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Phytochemical Analysis and *In-vitro* Anticancer Potential of *Musa paradisiaca* L Stem Extract

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ABSTRACT

Selected medicinal plants possess many phytochemicals that have excellent antioxidant and anti-cell proliferation potential. The banana stem extract (BSE) is also one among them which have many therapeutic values. The objective of the current experiment was to identify and confirm anti-cell proliferation activity using suitable validated *in-vitro* experiments. Banana stem extract was prepared by traditional extraction method. The presence of various classes of phytochemicals were confirmed using qualitative phytochemical screening tests using a standard protocol. BSE was subjected to cell viability assay for cell proliferation or cell viability using selected five organ types of human cancer cell lines. Suitable chemotherapeutic compounds were used as a reference in the above experiment. The presence of various classes of phytochemicals such as glycoside, tannin, saponin, alkaloids etc were confirmed by reaction test. Cell viability test showed favorable activity with certain types of human cancer cells. Promising inhibitory activity was seen in breast, Colon, Brain, Prostate, and lung cancer. The maximal activity was found at different concentrations in each cancer type. It is also important to note that the activity noticed was in dose-dependent manner and hence we could calculate the IC_{50} value. The ability inhibition of cell proliferation was encouraging with differential IC_{50} values. The activity could be due to the presence of various phytochemicals such as alkaloids, tannins, and glycosides in the BSE. Collectively, it can be concluded that the traditional preparation of BSE has significant anti-cancer potential in *in-vitro* methods. However, the same can be further explored in a suitable novel animal efficacy model with a multiparametric readout to substantiate the claim.

Keywords: MTT, Glioblastoma cell line, Colon carcinoma, Prostrate cancer, Breast cancer, Lung cancer.

INTRODUCTION

In several parts of the world, medicinal plants are commonly utilised in traditional medicine to cure various disorders[1] has made a substantial contribution to the growth of several traditional medical systems across the world[2] and assisted in the investigation of various medicinal plants to

uncover the scientific concepts of their traditional applications. Countless research studies have found that consuming fruits and vegetables reduces the chance of developing cancer[3]. This category of phytochemicals has a wide range of biological activities in addition to their fundamental significant antioxidant action, most of which are associated to interventions in different stages in the growth of cancer, such as initiation, progression, promotion, invasion, and metastasis[4,5].

Banana, also known as *Musa paradisiaca (M. paradisiaca)*, is a plant that is grown in tropical and semi-tropical regions and is a member of the Musaceae family[6]. It is an herbaceous plant with a sturdy pseudostem that resembles a tree and a crown of enormous, long, oval, deep-green leaves with a pronounced midrib. Bananas have been discovered to have therapeutic benefits, both traditionally and scientifically. The blossom of banana is a rich source of proteins, vitamins, and flavonoids, among other compounds. Free radicals are eliminated by the extract's natural antioxidants, which also inhibit tissue and cell damage. Bhaskar *et al.,* in their study explored that Banana (*Musa sp.)* flower and pseudostem extracts were shown to increase glucose absorption in Ehrlich ascites cancer cells. China *et al.,* also revealed that banana blossoms are a possible natural source of antioxidant compounds[7,8].

Numerous investigational studies have been conducted on that banana extract and its by-products and results reported that it's a vital Credle of bioactives and phytoconstituents. In a research done by Kim *et al.,* (2022) on banana flesh has revealed its antioxidant potential due to the presence of rich flavonoid content[9]. According to El-Enein *et al.,* (2016), the banana peel *(Musa paradisiaca* L.*)* acetone extract exhibited the strongest antibacterial and antioxidant properties at 600ppm. The phenolic profiles of the banana peel acetone extract included quercetin, catechin, and chrysin[10]. Mokbel and Hashinaga. (2005) reported ethyl extract from green banana peels has significant antimicrobial activities against several bacterial strains (such as *Staphylococcus aureus, Bacillus subtilis, Bacillus cereus, Salmonella enteritidis*)[11]. Additionally, it was noted that the presence of flavonoids and tannins has been linked to neuroprotective[12], anticancer[13], and chemopreventive[14,15] properties. *Musa spp*. blooms possess crucial phytochemicals, including antioxidant-rich flavonoids and terpenoids[16]. Although humans have built-in antioxidant mechanisms to fight cancer-causing free radicals, eating more antioxidants, especially from fruits and vegetables, could be helpful[17].

Pharmacological tests conducted on *Musa spp*. blooms revealed they possess antidiarrheal, antiulcerative, hypoglycemic, and hypocholesterolemic properties[18]. The floral extracts also demonstrated cytotoxic and antiproliferative effects against human colon cancer cells (HT29, HCT-116), HeLa cells, and breast cancer cells. Despite extensive exploration of the pharmacological potential of *Musa spp*. flowers, few studies have identified the specific constituents responsible for these effects. Therefore, further research should focus on isolating these compounds, which could potentially be developed into significant medicinal products. While synthetic materials are predominantly utilized in medical and pharmaceutical fields[19, 20], there is increasing interest in assessing plant phytochemicals as alternatives[21,22,23], given their abundant presence in plant tissues[24]. Thus, exploring the phytochemical content of bananas warrants further investigation.

The current work concentrated on the above to identify the phytoconstituents and anticancer activity since there were insufficient references related to the phytoconstituents and to establish the in-vitro anticancer activity of *Musa paradisiaca* stem extract against different cell lines.

MATERIALS AND METHODS

Preparation and collection of plant

Whole Banana tree stem *Musa paradisiaca* stem was identified and purchased through authenticated vegetable market, Ghaziabad (UP). Foils of the stem was peeled off and the pith of the stem was separated out. Pith was made into small pieces. 100 g of the stem pieces were combined with 10 mL of distilled water, then ground in a mixer. The slurry of the stem was obtained and then filtered using muslin cloth to get BSE. The BSE was prepared freshly prepared whenever the experiment was planned[25].

Qualitative Phytochemical Screening

The primary classes of phytochemical ingredients such as steroids, alkaloids, tannins, saponins, terpenoids, carbohydrates, flavonoids, phenols, protein etc, were identified from the qualitative phytochemical analysis of the BSE using the following colour reaction tests and their results are mentioned in Table 1.

Phytoconstituents Identification

Detection of Steroids

In the test tube, 10 mL of chloroform were mixed with 1 mL of BSE to make a solution. Sulfuric acid was gently added in an amount of 11 mL. Sulfuric acid layer appears yellow with green fluorescence, and the top layer turns red. This suggested that steroids were present.

Detection of Alkaloids

One millilitre of BSE was mixed with 10 millilitres of acidified alcohol before being heated and filtered. 1 mL of filtrate was combined with 0.4 mL of diluted ammonia and 1 mL of chloroform, then the mixture was gently shaken. The chloroform layer was extracted with 2 mL of acetic acid. This was then split into two halves. Different alkaloidal reagents, including Mayer's reagent and Dragendroff's reagent, were added in different halves for the test.

Portion 1: Portion 1: Mayer's reagent, which is freshly made by combining potassium iodide (5.00 g) and mercuric chloride (1.36 g) in water (100.0 ml), when added to the above first half resulted in a cream-colored precipitate.

Portion 2: Dragendroff's reagent, a solution of potassium bismuth iodide composed of basic bismuth nitrate (Bi $(NO_3)_3$), tartaric acid, and potassium iodide (KI), was added to the other half to get reddish-brown precipitate.

Detection of Phenolics

The small quantity of BSE was taken in the test tube and diluted with ferric chloride solution (5%) and lead acetate solution (10%). The appearance of a deep blue-black color and white precipitate indicate the presence of phenolics.

Detection of flavonoids

A portion of the BSE was treated with 1N aqueous NaOH solution and concentrated sulphuric acid. Flavonoids are present as evidenced by the color of yellowish orange.

Detection of Saponins

5 mL of BSE was taken in the test tube and add a drop of sodium bicarbonate. Shake the mixture strongly and keep aside for 3 minutes. The formation of a honeycomb-like froth showed the presence of saponins.

Detection of Tannins

Dimethyl sulfoxide (DMSO) was heated with 1 mL of BSE for 2 mL, then the mixture was filtered. It is diluted with a few drops of ferric chloride solution at 0.1%. The presence of tannins is indicated by the presence of brownish green or a blue-black colouring.

Detection of Terpenoids

Salkowski's test: To 100 µL of the BSE, add 0.4 mL of chloroform followed by few drops of conc. H_2SO_4. The appearance of a reddish-brown color near the interface denotes the presence of terpenoids.

Detection of Proteins

Transfer 2 mL of BSE in clean test tube. Add 2 mL of biuret reagent and observe. Proteins can be confirmed by the appearance of violet colour.

Detection of Carbohydrates

Molisch's test: Pour 1 mL of BSE into a clean test tube. Add a few drops of strong sulfuric acid to the BSE after adding Molisch's reagent, which is naphthol that has been dissolved in ethanol. The formation of a purple ring at the test material's and acid's interface denotes the presence of carbohydrates.

Detection of Fatty Acids

5 mL of ether were combined with 0.5 mL of BSE. On filter paper, this mixture was allowed to evaporate. and the filter paper was dried. Fatty acids are present when a translucent layer appears on the filter paper.

Detection of Glycosides

Fehling's test: The BSE was warmed on water bath. The test tube was filled with 2 mL of the BSE. Fehling's solutions A and B, each containing 1 mL, were added. The mixture was mixed and boiled for 15 min in a water bath. Reducing sugar is indicated by a brick-red precipitate.

Table 1: Phytochemical presence screening test of BSE extract

Test	Observation	Inference
Steroids	No Observation	-
Alkaloids (Mayer's Test)	Cream colour precipitate	+
Alkaloids (Dragendroff's Test)	Reddish-brown precipitate	+
Phenolics	No Observation	-
Flavonoids	Yellowish orange colour	+
Saponins	Honeycomb like froth	++
Tannins	Brownish green coloration	++
Terpenoids	No Observation	-
Proteins	No Observation	-
Carbohydrates	No Observation	-
Fatty Acids	No Observation	-
Glycosides	Brick-red precipitate	++

++: Presence of maximum active constituents; +: Presence of moderate active constituents
-: Absence of active constituents

Anticancer activity

Cell viability assay (MTT Assessment)

The MTT (3-(4,5-dimethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide) assay was used to evaluate the cell viability and the cytotoxicity. The cancer cells (U87MG, HCT116, MCF-7, DU145 and PC3) were harvested and cell suspension were prepared. 96-well culture plates were used to cultivate 100 µL of cell suspension at a seeding density of 5000–10,000 cells per well. To determine the cytotoxicities of BSE and various reference standards such as TMZ, 5-FU, Doxorubicin and Paclitaxel were added 100 µL at six different concentrations into the cell suspension present in the wells. Each concentration was tested in triplicate wells. The control wells were added with respective culture media.

All the 96-well culture plates were incubated in CO_2 Incubator with 5% CO_2 at 37°C. After 72 h following treatment, the media in the wells were replaced by 100 µL/well of medium containing 0.5 g/µL of MTT reagent, and the incubation time was extended by 4 hours. The media present in the wells was decanted and completely aspirated out using a multichannel pipette. Formazan crystals are formed by the reduction of MTT dye by mitochondrial succinate dehydrogenase enzyme. To dissolve these formazan crystals (100 µL of DMSO was poured into each well. The plate is thoroughly shaken to ensure complete dissolution. Microplate reader (BioTek) was used to test the solution's absorbance at 590nm wavelength. Relative viability (as a percentage of control) was used to express the cytotoxicity. Cell survival in the medium control (without treatment) was taken to be 100%.

Hence, Relative viability = [(Test absorbance – basal absorbance)/(Untreated control Absorbance– basal absorbance)] × 100%. Percentage cytotoxicity was calculated by subtracting the %viability with 100. The inhibitory concentration (IC_{50}) values of BSE and various cytotoxic agents were calculated using the survival curves.[26,27].

Apoptosis Investigation by Inverted Microscopy

Cells were plated in 6-well plates at a density of 1.5×10^5 cells per well and allowed to adhere for 16 hours. They were then treated with BSE 50% at their respective IC_{50} concentrations for 48 h using the Glioblastoma cancer cell line, HCT-116 cancer cell line, MCF-7 breast cancer cell line, DU-145 prostate cancer cell line, and A-549 Lung Cancer cell line. Cell death mechanisms were observed using an Olympus Culture Microscope model at 100xmagnification (Olympus Corporation, Tokyo, Japan)[28].

RESULTS

Effect of *Musa paradisiaca* stem extract on Glioblastoma cancer cell line

Musa paradisiaca extract's anticancer activity was measured using the MTT test. Fig. 1 displays the MTT assay's outcomes. The plant extract significantly damaged U87MG cells, and this cytotoxicity was dose-dependent. The estimated IC_{50} for U87MG cells was 55.24, but the actual IC_{50} for Temozolomide cells was determined to be 21.45.

The MTT assessment results depict *Musa paradisiaca* stem extract exhibits specific growth inhibition IC_{50} in Glioblastoma cancer cells (U87MG cells). The graph shows the percentage significant cytotoxic effect. The results were compared with Temozolomide.

Table 2: Results of MTT assay on Glioblastoma cell line

Treatment	U87MG-GLIOBLASTOMA (Cell seeding density: 10000 per well) 72 h-MTT assay							
	Optical density			Average	Standard deviation	%Cell viability	%Cytotoxicity	IC_{50} value
	Well 1	Well 2	Well 3					
BSE, 5%	1.755	1.792	1.884	1.810	0.066	102.7	-2.7	55.24%
BSE, 10%	1.719	1.701	1.734	1.718	0.017	96.8	3.2	
BSE, 20%	1.678	1.631	1.653	1.654	0.024	92.7	7.3	
BSE, 30%	1.567	1.481	1.492	1.513	0.047	83.7	16.3	
BSE, 40%	1.007	1.105	1.206	1.106	0.100	57.7	42.3	
BSE, 50%	0.716	0.604	0.815	0.712	0.106	32.5	67.5	
TMZ, 3uM	1.721	1.622	1.605	1.649	0.063	92.4	7.6	21.45 µM
TMZ, 10uM	1.439	1.394	1.398	1.410	0.025	77.1	22.9	
TMZ, 30uM	1.215	1.219	1.202	1.212	0.009	64.4	35.6	
TMZ, 100uM	1.018	0.927	1.101	1.015	0.087	51.9	48.1	
TMZ, 300uM	0.511	0.504	0.529	0.515	0.013	19.9	80.1	
TMZ, 1000uM	0.293	0.305	0.256	0.285	0.026	5.2	94.8	
CONTROL-72 h	1.765	1.654	1.887	1.769	0.117	100.0	0.0	
BASAL, 0 h	0.203	0.197	0.211	0.204	0.007	0.0	NA	

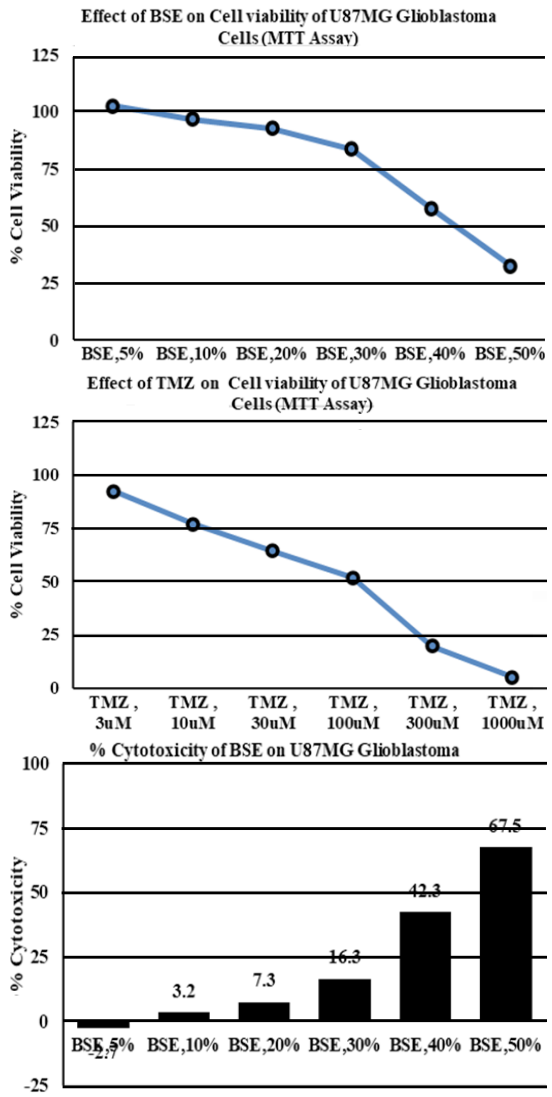


Fig. 1. Effect of the BSE extract on percentage cell viability on Glioblastoma cell line

Effect of *Musa paradisiaca* stem extract on HCT-116 cancer cell line

MTT assay was also used to further examine *Musa paradisiaca's* possible anticancer effects on HCT-116 cells. In general, cancer cells have a propensity to form colonies and proliferate in close proximity to other cells. When cells were treated with the extract, HCT-116 proliferation was greatly suppressed in comparison to the control group, according to the results of the MTT

experiment (Fig. 2). The estimated IC_{50} for HCT-116 cells was 33.15, whereas the IC_{50} for 5-FU cells was 10.09, respectively. The results of this study confirmed the *Musa paradisiaca* stem extract's anticancer properties even more. Results from the MTT experiment reveal that *Musa paradisiaca* stem extract specifically inhibits proliferation in HCT-116 cells. The results were compared with 5-Fluorouracil.

Table 3: Results of MTT assay on Colon Carcinoma

Treatment	HCT 116 COLON CARCINOMA (Cell seeding density:5000 per well) 72 h-MTT assay							
	Optical density			Average	Standard deviation	%Cell viability	%Cytotoxicity	IC_{50} value
	Well 1	Well 2	Well 3					
BSE, 5%	1.823	1.997	1.829	1.883	0.099	93.0	7.0	33.15%
BSE, 10%	1.892	1.799	1.905	1.865	0.058	92.0	8.0	
BSE, 20%	1.654	1.743	1.728	1.708	0.048	82.8	17.2	
BSE, 30%	1.477	1.446	1.378	1.434	0.051	66.7	33.3	
BSE, 40%	1.032	0.927	1.117	1.025	0.095	42.7	57.3	
BSE, 50%	0.864	0.888	0.915	0.889	0.026	34.7	65.3	
5-FU, 0.3uM	1.886	1.927	1.817	1.877	0.056	92.6	7.4	10.09 µM
5-FU, 1uM	1.761	1.618	1.559	1.646	0.104	79.1	20.9	
5-FU, 3uM	1.273	1.301	1.237	1.270	0.032	57.1	42.9	
5-FU, 10uM	0.993	1.122	0.935	1.017	0.096	42.2	57.8	
5-FU, 30uM	0.442	0.418	0.537	0.466	0.063	9.9	90.1	
5-FU, 100uM	0.219	0.233	0.208	0.220	0.013	-4.5	104.5	
CONTROL-72 h	1.965	1.954	2.087	2.002	0.074	100.0	0.0	
BASAL, 0 h	0.311	0.297	0.284	0.297	0.014	0.0	NA	

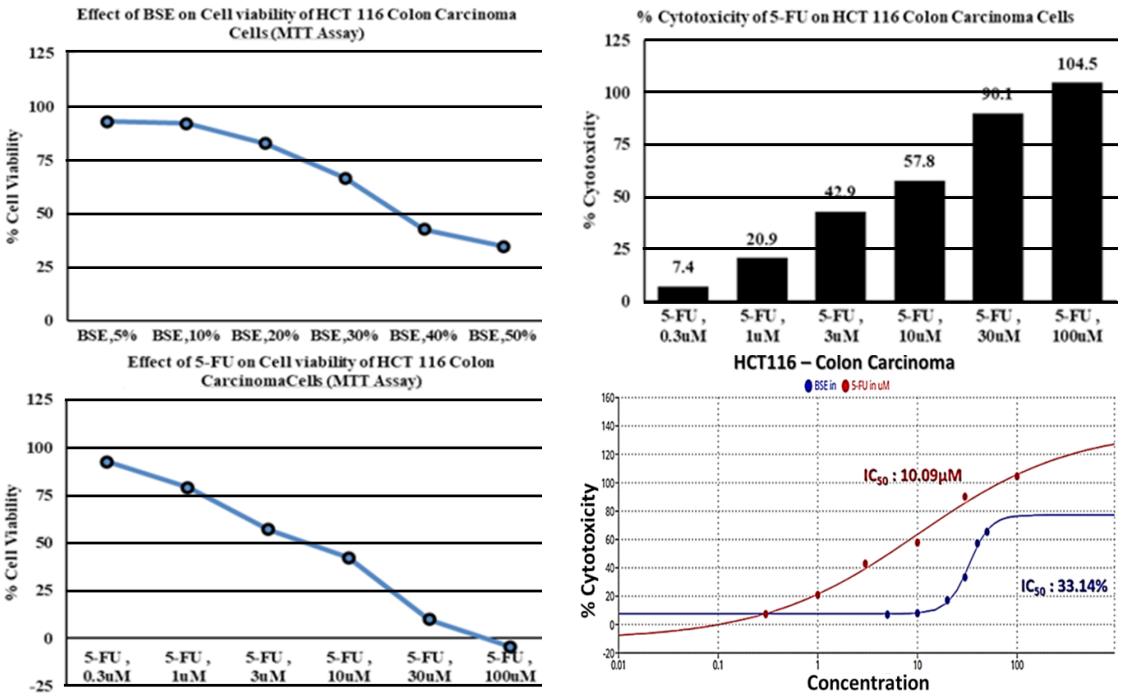


Fig. 2. Effect of the BSE extract on percentage cell viability on Colon Carcinoma cell line

Effect of *Musa paradisiaca* stem extract against MCF-7 breast cancer cell line

Results of MTT assay showed *Musa paradisiaca* stem extract exhibits specific growth inhibition in breast cancer cells. The results demonstrated that the *Musa paradisiaca* stem extract reduced all cells' percentage viability and that it increased cytotoxicity towards the cancer cell line MCF-7. The extracts' effects are

quite similar to those of major chemotherapy medications like doxorubicin, which is frequently prescribed for the treatment of breast cancer. Fig. 3 displays the *Musa paradisiaca* stem extract's IC_{50} values for the (MCF-7) breast cancer cell lines.

Table 4: Results of MTT assay on Breast Carcinoma

Treatment	MCF-7 BREAST CARCINOMA (Cell seeding density:7500 per well) 72 h-MTT assay							
	Optical density			Average	Standard deviation	%Cell viability	%Cytotoxicity	IC_{50} value
	Well 1	Well 2	Well 3					
BSE,5%	1.602	1.591	1.539	1.577	0.034	98.3	1.7	209.23%
BSE,10%	1.417	1.424	1.391	1.411	0.017	86.0	14.0	
BSE,20%	1.227	1.204	1.382	1.271	0.097	75.7	24.3	
BSE,30%	1.002	1.104	1.148	1.085	0.075	62.0	38.0	
BSE,40%	0.882	0.818	0.855	0.852	0.032	44.8	55.2	
BSE,50%	0.537	0.574	0.549	0.553	0.019	22.8	77.2	
Dox, 0.1uM	1.466	1.419	1.392	1.426	0.037	87.1	12.9	0.50 µM
Dox, 0.3uM	1.104	1.189	1.026	1.106	0.082	63.6	36.4	
Dox, 1uM	0.792	0.718	0.835	0.782	0.059	39.7	60.3	
Dox, 3uM	0.522	0.541	0.547	0.537	0.013	21.6	78.4	
Dox, 10uM	0.229	0.217	0.206	0.217	0.012	-2.0	102.0	
Dox, 30uM	0.201	0.211	0.192	0.201	0.010	-3.1	103.1	
CONTROL-72 h	1.582	1.624	1.594	1.600	0.022	100.0	0.0	
BASAL,0h	0.227	0.267	0.238	0.244	0.021	0.0	NA	

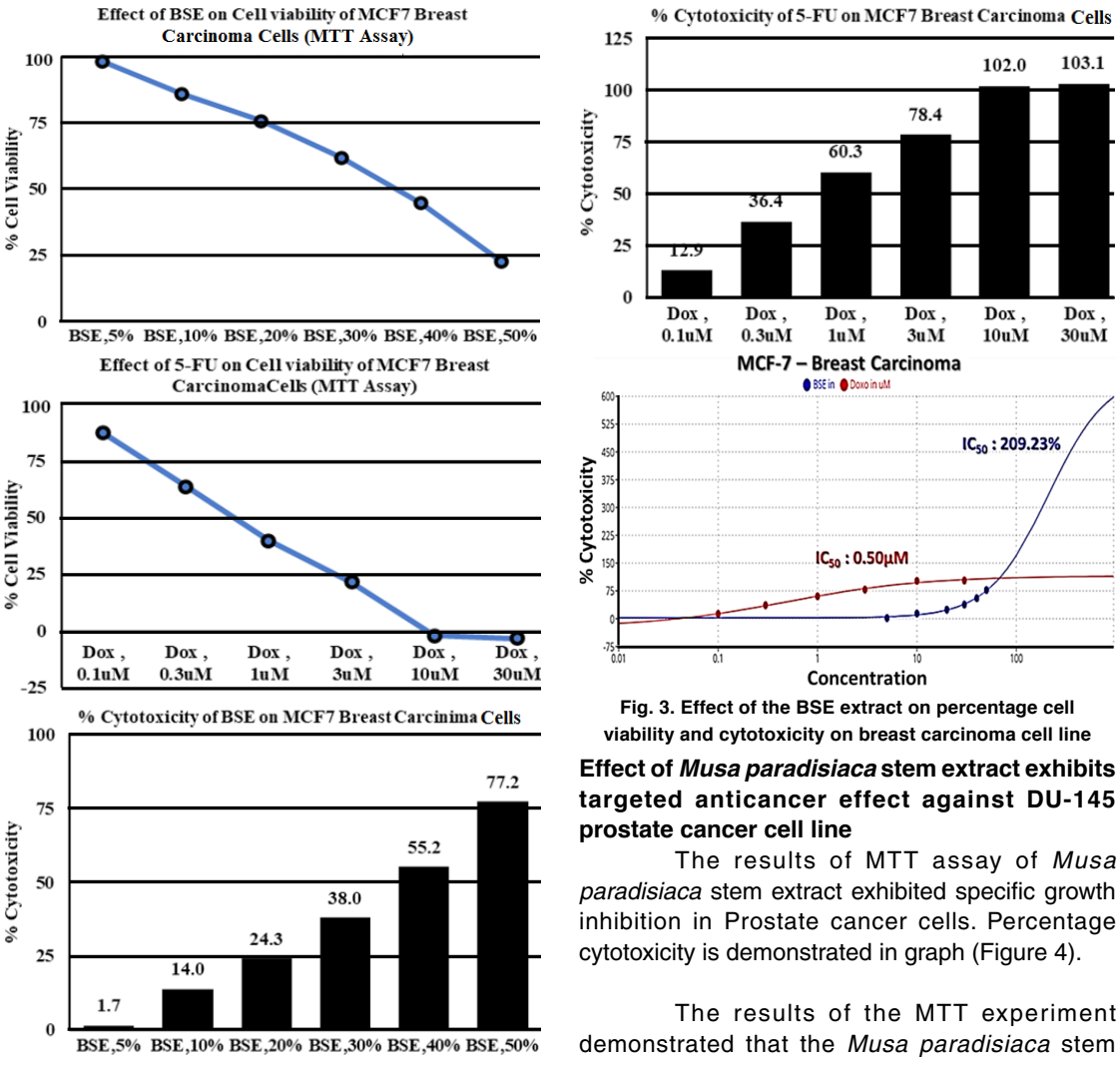


Fig. 3. Effect of the BSE extract on percentage cell viability and cytotoxicity on breast carcinoma cell line

Effect of *Musa paradisiaca* stem extract exhibits targeted anticancer effect against DU-145 prostate cancer cell line

The results of MTT assay of *Musa paradisiaca* stem extract exhibited specific growth inhibition in Prostate cancer cells. Percentage cytotoxicity is demonstrated in graph (Figure 4).

The results of the MTT experiment demonstrated that the *Musa paradisiaca* stem

extract decreased the percentage viability of cells and increased the cytotoxicity of cancer cell types DU-145. These findings showed that the extracts caused cell death in the prostate cancer cell lines. The extracts' effects are quite similar to those of major chemotherapy medications like paclitaxel, which is frequently prescribed for the cancer chemotherapy. Musa paradisiaca stem extract's IC_{50} values for prostate cancer cell lines (DU-145) shown in Figure 4.

Table 5: Results of MTT Assay on Prostrate cell line

Treatment	DU145 PROSTATE CANCER (Cell seeding density:10000 per well) 72 h-MTT assay							
	Optical density			Average	Standard deviation	%Cell viability	%Cytotoxicity	IC_{50} value
	Well 1	Well 2	Well 3					
BSE,5%	1.504	1.527	1.495	1.509	0.017	88.7	11.3	25.28%
BSE,10%	1.378	1.389	1.372	1.380	0.009	78.1	21.9	
BSE,20%	1.118	1.082	1.142	1.114	0.030	56.2	43.8	
BSE,30%	0.881	0.955	0.899	0.912	0.039	39.6	60.4	
BSE,40%	0.776	0.802	0.738	0.772	0.032	28.1	71.9	
BSE,50%	0.716	0.749	0.607	0.691	0.074	21.4	78.6	
Pacli,0.1uM	1.522	1.582	1.529	1.544	0.033	91.6	8.4	5.97 µM
Pacli,0.3uM	1.428	1.405	1.445	1.426	0.020	81.9	18.1	
Pacli,1uM	1.31	1.289	1.376	1.325	0.045	73.6	26.4	
Pacli,3uM	1.002	1.118	1.052	1.057	0.058	51.6	48.4	
Pacli,10uM	0.818	0.727	0.761	0.769	0.046	27.8	72.2	
Pacli,30uM	0.582	0.505	0.489	0.525	0.050	7.8	92.2	
CONTROL-72 h	1.566	1.672	1.702	1.647	0.071	100.0	0.0	
BASAL, 0 h	0.416	0.422	0.452	0.430	0.019	0.0	NA	

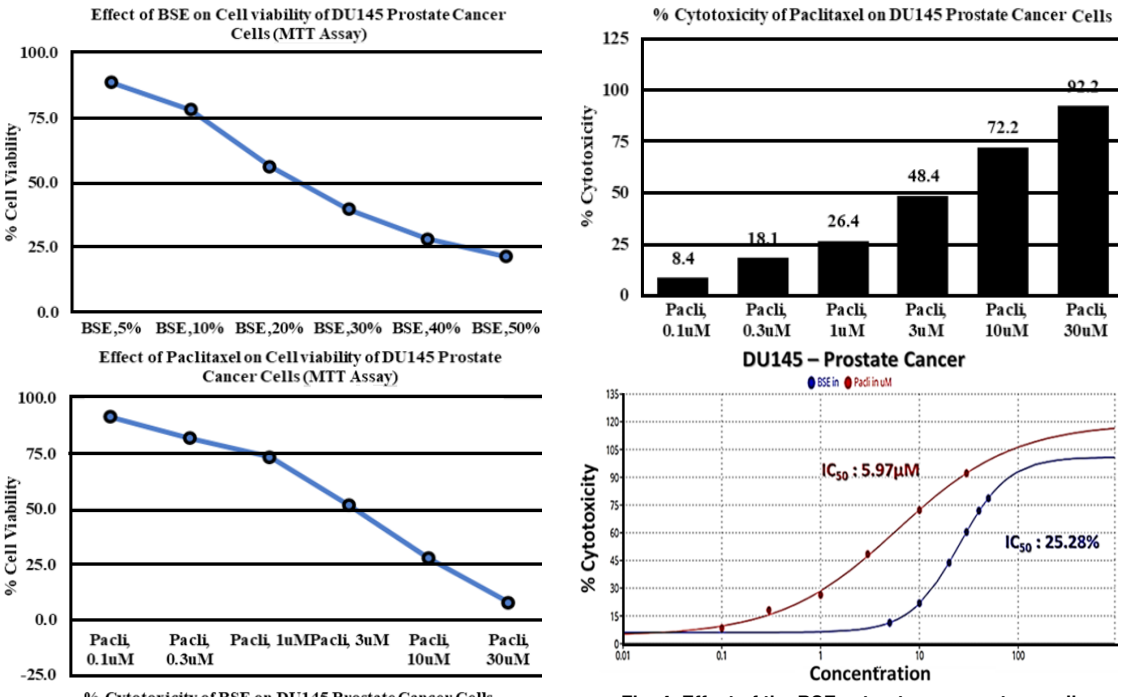


Fig. 4. Effect of the BSE extract on percentage cell viability and cytotoxicity on Prostrate cell line

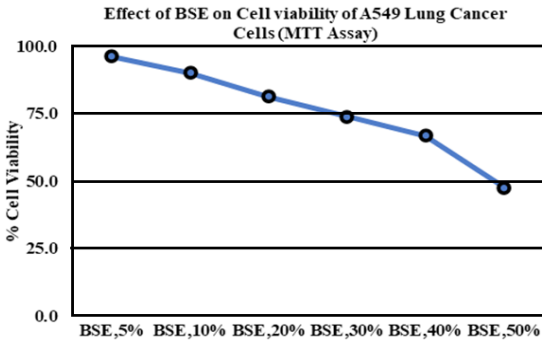
Effect of *Musa paradisiaca* stem extract exhibits targeted anticancer effect against A549 lung cancer cell line

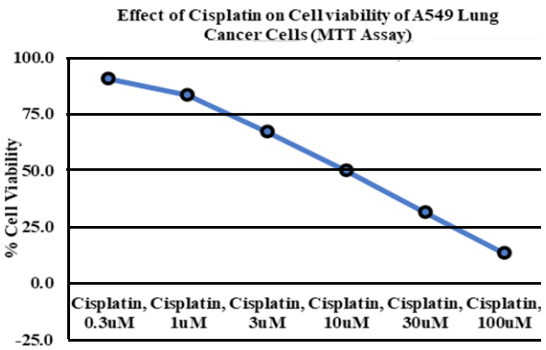
An anti-cancer effect that was dose and duration dependent was seen in A549 cells after treatment with *Musa paradisiaca* stem extract. When exposed to the extract for 72 h, the percentage of viability was found to be reduced. The viability percentage was 47.6 after 72 h of therapy, in case

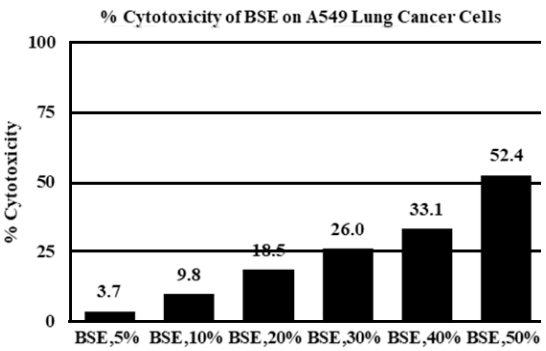
of cisplatin it shows 13.4 percentage of cell viability. It was evident that the stem extract shows negligible effect on A549 Cancer cell line. The MTT assay results show *Musa paradisiaca* stem extract exhibits specific growth inhibition in lung cancer cells. The results are depicted in Table 6 and Figure 5.

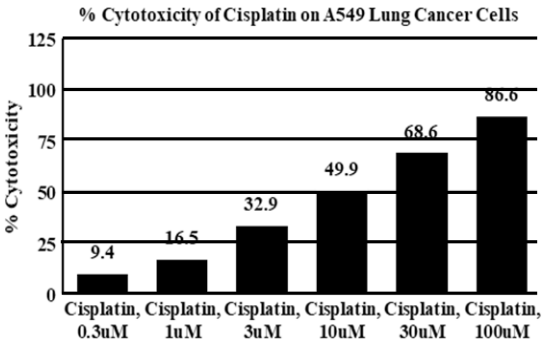
Table 6 : Results of MTT Assay on Lung Cancer cell line

Treatment	A549 LUNG CANCER (Cell seeding density:5000 per well) 72 h-MTT assay							
	Optical density			Average	Standard deviation	%Cell Viability	%Cytotoxicity	IC_{50} value
	Well 1	Well 2	Well 3					
BSE, 5%	1.772	1.825	1.803	1.800	0.027	96.3	3.7	288.34%
BSE, 10%	1.692	1.704	1.725	1.707	0.017	90.2	9.8	
BSE, 20%	1.599	1.601	1.527	1.576	0.042	81.5	18.5	
BSE, 30%	1.528	1.421	1.438	1.462	0.058	74.0	26.0	
BSE, 40%	1.444	1.317	1.302	1.354	0.078	66.9	33.1	
BSE, 50%	1.126	1.082	0.982	1.063	0.074	47.6	52.4	
Cisplatin, 0.3uM	1.716	1.703	1.722	1.714	0.010	90.6	9.4	5.32µM
Cisplatin, 1uM	1.605	1.599	1.616	1.607	0.009	83.5	16.5	
Cisplatin, 3uM	1.342	1.405	1.328	1.358	0.041	67.1	32.9	
Cisplatin, 10uM	1.119	1.005	1.181	1.102	0.089	50.1	49.9	
Cisplatin, 30uM	0.881	0.857	0.719	0.819	0.087	31.4	68.6	
Cisplatin, 100uM	0.528	0.508	0.603	0.546	0.050	13.4	86.6	
CONTROL-72 h	1.827	1.882	1.857	1.855	0.028	100.0	0.0	
BASAL, 0 h	0.352	0.381	0.299	0.344	0.042	0.0	NA	









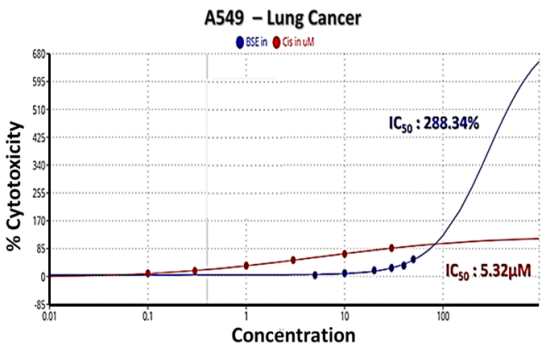


Fig. 5. Effect of the BSE extract on percentage cell viability and cytotoxicity on lung cancer cell line

Effect of ACE on the Cell Morphology

The cytotoxic results clearly demonstrated that BSE (presumably a plant extract) was highly effective against U87MP-Glioblastoma and HCT-116 (Colon cancer) with a notably low IC_{50} value. When cancer cells from lung (A549), breast (MCF-7), glioblastoma (U87MG), colon (HCT-116), and prostate (DU145-) were treated with BSE at its IC_{50} concentration for 48 h, significant

changes in cell morphology were observed. Compared to untreated cells, a majority of the BSE-treated cancer cells transitioned from spindle to star-shaped, with some showing signs of damage and shrinking (Fig. 6). This morphological shift is characteristic of apoptosis, suggesting that BSE induces programmed cell death in a concentration-dependent manner, inhibiting cell growth. The number of viable cells was higher in untreated control samples than in those treated with 50% IC_{50} of BSE, indicating the potential of this peel extract as an anticancer agent. These findings underscore the presence of bioactive compounds within BSE capable of suppressing cell proliferation.

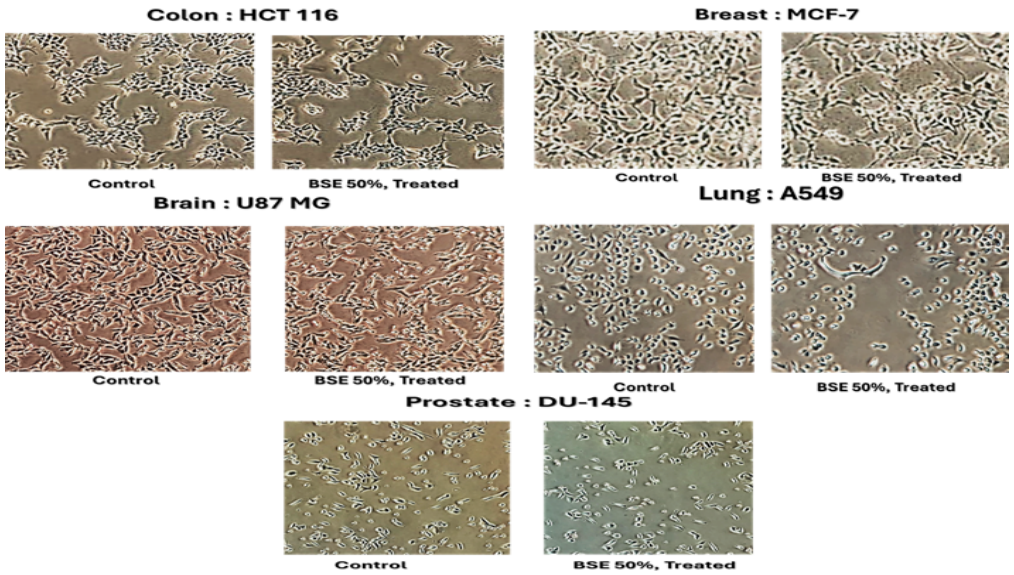


Fig. 6. Effect of the BSE extract on cell surface morphology of cancer cells (a) HCT-116 colon cancer cell lines (b) MCF-7 Breast Cancer cell lines (c) U87 glioblastoma cell lines (d) A549 lung cancer cell lines (e) DU-145 prostate cancer cell lines

DISCUSSION

In the present study, banana stem extract was prepared, and quantitative screening of phytoconstituents presence such as steroids, alkaloids, Phenolics, flavonoids, Tannins, saponins, terpenoids, proteins, carbohydrates, fatty acids, and glycosides was done by various phytochemical tests. Cell viability assay of cancer cells for anticancer activity of the extracts was measured by MTT assay. Extract Cell viability assay results show that cell cytotoxicity on cancer cells is dose dependent. BSE 50% Extract showed 67.5% cytotoxicity on glioblastoma cells (U87MG cells) with an IC_{50} value of 55.24 in comparison to standard Temozolomide IC_{50} which was 21.45 on colon cancer cell lines (HCT-116) BSE 50% extract estimated IC_{50} value was 33.15, whereas the IC_{50} for 5-FU cells was 10.09, respectively. The results of this study confirmed the *Musa paradisiaca* stem extract's anticancer properties even more. The extracts' effects are quite similar (%Cytotoxicity) to those of major chemotherapy medications like doxorubicin, which is frequently prescribed for the treatment of breast cancer on breast cancer cell lines (MCF7). The results of the MTT experiment demonstrated that the *Musa paradisiaca* stem extract decreased the percentage viability of cells and increased the cytotoxicity on prostate cancer cell lines (DU-145) with IC_{50} value 25.28 as compared with paclitaxel (5.97). on lung cancer cell lines, BSE extract viability percentage was 47.6 after 72 h of therapy, as compared to cisplatin which shows 13.4 percentage of cell viability. It was evident that the stem extract showed negligible effect on the A549 Cancer cell line.

Cell morphological changes by apoptosis were also seen by inverted microscopy results showing that BSE extract inhibit cancer cell proliferation and progression in all type of cancer cell lines due to their anticancer potential.

All the results shown that BSE extract have anticancer activity against many cancer cell lines, although it may not provide first line defence but found to be a suitable supplement for cancer prevention and therapy along with other medications.

Plant extracts derive their biological activities from a diverse array of essential micronutrients and phytochemicals, including alkaloids, carotenoids, flavonoids, lignans, phenolics, and tannins. These compounds play pivotal roles in the prevention of cancer through mechanisms such as antioxidant activity, inhibition of cell proliferation, induction of apoptosis, suppression of cell invasion, and modulation of cellular signalling pathways[29,30].

Cancer cells undergo a complex series of changes, acquiring specific traits that promote their growth and survival. These traits include sustained proliferative signalling, evasion of growth suppressors, resistance to programmed cell death (apoptosis), attainment of replicative immortality, promotion of angiogenesis, and facilitation of invasion and metastasis[31]. These characteristics collectively underlie the malignant transformation of cells.

CONCLUSION

The study demonstrates that the extract from *Musa paradisiaca* exhibits promising properties and is highly effective against lung cancer cells (A549) and breast cancer cells (MCF-7). It also shows significant efficacy against U87MP-Glioblastoma, HCT-116 (Colon cancer), and DU145-Prostate cancer cells. Moreover, the results indicate that the extract notably reduces the migratory ability and colony formation of cancer cells in a dose-dependent manner. The *Musa paradisiaca* extract also induces apoptosis in cancer cells. These findings suggest that this extract could potentially serve as a preferred therapeutic option for individuals with lung and breast cancer, depending on its specific mechanisms of action.

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Conflict of interest: Nil

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