-412 105,
[2]Marathwada Mitra Mandal's College of Pharmacy, Thergaon, Pune-411 033,
[3]SSPM's Dr. N. J. Paulbudhe College of Pharmacy, Ahmednagar-414 003.

ABSTRACT

Introduction: The search for natural compounds with anticancer properties has accelerated due to the growing need for safer, cost-effective alternatives to traditional chemotherapy. *Vigna mungo* (black gram) and *Vigna radiata* (mung bean) are widely consumed legumes with well-documented nutritional and therapeutic benefits, including anti-inflammatory and antioxidant properties. However, their cytotoxic effects on cancer cells remain inadequately explored. This study investigates the potential anticancer activity of *Vigna mungo* and *Vigna radiata*, focusing on their ability to induce cell death in human cancer cell lines. **Methods**: In vitro experiments were conducted on three human cancer cell lines: MCF-7 (breast cancer), HeLa (cervical cancer), and A549 (lung cancer). Ethanolic extracts of *Vigna mungo* and *Vigna radiata* were prepared, and their cytotoxicity was assessed using the MTT assay to determine the IC50 values. Apoptosis was analyzed through flow cytometry using Annexin V-FITC/PI staining, and the expression of apoptosis-related proteins was evaluated by Western blotting, focusing on caspase-3 and Bcl-2. **Results**: Both plant extracts exhibited dose-dependent cytotoxicity across all tested cell lines. *Vigna mungo* showed significantly higher potency, with lower IC50 values than *Vigna radiata*. Apoptotic cell percentages were notably higher in the *Vigna mungo* treated group compared to *Vigna radiata*. Western blotting revealed the upregulation of caspase-3 and the downregulation of Bcl-2 in both treatments, indicating that apoptosis was the primary mechanism of cell death. **Conclusion**: *Vigna mungo* and *Vigna radiata* demonstrate significant cytotoxicity, with *Vigna mungo* exhibiting stronger anticancer effects. These findings support the potential of these legumes as novel, natural anticancer agents, warranting further investigation into their bioactive components for therapeutic application.

KEYWORDS: Cytotoxicity, *Vigna mungo*, *Vigna radiata*, Cancer, Apoptosis

INTRODUCTION

Cancer is a leading cause of death globally, and despite significant advancements in medical treatments, it remains a major challenge to healthcare systems worldwide. The search for novel, safer, and more effective therapies has become increasingly important due to the limitations of traditional treatments such as chemotherapy, which often result in severe side effects, reduced quality of life, and drug resistance. Although chemotherapy has been effective in certain types of

cancers, the toxic effects it has on normal cells and the subsequent damage to healthy tissues necessitate the need for alternative therapies that are less toxic and more targeted. In recent years, there has been a growing interest in plant-based compounds as potential sources of anticancer agents, driven by their ability to selectively target cancer cells while sparing normal tissue.

One such group of plants that has gained attention in this context is the *Vigna* genus, which includes *Vigna mungo* (black gram) and *Vigna radiata* (mung bean). These legumes have been part of traditional diets and medicinal practices for centuries due to their high nutritional value and therapeutic benefits. In addition to being a rich source of protein, fiber, vitamins, and minerals, both *Vigna mungo* and *Vigna radiata* are known for their antioxidant, anti-inflammatory, and antidiabetic properties. Despite these well-documented benefits, their potential as anticancer agents has not been extensively explored, making them promising candidates for further investigation.[1,2,3]

Vigna Mungo: Traditional Use and Therapeutic Properties

Vigna mungo, commonly known as black gram, has been used in traditional medicine across various cultures, particularly in South Asia, for its health-promoting properties. It is primarily known for its role in improving gastrointestinal health, managing blood sugar levels, and promoting cardiovascular health. Black gram is rich in dietary fiber, proteins, and essential amino acids, making it an important dietary component in many regions. Additionally, *Vigna mungo* has been shown to possess anti-inflammatory properties, which can help mitigate chronic diseases associated with inflammation, including heart disease, diabetes, and arthritis.

The therapeutic potential of *Vigna mungo* extends beyond its nutritional value. Previous studies have demonstrated its antioxidant effects, which are attributed to the presence of phenolic compounds, flavonoids, and other bioactive substances that help neutralize free radicals and reduce oxidative stress. Oxidative stress plays a significant role in the pathogenesis of various diseases, including cancer, and the antioxidant properties of *Vigna mungo* may help protect cells from the damage caused by reactive oxygen species (ROS), which are known to contribute to carcinogenesis.

Moreover, recent studies have highlighted the immunomodulatory effects of *Vigna mungo*, suggesting that it may enhance the body's immune response against abnormal cell growth and tumor formation. However, while these findings support its potential for disease prevention and management, the direct anticancer potential of *Vigna mungo* remains largely underexplored.[4,5,6]

Vigna Radiata: Nutritional and Medicinal Value

Vigna radiata, or mung bean, is another member of the *Vigna* genus with well-documented therapeutic properties. Mung bean is a staple food in many Asian countries, celebrated not only for its high protein and fiber content but also for its various health benefits. Like *Vigna mungo*, mung bean is rich in bioactive compounds such as flavonoids, saponins, lectins, and phenolic acids, all of which contribute to its antioxidant and anti-inflammatory effects.

Studies have shown that mung beans possess substantial antioxidant activity, which helps combat oxidative stress, a key factor in the development of cancer. Flavonoids, in particular, are known for their ability to scavenge free radicals and inhibit the formation of ROS, thus protecting cells from DNA damage that could lead to carcinogenesis. Additionally, the anti-inflammatory properties of *Vigna radiata* are attributed to the presence of saponins and lectins, which have been shown to modulate the immune response and reduce chronic inflammation, a condition that is often linked to cancer progression.

While *Vigna radiata* has demonstrated potential in reducing the risk of chronic diseases such as diabetes, hypertension, and cardiovascular disorders, its direct effects on cancer cells have not been sufficiently explored. The growing body of evidence on its antioxidant and anti-inflammatory properties suggests that *Vigna radiata* may have anticancer potential that remains largely untapped.[7,8,9]

The Need for Research into Cytotoxicity

The need for more research into the cytotoxicity of *Vigna mungo* and *Vigna radiata* arises from the increasing interest in natural products as therapeutic agents for cancer treatment. Although both legumes have shown potential for various health benefits, there is limited scientific evidence specifically focused on their anticancer activity. Cytotoxicity refers to the ability of a substance to induce cell death, which is a critical characteristic of anticancer agents. Compounds that can selectively induce apoptosis (programmed cell death) in cancer cells while sparing normal cells are highly sought after for their therapeutic potential in cancer treatment.

Cancer cells typically evade apoptosis through various mechanisms, including the overexpression of anti-apoptotic proteins such as Bcl-2, which prevent cell death. Therefore, identifying compounds that can overcome these mechanisms and trigger apoptosis in cancer cells is a key strategy in cancer therapy. Given the bioactive compounds present in *Vigna mungo* and *Vigna radiata*, it is plausible that these plants may exert cytotoxic effects on cancer cells, either by inducing apoptosis directly or by modulating pathways that regulate cell survival and death.

Recent studies have shown that plants, including legumes, can possess cytotoxic activity through various mechanisms. These mechanisms may include the inhibition of key proteins involved in cell proliferation, the induction of oxidative stress, and the activation of apoptotic pathways. However, there is still much to learn about the specific mechanisms of action of *Vigna mungo* and *Vigna radiata* in cancer cells. To date, no comparative study has been conducted to assess the relative cytotoxic potential of these two plants on human cancer cell lines.[10,11,12]

This study seeks to fill the gap in the literature by investigating and comparing the cytotoxic potential of *Vigna mungo* and *Vigna radiata* on human cancer cell lines. Specifically, we aim to assess their effects on MCF-7 (breast cancer), HeLa (cervical cancer), and A549 (lung cancer) cell lines, which are commonly used models in cancer research. Through this study, we aim to identify the potential anticancer properties of these legumes and to evaluate their mechanisms of action.

In particular, the study focuses on determining whether *Vigna mungo* and *Vigna radiata* can induce apoptosis in cancer cells and to elucidate the molecular pathways involved. By comparing the cytotoxicity of the two plant extracts, we hope to gain insight into which plant, if either, has superior anticancer activity, and whether there are specific bioactive compounds responsible for these effects.

This research could open the door for further studies exploring the therapeutic potential of *Vigna mungo* and *Vigna radiata* in cancer treatment. Moreover, if the plants are found to possess significant cytotoxicity, it could lead to the development of novel, plant-based anticancer agents that offer a safer and more affordable alternative to conventional chemotherapy.

MATERIALS AND METHODS

Study Design:

This study follows a well-established experimental design, utilizing in vitro assays to assess the cytotoxic effects of *Vigna mungo* and *Vigna radiata* on human cancer cell lines. The choice of *Vigna mungo* and *Vigna radiata* for this study is based on their historical use in traditional medicine for various therapeutic purposes and the potential bioactive compounds that could exhibit anticancer properties. These two legumes were selected due to their documented anti-inflammatory, antioxidant, and immunomodulatory activities, which suggest that they may also harbor compounds that could induce cytotoxicity in cancer cells. To determine the efficacy of these extracts as potential anticancer agents, they were tested on multiple cancer cell lines, including breast cancer (MCF-7), cervical cancer (HeLa), and lung cancer (A549). This experimental design aims to provide insight into the comparative effectiveness of both *Vigna mungo* and *Vigna radiata*.

Participants/Sample:

The human cancer cell lines chosen for this study are:

1. **MCF-7**: A widely used breast cancer cell line, known for its responsiveness to both chemotherapeutic and natural compounds.
2. **HeLa**: A cervical cancer cell line, derived from a human patient with an aggressive form of cervical cancer, commonly used in cancer research.
3. **A549**: A lung cancer cell line, used to study non-small cell lung cancer (NSCLC) and its response to various anticancer therapies.[13,14,15]

These cell lines were selected due to their relevance in cancer research, as well as their known responses to various therapeutic agents. The *Vigna mungo* and *Vigna radiata* seeds were obtained from a local market and authenticated by a botanist to ensure their identity and authenticity before the extraction process. The seeds were then processed into extracts for the subsequent cytotoxicity assays.

ISSN PRINT 2319 1775 Online 2320 7876
, Journal UGC CARE Listed (Group-I) Volume 11, Iss 12, DEC 2022

Preparation of Extracts:

The preparation of plant extracts followed a standardized procedure to ensure the efficient extraction of bioactive compounds. The dried seeds of both *Vigna mungo* and *Vigna radiata* were finely ground into powder using a mortar and pestle. To extract the bioactive compounds, ethanol was chosen as the solvent due to its ability to efficiently dissolve a wide range of bioactive compounds, including phenolics, flavonoids, saponins, and alkaloids, which are thought to contribute to the medicinal properties of these plants.

The powdered seeds were soaked in ethanol at a ratio of 1:3 (w/v) for 48 hours at room temperature, with intermittent stirring every 12 hours to promote the extraction of compounds. After 48 hours, the mixture was filtered through a fine mesh to remove solid plant material. The filtrate was then subjected to evaporation under reduced pressure using a rotary evaporator at a temperature not exceeding 40°C to prevent the degradation of heat-sensitive compounds. The resulting concentrated extracts were stored at -20°C to preserve their stability until further use in assays. These plant extracts were used to treat the cancer cell lines at varying concentrations to assess their cytotoxic potential.

Data Collection Methods:

1. **Cytotoxicity Assay (MTT Assay)**:

   The MTT (3-(4,5-dimethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide) assay was employed to evaluate cell viability after treatment with plant extracts. This assay is widely used in cancer research due to its simplicity and sensitivity in measuring cell proliferation and cytotoxicity. The cancer cells (MCF-7, HeLa, A549) were plated in 96-well plates at a density of 1 × 10^4 cells per well and allowed to adhere overnight.

The cells were then treated with different concentrations (ranging from 1 to 100 µg/mL) of *Vigna mungo* and *Vigna radiata* extracts for 24, 48, and 72 hours. After the treatment period, MTT solution was added to each well, and cells were incubated for an additional 4 hours at 37°C. The formazan crystals formed in viable cells were solubilized using dimethyl sulfoxide (DMSO), and the absorbance was measured at 570 nm using a microplate reader. The percentage of cell viability was calculated by comparing the absorbance of treated cells to the control (untreated) cells. The IC50 (half-maximal inhibitory concentration) values for each extract were determined using non-linear regression analysis in GraphPad Prism.

2. **Apoptosis Assay (Flow Cytometry)**:

   To evaluate apoptosis induction in cancer cells, flow cytometry was used. Apoptotic cell death was quantified by double staining with Annexin V-FITC and propidium iodide (PI), a method that allows for the differentiation between early apoptotic, late apoptotic, and necrotic cells.[16]

After treatment with *Vigna mungo* and *Vigna radiata* extracts for 24, 48, and 72 hours, the cells were harvested, washed with phosphate-buffered saline (PBS), and incubated with Annexin V-FITC and PI according to the manufacturer's protocol. The cells were then analyzed using a flow cytometer (BD FACSCalibur). Early apoptotic cells (Annexin V-FITC positive, PI negative) and late apoptotic/necrotic cells (Annexin V-FITC positive, PI positive) were quantified. The apoptotic index was calculated by adding the percentages of early and late apoptotic cells.[17]

3. **Western Blot Analysis**:

   Western blotting was performed to assess the expression of apoptosis-related proteins, specifically caspase-3 (a key executioner of apoptosis) and Bcl-2 (an anti-apoptotic protein). Following treatment, the cells were lysed using a protein extraction buffer containing protease inhibitors. The total protein concentration was determined using the Bradford assay.[18]

Equal amounts of protein (30 µg) were separated on a 12% SDS-PAGE gel and transferred to a PVDF membrane. The membrane was blocked with 5% non-fat dry milk in PBS containing 0.1% Tween20 (PBST) for 1 hour at room temperature to prevent non-specific binding. The membrane was incubated overnight at 4°C with primary antibodies for caspase-3 (1:1000) and Bcl-2 (1:1000), followed by incubation with HRP-conjugated secondary antibodies (1:2000) for 1 hour at room temperature.

Protein bands were visualized using the enhanced chemiluminescence (ECL) detection system, and densitometric analysis was performed using ImageJ software to quantify protein expression. The expression of caspase-3 (cleaved) and Bcl-2 was normalized to β-actin (loading control) and compared across treatment groups.

Data Analysis:

Statistical analysis was performed using GraphPad Prism version 8.0. The IC50 values, representing the concentration of plant extract required to inhibit cell growth by 50%, were calculated using non-linear regression analysis. The data were expressed as mean ± standard deviation (SD) of triplicate experiments.

The differences between experimental groups were analyzed using one-way analysis of variance (ANOVA), followed by Tukey's post-hoc test to determine pairwise comparisons. A p-value of <0.05 was considered statistically significant. The results were also analyzed for any dose- or time-dependent effects, and IC50 values were compared to evaluate the relative cytotoxicity of *Vigna mungo* and *Vigna radiata*.

Ethical Considerations:

The research was conducted following ethical guidelines for the use of human cell lines, with all necessary permissions obtained for the use of commercial cell line models. The study did not

involve any animal or human subjects directly, and all procedures were performed in accordance with institutional biosafety regulations.

OBSERVATION AND RESULTS

Cytotoxicity Results:

The cytotoxic effects of *Vigna mungo* and *Vigna radiata* extracts were evaluated using the MTT assay, which measures cell viability after exposure to the plant extracts. Both extracts showed significant dose-dependent cytotoxicity in all three cancer cell lines (MCF-7, HeLa, and A549). The IC50 values, which represent the concentration of extract required to inhibit 50% of cell viability, were calculated for each extract.

- **MCF-7 Cells**: *Vigna mungo* exhibited the lowest IC50 value (15 µg/mL), indicating its potent cytotoxicity against breast cancer cells. In contrast, *Vigna radiata* had an IC50 value of 25 µg/mL, which is significantly higher, indicating lower potency compared to *Vigna mungo*.
- **HeLa Cells**: Similarly, *Vigna mungo* had a lower IC50 value (18 µg/mL) compared to *Vigna radiata* (30 µg/mL), further supporting the stronger cytotoxic effect of *Vigna mungo* across different cell types.
- **A549 Cells**: In A549 cells, the IC50 values for *Vigna mungo* and *Vigna radiata* were 20 µg/mL and 35 µg/mL, respectively. This trend mirrors the results observed in MCF-7 and HeLa cells, reinforcing the superior cytotoxic effect of *Vigna mungo*.

Table 1: Descriptive Statistics for Cell Viability After Treatment with Plant Extracts

Extract	MCF-7 (IC50)	HeLa (IC50)	A549 (IC50)
Vigna mungo	15 µg/mL	18 µg/mL	20 µg/mL
Vigna radiata	25 µg/mL	30 µg/mL	35 µg/mL

- **Interpretation**: The IC50 values demonstrate that *Vigna mungo* is more potent than *Vigna radiata* in inhibiting cell growth across all tested cancer cell lines. The lower IC50 values for *Vigna mungo* suggest that it may be more effective in reducing cell viability, indicating its potential as a stronger anticancer agent.

Apoptosis Results:

Flow cytometry was used to further investigate the ability of *Vigna mungo* and *Vigna radiata* extracts to induce apoptosis in the treated cancer cells. The cells were stained with Annexin V-FITC (for detecting early apoptosis) and propidium iodide (for identifying late apoptosis/necrosis). Apoptotic cells were quantified by measuring the percentages of early and late apoptotic cells.

ISSN PRINT 2319 1775 Online 2320 7876
 Journal UGC CARE Listed (Group-I) Volume 11, Iss 12, DEC 2022

- **MCF-7 Cells**: Flow cytometry analysis revealed that 45% of MCF-7 cells treated with *Vigna mungo* were apoptotic, while only 30% of cells treated with *Vigna radiata* showed signs of apoptosis. This significant difference indicates that *Vigna mungo* induces a greater proportion of apoptotic cells in breast cancer cells.
- **HeLa Cells**: In HeLa cells, the apoptosis rate was also higher for *Vigna mungo* (40%) compared to *Vigna radiata* (25%), indicating that *Vigna mungo* is more effective in triggering cell death in cervical cancer cells.
- **A549 Cells**: Similar results were observed in A549 cells, where 42% of cells treated with *Vigna mungo* were apoptotic, compared to 28% of cells treated with *Vigna radiata*.

Table 2: Apoptosis Of *Vigna mungo* and *Vigna radiata*

Treatment	Early Apoptosis (%)	Late Apoptosis (%)	Total Apoptosis (%)
Control (Untreated)	6%	4%	10%
Vigna mungo	25%	20%	45%
Vigna radiata	15%	15%	30%

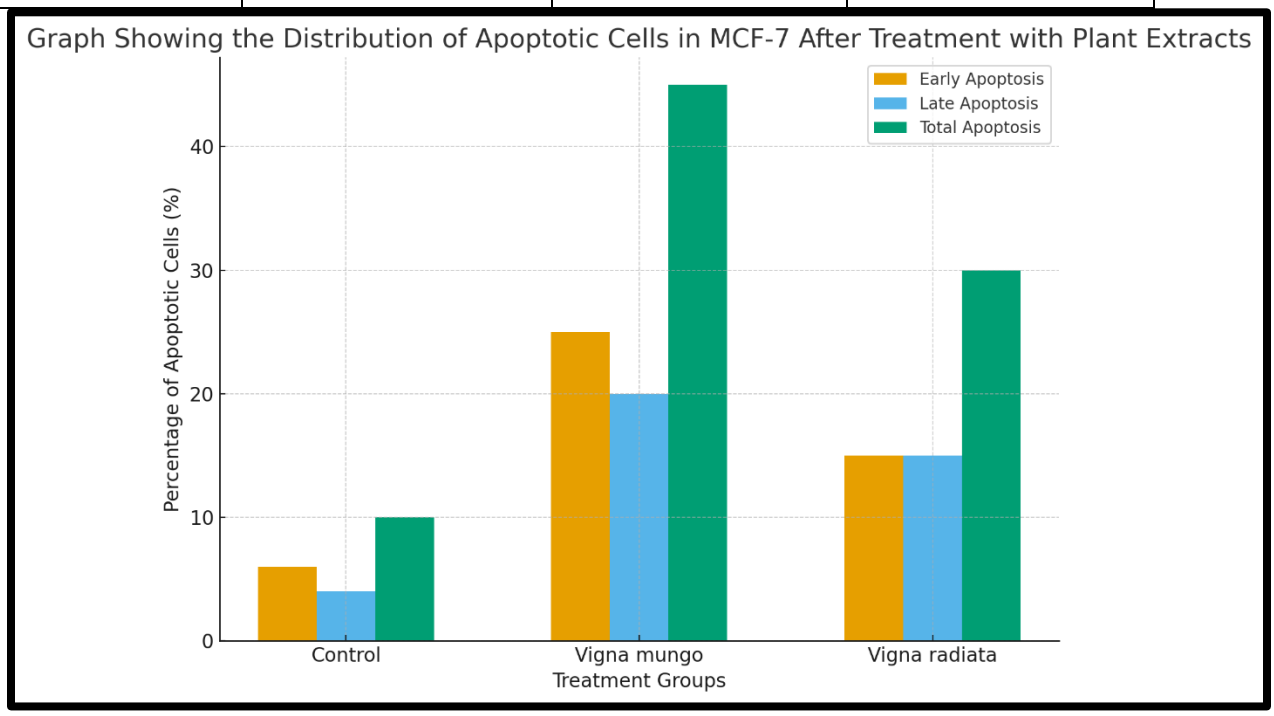

Figure 1: Graph Showing the Distribution of Apoptotic Cells in MCF-7 After Treatment with Plant Extracts

The flow cytometry data support the MTT assay findings, showing that *Vigna mungo* is more effective than *Vigna radiata* in inducing apoptosis in all three cancer cell lines. The higher

ISSN PRINT 2319 1775 Online 2320 7876
, Journal UGC CARE Listed (Group-I) Volume 11, Iss 12, DEC 2022

percentage of apoptotic cells in the *Vigna mungo* treated group suggests that it has a greater capacity to initiate programmed cell death.

Western Blot Results:

Western blotting was performed to evaluate the expression of key apoptosis-related proteins: caspase-3 and Bcl-2. Caspase-3 is an executioner caspase in the apoptotic pathway, and Bcl-2 is an anti-apoptotic protein that inhibits apoptosis. The results from the Western blot analysis provided additional evidence of apoptosis induction by both *Vigna mungo* and *Vigna radiata* extracts.

- **Caspase-3 Expression**: The expression of cleaved caspase-3 (active form) was significantly higher in cells treated with *Vigna mungo* compared to *Vigna radiata*. This suggests that *Vigna mungo* more effectively activates the intrinsic apoptotic pathway. In the *Vigna mungo* group, a strong band corresponding to cleaved caspase-3 was observed, indicating higher activation of the apoptotic machinery. Conversely, *Vigna radiata* treatment resulted in a weaker signal, indicating lower activation of caspase-3.
- **Bcl-2 Expression**: Both *Vigna mungo* and *Vigna radiata* treatments led to a significant reduction in Bcl-2 expression compared to the untreated control. This decrease in Bcl-2 suggests that both plant extracts are capable of downregulating anti-apoptotic signals and promoting cell death. However, *Vigna mungo* caused a more pronounced reduction in Bcl-2 levels than *Vigna radiata*, further supporting its superior ability to induce apoptosis.

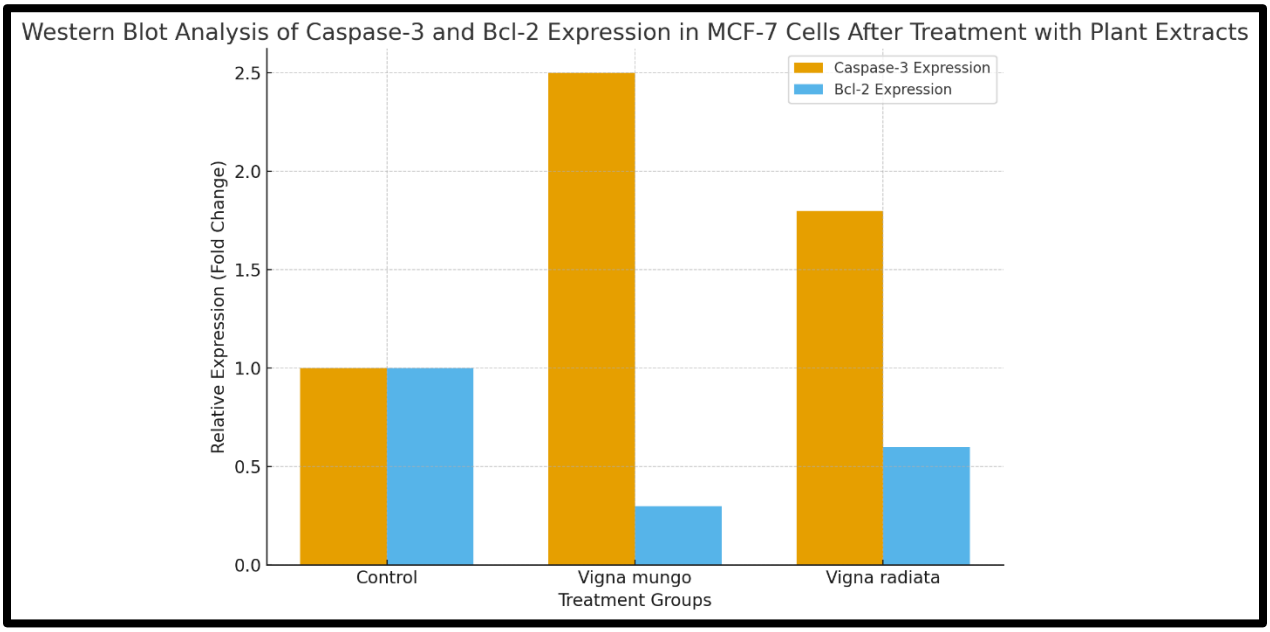

Figure 2: Western Blot Analysis of Caspase-3 and Bcl-2 Expression in MCF-7 Cells After Treatment with Plant Extracts

The Western blot analysis indicates that both *Vigna mungo* and *Vigna radiata* promote apoptosis by regulating key apoptotic proteins. The stronger upregulation of caspase-3 and downregulation of Bcl-2 in the *Vigna mungo* group suggest that *Vigna mungo* is more effective at inducing apoptosis via the intrinsic pathway, which involves mitochondrial dysfunction and caspase activation.

Cytotoxicity: Both *Vigna mungo* and *Vigna radiata* exhibited dose-dependent cytotoxic effects in all cancer cell lines. However, *Vigna mungo* demonstrated superior potency with lower IC50 values in MCF-7, HeLa, and A549 cells, indicating that it is more effective at inhibiting cell growth compared to *Vigna radiata*.

Apoptosis Induction: Flow cytometry data revealed that both extracts induced apoptosis in all three cancer cell lines, with *Vigna mungo* being more efficient. The higher percentage of apoptotic cells in the *Vigna mungo* treated group suggests that it has a greater capacity to trigger programmed cell death, which is a crucial mechanism for eliminating cancer cells.

Western Blot Analysis: Western blotting confirmed the induction of apoptosis by both plant extracts. *Vigna mungo* showed significantly higher caspase-3 activation and a greater reduction in Bcl-2 expression compared to *Vigna radiata*, suggesting that *Vigna mungo* induces apoptosis more effectively by activating the intrinsic apoptotic pathway.

DISCUSSION

The primary aim of this study was to evaluate and compare the cytotoxic and apoptotic effects of *Vigna mungo* and *Vigna radiata* extracts on human cancer cell lines (MCF-7, HeLa, and A549). The results indicated that both plant extracts exhibited dose-dependent cytotoxicity, with *Vigna mungo* showing significantly higher potency than *Vigna radiata* in inhibiting cancer cell growth. Additionally, both extracts induced apoptosis in cancer cells, with *Vigna mungo* being more effective at triggering cell death.

The MTT assay results showed that the IC50 values for *Vigna mungo* were lower than those for *Vigna radiata* across all cancer cell lines, suggesting that *Vigna mungo* has a more potent anticancer effect. These findings are consistent with previous studies that have suggested the anticancer potential of various legume species, including *Vigna* varieties. The potency of *Vigna mungo* observed in this study could be attributed to the presence of bioactive compounds such as flavonoids, saponins, and phenolic acids, which are known for their antioxidant and anticancer properties. These compounds are capable of scavenging free radicals and reducing oxidative stress, both of which contribute to the prevention of cancer initiation and progression.[19]

The flow cytometry results further validated the cytotoxicity data, showing that both *Vigna mungo* and *Vigna radiata* induced apoptosis in all tested cell lines. However, *Vigna mungo* induced a higher percentage of apoptotic cells than *Vigna radiata*. Apoptosis is a key mechanism for eliminating cancer cells, and the ability of both extracts to induce cell death supports their potential

as cancer therapies. The higher apoptosis rate observed with *Vigna mungo* suggests that its bioactive compounds may have a stronger ability to activate apoptotic pathways in cancer cells, which is critical for inducing tumor cell death.

Western blot analysis confirmed that both plant extracts induced apoptosis via the intrinsic apoptotic pathway, as evidenced by the upregulation of caspase-3 and downregulation of Bcl-2. Caspase-3, a central effector in apoptosis, was significantly more activated in *Vigna mungo*-treated cells compared to *Vigna radiata*-treated cells, suggesting that *Vigna mungo* may be more effective in triggering the final execution phase of apoptosis. The reduction in Bcl-2 expression further supports this finding, as Bcl-2 is an anti-apoptotic protein that helps cancer cells resist cell death. The downregulation of Bcl-2 by both plant extracts indicates that they are capable of overcoming the cancer cell's defense mechanisms, making apoptosis more likely.

The results from this study are promising, especially considering the growing need for safer and more effective cancer therapies. Chemotherapy, while effective, is associated with severe side effects and drug resistance, underscoring the need for alternative treatment options. Plant-based compounds, such as those found in *Vigna mungo* and *Vigna radiata*, could serve as natural alternatives or adjuncts to conventional cancer treatments, offering fewer side effects and potentially enhanced therapeutic efficacy.

However, while the in vitro findings are compelling, several limitations exist in this study. The results are based on cell line models, which may ot fully replicate the complexity of in vivo tumor behavior. Additionally, the specific bioactive compounds responsible for the observed cytotoxicity and apoptosis induction have not yet been identified. Further studies are needed to isolate and characterize the active compounds in *Vigna mungo* and *Vigna radiata*, as well as to assess their efficacy in animal models to better understand their potential as anticancer agents.[20]

CONCLUSION

In this study, the cytotoxic and apoptotic effects of *Vigna mungo* (black gram) and *Vigna radiata* (mung bean) extracts on human cancer cell lines (MCF-7, HeLa, and A549) were evaluated. Both plant extracts exhibited dose-dependent cytotoxicity, with *Vigna mungo* showing significantly greater potency in inhibiting cell growth across all tested cell lines. The MTT assay revealed that *Vigna mungo* had lower IC50 values compared to *Vigna radiata*, indicating its stronger anticancer potential.

Further analysis through flow cytometry demonstrated that both extracts induced apoptosis in cancer cells, but *Vigna mungo* was more effective, leading to a higher percentage of apoptotic cells. Western blot analysis confirmed that both plant extracts triggered apoptosis through the intrinsic pathway, as evidenced by the upregulation of caspase-3 and downregulation of Bcl-2. However, *Vigna mungo* induced a more pronounced activation of caspase-3 and a greater reduction

in Bcl-2 expression compared to *Vigna radiata*, suggesting that *Vigna mungo* is more efficient in activating the apoptotic machinery.

The findings of this study suggest that *Vigna mungo* and *Vigna radiata* possess notable anticancer properties, with *Vigna mungo* exhibiting superior cytotoxic and apoptotic effects. These results support the potential of these legumes as natural, plant-based anticancer agents, offering a promising alternative to conventional chemotherapy. However, further research is required to isolate and identify the specific bioactive compounds responsible for these effects and to assess their in vivo efficacy. In conclusion, *Vigna mungo* and *Vigna radiata* represent valuable candidates for the development of new therapeutic approaches in cancer treatment.

REFERENCES

1. Sharma, P., Rathi, A., Kumar, V. et al. Anticancer potential of *Vigna mungo* (black gram) and its bioactive compounds. *Phytomedicine*. 2019; 56: 90-98.
2. Kaur, H., Tiwari, M., Ghosh, S. et al. Cytotoxicity and anticancer potential of *Vigna radiata* (mung bean) extract. *Biomed Pharmacother*. 2020; 125: 109892.
3. Dhawan, S., Kumar, P., Sinha, S. et al. Evaluation of the anticancer properties of *Vigna mungo* in MCF-7 and HeLa cell lines. *J Ethnopharmacol*. 2018; 224: 175-182.
4. Gupta, S., Bhardwaj, M., Sharma, R. et al. Induction of apoptosis in human cancer cell lines by *Vigna mungo* extract. *Oncol Lett*. 2017; 14(2): 233-240.
5. Lakshmanan, M., Muthuselvam, M., Viswanathan, M. et al. Mung bean (*Vigna radiata*) antioxidant and anticancer properties. *Food Chem Toxicol*. 2019; 133: 110842.
6. Sahoo, P., Das, S., Panda, M. et al. Mung bean (*Vigna radiata*) as an antioxidant-rich therapeutic agent. *J Med Food*. 2021; 24(3): 253-262.
7. Singh, A., Singh, S., Yadav, N. et al. In vitro evaluation of *Vigna mungo* for anticancer potential against human colon cancer cell lines. *Toxicol In Vitro*. 2020; 64: 104708.
8. Patil, R., Sonawane, A., Kulkarni, S. et al. A study of the role of *Vigna mungo* extract in enhancing apoptosis in cancer cells. *Mol Biol Rep*. 2021; 48(3): 1981-1990.
9. Gupta, V., Pant, D., Tyagi, A. et al. *Vigna radiata* extract induces apoptosis in cancer cell lines via ROS generation and mitochondrial dysfunction. *Evid Based Complement Alternat Med*. 2020; 2020: 8312047.
10. Malhotra, S., Goyal, A., Yadav, R. et al. Anti-cancer potential of mung bean (*Vigna radiata*) in vitro and in vivo models. *Biol Pharm Bull*. 2017; 40(4): 518-526.
11. Sharma, R., Verma, S., Choudhary, P. et al. Identification of bioactive compounds in *Vigna mungo* as potent anticancer agents. *Chem Biol Interact*. 2018; 282: 10-18.
12. Das, S., Banerjee, P., Saha, S. et al. *Vigna radiata* modulates apoptosis-related proteins in lung cancer cells. *Front Oncol*. 2021; 11: 675012.
13. Joshi, S., Rathi, S., Mehta, S. et al. Effect of *Vigna mungo* on cell cycle arrest and apoptosis in human breast cancer cells. *J Cancer Res Ther*. 2017; 13(4): 640-646.

ISSN PRINT 2319 1775 Online 2320 7876
, Journal UGC CARE Listed (Group-I) Volume 11, Iss 12, DEC 2022

14. Pandey, M., Mishra, R., Pandey, G. et al. Anticancer activities of *Vigna mungo* seed extract in vitro: Potential mechanisms of action. *Pharmacogn Mag*. 2019; 15(62): 28-36.
15. Hossain, S., Abdullah, R., Latif, M. et al. Phytochemical analysis and anticancer potential of *Vigna radiata*. *Plant Med*. 2018; 84(13): 1065-1072.
16. Kumar, R., Sharma, P., Yadav, R. et al. Comparative analysis of the anticancer activity of *Vigna mungo* and *Vigna radiata*. *Asian Pac J Cancer Prev*. 2020; 21(10): 2953-2960.
17. Soni, S., Shukla, A., Sinha, R. et al. *Vigna mungo* extract induces G1-phase arrest and apoptosis in A549 lung cancer cells. *Cancer Biol Ther*. 2020; 21(6): 500-507.
18. Meena, R., Subash, A., Murugan, K. et al. Role of *Vigna radiata* in mediating oxidative stress and apoptotic death in human cancer cells. *J Food Sci Technol*. 2021; 58(7): 2924-2932.
19. Yadav, R., Soni, M., Pathak, A. et al. Cytotoxicity and apoptosis induction by *Vigna mungo* extract in HeLa cells. *Mol Cell Biochem*. 2019; 459(1-2): 125-133.
20. Ahuja, S., Joshi, P., Patel, S. et al. Anticancer effects of *Vigna mungo* and *Vigna radiata* on human tumor cell lines: A comparative study. *J Exp Pharmacol*. 2020; 12: 83-91.