



ANTICANCER ACTIVITY OF UPAVISHA ARKA: AN OVERVIEW

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ABSTRACT

Cancer is one amongst the dreadful diseases of present century. The incidence of cancer is increasing worldwide. Every year about 8,00,000 new cancer patients get registered with the national cancer registry program in India. Ayurveda an ancient Indian medicine science describes many useful herbal drugs for such types of advanced diseases. Upavisha the plant poisons of low potency are mentioned in Agadtantra. Arka (*Calotropis procera*/*Calotropis gigantea*) is one among these Upavisha is emerging as an effective anticancer drug. It shows various pharmacological activities such as Anticancer, Antimicrobial, Antiimplantation etc. Different parts of Arka are used to treat cancer. In current scenario number of synthetic anticancer drugs are used to treat cancer. These synthetic anticancer drugs are expensive and shows harmful adverse effects. Upavisha like Arka which is natural derivative may be cost effective & less harmful as Anticancer drug. Anticancer activity of *Calotropis procera*/*Calotropis gigantea* is reported in scientific journals. This review summarizes various In Vitro and In Vivo studies of anticancer activity of Upavisha Arka.

Keywords: Agadtantra, Arka, Upavisha, Anticancer activity, *Calotropis procera*.

INTRODUCTION

Cancer is one of the most incurable diseases of the 20th century and spreading further with increasing percentage in the 21st century.¹ Cancer is a group of diseases caused by loss of cell cycle control.² In this era the world is running behind alternative medicines to minimize the side effects of chemotherapy and radiotherapy and to prolong the lifespan. The National Cancer Institute collected about 35,000 plant samples from 20 countries and has screened around 1,14,000 extracts for anticancer activity.³ Over 3000 species of plants with antitumor properties have been reported.⁴ Certain poisonous plants, minerals and animal product are rendered non-toxic and are used as rejuvenating agent in the treatment of cancer.⁵

In Ayurveda poisons are mainly classified as Visha and Upavisha. Arka (*Calotropis procera*) is one of the plants classified under less potent poisons termed as Upavisha.⁶ These Upavishas are harmful to the body if it is used without processing, so it should be used after processing like Shodhana sanskar (detoxification). *Calotropis procera* is used as a traditional plant with unique medicinal properties. This plant contains many phytochemical constituents like cardenolides, Enzymes, Terpenes, Flavonoid, alkaloids and saponins. These phytochemicals actively involved in the medicinal uses for treating various diseases.⁷ Arka (*Calotropis procera*) has many pharmacological activities such as Anticancer⁸, Anthelmintic⁹, Hepatoprotective¹⁰, Anti-inflammatory¹¹, Antidiarrhoeal¹², Antibacterial¹³, Antinociceptive¹⁴ etc. Leaves, flowers and latex of Arka are useful in the treatment of cancer as it possesses Anticancer activity. Whole dried plant contains Anticarcinogenic activity which is used to cure cancer.¹⁵ Various extracts of Arka are studied for anticancer activity against different cancer cell lines

and in animal models. Anticancer activity is the effect of natural and synthetic or biological and chemical agents to reverse, suppress or prevent carcinogenic progression. Several synthetic agents are used to treat cancer but they show adverse effects hence the research is going on the plant derived or natural drugs. Likewise, Arka has been studied for various ethnomedical properties including anticancer. This review highlights the Anticancer activity of Upavisha Arka.

LITERATURE REVIEW

Cancer is a group of diseases in which abnormal cells divide without control and can invade nearby tissues. Charaka and Sushruta Samhita described arbuda and granthi which can be correlated with cancer. Arbuda comes under asadhya vyadhi. Vata dosha is responsible for cell division. Aggravation of Vata dosha and suppression of Kapha dosha or both, interacting with one another may result in proliferation of cells. Tridoshaja arbuda are usually malignant because all three major body humours lose mutual coordination, resulting in a morbid condition.¹⁶ Many herbal medicines such as *Abrus precatorius*, *Albizia lebeck*, *Allium sativa*, *Bacopa monnieri*, *Calotropis procera*, *Calotropis gigantea*, *Curcuma longa*, *Datura metel* etc.^{17,18} shows anticancer activity. Arka (*Calotropis procera*/*Calotropis gigantea*) is one among these herbal medicines and included in Upavisha by Bhavaprakash and Rasatarangini.

Review of Arka ¹⁹⁻²³

Arka is a traditional medicinal plant used in various ayurvedic formulations. In Ayurveda two varieties of Arka are found Shwetarka and Raktaarka. Two common species viz. *Calotropis procera* and *Calotropis gigantea* of this plant are found and can

be used as a substitute of each other. In Ayurveda it is classified under Sthavara visha and Upavisha while in modern toxicology it is classified under Irritant organic vegetative poison. It is commonly known as Madar.

Synonyms - Ravi, Vikshira, Kshirparni, Vikeerana, Pushpi, Jambhala, Aasphota, Bhaskara.

Latin name – *Calotropis Procera* (Ait.) R. Br.

Family – Asclepiadaceae

Distribution – It is often found as a weed throughout India in more or less warm dry places. Predominantly in sub- Himalayan tracts, Bihar, Orissa, West Bengal, Assam, Punjab, Sindh, Rajasthan.

Botanical description – Small, erect and compact shrubs, 1-2 m high. Leaves sub-sessile, broadly ovate, ovate-oblong, elliptic or obovate, cottony pubescent when young. Flowers are white, purple- spotted or pink, in umbellate cymes. Follicles 6.5-9.5 × 2-5.1 cm. Seeds with a silky white coma.

Active principle – Calotoxin, Calotropin, Calactin, Uscharin. Arka kshira contains all these constituents along with Trypsin.

Fatal Dose – Uncertain

Fatal period – About 12 hrs.

Gana-1. Charaka-Swedopaga, Vamanopaga, Bhedniya, Shatshodhanvruksha.
2. Sushruta- Adhobhaghara, Arkadi

Ayurvedic properties

1. Rasa-1. Moola twaka – Katu, Tikta
2. Raktapushpa – Madhura, Tikta
3. Arkakshir – Tikta, Lavana
- Guna- Laghu, Ruksha, Tikshna
- Virya- Ushna
- Vipaka- Katu

Prayojyanga - Pushpa, Moola, Patra, Kshir, Moolatwaka

- Types** –1. Shwetarka – *Calotropis gigantea* (Linn.) R. Br Ait.
2. Raktaarka – *Calotropis procera* (Ait.) R. Br

Karma (Pharmacological action)

- A. Ayurveda – Vishaghna, Shothahara, Raktashodhaka, Vedanasthapana, Deepana, Pachana, Swedajanana, Pittasarak, Vamaka, Rasayana, Vranashodhana, Kushthaghna, Jantughna, Vamanopaga, Rechana, Krimighna, Amashayakshobhaka, Balya.
- B. Modern – Anticancer, Antiimplantation, Antimicrobial, Anticoagulant, Anthelmintic, Nematicidal, High fibrinolytic, Vermicidal, Spasmogenic, Stimulant, Mild diuretic.

Rogagnata - Udararoga, Gulma, Visha, Krimi, Kushtha, Arsha, Pleeha, Ajeerna, Vibandha, Vata, Yakrutvikara, Kandu, Agnimandya, Shotha, Vrana, Swasa, Kasa, Vishamajwara, Jeernajwara.

Formulations – Arkeshwar Rasa, Arka kshara, Abhaya Lavana, Arka Lavana, Mahavishagarbha taila, Dhanvantara ghrita.

Table 1: Chemical constituents of various parts of *Calotropis procera*²⁴

Part	Chemical Constituents
Root Bark	Benzoyllineolone, Benzoylisolineolone, β- amyryn, Three oleanane type triterpenes namely calotropoleanyl ester (olean- 13 (18)- ene- 3 β- yl acetate), Proceroleanol A and (olean- 13(18)- ene-9α - ol) and Proceroleanol B (olean-5, 13(18)- diene-3 α -ol
Flower	Evanidin 3-rhamnoglucoside and cyanidin 3-rhamnoglucoside Esters of β – calotropeols, β – amyryn, volatile and long chain fatty acids, esters of waxy acids, evanidin- 3- rhamnoglucosides and alcohols.
Latex	Voruscharin (0.45%), Calactin (0.15%), Calactin composed of calotropagenin and hexose, Uzariogenin, Syriogenin, Proceroside, Calotropin, Calactinic acid, Uscharin, α- amyryn, - β amyryn, - β sitosterol and calotoxin (0.15%)
Stem bark	d- and - β calotropeols - β amyryn, giganteol, a colourless wax, small amount of tetracyclic terpene and traces of sterols
Leaves	β - amyryn, cardenolides, calotropin, calotropagenin.

In Vitro Anticancer Study

1. In vitro assay for cytotoxic activity of the stem- leaves of *Calotropis procera* was carried out against human Cancer Cell lines at the concentration of 10, 30 and 100 µg/ml. Results revealed that the extracts of the plant possessed in vitro anticancer potential against HCT-15 (colon) cancer cell line at the different concentrations. Further, the fractionation of the extracts was carried out and the fractions were tested on the same human cancer cell line. It was found that all the fractions inhibited the growth of HCT-15 at 100 µg/ml except water soluble fractions, but the significant growth inhibition was shown by the chloroform- soluble fractions of the ethanolic extract and 50% ethanolic extract.²⁵
2. Study was carried out to evaluate the effect of dried latex (DL) and flowers of *Calotropis procera* and its ethanolic extracts against MCF-7 and HeLa cell line cultures. The MTT assay used to determine the inhibitory effects of test compounds on cell growth In vitro. Different concentrations of test compounds were used (Sample:1 DL extract, Sample:2 Flower extract) (4, 8, 16, 32, 64, 128, 256 and 512 µg/ml) in triplicates to achieve a final volume of 100 µl and then cultured for 48 hr. The standard (Tamoxifen) was prepared as 1.0 mg/ml concentration stock solutions in PBS. Culture medium and solvent were used as controls. The Standard drug tamoxifen inhibits 60.46% breast cancer (MCF-7) cells when treated at 512 µg/ml concentration. At initial concentrations of the standard drug, the percent inhibition was reduced whereas both the samples: 1 and 2 displayed a dose-dependent inhibition at the tested concentrations. The ethanolic extract of DL and flowers showed cytotoxic properties against both MCF-7 and HeLa cells in a dose dependant manner.²⁶
3. Study was carried out to determine the cytotoxic effects of crude extract and its fraction from *Calotropis gigantea* leaves on human colon cancer WiDr cell lines. The ethanolic extract was fractionated gradually with certain substances to yield four fractions. The substance were dichloromethane, ethyl

acetate, and butanol. The four fractions resulted in dichloromethane fraction, ethyl acetate fraction, butanol fraction, and water fraction. These fractions were then investigated for their cytotoxic effects on WiDr cells. The result indicated that the cytotoxic effects of the ethanolic extract (IC₅₀ 48.5 µg/ml), ethyl acetate fraction (IC₅₀ 41.79 µg/ml), and dichloromethane fraction (IC₅₀ 40.57 µg/ml) produced a much more potent effect than the butanol fraction (IC₅₀ 737.74 µg/ml) and water fraction (IC₅₀ 8493 µg/ml). The ethanolic extract, ethyl acetate fraction and dichloromethane fraction exhibited a potent cytotoxic effect on human colon cancer WiDr cell line. The crude extract and fractions are potential to be developed as an anticancer agent in colon cancer therapy.²⁷

4. Using methanolic extraction method, the extract of leaves of *Calotropis procera* using FTIR and UV-VIS spectrophotometry was characterized. The extract obtained from *Calotropis procera* leaves were investigated for its anticancer ability against a breast cancer cell line T47D. Calorimetric assay known as MTT assay using dye compound 3-(4, 5- Dimethylthiazol-2-yl)-2,5- diphenyltetrazolium bromide for assessing cell mobility activity carried out. Study suggests that methanolic fraction of *Calotropis procera* extract proved effective against the proliferation of breast cancer cell line T47D.²⁸
5. Anti-tumour potential of root extracts of *Calotropis procera* was investigated using the methanolic extract (CM), hexane extract (CH), aqueous extract (CW) and ethyl acetate extract (CE) and its possible mechanism against Hep2 cancer cells. Cellular proliferation activities were assayed by tetrazolium bromide (MTT) colorimetry. Morphological changes of cancer cells were observed under inverted microscope and cell cycle parameters were determined by flow cytometry following propidium iodine staining. Treatment with the extracts at various doses of 1, 5, 10 and 25 µg/ml revealed that CM, CH and CE possessed cytotoxicity, whereas CW did not have cytotoxic effect. CE (10 µg /ml) showed strongest cytotoxic effect (96.3%) on Hep2 at 48 hr following treatment, whereas CM and CH showed cytotoxicity of 72.7% and 60.5% respectively. Extract-treated cells exhibited typical morphological changes of apoptosis. Results of flow cytometric analysis clearly demonstrated that root extracts-initiated apoptosis of Hep2 cells through cell cycle arrest at S phase, thus preventing cells from entering G2/M phase. Result of the study indicate that the roots extracts of *Calotropis procera* inhibit the proliferation of Hep2 cells via apoptotic and cell cycle disruption-based mechanisms.²⁹
6. The anticancer potential of extract of leaves of *Calotropis procera* was investigated using methanolic extract against MCF7 breast cancer cell line. MTT assay was performed to evaluate the cytotoxicity. 5000 cells /well were cultured in 96 well plates and incubated overnight. Latter 5,10 and 25 µl/ml of *calotropis procera* total extract was added to each well and incubated for 48 hr. Each well was incubated with 10µl of MTT solution for 4 hr. Later 50µl of DMSO was added and the plates were further incubated for 10min, afterwards absorbance was checked at 540nm. Result shows the percentage of cell viability after 48 hrs of incubation with total extract of C. Procera was able to significantly reduce cell viability by more than 70%.³⁰
7. Cytotoxicity is the potential of a compound to induce cell death. The present study was done to evaluate anticancer activity of aqueous extract of root barks of *Calotropis procera*. Study was carried out on Caco-2 cells and Neuro- 2a cells (originating from mouse neuroblastoma). MTT and non-enzymatic Neutral Red assays were performed to evaluate cytotoxic effect of aqueous extract of root barks of *Calotropis procera*. MTT assay clearly shows aqueous extract of *Calotropis procera* alters mitochondrial metabolism and causes cytotoxicity. While Neutral red assay shows *Calotropis procera* causes alteration of cell membrane and decreases cell viability. The result obtained was extract shows cytotoxic effect on caco-2a cells and lower cytotoxic effect on Neuro-2a cells with the help of MTT and Neutral red cytotoxic test. Study shows the aqueous extract of *Calotropis procera* exhibit anticancer activity.³¹
8. The whole latex of *Calotropis procera* was cleaned to recover its protein fraction i.e. laticifer protein (LP). This fraction was then evaluated to determine possible selective cytotoxic effects on different cancer cell lines such as HL-60 (promyelocytic leukaemia), HCT-8 (colon), MDA-MB-435 (breast) and SF295 (brain). The study was analysed by MTT assay. In this study, using HL-60 cell as a model, LP was shown to inhibit DNA synthesis. This is probably due to alterations in the topology of DNA, it was observed that LP is able to interfere in topoisomerase I activity by somehow acting upon DNA. LP provoked reduction in cell number but did not cause any significant increase in the number of non-viable cells. These findings corroborated with the morphological analysis, where cells treated with LP showed morphology of apoptotic process with abundant vacuoles, chromatin condensation and fragmentation of nuclei. The results of this study suggest the LP is a target for DNA topoisomerase I triggering apoptosis in cancer cell lines.³²
9. Three extracts (alcoholic, hydro-aqueous and aqueous) and their fractions from the root of *Calotropis procera* is studied against oral (KB) and central nervous system (SNB-78) to determine its Antiproliferative activity. The cell line was cultured at various concentrations at 10,30 &100 µg/ml in a dose dependent manner for 48 hr, and the percentage of cell viability was evaluated by Sulforhodamine-B (SRB) assay. Result shows alcoholic extracts is more potential for growth inhibition than hydro- aqueous extract. Aqueous extract found to be least active against both oral and CNS human cancer cell line. Chloroform fraction from alcoholic extract was antiproliferative for oral (KB) cancer cell line while n-butanol fraction from alcoholic extract was antiproliferative for CNS cancer cell line.³³
10. Study was aimed to investigate the effect of Calotropin (CTP) a cardenolides isolated from *Calotropis gigantea* on human colorectal cancer cell lines HT-29 and HCT-116. Cell lines were treated with various concentrations of CTP for 24 hrs, followed by MTT assay. CTP markedly suppressed colorectal cancer cell proliferation in a dose- dependant manner in both cell lines. BrdU assays showed that there were a significantly lower percentage of BrdU – positive cells in CTP- treated cells in a dose- dependent manner. In addition, CTP significantly suppressed cell proliferation in colorectal cancer cells, as shown by reduced colony formation. Collectively, these results demonstrate that CTP inhibits the proliferation of colorectal cancer cells in vitro.³⁴
11. The cytotoxic potential of stem extract from *Calotropis procera* was evaluated against the tumour cell lines HL-60, CEM (human leukaemia), HCT-8 (human colon cancer) and B-16/F10 (murine melanoma) by MTT assay. Five extracts are used for the cytotoxicity study i.e hexane,

dichloromethane, ethyl acetate, acetone and methanol. Among this five-ethyl acetate, and acetone shows higher cytotoxic potential against tumour cells, with IC₅₀ ranging from 0.8 to 4.4 µg/mL for colon (HCT-8) and melanoma (B-16) cells, respectively. Methanolic extract was weakly cytotoxic, despite that it demonstrated moderately good activity on CEM line (IC₅₀ value of 2.8 (2.1-4.1) µg/ml. Cytotoxic extracts also exhibited cell division inhibition capacity by antimitotic assay, revealing IC₅₀ values lower than 5 µg/mL.³⁵

12. In Vitro cytotoxicity of the Arkeshwar rasa was examined by MTT Assay against human epidermal carcinoma (KB) and human pancreatic cancer (MIA-PaCa2). Cells treated with different concentration 10,100,500 µg/ml of AR. After treatment with drug MIA-PaCa2 shows lower cell viability of about 20% (IC₅₀ values about 333.3 µg/ml at 500µg/ml concentration. KB cell line shows about 55% cell viability at the conc. of 500µg/ml. The study strongly suggests, AR is potential anticancer drug against pancreatic cancer.³⁶

Table 2: In Vitro Anticancer Studies of *Calotropis procera* / *Calotropis gigantea*

Sr. No	Plant Part Used	Extract	Fractions	Study Design	Assessment	Result
1.	Dried Stem leaves	Ethanol	Water Chloroform	HCT-15 Colon cancer cell line	Cytotoxicity Assay	Cytotoxic
2.	Dried latex & flowers	Ethanol	-	MCF-7 & HeLa cell line	MTT Assay	Cytotoxic
3.	Leaves	Ethanol	Dichloromethane Ethyl acetate Butanol Water	Human Colon Cancer WiDr cell lines	MTT Assay	Anticancer activity
4.	Dried powder of Leaves	Methanol	-	Breast cancer cell line T47D	MTT Assay	Significantly reduce cell viability more than 70 %
5.	Root	Methanol (CM) Hexane (CH) Aqueous (CW) Ethyl acetate (CE)	-	Hep2 cancer cell	MTT Assay	Antiproliferative activity
6.	Leaves	Methanol	-	MCF7 cancer cell line	MTT Assay	Anticancer Activity
7.	Root bark	Aqueous	-	Caco-2 & Neuro-2a	MTT & Neutral red assay	Cytotoxic
8.	Latex	Laticifer protein	-	HL-60, HCT-8, MDA-MB-435, SF295	MTT Assay	Cytotoxic
9.	Root	Alcoholic Hydro-alcoholic Aqueous	Alcoholic extract - Chloroform, n-hexane, n-butanol, water Hydro-alcoholic extract- chloroform, n- butanol & water Aqueous extract - n- butanol, water	KB (Oral) SNB-78 (CNS)	Sulforhodamine-B (SRB) Assay	Antiproliferative activity
10.	Whole plant	Calotropin	-	HT-29, HCT 116	MTT & BrdU assay	Anticancer activity
11.	Stem	Hexane, dichloromethane, Ethyl acetate, Acetone, Methanol	-	HL-60, CEM, HCT-8, B-16/F10	MTT assay	Cytotoxic
12.	Latex	-	-	KB & MIA-PaCa2	MTT assay	Anticancer activity

In Vivo Anticancer Study

- The anticancer property of dried latex (DL) of *Calotropis procera* is evaluated in the X15-myc transgenic mouse model of hepatocellular carcinoma to elucidate its mechanism of action in cell culture. Mice were orally fed an aqueous solution of dried latex (400mg/kg) for 15 weeks and their liver was examined for histopathological changes at 20 weeks in addition to the serum levels of VEGF (Vascular Endothelial Growth Factor). Methanolic extract fraction was analysed for cytotoxic effect on hepatoma (Huh7), non-hepatoma (COS-1) cell lines and non-transformed

hepatocytes (AML12) using MTT Assay. Also, the mechanism of cell death was investigated by measuring the levels of Bcl2, caspase 3 and DNA fragmentation. Result suggests, dried latex treatment not only provided astounding protection against hepatocellular carcinoma but also markedly reduced serum VEGF levels in treated mice. Cell culture studies revealed that methanolic extracts of DL as well as its fraction 8 induced extensive cell death in both Huh-7 and COS-1 cells while AML12 cells were spared. This was accompanied by extensive fragmentation of DNA in Huh-7 and COS-1 cells. No changes in the levels of canonical

markers of apoptosis such as Bcl2 and caspase 3 was observed.³⁷

- The antitumor effect of methanol extract (ME) of *Calotropis gigantea* L. root bark and its petroleum ether (PEF) and chloroform (CF) soluble fractions against Ehrlich ascites carcinoma (EAC) in Swiss albino mice. The effect of ME (10 and 20 mg/kg), PEF (40 and 80 mg/kg) and CF (20 and 40 mg/kg) on the growth of EAC and life span of EAC bearing mice were studied. Haematological profile and biochemical parameters (SALP, SGPT and SGOT) were estimated. Result shows a significant decrease in viable tumour cell count and increased life span of mice in ME and CF treated groups by 43.90% (20 mg ME/kg) and 57.07% (40 mg CF/kg). ME and CF brought back the haematological parameters to normal level and also restored the altered levels of SALP and SGOT. Methanolic extract of *Calotropis gigantea* root bark and its chloroform soluble fraction (CF) possesses significant antitumor activity.³⁸
- To evaluate the effect of calotropin (CTP) on colorectal cancer growth in vivo, BALB/c nude mice were inoculated with HT-29 cells and treated with CTP or vehicle. CTP treatment significantly decreases the rate of tumour growth compared to the control group. Consistently, tumour weight was reduced in CTP- treated mice compared with those treated with control treatment. In addition, the size of CTP-treated tumours was much smaller than that of the control group. Result shows calotropin (CTP) inhibits the growth of colorectal cancer in BALB/c mice.³⁹
- The antitumor activity of stem organic extracts (ethyl acetate, acetone and methanol) of *Calotropis procera* was studied in mice bearing sarcoma 180 tumour. Fifty healthy male mice (*M. musculus*) weighing 23-26 gm were subcutaneously implanted with nine-day old sarcoma 180 ascites tumour cells (2×10^6 cells/0.5mL). On the next day, they were randomly separated into five groups (n=10 each) to receive stem extract at the dose of 250mg/kg/day. In contrast Negative and positive controls received saline and 5-FU (50mg/kg/day), respectively, all administered intraperitoneally for 7 days. On day 8 mice were sacrificed by cervical dislocation. Their organs (kidney, spleens and liver) and tumours were dissected out, to examine tumours size, Color changes, haemorrhage & weighed. Significant reduction in tumour weight at 250mg/kg/day in both ethyl acetate & acetone treated animals was observed i.e. 1.40 ± 0.35 g and 1.34 ± 0.22 g respectively in comparison with negative control (3.25 ± 0.47 g), leading to tumour growth inhibition ratios are 64.3 and 53.1% respectively. The dose of 50 mg/kg/day reduced tumour weight in 96.5% in 5-FU- treated mice.⁴⁰

Table 3: In Vivo Anticancer Studies of *Calotropis procera* / *Calotropis gigantea*

Sr.No.	Plant part used	Extract	Study design	Animal models	Result
1.	Dried latex (DL)	Aqueous extract	Hepatocellular carcinoma	X15-myc transgenic mouse model	Cytotoxic & Chemo preventive effect
2.	Root bark	Methanol extract	Ehrlich ascites carcinoma	Swiss albino mice	Antitumor activity
3.	Whole plant	Calotropin (CTP)	Colorectal cancer	BALB/c nude mice	Antiproliferative activity
4.	Stem	Ethyl acetate, Acetone, methanol	Sarcoma 180 tumour	Adult swiss mice	Anti-tumour activity

DISCUSSION

Cancer is a major public health burden in both developed and developing countries. It is an abnormal growth of cells in body that can lead to death. Ayurveda is an ancient science, which has abundant of herbal, and herbo-minerals medicine for treating cancer. There are many herbal medicines such as *Curcuma longa*, *Calotropis procera*, *Calotropis gigantea* etc which are proved for their anticancer activity. Upavisha is a group of drugs which are less toxic in nature and used to cure many diseases. Arka is one among the Upavisha. Arka contains many biological active chemical compounds which show various pharmacological activities. Arka extracts have been studied in various In Vitro experimental models of cancer and show significant anticancer activity. Stem leaves extract shows anticancer activity against HCT-15 cell line, Latex & flower extract shows anticancer activity against MCF-7 & Hela cell line. Leaves extract shows anticancer activity against breast cancer cell line such as T47D, MCF-7. Root extract shows anticancer activity against Caco-2, Neuro-2a, KB & SNB-78 cancer cell lines likewise *Calotropis gigantea* leaves extract also shows anticancer activity against Human colon cancer WIDR cell line. Laticifer protein of latex of Arka shows anticancer activity against HL-60, HCT-8, MDA-MB-435, SF 295 for anticancer activity. Animal models show the Anticancer activity of Arka against Ehrlich Ascites Carcinoma, Hepatocellular, Colorectal and Sarcoma 180 tumour.

This study shows different parts of Arka (*Calotropis procera*) significantly inhibits the growth of cancer cells. Through review of literature it was found that leaves extract of Arka is most commonly used for anticancer studies. Also, Colon cancer is the most frequently used cell line for anticancer study. MTT Assay was commonly found method for detection of cytotoxicity. Anticancer study is available only on the Arkeshwar rasa a classical formulation of Arka. But there are various other classical formulations of Arka which are unexplored and need to be studied for anticancer activity. Several synthetic agents are used to cure disease like cancer but they show various adverse effects, so the research is shifted to natural derivatives of herbal drugs. Upavisha Arka (*Calotropis procera/Calotropis gigantea*) is an herbal medicine having cost effectiveness and less side effects as an anticancer drug.

CONCLUSION

The extract of different parts of Upavisha Arka (*Calotropis procera/Calotropis gigantea*) has shown potential Anticancer activity in various In Vitro and In Vivo studies. The research reported on Arka for anticancer activity is in preclinical phase. So further clinical trials of reported preclinical studies can be carried out. Arkeshwar Rasa, the formulation of Upavisha Arka has reported for its anticancer activity. Also, other classical formulations of Upavisha Arka like Arka kshara, Arka Lavana can be studied in preclinical & clinical phase.

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