Anticancer Activity of Polyherbal Extract against Colorectal Cancer Cell Line HT29 and Docking Studies

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Abstract
In Ayurveda there are two systems of treatment, one is single medicinal herbal and the other is a combination of two or more medicinal herbs to complement and increase the potency of the drug. The present study’s deals with assessing the anticancer effects of Polyherbal extraction of Ocimum tenuiflorum, Phyllanthus emblica, Aloe vera, Piper nigrum and Foeniculum vulgare on HT29 cells, the investigation of their synthesized nanoparticle enhancement of the extracted compounds. In addition, the docking studies of compounds and their derivatives for detection of a novel drug compound.

Keywords
Polyherbal extraction, Ocimum tenuiflorum, Phyllanthus emblica, Aloe vera, Piper nigrum, Foeniculum vulgare, HT29 cells

Introduction
In Ayurveda there are two systems of treatments, single medicinal herbal and combination of two or more medicinal herbs to complement and increase the potency of the drug. The combining of different medicinal herbs is exploited by this key traditional therapeutic herbal strategy to gain extra therapeutic effectiveness which is commonly known as polypharmacy or polyherbalism [1].

In recent years, more interest has been paid to protect human beings against oxidative damage caused by free radicals. These can lead to ageing and human diseases like diabetes and cancer. One promising solution would be to explore the herbal or polyherbal extracts for their potential antioxidant and anticancer properties. Since ancient times for treating numerous human diseases we have been using various polyherbal preparations with different active principles and properties. An assortment of therapeutic components is called polyherbal formulations. They are formulated and prepared based on the healing properties of individual component concerning the state of illness. There are various pharmacological activities in the herbal constituents and they primarily work together in an active way to provide maximum therapeutic benefits and minimum side effects. Meanwhile, WHO expression also recommends advance research on the traditional system of medicine [2]. At present, for treating various diseases like Cancer, Acquired Immunodeficiency Syndrome (AIDS), Diabetes, Respiratory Diseases and Ulcer, polyherbal formulations are employed so that better therapeutic effects can be achieved.

The nanotechnology industry is gifted with many products and the silver nanoparticles are one of the promising products. The synthesis of silver nanoparticles is a very significant part of current nanotechnology research and there is a need for the development of consistent processes for its synthesis. Green synthesis is one such promising process. There are many methods to synthesize the silver nanoparticles
like Physical, Chemical and Biological methods. Yet, in the recent years, green synthesis has been replacing different rapid chemical methods, as the toxicity of the process can be avoided and quality can be increased.

Studies showed that Gallic Acid being a polyphenol exerts antiproliferative activity against many cancer cell lines. Apart from this, gallic acid also has cytoprotective activity and hence this potential compound is used in cancer therapy. The present study researches the anticancer property of Gallic Acid on Colon Cancer and Breast cancer as these two cancers are more predominant in HCT15, human colon cancer cell line and MDA-MB 231, Human breast cancer cell line. Their study predicted apoptosis as the possible mechanism of the activity [3].

Mallikarjuna et al. in 2011 reported that silver nanoparticles can be synthesized from aqueous silver nitrate (1 mM) by a simple and eco-friendly way where the broth of Ocimum sanctum leaf is used as reductant and stabilizer. In this work, the possible biomolecules due to which effective stabilization of silver nanoparticles were achieved was done using characterization techniques like UV, XRD, TEM and FTIR [4].

Pradeepa et al. in 2014 studied the potency of oats phytocompounds against Anticicol Cancer by an in-silico method. They chose fourteen phytocompounds of oats as ligands and used them for molecular docking analyses to inhibit c-Met receptor which is the potential stimulator for colon cancer. Out of 14 phytocompounds, 10 compounds fulfilled the Lipinski’s properties. They used the commercial tool Accelrys Discovery Studio 2.1 for the docking studies of these 10 compounds. Out of the 10 compounds, Gallic acid gave the highest dock score of 126.44 with more hydrogen bond formation i.e. 9.0. The results indicate that Gallic acid acts on Human Colon Cancer by blocking c-Met receptor. This can be developed into a potential drug for Human Colon Cancer in the future [5].

Methods

Collection of plants

Fresh plant leaves of Ocimum tenuiflorum, fruits of Piper nigrum, Foeniculum vulgare, Phyllanthus emblica and gel of Aloe vera leaves were collected.

Extraction of bioactive compounds

The plant materials were thoroughly washed and the leaves and fruits were separated. The leaves were air dried in the shade. The dried leaves of Ocimum tenuiflorum was powdered and 20 g was taken. 20 g each of fresh fruits of Piper nigrum, Foeniculum vulgare, Phyllanthus emblica and fresh gel of Aloe Vera weighing 20 g were taken. All the above mentioned plant samples were taken in the ratio of 1:1:1:1:1, 20 g of each sample was used. With the help of a mechanical grinder the samples were pulverized and 100 mg of finely ground plant material was weighed and extracted with 500 ml of ethanol as the solvent. The extracting solvent in flask was heated, at 50 °C for 24 hours [6]. Then the solvent was filtered using Whatman Grade No. 1 filter paper and condensed using rotatory evaporator.

Thin Layer Chromatography (TLC)

Samples were loaded on the silica gel plate with the help of capillary tubes and run using the solvents Ethyl acetate, Petroleum Ether and Formic acid in the ratio of 5:5:1. The solvent system was allowed to run till ¾th of the plate. A line was drawn with a pencil on the spot where the elution of the solvent ended. The plates were taken out carefully and dried using a hair dryer and observed under a UV Lamp for spots. Spots were separated by running on preparative TLC plates in the selected solvent systems and collected by scrapping silica from the TLC plate for further studies [7].

UV-visible spectrophotometer

Ethanol Extract of the plant material was dissolved in ethanol and observed under absorption spectra at 200-800 nm using UV-1800 spectrophotometer.
High Performance Thin Layer Chromatography (HPTLC)

HPTLC is a versatile separation technique and it is routinely used in most of the pharmacopoeias for determining content conformity, purity profile, assay values and dissolution rates in unlimited number of monographs.

Sample and standard preparation

The sample was prepared by diluting 10 mg of plant extracts in 1 ml of ethanol as solvent and the standard was prepared by diluting 100 mg of standard compounds in 100 ml of solvent (ethanol). The solution was mixed properly and 1 ml of the prepared solution was further added to 10 ml of Ethanol thereby standardizing the concentration of the standard compound. HPTLC plate silica gel 60 F 254 was cut into a square size of 10 × 10 cm using scissors. Pre-washing was done using Methanol. Twin Trough Chamber 20 × 10 cm was cleaned and the mobile phase of Petroleum Ether: Ethyl acetate: Formic acid was poured into the tank in the ratio [8] of 5:5:1 and kept for saturation for a period of half an hour. The samples were loaded on the HPTLC using CAMAG Linomat 5 applicator then the plates were kept in the CAMAG Twin Trough Chamber for separation of the compounds. After the separation, the HPTLC plates were scanned using CAMAG TLC Scanner 3.

Fourier Transformed Infrared (FTIR)

Polyherbal extract of plant sample was analysed using FTIR and their functional groups were identified by comparing the graph with the standard reference spectrum from NIST library.

Nuclear Magnetic Resonance (1H NMR)

Nuclear Magnetic Resonance (DRX-300 Mega Hz Bruker, Switzerland) was obtained for the isolated compound. The sample was dissolved in respective solvent (DMSO) and about 600 μl was poured into NMR tube and observed on the applied magnetic field [9]. 1H NMR spectra of ethanol extract of the Polyherbal formulation along with another compound was also recorded on a NMR-500 MHz and the chemical shifts were recorded as values [10].

GC-MS analysis of bioactive compounds

The sample of major compounds collected by purification of plant extract was subjected to Gas Chromatography and Mass Spectroscopy for the determination of bioactive volatile compounds. Shimadzu Make QP-2010 with nonpolar 60 M RTX 5MS Column was used to perform GC-MS analysis of the samples at SOPHISTICATED ANALYTICAL INSTRUMENT FACILITY, Indian Institute of Technology, Madras.

Green synthesis of nanoparticle

For the synthesis of silver nanoparticles aqueous solution of 1 mM silver nitrate (AgNO₃) was prepared and used. Where, 90 ml of an aqueous solution of 1 mM silver nitrate is added with 10 ml of plant extract for reduction into Ag⁺ ion. A magnetic mixer was used to stir the solution at 1000 rpm magnetically mixer for 20 minutes followed by filtration through Whatman Grade No. 1 filter paper [11] and then centrifuged at 3000 rpm for 10 minutes to remove heavy biomass and stored.

Purification of sliver nanoparticle

The extract was further centrifuged at 10,000 rpm for 15 minutes and washed thrice with Deionized water to remove excess Silver Ions. A dried powder of the nanoparticles was obtained by freeze-drying for further characterization study [11].

Molecular docking on Phosphoinositide 3-kinase (PI3-K)

Preparation of protein structure Protein Data Bank (PDB): The Protein Data Bank (PDB) is the global archive for information about the 3D structure of Bio-Macromolecules and their complexes. PI3K-gamma was selected as a receptor in the present study based on the fact that unrestrained signaling by the PI3K pathway can lead to
many forms of cancer including pancreatic, ovarian and colorectal cancer. The 3D structure of the receptor was downloaded from a Protein data bank (http://www.rcsb.org/pdb/home.do) with the specific resolution and the PDB ID is 4LFH.

**Preparation of ligand structures chem sketch:** Preparation of Ligand structures ChemSketch ACD/Chemsketch is the powerful chemical drawing and graphics package from ACD/Labs software, which draws molecular structures, reactions and calculates chemical properties very efficiently [5].

**SmilLib v2.0:** SmilLib is a platform independent command line and expand Graphical user Interface Software Tool designed to rapidly create combinatorial libraries in SMILES format. This software was used to create the combinatorial libraries of the lead compound from the plant extract using scaffold, linkers and building blocks.

**Lipinski’s analysis for drug like compound:** As per Lipinski’s rule to evaluate drug likeness and determine the pharmacological activity, the properties like molecular weight, log p, number of hydrogen bond donors and acceptors need to be analysed. Here it was done using Open Source Tools at Supercomputing Facility for Bioinformatics and Computational Biology, IIT Delhi.

**Open babel:** SMILES (Simplified Molecular Input Line Entry System) strings created from 2D model of chemsketch were converted into 3D models in PDB format using Open Babel software 18.

**Preparation of active site:** Argus Lab, Docking Software was used to add the explicit Hydrogen atoms missing in the PDB structure. Besides, the Atom list of the molecules was prepared where the atom numbers represent the active site residues involved [12].

**Energy minimization:** The Swiss PDB Viewer was reloaded with proteins with Hydrogen clean files. By reducing the energy, the conformations and energy states of the newly added hydrogen were fixed and corrected. For deviations in RMSD with its actual PDB structures, the new energy levels were checked.

**Docking study with ArgusLab:** ArgusLab4.0.1 is implemented with shape-based search algorithm. Docking was done using Laramckian Genetic Algorithm Docking Engine exhaustive search docking 19, function of ArgusLab with grid dimension of 13.34 \times 11.72 \times 10.29. Docking precision was set to Regular precision and Flexible ligand docking mode was employed for each docking run. ArgusLab energy calculations are used to calculate the stability of each docked poses and the number of hydrogen bonds formed. The maximum size for each complex is 50. Based on the energy levels calculated by ArgusLab, the one with lowest energy is selected as the best docking model. According to the hydrogen bond interactions between the ligand and protein near the substrate binding site the most suitable binding conformation was selected. The study indicates that the lowest energy poses have the highest binding affinity and high energy produces the unstable conformation [13].

### Cytotoxicity Assay on Cancer Cell Lines

**Chemicals and reagents**

MTT (3-[4,5-dimethylthiazol-2-yl]-2,5-diphenyl tetrazolium bromide) Invitrogen, USA. Acridine Orange was obtained from Sigma, USA. All other fine chemicals were obtained from Sigma-Aldrich, St. Louis.

**Cell culture**

Colon Cancer (HT-29) Cells obtained from NCCS (National Centre For Cell Science, Pune) were cultured in Rose well Park Memorial Institute medium (RPMI), supplemented with 10% fetal bovine serum, Penicillin/Streptomycin (250 U/ml), gentamycin (100 μg/mL) and Amphotericin B (1 mg/mL) were obtained from Sigma Chemicals, MO, USA. The cell cultures were maintained in a humidified atmosphere with 5% CO₂ at 37 °C. Cells were incubated over 24 hours to allow confluence growth before usage.
Cell growth inhibition studies by MTT assay

As mentioned early, the cell viability was measured by the conventional MTT reduction assay with slight modification. Briefly, Colon cancer (HT-29) cells were seeded at a density of $5 \times 10^3$ cells/well in 96-well plates for 24 hours, in 200 ul of RPMI with 10% FBS. Later, the culture supernatant was removed. The RPMI with different concentrations of test samples were added and incubated for 48 hours. Post-treatment, cells were added with MTT (10 μl, 5 mg/mL) and incubated at 37 °C for 4 hours and then DMSO was added and incubated at room temperature for 1 hour. A scanning multi-well spectrophotometer was used to read the plates at 595 nm [14].

Results

Extraction of bioactive compounds

A Soxhlet apparatus was used to collect the extractions of the compounds and the collected solvent was filtered using Whatman Grade No. 1 filter paper. The solvents were evaporated overnight using Rotatory evaporator at 55 °C and dried in petri dishes using a hot air oven.

UV-visible spectrophotometer

UV spectrophotometer analysis of both Ethanol extract and synthesized nanoparticles were done. The UV Spectra analysis confirmed the synthesis of Nanoparticles and the absorbance was clearly above 420 nm and below 450 nm (Figure 1).

Column and Thin Layer chromatography (TLC)

Column chromatography was used to isolate and partially purify the fractions of the compounds. TLC was also run to identify the polarity and the nature of the compounds. For Phenolic compounds Gallic Acid was used as the standard. PE: EA: FA in the ratio of 5:5:1 was found to be the best solvent. The TLC plates were viewed under UV lamp at 324 nm (Figure 2).

High Performance Thin Layer Chromatography (HPTLC)

HPTLC was performed with Gallic acid as a standard compound for phenolic groups of the ethanol extract sample and was scanned at 254 nm wavelength under D2 lamp. The scanned value shows 550 ng of Gallic acid present in 10 μl of extracted sample.

Fourier Transformed Infrared (FTIR)

The obtained graph was compared with the standard reference spectrum from NIST library. The FTIR graph shows some similarities in Carbonyl frequency (Carboxylic acid), between the plant extract and the standard graph at 1700 cm$^{-1}$. And also, two phenol groups (C$_6$H$_4$-OH) were observed around 3000 cm$^{-1}$ region.
Nuclear Magnetic Resonance (1H NMR)

The metabolites were identified by interpreting the chemical shifts of ethanol extract of plants and partially purified Gallic Acid from the plant extract with standard compounds using the NMR Suite software. $^1$H NMR of crude ethanol extract of the plant has given signals at $\delta$ 1.05, 2.51, 3.42, 6.04, 6.93 and 7.01. $^1$H NMR of partially purified Gallic Acid of plant extract has given signals at $\delta$ 3.35, 6.92, 9.16 and 12.20. These chemical shifts match with that of standard Gallic Acid (Figure 3).

GC-MS analysis of bioactive compounds

GC-MS was employed to perform global metabolite profiling. Totally four compounds were present in a partially purified fraction of plant extract (Table 1). In the second region of a partially purified extract of plant sample six compounds were identified (Table 2). The compounds along with their molecular weight, molecular formula and retention time are presented in the following Table 1 and Table 2 (Figure 4).

Green synthesis of nano particle

After keeping the sample in magnetic stirrer for 20-30 minutes, the colour of the sample turned from dark brown to yellow. Further analysis on UV Spectrophotome-
ter confirmed the synthesis of Silver Nano particle. It was then stored in Dark conditions to avoid photo-luminescence reaction.

**Scanning Electron Microscopy (SEM)**

The SEM images revealed that the Nanoparticles synthesized are spherical in

<table>
<thead>
<tr>
<th>S. no</th>
<th>RT</th>
<th>Name</th>
<th>Mol. wt</th>
<th>Structure</th>
<th>Mol. formula</th>
<th>IUPAC name</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>17.52</td>
<td>Pentadecanoic acid, 3-Oxo-, methyl ester</td>
<td>270.408</td>
<td>C_{16}H_{30}O_{3}</td>
<td>Methyl 3-oxopentadecanoate</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>18.53</td>
<td>Z, E-2-Methyl-3, 13-octadecadien-1-ol</td>
<td>280.488</td>
<td>C_{16}H_{30}O</td>
<td>(3E,13E) -2-Methyl-3,13-octadecadien-1-ol</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>17.22</td>
<td>Gallic acid</td>
<td>170.12</td>
<td>C_{7}H_{6}O_{5}</td>
<td>3,4,5-Trihydroxybenzoic acid</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>19.02</td>
<td>9,12,15-Octadecatrienoic acid, methyl ester, [Z, Z, Z]-</td>
<td>292.456</td>
<td>C_{19}H_{32}O_{2}</td>
<td>Methyl (9Z,12Z,15Z)-octadeca-9,12,15-Tret</td>
<td></td>
</tr>
</tbody>
</table>

**Table 1:** Chromatographic data of the identified compounds from partially purified fraction of phenolic compounds.

<table>
<thead>
<tr>
<th>S. no</th>
<th>RT</th>
<th>Name</th>
<th>Mol. wt</th>
<th>Structure</th>
<th>Mol. formula</th>
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<td>1</td>
<td>19.07</td>
<td>Heptadecanoic acid, 9-methyl-, methyl ester</td>
<td>284.47</td>
<td>C_{18}H_{36}O_{2}</td>
<td>Methyl heptadecanoate</td>
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</tr>
<tr>
<td>2</td>
<td>22.57</td>
<td>13-Docosenoic acid, methyl ester, [Z]</td>
<td>352.594</td>
<td>C_{23}H_{44}O_{2}</td>
<td>Methyl (13Z)-13-docosenoate</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>20.65</td>
<td>10-Octylundec-10-enoic acid, methyl ester</td>
<td>310.514</td>
<td>C_{20}H_{38}O_{2}</td>
<td>Methyl 0-methylideneoctadecanoate</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>19.72</td>
<td>Mesterolone</td>
<td>304.467</td>
<td>C_{20}H_{32}O_{2}</td>
<td>(1α,5α,17β) -17-Hydroxy-1-methylandrostan-3-one</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>18.82</td>
<td>14,17-Octadecadienoic acid, methyl ester</td>
<td>320.51</td>
<td>C_{21}H_{36}O_{2}</td>
<td>Methyl (11E,14E,17E)-icoso-11,14,17-trienoate</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>17.13</td>
<td>Kyselina gallova, Gallic acid</td>
<td>170.120</td>
<td>C_{7}H_{6}O_{5}</td>
<td>3,4,5-Trihydroxybenzoic acid</td>
<td></td>
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</tbody>
</table>
shape. The particles are well dispersed and the size of the Particles range from 50-300 nm (Figure 5).

### Molecular docking

The protein-ligand interaction plays a significant role in structure-based drug designing. It also reduces cost and time in drug discovery. Gallic acid was found to be effective against cancer as it docks it on 4LFH with different other compounds present in the plant extract and hence it was taken as the lead compound. A combinatorial library of Gallic acid was created with Smilib v2.0. Out of 10 bioactive compounds, 5 compounds satisfied the Lipinski’s properties. The selected ligands and 4LFH receptor were subjected to docking studies using Aurgus Lab (Figure 6, Table 3, Table 4 and Table 5).

### Cytotoxicity assay on cancer cell lines

From the following results, it is evident that the three samples given below have

<table>
<thead>
<tr>
<th>Compound</th>
<th>Log p</th>
<th>Molecular mass</th>
<th>H bond donor</th>
<th>H bond receptor</th>
<th>Molar refractivity</th>
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<tr>
<td>Gallic acid</td>
<td>-0.833100</td>
<td>169</td>
<td>3</td>
<td>5</td>
<td>35.766895</td>
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<tr>
<td>G1</td>
<td>1.370200</td>
<td>212</td>
<td>3</td>
<td>5</td>
<td>52.009895</td>
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<tr>
<td>G2</td>
<td>0.980100</td>
<td>198</td>
<td>3</td>
<td>5</td>
<td>47.392895</td>
</tr>
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<td>G3</td>
<td>3.345179</td>
<td>248</td>
<td>2</td>
<td>5</td>
<td>67.075584</td>
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<tr>
<td>G4</td>
<td>2.465760</td>
<td>246</td>
<td>2</td>
<td>5</td>
<td>66.189583</td>
</tr>
</tbody>
</table>

**Table 3: Lipinski’s filter for derivatives of gallic acid.**

**Figure 4:** Mass spectra of partially purified fraction of polyherbal extract.

GC MS spectra depicting the presence of important compounds in the polyherbal extract.

**Figure 5:** SEM Images.
The SEM images of nanoparticles synthesized from the polyherbal mix.
anti-carcinogenic properties and they are potential anti-cancer drugs. But it is also significant that Nano particle enhanced polyherbal extract has the highest percentile of cell death among the test samples and it is also clear that polyherbal formulation of active constituents of compounds are much significant than single plant extract or single compound drug (Figure 7).

Discussion

In the recent years, a remarkable interest in the investigation of anticancer properties of natural products has been seen. This interest is due to the fact that conventional cancer treatment procedures [such as surgery, radiotherapy and chemotherapy] are not effective in all cases and result in serious side effects, apart from drug resistance associated with chemotherapy. This study was originated to fulfill the aim of discovering new anticancer agents from natural materials.

When compared to single herbal formulation, polyherbal formulation has been found to exhibit maximum therapeutic benefits. Hence, in the present investigation,
polyherbal formulation of *Ocimum tenuiflorum*, *Phyllanthus emblica*, *Aloe vera*, *Piper nigrum* and *Foeniculum vulgare* has been used and their anticancer property against Colon Cancer (HT29) was investigated. The nanoparticle preparation was found to show enhanced anticancer activity when compared to the samples without nanoparticle. It was quite evident from the results that the polyherbal extract has anti-carcinogenic effect on colon cancer and is a potential anti-cancer drug.

The compounds present in the Polyherbal extract were characterized. The phenolic compound, Gallic acid was targeted and it was purified from the plant extract using column chromatography and TLC techniques. Quantification of phenolic compounds present in the plant sample was done by HPTLC method using Gallic acid as the standard. UV, FTIR, NMR and GC MS confirm the presence of phenolic groups in the plant extract. Silver nanoparticles were also synthesized from the polyherbal plant extract for drug enhancement. It was further investigated along with the

**Table 5:** Best docking scores.

<table>
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<th>Ligand</th>
<th>Structure</th>
<th>Docking score</th>
<th>Target</th>
</tr>
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<tbody>
<tr>
<td>Gallic acid</td>
<td><img src="image" alt="Gallic acid structure" /></td>
<td>-6.55469 kcal/mol</td>
<td>4LFH</td>
</tr>
<tr>
<td>G1</td>
<td><img src="image" alt="G1 structure" /></td>
<td>-7.08407 kcal/mol</td>
<td>4LFH</td>
</tr>
<tr>
<td>G2</td>
<td><img src="image" alt="G2 structure" /></td>
<td>-4.78176 kcal/mol</td>
<td>4LFH</td>
</tr>
<tr>
<td>G4</td>
<td><img src="image" alt="G4 structure" /></td>
<td>-5.42757 kcal/mol</td>
<td>4LFH</td>
</tr>
</tbody>
</table>

**Figure 7:** Cytotoxicity assay on HT-29 colon cancer cells.

Effect of the polyherbal extract, nanoparticle and standard Gallic acid on the HT-29 colon cancer cells.
purified Gallic acid for anti-cancer activity. Nanoparticles enhanced the drug and showed a highest anti-carcinogenic effect than the Polyherbal extract of plants and Gallic acid. Saraniya Devi [15] also did a similar study to evaluate the anti-bacterial and anticancer properties of the silver nanoparticles synthesized using the macro algae-Gelidiella sp. The anticancer activity of nanoparticles has been assessed in-vitro using (4,3,5-dimethylthiazol-2-yl)-2,5-diphenyl tetrazolium bromide (MTT assay) on (HT-29) colon cell line. Decrease in viable cell count compared to the control line was recorded as growth. The potency of silver nanoparticles to inhibit the cancer was analysed. The observation showed that the inhibition of the growth of the human colon cell line (HT 29) was dose dependent. Among the various compounds obtained from the plant extract, Gallic acid was found to be the lead compound by docking it on 4LFH with various other compounds present in the plant extract. A combinatorial library of ten derivatives of Gallic acid was then created using Smiliv V2.0. Lipinski’s rules were used to determine the potential drug like compound of the derivatives. Five compounds were selected which passed the Lipinski’s filter. They were then docked with 4LFH. Compound G1 showed the highest docking score and can be taken as a potential drug for Colon Cancer and can be developed into a potent drug for human colon cancer in the future.

This report revealed that a polyherbal extract of Ocimum tenuiflorum, Phyllanthus emblica, Aloe vera, Piper nigrum and Foeniculum vulgare is a good source of phenolic compounds. In this study, the in-vitro antiproliferative and cytotoxic effects of the Polyherbal extracts on Human Colon Cancer HT-29 cells were assessed. It was found that all samples exert concentration based anti-proliferative activity. But a synthesized nanoparticle of plant was the most effective among the three samples and it is a potential anticancer drug. Docking studies on Phosphoinositide 3-kinase enzyme was also done by taking Gallic acid as lead compound and creating a combinatorial library of compounds of the lead. Derivative G1 showed the best docking scores and it is a potential drug for colon cancer. The lower concentration of 0.781 μg/ml Ethanolic extracted commercial Gallic acid and the Nanoparticle conjugated extracted samples are compared. Finally, Nanoparticle enhanced the compound and has given better results.

References


