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A SURVEY ON ANTICANCER PROPERTIES OF INDIAN MEDICINAL PLANTS - A BROAD SPECTRUM ANALYSIS

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ABSTRACT: Several plants across the world possess specific therapeutic and diagnostic properties. The identification of the properties among them is the most difficult task. Several researchers have used several methodologies to express the therapeutic properties in the plants. The interest of scientists among the anticancer studies has been increasing widely as cancer has become one of the deadliest diseases. The usage of different parts of the plant and using the different extracting solvents has shown effective results on different types of cancer cell lines. Several plants synthesize metabolites which possess anticancer properties that have been used in the development of drugs by clinical trials. The application of nanoparticles from plants in cancer treatment has been regarded as a successful method recently. The present review aims at the study of a broad spectrum of plants having anticancer properties using the *in-vitro* analysis of particular cell lines. The anticancer activity was analyzed by different assays such as MTT assay, "Alamar Blue" Resazurin reduction assay, SRB assay, and WST-1 assay. The results were calculated based on absorbance values. Thus, the potential of the plant extract against specific cancer cell line was evaluated.

INTRODUCTION: Cancer is one of the five leading causes of death in the world [1]. Cancer is the abnormal, uncontrolled division of cells in the body [2]. The cancer cells when malignant, invade various parts of the body through the bloodstream. Men are mostly affected by lung cancer, colon cancer, rectum, and prostate cancer. Women are mostly affected by breast, colon, rectal and stomach cancer [3]. Every year, millions of people are affected by cancer, leading to death [4]. It is estimated that by 2030, there will be 17 million deaths caused by cancer [5].

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The cancer patients can be treated by some methods such as chemotherapy, radiotherapy and chemically derived drugs [6]. Among the methods, chemotherapy is the most used treatment used for curing the advanced stages of cancer. Apart from treating the cancer cells, it also produces toxicity to the normal cells [7].

Cancer can be broadly classified into carcinoma, sarcoma, melanoma, lymphoma, and leukemia. Carcinomas include almost 81% of overall cancer available, which originate in the skin, lungs, breasts, pancreas, and other organs and glands. Lymphomas are the cancers of lymphocytes. Leukemia is the form of cancer in blood. Sarcomas occur in bone, muscle, fat, blood vessels, cartilage, or other soft or connective tissues of the body. Melanomas are cancers that arise in the cells that make the pigment in the skin. Cancer has been recognized for thousands of years as a human ailment, yet only in the past century has medical science understood what cancer is and how it progresses. Cancer specialists, called oncologists, have made remarkable advances in cancer diagnosis, prevention, and treatment. Today, more people diagnosed with cancer are living longer. However, some forms of the disease remain frustratingly difficult to treat. Modern treatment can significantly improve the quality of life and may extend survival. According to the WHO, more than 80% of the population in the developing countries are dependent on traditional medicine for treating cancer [8]. According to statistics, 60% of the drugs for treating cancer derived from plants [9]. More than 3000 plants have anticancer activity [5]. India is one among the 12 centers in the world that contain a diversity of plant producing novel bio-molecules [9]. India is known as "the botanical garden of the world" and is the highest plant producer of the world [10]. The main rationale of the review is to study the *in-vitro* anticancer activity of different plants available in a broad spectrum survey.

Extraction: The extracts from different parts of the plants such as leaves, fruits, stems, shoot, bark, flowers, roots, and rhizome were used for the analysis of anticancer properties. Soxhlet extraction apparatus was preferred by researchers for extraction. One among the following assays was used for the anticancer activity.

In-vitro Anticancer Activity:

MTT Assay: [3-(4, 5-dimethylthiazol-2-yl)-2, 5-diphenyltetrazolium bromide] MTT colorimetric assay is the mostly used assay for anticancer activity. In this assay, the extracts were made to be dissolved in (dimethylsulfoxide) DMSO along with diluted cell culture media. Initially, the cells taken from the cell lines were counted. The cells were diluted and seeded in 96 well microtiter plates. This was kept for incubation. The absorption was measured and the cell viability was calculated [11].

"Alamar Blue" Resazurin Reduction Assay: In Resazurin reduction assay, the cells of cell lines were suspended in DMEM. This was seeded in 96-well plate at dilution. The plant extracts were made to be serially diluted along with the medium and supplied to the cells. This was kept for incubation. Following incubation, fresh media along with Resazurin was added and again incubated. The fluorescent intensity of dye was measured as a result of the cytotoxic activity of the cells [12].

SRB Assay: RPMI 1640 medium containing fetal bovine serum was selected, and the diluted cells were inoculated to 96 well plates. This was kept for incubation. The extract was then added and again incubated. The assay was then completed by the addition of TCA to the cells. Then the cells were finally added to the SRB solution. The absorbance was read [13].

WST-1 Colorimetric Assay: WST-1 (4- [3- (4-iodophenyl)-2 -(4-nitrophenyl) -2H-5-tetrazolio]-1, 3-benzene disulfonate) colorimetric assay was performed by incubating the inoculated cells to the 96 well plates along with the media. After incubation, appropriate concentrations of the extracts were made to be added. This was again incubated. The cells and the extract were solubilized in DMSO, and an appropriate quantity of WST-1 was added. The absorbance was calculated [14].

In-vitro Anticancer Activity of Medicinal Plants: Some of the plants that exhibit anticancer activity are given in **Table 1**.

TABLE 1: LIST OF _IN-VITRO_ ANTICANCER ACTIVITIES OF DIFFERENT PLANT EXTRACTS

S. no.	Plant	Family	Part of Plant Used	Specific Cancer Suppressed	Reference
1	*Aloe vera*	Asphodelaceae	Whole plant	HepG2	15
2	*Annona muricata*	Annonaceae	Leaves	EACC, MDA and SKBR3	16
3	*Annona squamosa*	Annonaceae	Flower	MCF-7	17
4	*Arbutus andrachne*	Ericaceae	Aerial parts	MCF-7, T47D, CACO-2, HRT18, A375.S2 and WM1361A	18
5	*Aristolochia longa*	Aristolochiaceae	Roots	VCREMS	19
6	*Aristolochia ringens*	Aristolochiaceae	Roots	HCT-116, A431, A549, PC3, THP-1 and HeLa	20
7	*Asplenium nidus*	Aspleniaceae	Whole plant	HepG2 and HeLa	21
8	*Averrhoa bilimbi*	Oxalidaceae	Fruit, leaves	MCF-7	22
9	*Azadirachta indica*	Meliaceae	Leaves, seeds	EACC	23

10	*Barleria grandiflora*	Acanthaceae	Leaves	A-549 and DLA	24
11	*Beberis aristata*	Berberidaceae	Root, stem	Colo 205, Hop 62,HT 29, SiHa, MIA-PA-CIA-2, DWD, T 24, PC 3, A549, ZR 75-1, A 2780, DU 145, MC F7 and K 562	25, 26
12	*Caesalpinia sappan*	Caesalpiniaceae	Hear wood, leaves	MCF7 and A549 cell lines	27
13	*Calligonum comosum*	Polygonaceae	Whole plant	HepG2	15
14	*Cedrus deodara*	Pinaceae	Wood	Colo 205, Hop 62,HT 29, SiHa, MIA-PA-CIA-2, DWD, T 24, PC 3, A549, ZR 75-1, A 2780, DU 145, MC F7 and K 562	25
15	*Cenchrus ciliaris*	Poaceae	Aerial parts, roots	hepG-2, CACO, and A-549	28
16	*C. antiochia* var. praealta	Asteraceae	Aerial parts	Vero and HeLa	29
17	*Centaurea nerimaniae*	Asteraceae	Aerial parts	Vero and HeLa	29
18	*Chrysanthemum coronarium*	Asteraceae	Aerial parts	MCF-7, T47D, CACO-2, HRT18, A375.S2 and WM1361A	18
19	*Cocculus hirsutus*	Menispermaceae	Aerial parts	MCF-7	30
20	*Corda dichotoma*	Boraginaceae	Leaves	PC3	31
21	*Cotynus coggygria*	Anacardiaceae	Leaves	Vero and HeLa	29
22	*Crataegus microphylla*	Rosaceae	Leaves	Vero and HeLa	29
23	*Croton caudatus*	Euphorbiaceae	Leaves	DL, MCF-7, and HeLa	32
24	*Curcuma longa*	Zingiberaceae	Rhizome	HL-60, HeLa	33
25	*Delphinium staphisagaria*	Ranunculaceae	Seeds	H5-6 and N2A	19
26	*Dillenia pentagyna*	Dillenaceae	Stem bark	DL, MCF-7 and HeLa	32
27	*Euphorbia tirucalli*	Euphorbiaceae	Leaves, stem	Mia-PaCa2	34
28	*Ficus beecheyana*	Moraceae	Roots	HL-60	35
29	*Ficus carica*	Moraceae	Fruit, leaves, sap	MCF-7, B16F10 and HeLa	12
30	*Ficus racemosa*	Moraceae	Fruit	MCF-7	13
31	*Helicteres isora*	Sterculiaceae	Whole plant	HeLa-B75, H-60, HEP-3B and PN-15	36
32	*Hibiscus calyphyllus*	Malvaceae	Aerial parts	HepG2 and MCF-7	37
33	*Hibiscus deflersii*	Malvaceae	Aerial parts	HepG2 and MCF-7	37
34	*Hibiscus micranthus*	Malvaceae	Aerial parts	HepG2 and MCF-7	37
35	*Hypericum kotshcyanum*	Hypericaceae	Aerial parts	Vero and HeLa	29
36	*Inula viscosa*	Compositae	Flowers	MCF-7 and Hep-2	38
37	*Jasmium sambac*	Oleaceae	Flowers	MCF-7 and Hep-2	38
38	*Lavandula angustifolia*	Lamiaceae	Flowers	MCF-7 and Hep-2	38
39	*Leea indica*	Vitaceae	Leaves	DU-145 and PC-3	39
40	*Limonium densiflorum*	Plumbaginaceae	Shoots	human lung carcinoma A-549, colon adenocarcinoma DLD-1Cell lines	40
41	*Luffa cylindrica*	Araceae	Aerial parts	MCF-7 and Hep-2	38
42	*Manilkara zapota*	Sapotaceae	Flower	MCF-7	17
43	*Mirabilis jalapa*	Nyctaginaceae	Aerial parts, roots, stems	MCF-7 and Hep-2	38
44	*Morus nigra*	Moraceae	Leaves	heLa	41
45	*Narcissus tazetta*	Amaryllidaceae	Aerial parts, fowers	MCF-7 and Hep-2	38
46	*Nepeta italica*	Laminaceae	Aerial parts	Vero and HeLa	29
47	*Ocimum sanctum*	Laminaceae	Leaves	HFS-1080	42
48	*Oldenlandia corymbosa*	Rubiaceae	Leaves	K562	43
49	*Olea europaea*	Oleaceae	Leaves	MCF-7, B16F10 and HeLa	12
50	*Olea europaea*	Oleaceae	Leaves	Vero and HeLa	29
51	*Ononis hirta*	Fabaceae	Aerial parts	MCF-7 and Hep-2	38
52	*Ononis sicula*	Fabaceae	Aerial parts	MCF-7 and Hep-2	38
53	*Origanum sipyleum*	Laminaceae	Aerial parts	Vero and HeLa	29
54	*Parthenium hysterophorus*	Asteraceae	Leaves	K562	43
55	*Phagnalon rupstre*	Asteraceae	Aerial parts	MCF-7 and Hep-2	38
56	*Phyllanthus emblica*	Phyllanthacae	Leaves, fruit	HT-29	44
57	*Picrorhiza kurroa*	Picrorhiza	Root	Colo 205, Hop 62,HT 29, SiHa, MIA-PA-CIA-2, DWD, T 24, PC 3, A549, ZR 75-1, A 2780, DU 145, MC F7 and K 562	25
58	*Piper longum*	Piperaceae	Fruit	Colo 205, Hop 62,HT 29, SiHa, MIA-PA-CIA-2 DWD, T 24, PC 3, A549, ZR 75-1, A 2780, DU 145, MC F7 and K 562	25
59	*Piper regnelli*	Piperaceae	Leaves	UACC-62, MCF7, 786-0, NCI-H460, PC-3, OVCAR-3, HT29 and K-562	45
60	*Plectranthus*	Lamiaceae	Leaves, stem	MCF-7, RAW 264.7 and Caco-2 cell	11

	stocksii			lines	
61	*Populous alba*	Salicaceae	Flowers	MCF-7 and Hep-2	38
62	*Pterocephalus pulverulentus*	Dipsacaceae	Aerial parts	MCF-7 and Hep-2	38
63	*Rosa damascena*	Rosaceae	Flowers	Vero and HeLa	29
64	*Rosa damascene*	Rosaceae	Receptacles seeds	MCF-7 and Hep-2	38
65	*Saliva pinardi*	Labiatae	Aerial parts	MCF-7 and Hep-2	38
66	*Salvia hypargeia*	Lamiaceae	Aerial parts	Vero and HeLa	29
67	*Salvia officinalis*	Lamiaceae	Leaves, stems	MCF-7, B16F10 and HeLa	12
68	*Saururus chinensis*	Saururaceae	Roots	MCF-7	46
69	*Scorzonera tomentosa*	Asteraceae	Aerial parts	Vero and HeLa	29
70	*Senecio scandens*	Asteraceae	Leaves	DL, MCF-7 and HeLa	32
71	*Solanum khasianum*	Solanaceae	Fruit	DL, MCF-7 and HeLa	32
72	*S. cretica* subsp. vacillans	Laminaceae	Aerial parts	Vero and HeLa	29
73	*Syringa vulgaris*	Oleaceae	Aerial parts, seeds	MCF-7 and Hep-2	38
74	*Syzygium cumini*	Myrtaceae	Seeds	A2780, MCF7, PC-3 and H460	47
75	*Tabernaemontana divaricata*	Apocynaceae	Flowers	NIH 3T3 and HeLa	48
76	*Tecoma stans*	Bignoniaceae	Leaves, flowers	A549	49
77	*Terucrium polium*	Laminaceae	Leaves, stems, aerial parts	MCF-7, B16F10 T47D, CACO-2, HRT18, A375.S2 WM1361A, Hep-2 and HeLa	12, 38
79	*Teucrium polium*	Laminaceae	Aerial parts	MCF-7,	18
80	*Teucrium sandrasicum*	Lamiaceae	Aerial parts	Vero and HeLa	29
81	*Tillandsia recurvata*	Bromeliaceae	Whole plant	A375, MCF-7 and PC-3	14
82	*Verbascum sinaticum*	Scrophulariaceae	Flowers, aerial parts	MCF-7 and Hep-2	38
83	*Vitis vinifera*	Vitaceae	Liquid sap of stem	MCF-7, B16F10 and HeLa	12
84	*Withania coagulants*	Solanaceae	Root, leaves, stalk, Fruit	HeLa, MCF-7, RD, RG and INS-1	50
85	*Withania somnifera*	Solanaceae	Root	Colo 205, Hop 62,HT 29, SiHa, MIA-PA-CIA-2, DWD, T 24, PC 3, A549, ZR 75-1, A 2780, DU 145, MC F7 & K 562	25
86	*Zea mays*	Gramineae	Leaves	Hep2	51

CONCLUSION: In this review paper, the anticancer properties of various plants were analyzed in a broad spectrum. From this analysis, it is well understood that even locally available plants which all come across in day-to-day life can cure many deadly diseases and capacity to cure many deadly diseases and disorders. The *in-vitro* anticancer analysis is the basic step for identification of the anticancer potentials of the plants. Followed by the *in-vitro* studies, further studies such as preclinical and clinical studies can be carried out in detail. In the future, by understanding the importance of these plants and by utilizing their properties, further research can be carried out for drug discovery to reduce the viability of diseases.

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REFERENCES:

1. Fadeyi SA, Fadeyei OO, AAdejumo A, Okoro C and Myles EL: *In-vitro* anticancer screening of 24 locally used Nigerian medicinal plants. BMC Complementary and Alternative Medicine 2013; 13: 79.
2. Rahman AHMM: A review of medicinal plants with anticancer activity in Bangladesh. Modern Applications in Pharmacy & Pharmacology 2018; 1(4): 000516.
3. Chavan SS, Damale MG, Shamkumar PB and Pawar DP: Traditional medicinal plants for anticancer activity. International Journal of Current Pharmaceutical Research 2013; 5(4): 50-54.
4. Manivel G, Kandasamy CS, Hariprasad R, Baskar K, Jegadeesh S and Venkatanarayanan R: Review on anticancer activity of medicinal plants. International Journal of Advance. Ideas and Innovations in Technology 2017; 3(3): 1024-28.
5. Solowey E, Lichtenstein M, Sallon S, Paavilainen H, Solowey E and Lorberboum-Galski H: Evaluating medicinal plants for anticancer activity. The Scientific World Journal 2014; 1-12.
6. Singh N, Mathur C, Sase NA, Rai S and Abraham J: Pharmaceutical properties of *Emblica officinalis* and *Phyllanthus Emblica* extracts. Research Journal of Pharmaceutical, Biological and Chemical Sciences 2015; 6(1): 1007-16.
7. Kaur R, Singh J, Singh G and Kaur H: Anticancer plants: A review. J Nat Prod Plant Resour 2011; 1(4): 131-36.

8. Merina N, Chandra KJ and Jibon K: Medicinal plants with potential anticancer activity: A review. International Research Journal of Pharmacy 2012; 3(6): 26-30.
9. Garg A, Darokar MP, Sundaresan V, Faridi U, Luqman S and Rajkumar S: Anticancer activity of some medicinal plants from high altitude evergreen elements of Indian Western Ghats. The Journal of Research and Education in Indian Medicine in 2007; 13: 1-6.
10. Umadevi M, Sampath Kumar KP, Debjit B and Duraivel S: Traditionally used anticancer herbs in India. Journal of Medicinal Plants Studies 2013; 1(3): 56-74.
11. Muniyandi K, George E, Mudidli V, Kalagatur NK, Anthuvan AJ and Krishna K: Antioxidant and anticancer activities of *P. stocksii* Hook. f. leaf and stem extracts. Agriculture and Natural Resources 2017; 51: 63-73.
12. Alzeer J, Vummidi BR, Arafeh R, Rimawi W, Saleem H and Luedtke NW: The influence of extraction solvents on the anticancer activities of Palestinian medicinal plants. Journal of Medicinal Plant Research 2014; 8(8): 408-15.
13. Gavhane DS, Moreganokar SD and Mhase AK: Cytotoxic and anticancer activity of *F. racemosa* fruit extracton MCF7 human breast cancer cell line by SRB method. Journal of Animal Research 2016; 6(1): 43-7.
14. Lowe HIC, Toyang NJ, Watson C, Badal S, Bahado-Singh P and Bryant J: *In-vitro* anticancer activity of the crude extract and two dicinnamate isolates from the Jamaican Ball Moss (*Tillandsia recurvata* L.) 2013; 3(1): 93-6.
15. Shalabi M, Khilo K, Zakira MM, Elsebaei MG, Abdo W and Awadin W: Anticancer activity of *Aloe vera* and *Calligonum comosum* extracts separately on hepatocellular carcinoma cells. Asian Pacific Journal of Tropical Biomedicine 2015; 5(5): 375-81.
16. Gavamukulya Y, Abou-Elella F, Wamunyokoli F and AEI-Shemy H: Phytochemical screening, anti-oxidant activity and *in-vitro* anticancer potential of ethanolic and water leaves extracts of *Annona muricata*. Asian Pacific Journal of Tropical Medicine 2014; 7(1): S355-S363.
17. Sumithra P, Gricilda Shoba F, Vimala G, Sathya J, Sankar V and Saraswathi R: Anti-cancer activity of *Annona squamosa* and *Manilkara zapota* flower extract against MCF-7 cell line 2014; 5(6): 98-104.
18. Abu-rish EY, Kasabri VN, Hudaib MM, Mashalla SH, Al-Alawi LH and Tawaha KA: Evaluation of antiproliferative activity of some traditional anticancer herbal remedies from Jordan. Tropical Journal of Pharmaceutical Research 2016; 15(3): 469-74.
19. Daoudi A, Amal EL, Youbi HEL, Bagrel D and Aarab L: *In-vitro* anticancer activity of some plants used in Moroccan traditional medicine. Journal of Medicinal Plants Research 2013; 7(17): 1182-89.
20. Akindele AJ, Wani Z, Mahajan G, Sharma S, Aigbe FR and Sati N: Anticancer activity of *Aristolochia ringens* Vahl. (Aristolochiaceae). Journal of Traditional and Complementary Medicine 2015; 5(1): 35-41.
21. Jarial R, Thakur S, Sakinah M, Zularisam AW, Sharad A and Kanwar SS: Potent anticancer, antioxidant and antibacterial activities of isolated flavonoids from *Asplenium nidus*. Journal of King Saud University-Science 2018; 30: 185-92.
22. Nair MS, Soren K, Singh V and Boro B: Anticancer activity of fruit and leaf extracts of *Averrhoa bilimbi* on MCF-7 Human breast cancer cell lines: A preliminary study. Austin Journal of Pharmacology and Therapeutics 2016; 4(2): 1082.
23. Amer H, Helmy WA and Taie HAA: *In-vitro* antitumor and antiviral activities of seeds and leaves neem (*Azadirachta indica*) extracts. International Journal of Academic Research 2010; 2(2): 47-51.
24. Manglani N, Vaishnava S, Dhamodaran P and Sawarkar H: *In-vitro* and *in-vivo* anti-cancer activity of leaf extract of *B. grandiflora*. International Journal of Pharmaceutical Sciences 2014; 6(3): 70-2.
25. Gaidhani SN, Singh A, Kumari S, Lavekar GS, Juekar AS and Sen S: Evaluation of some plant extracts for standardization and anticancer activity. Indian Journal of Traditional Knowledge 2013; 12(4): 682-87.
26. Serasanambati M, Chilakapati SR, Manikonda PK and Kanala JR: Anticancer activity of methanolic extract of *Berberis aristata* in MCF-7 human breast cancer cell lines. International Journal of Life Sciences Biotechnology and Pharma Research 2015; 4(1): 31-5.
27. Bukke AN, Hadi FN, Babu KS and Shankar PC: *In-vitro* studies data on the anticancer activity of *Caesalpinia sappan* L. heartwood and leaf extracts on MCF7 and A549 cell lines. Data in Brief 2018; 19: 868-77.
28. Alothman EA, Awaad AS, Al-Qurayn NA, Al-Kanhal HF, El-Meligy RM and Zain YM: Anticancer effect of *Cenchrus ciliaris* L. Saudi Pharmaceutical Journal 2018.
29. Artun FT, Karagoz A, Ozcan G, Melikoglu G, Anil S and Kultur S: *In-vitro* anticancer and cytotoxic activities of some plant extracts on HeLa and Vero cell lines. Journal of the Balkan Union of Oncology 2016; 21(3): 720-5.
30. Thakkar KN, Prasad AK, Nayak J, Iyer SV and Kumar S: Antioxidant and *in-vitro* cytotoxic activity of extracts of aerial parts of *Cocculus hirsutus* (L) using cell line cultures (breast cell line). The J of Phytopharmacology 2014; 3(6): 395-9.
31. Rahman MA, Sahabjada and Akhtar J: Evaluation of anticancer activity of *Cordia dichotoma* leaves against a human prostate carcinoma cell line, PC3. Journal of Traditional and Complementary Medicine 2017; 7(3): 315-21.
32. Rosangkima G and Jagetia GC: *In-vitro* anticancer screening of medicinal plants of Mizoram state, India, against Dalton's lymphoma, MCF-7 and HeLa cells. International Journal of Recent Scientific Research 2015; 6(8): 5648-53.
33. Srivatsava P and Srivatsava A: *In-vitro* anti-cancer activity of ethanolic extract of *Cucurmin longa* (turmeric) in Hep-2 cell lines. International Journal of Engineering Research and General Science 2015; 3(5): 495-08.
34. Munro B, Vuong Q, Chalmers AC, Goldsmith CD, Bowyer MC and Scarlett CJ: Phytochemical, antioxidant and anti-cancer properties of *Euphorbia tirucalli* methanolic and aqueous extracts. Antioxidants 2015; 4: 647-61.
35. Yen GC, Chen CS, Chang WT, Wu MF, Cheng FT and Shiau DK: Antioxidant activity and anticancer effect of ethanolic and aqueous extracts of the roots of *Ficus beecheyana* and their phenolic components. Journal of Food and Drug Analysis 2018; 26(1): 182-92.
36. Shaikh R, Pund M, Dawane A and Iliyas S: Evaluation of anticancer, antioxidant, and possible anti-inflammatory properties of selected medicinal plants used in Indian traditional medication. Journal of Traditional and Complementary Medicine 2014; 4(4): 253-7.
37. Alam P, Al-Yousef HM, Sidiqui NA, Alhowiriny TA, Alqasoumi SI and Aminal M: Anticancer activity and concurrent analysis of ursolic acid, β- sitosterol and lupeol in three different *Hibiscus species* (aerial parts) by validated HPTLC method. Saudi Pharmaceutical Journal 2018; 26(7): 1060-67.

38. Talib WH and Mahasneh AM; Antiproliferative activity of plant extracts used against cancer in traditional medicine. Scientia Pharmaceutica 2010; 78: 33-45.
39. Ghagane SC, Puranik SI, Kumbar VM, Nerli RB, Jalalpure SS and Hiremath MB: *In-vitro* antioxidant and anticancer activity of *Leea indica* leaf extracts on human prostate cancer cell lines. Integrative Medicine Research 2017; 6(1): 79-87.
40. Medini F, Bourgou S, Lalancette KG, Snoussi M, Mkadmini K and Cote I: phytochemical analysis, anti-oxidant, anti-inflammatory and anticancer activities of the halophyte *Limonium densiflorum* extracts on human cell lines and murine macrophages. South African Journal of Botany 2015; 99: 158-64.
41. Qadir MI, Ali M and Ibrahim Z: Anticancer activity of *Morus nigra* leaves extract. A Journal of the Bangladesh Pharmacological Society 2014; 9: 496-7.
42. Karthikeyan K, Gunasekaran P, Ramamurthy N and Govindasamy S: Anticancer activity of *Ocimum sanctum*. Pharmaceutical Biology 1999; 37(4): 285-90.
43. Pandey K, Sharma PK and Dudhe R. Anticancer activity of *Parthenium hysterophorus* Linn. and *Oldenlandia corymbosa* Lam. by Srb method. Open Access Scientific Reports 2012; 1(6): 1-3.
44. Sumalatha D: Antioxidant and antitumor activity of *Phyllanthus emblica* in colon cancer cell lines. International Journal of Current Microbiology and Applied Sciences 2013; 2(5): 189-95.
45. Longato GB, Rizzo LY, de Oliveira Sousa IM, Tinti SV, Possenti A and Figueira GM: *In-vitro* and *in-vivo* anti-cancer activity of extracts, fractions and Eupomatenoid-5 obtained from *Piper regnelli* leaves. Planta Med 2011; 77: 1482-88.
46. Alaklabi A, Arif IA, Ahamed A, Kumar RS and Idhayadhulla A: Evaluation of antioxidant and anticancer activities of chemical constituents of the *Saururus Chinensis* root extracts. Saudi Journal of Biological Sciences 2017.
47. Yadav SS, Meshram GA, Shinde D, Patil RC, Manohar SM and Upadhye MV: Antibacterial and anticancer activity of a bioactive fraction of *Syzygium cumini* L. seeds. HAYATI Journal of Biosciences 2011; 18(3): 118-22.
48. Dantu AS, Shankarguru P, Ramya Devi D and Vedha Hari BN: Evaluation of *in-vitro* anticancer activity of hydroalcoholic extract of *Tabernaemontana divaricate*. Asian Journal of Pharmaceutical and Clinical Research 2012; 5(3): 59-61.
49. Robinson JP, Suriya K, Subbaiya R and Ponmurugan P: Antioxidant and cytotoxic activity of *Tecoma stans* against lung cancer cell line (A549). Brazilian Journal of Pharmaceutical Sciences 2017; 53(3): 6.
50. Maqsood M, Qureshi R, Ikram M, Ahmed S, Jabeen B and Asi MR: *In-vitro* anticancer activities of *Withania* coagulans against HeLa, MCF-7, RD, RG2 and INS-1 cancer cells and phytochemical analysis. Integrative Medicine Research 2018.
51. Balasubramanian K and Padma PR: Anticancer activity of *Zea mays* leaf extracts on oxidative stree-induced Hep2 cells. Journal of Aquaculture and Meridian Studies 2013; 6(3): 149-58.

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