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Revisión / Review

Broad-spectrum survey of medicinal plants as a potential source of anticancer agents

[Estudio de amplio espectro de plantas medicinales como fuente potencial de agentes contra el cáncer]

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Abstract: Cancer is an abnormal and uncontrolled growth of cells that spreads through cell division. There are different types of medicines available to treat cancers, but no drug is found to be fully effective and safe for humans. The major problem involved in the cancer treatments is the toxicity of the established drug and their side effects. Medicinal plants are used as folk medicines in Asian and African populations for thousands of years. 60% of the drugs for treating cancer are derived from plants. More than 3000 plants have anticancer activity. The present review aims at the study of a broad spectrum survey of plants having anticancer components for different type of cancers. This article consists of 364 medicinal plants and their different parts as potential Source of Anticancer Agents.

Keywords: Cancer; Medicinal plants; Anticancer activity; Phytochemicals; Cell lines.

Resumen: El cáncer es un crecimiento anormal y descontrolado de células que se disemina a través de la división celular. Hay diferentes tipos de medicamentos disponibles para tratar el cáncer, pero no se ha encontrado ningún medicamento que sea completamente efectivo y seguro para los seres humanos. El principal problema involucrado en los tratamientos del cáncer es la toxicidad del fármaco establecido y sus efectos secundarios. Las plantas medicinales se utilizan como medicinas populares en poblaciones asiáticas y africanas durante miles de años. El 60% de los medicamentos para el tratamiento del cáncer se derivan de plantas. Más de 3000 plantas tienen actividad anticancerígena. La presente revisión tiene como objetivo el estudio de un estudio de amplio espectro de plantas que tienen componentes anticancerígenos para diferentes tipos de cánceres. Este artículo consta de 364 plantas medicinales y sus diferentes partes como fuente potencial de agentes anticancerígenos.

Palabras clave: Cáncer; Plantas medicinales; Actividad anticancerígena; Fitoquímicos; Líneas celulares.

INTRODUCTION

Cancer is the abnormal and uncontrolled growth of cells that spreads through cell division. Cancer cells spread to other tissues through body fluids and destroy normal cells present in the other parts of the body. These cells are generated due to the imbalance of the body and by correcting this imbalance; the cancer can be treated (Prakash *et al*., 2013). Cancer begins with mutations in DNA, which instructs the cells how to grow and divide. Normal cells in the human body have the ability to repair the mutations in their DNA, but the mutation which is not repaired and causing the cells to grow becomes cancerous (Krishnamurthi, 2000). Every year, millions of people are diagnosed with cancer. Cancer is the second most cause of death in the world, and 9.6 million deaths in 2018. About 1 in 6 deaths in the world occur due to cancer. According to the American Cancer Society, deaths arising from cancer constitute 2 - 3% of the annual deaths recorded worldwide. Thus, cancer kills about 3500 million people annually all over the world (WHO, 2018).

Lung cancer is the most common cause of cancer in the world with 2,093,876 new cases and 1,761,007 deaths. Breast cancer is the most common type of cancer in women with 2,088,849 new cases and 626,679 deaths. Prostate cancer is the second most common cause of cancer in the world with 1,276,106 new cases and 358,989 deaths (Siegel *et al*., 2018). The different type of cancer that affecting the humans and most common effects of all the type of cancers affect the digestive tract. It is very difficult to find the specific cause of cancer. However, tobacco use, alcohol consumption, environmental pollutants, infectious agents, high body mass index (BMI), low fruit and vegetable intake, lack of physical activity, and lifestyles are some commonly known reasons responsible for this disease. Environmental factor that contributes to the cancer deaths includes radiation, infection, heredity, stress and environmental pollutants; Tobacco use is the most important risk factor for cancer and is responsible for approximately 22% of cancer deaths and smoking causes 90% of lung cancer (GBD, 2016). It also causes kidney, stomach, pancreas, larynx, and bladder cancer. Physical inactivity, obesity and diet relate to 30-35% of cancer deaths (Kuper *et al*., 2002). This article provides a comprehensive analysis of plant derived anticancer compounds and their anticancer therapeutic properties of various types of *in vitro* and *in vivo* models.

A*nticancer medicinal plants*

Medicinal plants place an important role in basis and traditional medicine systems, and it provided an effective and curable remedy for mankind. Medicinal plants have been used as folk medicines in Asian, Chinese and African populations for thousands of years. Herbal medicines have been used and are still used in developing countries as the primary source of medical treatment. Plants have been used in the medicine for their natural antiseptic properties and important drug sources (Garg *et al*., 2007). Phytochemicals and their derived medicinal components are present in different parts of the plant like flower, flower stigmas, pericarp, sprouts, fruits, seeds, roots, rhizomes, stem, leaf, embryo, bark and it contains phytochemical components like Terpenoids, Flavonoids, Phenols, Saponins, Tannins, Alkaloids, Proteins, and Amino acids, Resins, Oils, Carbohydrates, Steroids and Glycosides, biomolecules and other primary and secondary metabolites. They play significant roles in either inhibiting cancer cell or activating proteins to suppress the growth (Tariq *et al*., 2017). According to the WHO, more than 80% of the population in the developing countries is depending on traditional medicine for the treatment of cancer (Merina *et al*., 2012). According to statistics, 60% of the drugs used in cancer treatments are derived from plants. The effort of researchers to find anticancer components from plants was launched by the US National Cancer Institute (NCI) in 1957. Today, many of the most useful and curative anticancer drugs are derived from the natural plant products. Since the initiation of NCI program, more than 35,000 plant species had investigated and resulted in the discovery of anticancer drugs. Anticancer compounds have been identified and extracted from medicinal plants for their anticancer properties include Allicin, Apigenin, Berberine, Catechin gallate, Celastrol, Curcumin, Epigallocatechin gallate, Fisetin, Flavopiridol, Gambogicacid, Genistein, Plumbagin, Quercetin, Resveratrol, Silibinin, Taxol, Vinblastine, Vincristine, Combretastatins, Paclitaxel, Camptothecin, Homoharringtonine. Plant derived anticancer agents are highly effective in the treatment of cancer cells. Due to this, there is a high demand of these plants for the production of therapeutically important compounds. There are different types of medicinal plants all over the world, which are being used traditionally for cancer prevention and treatment. Some phytochemicals that are important active constituents of plants have shown in future

cancer management. The medicinal plants and their anticancer activities are mentioned in Table No. 1.

Development of anticancer agents, from plants

Medicinal plants are the important source of anticancer agents based upon the active phytochemical components present in the plants. Several medicinal plants used as a folk medicine in many countries (Jamshidi-Kia *et al.*, 2018). The main reason for the medicinal plants having the many pharmacological activities, it has a specific active component against the disease. Based on the pharmacological activities the active components are purged from the medicinal plants.

The purification of active phytochemical components forms medicinal plants having the many step chemical and biological process. Flower, flower stigmas, pericarp, sprouts, fruits, seeds, roots, rhizomes, stem, leaf, embryo and bark are the important part of the medicinal plants having anticancer properties. Extraction process was collecting the plant components in the different fractions using solvents. Most of the plant extraction process was using the Soxhlet extraction. Phytochemical analysis was process was identifying the phytochemical components present in the crude plant extract. The structural identification of active phytochemical components and bioactivity of the plant extract fractions using various analytical techniques such as TLC, HPLC, FTIR, Mass spectroscopy and NMR. These analytical techniques were analyzing the quantity and quality of components. Chromatography techniques used for purification of active components based upon the polarity of solvent and active component. Superdex, Sephadex, Silica and many other suitable matrixes can be used for fractionation of active components. Purified phytochemical components examined for preclinical study under in-vitro cancer cell lines and in-vivo animal models for pharmacokinetics, pharmacodynamics, metabolism, Biosafety and side effects. Detailed scheme of selection of medicinal plant, extractions, phytochemical analysis, compound identification, synthesis, preclinical studies and clinical trials of anticancer agent is shown in Figure No. 1.

Figure No. 1
Detailed scheme of selection of medicinal plant, extractions, phytochemical analysis, compound identification, synthesis, preclinical studies and clinical trials of anticancer agent

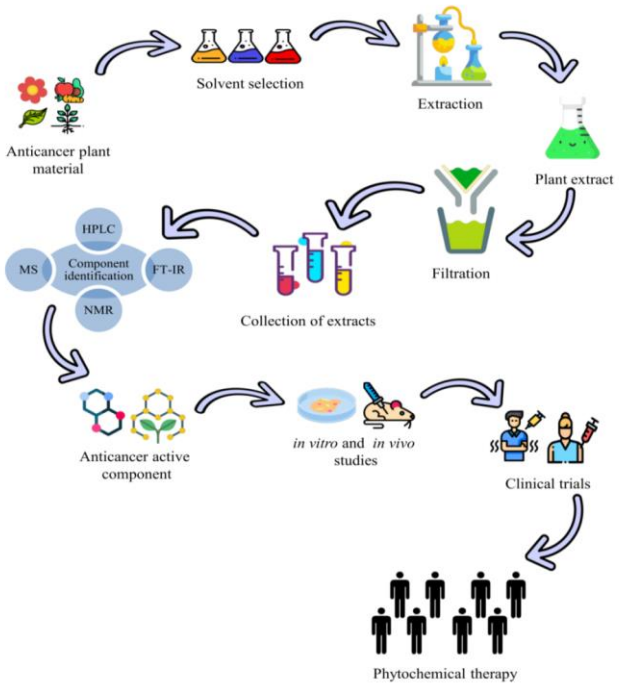

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Table No. 1
The medicinal plants and their anticancer activities

S.No.	Plant name	Plant part used	Anti cancer agents	Specific cancer suppressed	Reference s
1.	*Acacia Cyclops*	Pods	Monoterpenoid	breast cancer	Jelassi *et al*., 2014
2.	*Acacia salicina*	Leaves	Flavonoids	leukemia	Chatti *et al*., 2009
3.	*Achillea cretica*	Shoot	Lactone	breast, ovarian, colon cancer	Hichri *et al*., 2018
4.	*Acorus calamus*	Rhizome	α-asarone, β-asarone	gioblastoma	Das *et al*., 2019
5.	*Actaea racemosa*	Roots	Actein	liver and breast cancer	Rice *et al*.,2007
6.	*Actinidia chinensis*	Fruit, root	Polysaccharide known as ACPS-R	colon cancer, breast cancer	He *et al*., 2019
7.	*Aegiceras corniculatum*	All parts	Benzoquinones	gastric, liver cancer, myeloid leukaemia	Li *et al*., 2020
8.	*Aegle marmelos*	Bark	Skimmianine, Lupeol	liver cancer	Mukhija *et al*., 2015
9.	*Agapanthus africanus*	Root	Isoliquiritigenin	breast cancer	Srinivas & Afolayan, 2007
10.	*Agave Americana*	Leaves	Steroidal saponin, alkaloid, coumarin, isoflavonoid	breast cancer	Anajwala *et al*., 2010
11.	*Ageratum conizoides*	Leaves	Kaempferol	colon, breast, prostate Cancer, leukemia	Adebayo *et al*., 2010
12.	*Aglaila foveolata*	Fruits and twigs	Silvestrol	murine leukemia	Kim *et al*., 2007a
13.	*Aglaila sylvestre*	Fruit, twings	Silvesterol	breast cancer, liver cancer	Hwang *et al*., 2004
14.	*Agrimonia pilosa*	Herbs	Agrimonolide, flavonoid, triterpene, tannin and coumarin	cervical cancer, rhabdomyosarcoma	Koshiura *et al*., 1985
15.	*Agropyron repens*	Rhizomes	Polysaccharide and mucilage	cervical cancer	Sharma *et al*., 2011
16.	*Ailanthus Altissima*	Bark	Triterpene, tannin, saponin and quercetin-3-glucoside	breast cancer	Anderson *et al*., 1983
17.	*Akebia quinata*	Friut	Flavonoid and saponin	liver cancer	Tascilar *et al*., 2006
18.	*Alium cepa*	Flowers	Polyphenols	human cancer cells	Lee *et al*., 2014
19.	*Allium sativum*	Leaves	Allylmercaptocysteine Allicin, allicin alliin, alliinase	lymphoma, cervix cancer	Karmakar *et al*., 2011
20.	*Allium wallichii*	All parts	Steroids, terpenoids, Flavonoids	leukemia, glioblastoma and colon cancer	Bhandari *et al*., 2017
21.	*Aloe barbadensis*	Leaves	Alexin B, emodin	leukaemia, stomach cancer	Shalabi *et al*., 2015
22.	*Aloe ferox*	Leaves	Aloe-emodin, Emodin, Aloin	carcinoma, hepatoma cells, skin cancer	Jia *et al*., 2008
23.	*Aloe vera*	Leaves	Alexin B, emodin	leukaemia, stomach	Shalabi *et al*., 2015

				cancer	
24.	*Alpinia galangal*	Rhizomes	Kaempferide, Pinocembrin	breast cancer, lung cancer	Samarghandian *et al*., 2014
25.	*Alstonia scholaris*	Root, bark	O-methylmacralstonine, talcarpine, villalstonine, pleiocarpamine	lung cancer	Monika &Singh, 2015
26.	*Amoora rohituka*	Stem bark	Amooranin	lymphocytic leukaemia	Chan *et al*., 2011
27.	*Ananas comosus*	Fruit, stem	Bromelain	breast cancer	Chang *et al*., 2019
28.	*Andrographis paniculata*	Leaves	Andrographolide	liver cancer	Ji *et al*., 2007
29.	*Anemarrbena asphodeloides*	Root	Benzophenones	hepatocellular carcinoma	Shoemaker *et al*., 2005
30.	*Angelica sinensis*	Root	N-butylidenephthalide	stomach cancer	Liao *et al*., 2018
31.	*Annona crassiflora*	Leaves	Caffeic acid, sinapic acid, rutin	glioma, renal, ovary cancer	Formagio *et al*., 2015
32.	*Annona coriacea*	Seeds	Ferulic acid, sinapic acid	glioma, lymphoid melanoma, lung, renal, ovary cancer	Formagio *et al*., 2015
33.	*Annona squamosa*	Seed	Bullatacin	liver cancer	Biba *et al*., 2013
34.	*Anthriscus sylvestris*	Root	Podophyllotoxin, Sylvestris	human leukaemia	Jeong *et al*., 2007
35.	*Aphanamixis polystachya*	Bark	Amooranin	spleen and liver cancer	Jagetia & Venkatesha, 2012
36.	*Apium graveolens*	Seed	Apigenin	prostate cancer	Subhadra Devi *et al*., 2011
37.	*Arachis hypogaea*	Peanut-skin	procyanidin A1	leukemia	Al-Snafi , 2014
38.	*Arctium lappa*	Root, bark, seed	Lappaol F	breast cancer	Sun *et al*., 2014
39.	*Arcangelisia flava*	Root, stem	Protoberberine and 20-hydroxyecdysone	breast cancer	Pratama *et al*., 2018
40.	*Argemone gracilenta*	All parts	Argemonine and Berberine	B-cell lymphoma, leukaemia	Leyva-Peralta *et al*., 2015
41.	*Argemone mexicana*	Leaves	Pancorine, Argenaxine	gall bladder and breast cancer	Brahmachari *et al*., 2013
42.	*Aristolochia contorta*	Root and fruit	Lysicamine, oxaaporphine, aristolochic acid	stomach cancer	Akindele *et al*., 2014
43.	*Aronia melanocarpa*	Leaves	Polyphenol	leukemia	Thi &Hwang, 2018
44.	*Artemisia annua*	All parts	Artemisinin	liver, breast and pancreatic cancer	Efferth, 2017
45.	*Artemisia argyi*	All parts	Isoscopoletin	lung and colon cancer	McGovern *et al*., 2010
46.	*Artemisia maritima*	All parts	Santonin	kidney and colon cancer	Qadir *et al*., 2019
47.	*Artemisia vulgaris*	Flower, Leaves	Borneol	breast and kidney cancer	Gordanian *et al*., 2014

48.	*Artocarpus obtusus*	Bark	Xanthones	leukemia, breast cancer	Hashim *et al*., 2012
49.	*Asclepias curassavica*	Leaves	Asclepin, cardenolides	liver cancer	Li *et al*., 2009
50.	*Asparagus cochinchinensis*	Root	Spirosteroids, asparacosins A	hepatocellular carcinoma	Park *et al*., 2011
51.	*Asparagus officinalis*	Leaves	asparagamine A	lung, colon cancer	Bousserouel *et al*., 2013
52.	*Asparagus racemosus*	Root	Shatavarins	breast, colon, kidney carcinoma	Mitra *et al*., 2012
53.	*Aster tataricus*	All parts	Triterpene, monoterpene and epifriedelanol	head and neck cancer	Wang *et al*., 2017
54.	*Astragalus gummijera*	Leaves	Endotoxin	lung cancer	Wu *et al*., 2017
55.	*Astragalus membranaceus*	Leaves, root	Swainsonine	brain tumors, stomach cancer	William & Kwok, 2007
56.	*Azadirachata indica*	All parts	Azadirachtin, Nimbolide, Gedunin, Quercetin	cervical, ovarian, breast cancer	Moga *et al*., 2018
57.	*Bacopa monnieri*	Whole plant	Cucurbitacins, betulinic acid	breast cancer	Mallick *et al*., 2015a
58.	*Bauhinia racemosa*	Bark, Flowers	Kaempferol, quercetin	Ehrlich ascites carcinoma	Gupta *et al*., 2004a
59.	*Bauhinia variegate*	Bark	Kaempferol galactoside	breast, lung and liver cancer	Sharma *et al*., 2019
60.	*Berberis amurensis*	Fruit	Berbamine	breast cancer	Ghafourian *et al*., 2017
61.	*Berberis vulgaris*	Roots, bark	Berberine	breast, liver, colon cancers	Ghafourian *et al*., 2017
62.	*Betula alba*	Bark	Betulinic acid	thyroid, breast, lung and colon carcinoma,	Rzeski *et al*., 2006
63.	*Betula Sp.*	Leaves	Betulinic acid	human melanoma and leukaemia	Cragg &Newman, 2005
64.	*Betula utilis*	Bark	Betulinic acid, Betulin	Melanomas	Król *et al*., 2015
65.	*Biophytum sensitivum*	Fruits	Amentoflavone	Dalton's lymphoma ascites, Ehrlich ascites carcinoma	Oh *et al*., 2013
66.	*Bleekeria vitensis*	Leaves	Elliptinium	myelogenous leukaemia and breast cancer	Lauritano *et al*., 2016
67.	*Blumea balsamifera*	Whole plant	Dihydroflavonol	hepatocellular carcinoma	Pang *et al*., 2014a
68.	*Blumea lanceolaria*	Leaves	Borneol, caryophyllene	lymphoma	Norikura *et al*., 2008
69.	*Boerhavia diffusa*	Root	Punarnavine	malignant melanoma cancer	Mishra *et al*., 2014
70.	*Boswellia serrata*	Gum	Boswellic acid	prostate cancer	Garg & Deep, 2015
71.	*Brassica oleraceae*	red cabbage	Sulforaphane	epithelial carcinoma	Devi &Thangam, 2012
72.	*Broussonetia Papyrifera*	Fruits, Leaves, bark	2S-abyssinone Verubulin	glioblastoma, brain cancer	Pang *et al*., 2014b
73.	*Brucca javanica*	Seed	Quassinoids	lymphoblastic	Zhao *et al*., 2014

				leukemia	
74.	*Brucea antidysenterica*	Leaves, seed	Bruceantin	skin cancer	Cragg & Newman, 2005
75.	*Bryophyllum pinnatum*	Leaves	Bryophyllin A	cervical cancer	Mahata *et al*., 2012
76.	*Bryonia dioica*	Root	Myricetin	breast cancer	Benarba *et al*., 2019
77.	*Bulpleurum scorzoneraefolium*	Root	Saikosaponins	pancreatic, breast, cervical cancer	Law *et al*., 2014
78.	*Bursera microphylla*	Bark, leaves	Burseran	epidermoid carcinoma	Marcotullio *et al*., 2018
79.	*Butea monosperma*	Flower	Butrin	liver cancer	Choedon *et al*., 2010
80.	*Buxus hildebrandtii*	Leaves	cyclomicrobuxamine, buxamine-A, moenjodaramine	lung, urinary bladder carcinoma,breast cancer	Mothana *et al*., 2007
81.	*Cajanus cajan*	Root	Cajanol	breast cancer	Pal *et al*., 2011
82.	*Calotropis gigantea*	Flowers	Anhydrosophoradiol-3-acetate	Ehrlich's ascites carcinoma	Habib & Karim, 2013
83.	*Calotropis procera*	Latex	Calactin, calotropin, asceplin	brest cancer	Bhat *et al*., 2014
84.	*Calvatia caelata*	Fruit	Laccases, Calcaelin	liver, breast cancer	Ng *et al*., 2003
85.	*Camellia sinensis*	Leaves	Epigallocatechin gallate	brain, prostate, cervical and bladder cancer	Das *et al*., 2010
86.	*Camptotheca acuminate*	Fruits	Camptotheein	endometrial cancer, lung cancer	López-Meyer *et al*., 1994
87.	*Cannabis Sativa*	Leaves	Cannabinoid	lung, pancreas, breast, prostate and colorectal cancer	Appendino *et al*., 2011
88.	*Capsicum annuum*	Fruit	Luteolin	colorectal cancer	Osman *et al*., 2015
89.	*Careya arborea*	Leaves	Quercetin, rutin, catechin	lung cancer, leukaemia	Panda *et al*., 2017
90.	*Carissa spinarum*	Fruit	Alkaloids, saponins, tannins, flavonoids	nasopharyngeal carcinoma	Sahreen *et al*., 2013
91.	*Cassia auriculata*	Leaves	Procyanidins, 3-O-beta-D-xylopyranosides	breast and larynx cancer	Meena *et al*., 2019
92.	*Cassia fistula*	Fruit	Inositol and 2-pyrrolidone	cervical cancer and breast cancer	Ali, 2014
93.	*Cassia senna*	Flower, Leaves	Quercimeritrin , scutellarein and rutin	breast cancer, prostate cancer	Gurukumar *et al*., 2010
94.	*Catharanthus roseus*	Leaves	Vinblastine, Vincristine	breast, ovary, cervix, lung cancer	Almagro *et al*., 2015
95.	*Catunaregum spinosa*	Leaves	Doxorubicin	breast cancer	Sandoval *et al*., 2016
96.	*Centaurea montana*	Seed	Montamine	colon cancer	Shoeb *et al*., 2006
97.	*Centaurea schischkinii*	Seed	Schischkinnin	colon cancer, rectal cancer	Shoeb *et al*., 2005
98.	*Centella asiatica*	Leaves	Asiatic acid	melanoma, breast , glioblastoma cancer	Baby *et al*., 1995
99.	*Cephalotaxus hainanensis*	Bark and Leaves	Harringtonine and homoharringtonine	leukemia	Han , 1994
100.	*Cephalotaxus*	All parts	Homoharringtonine,	myelodysplastic	Feldman *et al*., 1996

	harringtonia		cephalotaxine	syndrome, chronic myeloid leukemia	
101.	*Chelidonium jajus*	Herbs	Sanguinarine and chelerythrine, chelidonine	pancreas cancer, colon cancer, breast cancer	Capistrano *et al*., 2015
102.	*Chelidonium majus var. asiaticum*	Herbs	Sanguinarine, chelerythrine, berberine	breast, lung, liver, colon cancer	Lee *et al*., 2005
103.	*Chimaphila umbellata*	All parts	Ericolin, arbutin, urson and tannin	breast cancer	Galván *et al*., 2008
104.	*Chrysanthemum morifolum*	Flowers	Heliantriol	gastric cancer	Ukiya *et al*., 2002
105.	*Cicer arietinum*	Seed	Bowman-Birk-type Protease	breast and prostate cancer	Magee *et al*., 2012
106.	*Cichorium intybus*	Leaves	Kaempferol, lutedin, epigenins and quercetin	breast and prostate cancer	Kandil *et al*., 2019
107.	*Cissus quadrangularis*	Leaves	Resveratrol, gallic acid, quercetin,	breast cancer	Suresh *et al*., 2019
108.	*Citrullus colocynthis*	Leaves	Cucurbitacin	breast cancer	Zheng *et al*., 2020
109.	*Citrus maxima*	Citrus peel	Hesperidin, neohesperidin and naringin	colon, prostate, lung and liver	KunduSen *et al*., 2011
110.	*Citrus medica*	All parts	limonin, nomilin, ichangin	breast cancer	Cirmi *et al*., 2017`
111.	*Clausena lansium*	Seed	Clausenalansamid A,B	gastric, liver cancer	Maneerat *et al*., 2011
112.	*Cleistanthus collinus*	Bark	Cleistanthin, Collinusin	colon cancer, breast cancer, lung cancer	Pradheepkumar & Shanmugam,1999
113.	*Clematis manshrica*	Flower, Leaves	1,4-benzoquinone,5-oethyl-embelin, 15-carbon isoprenoid	liver cancer and blood cancer	Zhao *et al*., 2005
114.	*Clerodendrum serratum*	Leaves	Cryptojaponol, fortunin E	myeloid leukemia, hepatocellular carcinoma	Zalke *et al*., 2010
115.	*Clerodendrum viscosum*	Leaves	Tannic acid, quercetin, gallic acid, and rutin	breast, brain, lung cancer	Shendge *et al*., 2017
116.	*Coccinia grandis*	Leaves	Protease inhibitors	colon cancer	Satheesh & Murugan , 2011
117.	*Codonopsis pilosula*	Leaves	Exopolysaccharides	hepatocellular carcinoma	Zhang *et al*., 2019
118.	*Coix lachrymal jobi*	Seed	Trans-ferulyl stigmasterol	colorectal cancer	Manosroi *et al*., 2016
119.	*Colchicum Autumnale*	Leaves	Colchicine	Hodgkin's lymphoma, chronic granulocytic leukaemia	Lin *et al*., 2015
120.	*Colchicum luteum*	Corm,seed	Colchicine, demecolcine	stomach cancer, hypopharyngeal cancer	Kumar *et al*., 2017

121.	*Coleus forskholli*	Root	Forskolin	gastric carcinoma	Kanne *et al*., 2015
122.	*Combretum caffrum*	Bark, and fruit	Combretastatins	colon and leukemia and lung cancer	Lauritano *et al*., 2016
123.	*Commiphora myrrha*	Myrrh	2-Cyclohexen-1-one	breast, hepatocellular, carcinomas, cervical, skin cancer	Chen *et al*., 2013
124.	*Conyza Canadensis*	Root	Conyzapyranone A and B	epidermoid carcinoma	Csupor-Löffler *et al*., 2011
125.	*Cratoxylum formosum*	Root	Formoxanthone, xanthone macluraxanthone	breast, oral, cervical, colon cancer	Boonsri *et al*., 2006
126.	*Crinum asiaticum*	Bulb	Crinamine, criasiaticidine A	cervical cancer	Min *et al*., 2001
127.	*Crocus sativus*	Flower	Crocin, picrocrocin, crocetin, and safranal	sarcoma and oral cancer	Bakshi *et al*., 2009
128.	*Croton lechleri*	Leaves , resin	Taspine, ethnomedicine	colorectal cancer, prostate cancer	Montopoli *et al*., 2012
129.	*Croton macrobotrys*	Leaves	Corydine, salutaridine	leukemia and lung cancer	Motta *et al*., 2011
130.	*Curcuma longa*	Dried rhizome	Curcumin	colon adenocarcinoma	Ooko *et al*., 2017
131.	*Curcuma zedoaria*	All parts	α-Curcumene	overian cancer	Shin & Lee, 2013
132.	*Daphne genkwa*	Flower	Yuanhualine, yuanhuahine and yuanhuagine	lung cancer	Du *et al*., 2016
133.	*Daphne mezereum*	All parts	Mezerein	leukemia	Kupchan & Baxter, 1975
134.	*Datura metal*	All parts	Withonilides	breast cancer	Kumaran *et al*., 2014
135.	*Daucus carota*	Carrot juice	Falcarinol and lutein	lymphoid leukaemia	Shebaby *et al*., 2014
136.	*Debregeasia saeneb*	Stem	Tannins	internal tumors	Tariq *et al*., 2017
137.	*Dillenia pentagyna*	Bark, leaves	Betulinic acid, glutathione	ascites Dalton's lymphoma	Rosangkima & Prasad, 2004
138.	*Dioscorea collettii*	Rhizomes	Dioscin	liver and human gastric cancer	Hu & Yao, 2003
139.	*Diospyros chamaethamnus*	Root	Anthraquinones, coumarins	renal and breast cancer	Dushimemaria *et al*., 2017
140.	*Diphylleia grayi*	Root, stem	Diphyllin, deoxypodophyllotoxin	prostate cancer	Hu *et al*., 2016
141.	*Dracena cinnabari*	Resin	Dracophan, ametacyclophan, Cinnabaron	oral carcinogenesis	Al-Afifi *et al*., 2018
142.	*Dryopteris crassirhizoma*	Rhizomes	Filicinic, filicic acids, aspidinol and aspidin	squamous cell carcinoma	Peng *et al*., 2009
143.	*Duchesnea indica*	All parts	Polysaccharide	ovarian, liver cancer	Xiang *et al*., 2019
144.	*Dysosma versipllis*	Root	Podophyllotoxin	cancer	Yu *et al*., 1991
145.	*Dysoxylum binectariferum*	Stem	Rohitukine	leukemia	Safia *et al*., 2015
146.	*Echinacea angustifolia*	Root	Arabinogalactan, doxorubicin	cervical cancer, breast cancer	Huntimer *et al*., 2006

147.	*Echinophora cinerea*	All parts	Quercetin and kaempferol	bladder carcinoma, leukemia	Hosseini *et al*., 2017
148.	*Echinops setifer*	All parts	Echinopsine	skin cancer	Shaikh *et al*., 2014
149.	*Elusine coracana*	Seed	Ragi bifunctional inhibitor	myeloid leukemia cell and K562 cell line	Srikanth & Chen, 2016
150.	*Embelia ribes*	Fruit	Embelin	liver, pancreas, colon cancer	Ko *et al*., 2018
151.	*Emblica officinalis*	Fruit	Coumaric and ferulic acids	breast, liver, leukemia	Jose *et al*., 2001
152.	*Enterolobium Contortisiliquum*	Seed	Trypsin inhibitor	gastric and breast cancer	Nakahata *et al*., 2011
153.	*Erythronium americanum*	All parts	α-methyl-enebutyrolactone	breast cancer	Cavallito & Haskell, 1946
154.	*Erythroxylum pervillei*	Root	Pervilleines	carcinoma	Restrepo *et al*., 2019
155.	*Euonymus alatus*	All parts	Triterpene, euolatin, steroid and sesquiterpene alkaloid	breast cancer	Zhai *et al*., 2016
156.	*Eupatorium cannabinum*	All parts	Sesquiterpene, lactone	colon cancer	Grigore *et al*., 2018
157.	*Euphorbia peplus*	Leaves	3-Ingenyl angelate	skin cancer	Ogbourne *et al*., 2004
158.	*Euphorbia semiperfoliata*	Leaves , stem	Jatrophane	pancreatic cancer	Bruni *et al*., 2004
159.	*Fagopyrum esculentum*	Seed	Amygdalin, rutin	T-acute lymphoblastic leukemia	Kim *et al*., 2007b
160.	*Ferula angulata*	Leaves and flower	Vinblastine and vincristine	gastric cancer	Heidari *et al*., 2014
161.	*Flacourtia jangomos*	Fruit and flower	Limonoid	carcinoma	George *et al*., 2017
162.	*Fragaria vesca*	Leaves and fruit	Flavonoid, tannin, borneol and ellagic acid	lung cancer	Erwiyani *et al*., 2016
163.	*Fritillaria thunbergii*	All parts	Alkaloid and peimine	lung cancer, liver cancer, breast cancer	Li *et al*., 2019a
164.	*Galium aparine*	All parts	Iridoid, polyphenolic acid, tannin, sitosterol	leukemia	Shi *et al*., 2016
165.	*Ginkgo biloba*	Leaves	Bilobalide	colon cancer	Li *et al*., 2019b
166.	*Gleditsia sinessis*	Thorns	Flavanocoumarin	breast cancer	Yu *et al*., 2017a
167.	*Gloriosa superba*	Seed	Colchicines	lung, colon,breast, pancreatic cancer	Balkrishna *et al*., 2019
168.	*Glycine max*	Seed	Soybean trypsin inhibitor	human ovarian cancer	Lima *et al*., 2017
169.	*Glycyrrhiza glabra*	Root	Glycyrrhizin	breast, gastrointestinal cancer	Nazmi *et al*., 2018
170.	*Glycyrrhiza uralensis*	Root	Isoliquiritigenin	lung cancer	Ayeka *et al*., 2016
171.	*Gossypium barbadense*	Seed, leaves	Gossypol	ovarian cancer, breast cancer, leukemia	Stipanovic *et al*., 2009

172.	*Gossypium hirsutum*	All parts	Gossypol	colorectal cancer	Stipanovic *et al*., 2009
173.	*Grsium bracteosum*	All parts	Podophyllotoxin	lung cancer, Kaposis sarcoma, lymphoma	Zi *et al*., 2018
174.	*Guibourtia coleosperma*	Root	Anthraquinones, coumarins	breast and cervical cancer	Dushimemaria *et al*., 2017
175.	*Gunnera perpensa*	Root	Z-venusol ,3-methyl 2-butenyl	breast cancer	Mathibe *et al*., 2016
176.	*Gynostemma pentaphyllum*	Aerial parts	Panoxadiol	leukemia ,colon cancer ,prostate carcinoma	Li *et al*., 2016
177.	*Gyrophora esculenta*	Lichen	β-d-glucan	sarcoma 180	Shibata *et al*., 1968
178.	*Herba epimedii*	Leaves	Icariin, icaritin, icarisideII	prostate, lung, kidney and gastric cancer	Yong *et al*., 2017
179.	*Hydrastis canadensis*	All parts	Hydrastine, berberine, lactone berberastine, candaline	cervical , breast , prostate cancer	Karmakar *et al*., 2010
180.	*Hypericum perforatum*	Aerial parts	Hypericin	skin cancer, prostate cancer, breast cancer,	Mirmalek *et al*., 2016
181.	*Hypoxis argentea*	Corms	Mononyasine A and B.	colorectal and breast cancer	Ncube *et al*., 2013
182.	*Hypoxis colchicifolia*	Leaves , root	Hypoxoside, rooperol	breast cancer, colon cancer, leukemia	Ncube *et al*., 2013
183.	*Indigofera aspalathoides*	Leaves	Colchicine	hepatocellular carcinoma	Krishnasamy *et al*., 2016
184.	*Indigofera tinctoria*	Root, stem, leaves	Indirubins	lung cancer, epidermoid cancer	Renukadevi & Sultana, 2011
185.	*Ipomoeca batatas*	Root	Trypsin inhibitor protein	promyelocytic leukemia cells	Sugata *et al*., 2015
186.	*Iridaceaelatea pallasii*	All parts	Irisquinone, Kaempferol	pancreatic, lung, ovarian, breast cancer	Gupta *et al*., 2017
187.	*Iris kumaoensis*	Rhizomes	Benzoquinones	gastric, live cancer, myeloid leukaemia	Mahmood *et al*., 2002
188.	*Jatropha curcas*	Leaves, root	Curcusone A and B	mouse lymphoma, human cervix cancer	Aiyelaagbe *et al*., 2011
189.	*Junchus effuses*	All parts	Tridecanone, effusol, juncanol, phenylpropanoid, dehydroeffusol	leukemia	Gao *et al*., 2014
190.	*Justicia procumbens*	All parts	Justicidin, diphyllin	colorectal cancer, bladder cancer	Liu *et al*., 2018a
191.	*Kaempferia angustifolia*	Rhizomes	Flavokawain A, Kaempfolienol and zeylenol	breast, colon cancer	Tang *et al*., 2014
192.	*Kaempferia galangal*	Rhizomes	kaempulchraol, ethyl trans p-methoxycinnamate	lung cancer, human cholangiocarcinoma	Elshamy *et al*., 2019
193.	*Kaempferia pulchra*	Rhizomes	kolavelool, 2β-	pancreatic and	Elshamy *et al*., 2019

			hydroxykolavelool	cervix cancers	
194.	*Kaempferia rotunda*	Rhizomes	methyl-β-D-galactopyranoside	Ehrlich ascites carcinoma	Elshamy *et al*., 2019
195.	*Khaya senegalensis*	Stem bark	3 α,7 α-dideacetylkhivorin and 1-O-acetylkhayanolide B	breast cancer, colorectal cancer	Zhang *et al*., 2007
196.	*Knowltonia capensis*	Leaves	Ranunculin and protoanemonin	leukemia	Powrie, 1975
197.	*Lagerstroemia speciosa*	Leaves	Benzo(a)pyrene	lung cancer	Mousa *et al*., 2019
198.	*Lanata camara*	All parts	Camerine, isocamerine, micranine, lantanine, lantadene	lung cancer, liver cancer	Ghosh *et al*., 2010
199.	*Larrea mexicana*	Leaves	Chaparral	leukaemia and melanoma	Morán-Santibañez *et al*., 2019
200.	*Larrea tridentate*	All parts	Cyclolignans	breast cancer	Morán-Santibañez *et al*., 2019
201.	*Leea indica*	Leaves	Gallic acid	Ehrlich ascites carcinoma	Ghagane *et al*., 2017
202.	*Lens culinaris*	Seed	Lectin	colon cancer	Chan *et al*., 2015
203.	*Lentinus edodes*	All parts	Lentinan	sarcoma-180 in mice	Vetchinkina *et al*., 2016
204.	*Ligustrum lucidum*	Fruit	Oleanolic acid and ursolic acid	lung and pancreatic carcinoma, breast and prostate	Xia *et al*., 2011
205.	*Limonia acidissima*	Fruit	Stigmasterol	breast cancer	Dhakar *et al*., 2019
206.	*Linium album*	All parts	Etopside, teniposide, etophose, podophylotoxin	gastric cancer	Asl *et al*., 2018
207.	*Linum persicum*	Aerial parts	Aryltetralin	myeloid leukemia and lung carcinoma	Javidnia *et al*., 2010
208.	*Linum usitatissimum*	Leaves, flowers	Cynogenetic glycosides	breast cancer	Sakarkar & Deshmukh, 2011
209.	*Liriodendron Tulipifera*	Stem	Costunolide, tulipinolide, liriodenine,	KB (oral cancer), HT29 cell line	Kang *et al*., 2014
210.	*Lonicera japonica*	All parts	Luteoin, Kaempferol, biflavonoids	lung cancer	Park *et al*., 2017
211.	*Lupinus angustifolius*	Root	Lupin	breast cancer	Stapel *et al*., 2015
212.	*Lupinus arcticus*	Seed	Lupin	lymphoblastic leukemia	Deeg *et al*., 2012
213.	*Lupinus luteus*	Flowers	Genistein-8-C-glucoside, genistein	ovarian carcinoma	Antosiak *et al*., 2017
214.	*Macrotyloma uniflorum*	Leaves	Phytic acid, phenolic acid	human osteosarcoma	Prasad &Singh, 2015
215.	*Mamordica charantia*	All parts	α-momorcharin and β-momorcharin	breast, colon and pancreatic cancer	Fang *et al*., 2019

216.	*Mappia foetida*	Bark	Camptothecin	leukemia, breast cancer	Wall & Wani, 1996
217.	*Matricaria chamomilla*	All parts	Apigenin	colorectal cancer	Al-Dabbagh *et al*., 2019
218.	*Macleaya cordata*	Root	Chelerythrine	breast cancer	Almeida *et al*., 2017
219.	*Medicago scutellata*	Seed	Trypsin inhibitor	human breast and cervical cancer	Lanza *et al*., 2004
220.	*Mimosa pudica*	All parts	L-Mimosine	erythroleukemic, lung adenocarcinoma	Jose *et al*., 2016
221.	*Momordica charantia*	Leaves, roots	Charantin	colon cancer and breast cancer	Fang *et al*., 2019
222.	*Morinda citrifolia*	Root	Damnacanthal	lung cancer, sarcomas	Brown, 2012
223.	*Moringa oleifera*	Leaves	Niazinine A	blood cancer	Al-Asmari *et al*., 2015
224.	*Nelumbo nucifera*	Flowers	Neferine	colon cancer	Zhao *et al*., 2017
225.	*Newbouldia laevis*	Root	2-acetylfuro-1,4-Naphthoquinone	pancreatic cancer, leukemia cancer	Eyong *et al*., 2005
226.	*Nicotiana tabacum*	Leaves	α-2,7,11-cyprotermine-4,6-diol	hepatocellular carcinoma	Yuan *et al*., 2019
227.	*Nigella sativa*	Seed	Thymoquinone	lymphocytic leukemia and liver cancer	Majdalawieh & Fayyad, 2016
228.	*Nothapodytes nimmoniana*	Bark	Camptothecin	colorectal and ovarian cancers	Mithun *et al*., 2017
229.	*Ochrosia elliptica*	All parts	Ellipticine, 9-methoxy ellipticine	breast cancer, carcinoma cells	Chen *et al*., 2017
230.	*Ocimum sanctum*	Leaves	Eugenol, orientin, vicenin, Luteolin	skin, liver, lung, breast cancer	Karthikeyan *et al*., 1999
231.	*Oldenlandia diffusa*	Stem, bark, leaves, fruit peel	Ursolic acid	lungs, ovary, uterus, stomach, liver, colon cancer	Gupta *et al*., 2004b
232.	*Olea europaea*	Leaves and oil	Oleic acid and oleuropein	skin cancer, leukemia	de Marino *et al*., 2014
233.	*Ononis spinosa*	Root	Formononetin	breast , colon , prostate, bladder, lung and cervical cancer	Jiang *et al*., 2019
234.	*Operculina turpethum*	Root	Glutathione, ascorbic acid and alpha tocopherol	breast cancer	Gupta & Ved, 2017
235.	*Oroxylum indicum*	Bark	Chrysine, baicalein and oroxylin-A	human leukemia	Dev *et al*., 2010
236.	*Oryza sativa*	Seed	Oryzanol, tocotrienol and tocopherol	fibrosarcoma, breast cancer	Pintha *et al*., 2014
237.	*Paeonia suffruticosa*	Seed	Oligostilbenes	lung, breast and bone cancer	Gao & He, 2017
238.	*Panax ginseng*	Root, leaves	Panaxadiol, panaxatriol	breast, ovary, lung, prostate and colon cancer	Du *et al*., 2013

239.	*Panax notoginseng*	Root	5-fluorouracil, panaxadiol and irinotecan	colon cancer	Wang *et al*., 2007a
240.	*Panax pseudoginseng*	Root	Fluorouracil, Protopanaxadiol	colon cancer	Wang *et al*., 2015
241.	*Panx quinquefolium*	Root	Ginsenoside, sesquiterpene	ovarian, breast, colon, liver cancer	Wang *et al*., 2008
242.	*Paris polyphilla*	Herbs	Polyphyllin	prostate cancer, lung cancer	Zhang *et al*., 2018a
243.	*Passiflora caerulea*	Flower	Chrysin	colorectal cancer	León *et al*., 2015
244.	*Patrinia heterophylla*	Root	Paclitaxel, etoposide, and irinotecan	gastric, cervical, colon, breast cancer	Sheng *et al*., 2019
245.	*Patrinia scabiosaefolia*	Essential oil	Caryophyllene oxide, caryophyllene, calarene	colon, liver, gastric cancer	Lin *et al*., 2018
246.	*Peganum harmala*	Root	Harmine	breast cancer	Ayoob *et al*., 2017
247.	*Peristrophe bicalyculata*	All parts	Caryophyllene, zingiberene	breast cancer	Ogunwande *et al*., 2010
248.	*Pestemon deustus*	All parts	Liriodendrin	colon, lung, skin and stomach cancer	Jolad *et al*., 1980
249.	*Pfaffia paniculata*	Root	Pfaffic acid and pfaffosides	breast cancer	Levitsky & Dembitsky, 2015
250.	*Phaleria macrocarpa*	Fruit	Gallic acid	colon, cervical, breast cancer	Hendra *et al*., 2011
251.	*Phaseolus acutifolius*	Seed	Tepary bean protease Inhibitor	leukemia L1210 and lymphoma MBL2	Sun *et al*., 2010
252.	*Phaseolus vulgaris*	Seed	Epicatechin, myricetin, formononetin, kaempferol	colorectal and breast cancer	Ombra *et al*., 2016
253.	*Picrorrhizia kurroa*	Root	Picrosides, cucurbitacins, apocynin	breast and cervix cancer	Mallick *et al*., 2015b
254.	*Pisum sativum*	Pea	Apigenin, daidzein, genistein, and kaempferol	human colorectal and colon cancer	Rungruangmaitree & Jiraungkoorskul, 2017
255.	*Platycodon grandiflorum*	Root	Platycodin D	colorectal, lung, breast cancer	Jeon *et al*., 2019
256.	*Pleurotus sajor-caju*	All parts	Polysaccharides	leukemia and liver cancer	Finimundy *et al*., 2013
257.	*Plumbago zeylanica*	Leaves	Plumbagin	liver, pancreatic, leukemia, breast cancer	Chen *et al*., 2009
258.	*Podophyllum emodii*	Leaves	Podophyllotoxin	lung cancer, brain tumors, lymphoblastic leukemia	Liang *et al*., 2016
259.	*Podophyllum hexandrum*	Leaves	Podophyllotoxin	breast, ovary, lung, liver, bladder cancer	Kumar *et al*., 2015
260.	*Podophyllum peltatum*	Leaves	Podophyllotoxin	lung carcinoma	Eyberger *et al*., 2006

261.	*Polygonum cuspidatum*	All parts	Resveratrol, polydatin, emodin, chrysophanic acid	colorectal, skin, liver cancer	Wu *et al*., 2018
262.	*Polygonum multiflorum*	All parts	Saponin, flavonoid and vitamin A	breast cancer	Liu *et al*., 2018b
263.	*Potentilla chinensis*	All parts	Gallic acid and tannin	osteosarcoma cancer	Wan *et al*., 2016
264.	*Potentilla fulgens*	Root	Kaempferol, ellagic acid	breast, stomach, gastric cancer	Radhika *et al*., 2012
265.	*Prunella vulgaris*	All parts	Oleanolic acid, ursolic acid	breast , lung cancer	Hwang *et al*., 2013
266.	*Psoralea corylifolia*	Seed	Psoralidin, bavachinin, psoralen	stomach and prostate cancer	Wang *et al*., 2011
267.	*Pteris multifida*	Root	Pterokaurane	colorectal, lung cancer	Kim *et al*., 2017
268.	*Pueraria lobata*	Root	Puerarin	colon cancer	Zhang *et al*., 2018b
269.	*Pycnanthus angolensis*	Root	Pycnanthulignene	carcinoma,colon cancer	Nono *et al*., 2010
270.	*Pygeum africanum*	Bark	Phytosterol, triterpene	prostate cancer	Shenouda *et al*., 2007
271.	*Pyrus malus*	Fruit	Quercetin, procyanidin	liver, breast cancer	He & Liu, 2007
272.	*Raphanus sativus*	Root	Glucosinolates	liver cancer	Hanlon *et al*., 2007
273.	*Rheum palmatum*	Root	Emodin and aloe-emodin	breast cancer	Nho *et al*., 2015
274.	*Rhinacanthus nasuta*	Leaves ,root	Rhinacanthin-C, rhinacanthone	cervical and liver cancers	Boueroy *et al*., 2018
275.	*Rhus chinensis*	Leaves ,seed	Pentagalloylglucose and gallic acid	breast, leukemia, melanoma and liver cancer	Djakpo & Yao, 2010
276.	*Rhus succedanea*	Sap	Heptadecenylhydroquinone	colon, liver, cervical cancer	Wu *et al*., 2002
277.	*Rosmarinus officinalis*	Aerial parts	Carnosic acid, carnosol, rosmarinic acid, rosmanol	colorectal cancer, leukemia	Allegra *et al*., 2020
278.	*Rubia akane*	Root	Anthraquinones	liver cancer	Moon *et al*., 2010
279.	*Rubia cordifolia*	Root, aerial parts	Rubidianin, purpurin, Xanthopurpurin	breast cancer, cervical cancer	Adwankar *et al*., 1980
280.	*Rubus idaeus*	Leaves	Flavonoid and tannin, ellagic acid	colorectal cancer	Veljkovic *et al*., 2018
281.	*Ruscus aculeatus*	Root	Ruscogenin and neoruscogenin	breast cancer	Cappelli *et al*., 1988
282.	*Ruscus hypophyllum*	Root	Ruscogenin, furostanol. spirostanol	promyelocytic leukemia	Mimakia *et al*., 2008
283.	*Salicornia europaea*	Leaves	Luteolin and quercetin	breast cancer	Samuel *et al*., 2017
284.	*Salvadora persica*	Leaves, root, bark	Ursolic and oleanolic acids	breast, ovary, colon cancer	Al Bratty *et al*., 2020
285.	*Salvia chinesis*	Aerial parts	Protocatechuic acid, salvianolic acid, xeractinol, kaempferol and apigenin	breast, lung, colon cancer	Zhao *et al*., 2015
286.	*Salvia hypargeia*	Root	Ferruginol, saprorthoquinone,	breast, lung, colon epidermoidal,	Ulubelen *et al*., 1999

			11,12-dioxoabieta-8,13-diene, taxodione, hypargenin	prostate cancer	
287.	*Salvia officinalis*	Essential oil	α-thujone, 1,8-cineole and camphor	prostate, breast, cervical cancer	Privitera *et al*., 2019
288.	*Salvia prionitis*	Root	3-keto-4-hydroxysaprortho-quinone	leukemia and stomach cancer	Chen *et al*., 2002
289.	*Sanguinaria Canadensis*	Root	Sanguinarine	breast cancer	Almeida *et al*., 2017
290.	*Saussurea lappa*	Root	Sesquiterpene, costunolide	colon, skin, breast, lung cancer	Robinson *et al*., 2008
291.	*Saxifraga stolonifera*	Leaves	Bergenin, gallic acid, β-sitosterol and quercetin	breast, gastric, esophageal cancer	Nagata *et al*., 2016
292.	*Schizophyllum commune*	All parts	Schizophyllan	gastric and neck cancer	Lemieszek & Rzeski, 2012
293.	*Scrophularia nodosa*	All parts	Iridoid, flavonoid and phenolic acid	astrocytoma	Lajimi *et al*., 2010
294.	*Scutellaria barbata*	All parts	Pheophorbide A	lung, ovarian cancer	Chen *et al*., 2017b
295.	*Selaginella tamariscina*	Leaves	Amentoflavone, hinokiflavone,apogenin	lung cancer	Yang *et al*., 2007
296.	*Semecarpus anacardium*	Kernel	3-(8(Z), 11(Z)-pentadecadienyl) catechol	human leukemia, breast, colon cancer	Nair *et al*., 2009
297.	*Smilax china*	Rhizomes	Kaempferol-7-O-beta-D-glucoside	breast, cervix cancer	Xu *et al*., 2008
298.	*Smilax glabra*	Rhizomes	Apigenin, astilbin, taxifolin, neoastilbin, isoastilbin, neoisoastilbin and engelitin	gastric, lung, colon, bladder, breast, liver, prostate and cervix cancer	She *et al*., 2015
299.	*Solanum aculeastrum*	Fruit	Tomatidine and solasodine	colon, cervical and breast cancer	Koduru *et al*., 2007
300.	*Solanum incanum*	Leaves	Solamargine, solasodine and solasonine	lung, breast and ovarian cancer	Yu *et al*., 2017b
301.	*Solanum lycopersicum*	Fruit	Lycopene	prostate and colon cancer	Hahm *et al*., 2011
302.	*solanum lyratum*	All parts	Sesquiterpenoids	breast, intestinal, lung, gastric cancer and hepatocarcinoma	Chen *et al*., 2017c
303.	*Solanum nigrum*	Leaves	Glycoalkaloids, polyphenols, polysaccharides, glycoproteins	breast cancer	Ling *et al*., 2019
304.	*Sophora flavescens*	Root	Matrine,oxymatrine and Kushen Injection	breast cancer	Cao & He, 2020

305.	*Sophora japonica*	Root	Matrine and oxymatrine	liver, colon, lung, cervix, ovary and breast cancers	Sun *et al*., 2012
306.	*Sophora subprostrata*	Root	Matrine and oxymatrine	liver, colon, lung, cervix, ovary and breast cancers	Sun *et al*., 2012
307.	*Stachys floridana*	Rhizomes	Rhamnose, glucuronic acid and arabinose	colon cancer	Ma *et al*., 2013
308.	*Stachys pilifera*	Leaves	Aucubin, carvacrol and harpagide	colon cancer	Kokhdan *et al*., 2018
309.	*Stevia rebaudiana*	Leaves	Steviol	gastrointestinal cancer	Chen *et al*., 2018a
310.	*swertia chirayita*	All parts	Amarogentin, mangiferin and antileishmanial,	colon, brain, breast cancer	Kumar & Van Staden, 2016
311.	*Sylibum marianum*	Leaves, flowers	Silymarin	gastric, colon cancer	Öztürk *et al*., 2015
312.	*Symphonia globulifera*	Leaves	Garcinol, xanthone V1	breast, cervix and leukemia	Lenta *et al*., 2007
313.	*Symplocus cochinchinensis*	Bark	Phloretin-2-glucoside	brain, liver, breast cancer	Abida *et al*., 2016
314.	*Syzygium cumini*	Fruit, seed	Bergenin, myricetin	cervical, breast cancer	Barh & Viswanathan, 2008
315.	*Tabebuia avellanedae*	Bark	Naphthofurandione	breast cancer	Telang *et al*., 2019
316.	*Tabebuia Impetiginosa*	Bark	Lapachol and β-lapachone	breast, lung, cervical cancer	Pires *et al*., 2015
317.	*Tamarindus indica*	Seed kernel	Polysaccharide PST001	lung, oral, breast cancer	Aravind *et al*., 2012
318.	*Taraxacum mongolicum*	Root	Dandelion	breast cancer	Li *et al*., 2007
319.	*Taraxacum officinale*	leaves, flowers and roots	Lupeol, α-Amyrin, β-sitosterol, and betulin	breast and prostate cancer	Sigstedt *et al*., 2008
320.	*Taxus baccata*	Needle	Paclitaxel	gastric and colon cancer	Durak *et al*., 2014
321.	*Taxus brevifolia*	Bark	Paclitaxel	ovarian and breast cancer	Wani *et al*., 1971
322.	*Taxus cuspidate*	Needles and twigs	5-Fluorouracil	breast, lung, prostate, gastric, melanoma	Shang *et al*., 2011
323.	*Taxus wallichiana*	Leaves and bark	Paclitaxel, taxiresinol	liver, colon, ovarian and breast cancer	Juyal *et al*., 2014
324.	*Terminalia arjuna*	Bark	Doxorubicin	lung and breast cancer	Sivalokanathan *et al*., 2006
325.	*Thuja occidentalis*	All parts	Thujone	skin cancer	Biswas *et al*., 2011
326.	*Thymus vulgaris*	All parts	Thymol, carvacrol, borneol, and p-cymene,	breast cancer, head and neck cancer	Kubatka *et al*., 2019
327.	*Tinospora cordifolia*	Stem	Berberine	colon cancer	Palmieri *et al*., 2019
328.	*Trifolium pratense*	Flower	Formononetin,	breast, colorectal	Ong *et al*., 2019

			biochanin A	and prostate cancer	
329.	*Trifolium repen*	Seed	Medicarpin, Formononetin	colon, breast and lung cancer	Sarno *et al*., 2020
330.	*Trigonella foenum graceum*	Root, seed	Trigonelline, diosgenin, protodioscin and dioscin	lung, breast, colon cancer	El Bairi *et al*., 2017
331.	*Tripterygium wilfordii*	Root	Triptolide and celastrol	melanoma, prostate and pancreatic cancers	Chen *et al*., 2018b
332.	*Triticum aestivum*	Shoot	Apigenin, quercitin, luteoline	lung and colon cancer	Mathankumar *et al*., 2015
333.	*Tulbaghia violaceae*	Leaves	Methylα-D-glucopyranoside	liver, breast. Lung colon cancer	Saibu *et al*., 2015
334.	*Tylophora Indica*	Leaves	Tylophorine	breast cancer	Dhiman *et al*., 2013
335.	*Typhonium flagelliforme*	All parts	Pheophorbide-a, pyropheophorbide-a and methyl pyropheophorbide-a	breast and lung cancer	Lai *et al*., 2010
336.	*Umbilicaria esculenta*	All parts	Polysaccharides β-glucans, α-glucans	leukemia	Sun *et al*., 2018
337.	*Uncaria tormentosa*	Bark	Mitraphylline	breast, lung, colon cancer	Pilarski *et al*., 2010
338.	*Vaccaria segetalis*	All parts	Segetoside I	hepatoma, breast, gastric, colon cancer	Firempong *et al*., 2016
339.	*Vaccinium macrocarpon*	Fruit	Hydroxycinnamoyl, ursolic acid	cervical, prostate cancer	Neto *et al*., 2008
340.	*Vaccinium stamineum*	Fruit	Resveratrol, quercetin, kaempferol	lung cancer, leukemia	Wang *et al*., 2007b
341.	*Ventilago madraspatana*	Bark	Physcion and emodin	skin melanoma, laryngeal carcinoma and lymphoma	Ghosh *et al*., 2010
342.	*Vernonia amygdalina*	Leaves	Paclitaxel, tamoxifen	breast cancer	Wong *et al*., 2013
343.	*Vernonia cinerea*	Leaves	Vernolide-A,B	melanoma	Pratheeshkumar & Kuttan, 2011
344.	*Vicia faba*	Fruit peels	Quercetin, quercetrin	breast and colon cancer	El-Feky *et al*., 2018
345.	*Viscum album*	Sprouts	Viscumin, chlorogenic acid, caffeic acid, sakuranetin	breast, cervsix, colon, kidney, lung cancer	Khwaja *et al*., 1986
346.	*Vismia laurentii*	Seed	Laurenquinone A, B	colon and cervical cancer	Wabo *et al*., 2007
347.	*Vitis vinifera*	Seed, Leaves and fruits	Cyanidin, gallic acid, catechin, resveratrol	kidney, breast and colon cancer	Esfahanian *et al*., 2013
348.	*Vitex agnus- castu*	Fruit	Luteolin	ovarian, cervical and breast cancer	Ohyama *et al*., 2003
349.	*Vitex negundo*	Fruit and leaves	Chrysoplenetin, luteolin-7-glucoside, casticin, iridoid	liver and pancreatic cancer	Kadir *et al*., 2013

350.	*Vitex rotundifolia*	All parts	Camphene, pinene and diterpene	breast cancer, colorectal cancer	Chaudhry *et al*., 2019
351.	*Vitex trifolia*	Leaves	Casticin, vitexin and luteolin	monocytic cell line	Wee *et al*., 2020
352.	*Wikstroemia indica*	Rhizome	Daphnoretin, chrysophanol, myricitrime and rutin	liver and human epithelial cancer	Lu *et al*., 2012
353.	*Wikstroemia viridi*	All parts	Wikstromol	breast cancer, prostate cancer	Tandon & Rastogi, 1976
354.	*Withania aduensis*	Leaves and fruit	Methanol extract	lung, bladder and breast cancer	Mothana *et al*., 2007
355.	*Withania riebeckii*	Leaves and fruit	Methanol extract	lung, bladder and breast cancer	Mothana *et al*., 2007
356.	*Withania somnifera*	Root and leaves	Adriamycin	lung, colon, breast cancer	Yadav *et al*., 2010
357.	*Xanthium strumarium*	Fruit, seed	Xanthatin, xanthostrumarin	hepatoma, lung, liver cancer	Al-Mekhlafi *et al*., 2017
358.	*Yucca glauca*	Flowers	Polysaccharide	melanoma	Ali *et al*., 1978
359.	*Zanthoxylum armatum*	Leaves	Cisplatin, mitomycin C and camptothecin	prostate, lung, cervical, bone cancer	Singh *et al*., 2015
360.	*Zingiber officinale*	Rhizomes	6-Shogaol,gingerol	ovary cancer	Park *et al*., 2014
361.	*Ziziphus jujube*	Fruits, eeds, leaves	Triterpenoids, linoleic acids	breast cancer	Tahergorabi *et al*., 2015
362.	*Ziziphus nummularia*	Root, bark, fruit	Betulinic acid, betulin	ovarian cancer, breast cancer, leukemia	Ray & Dewanjee, 2015
363.	*Ziziphus rugosa*	Pericarp and seed	Betulinic acid	cytotoxicity against melanoma cells	Prema *et al*., 2019
364.	*Ziziphus spina-christi*	Leaves	β-sitosterol, rutin and quercetin	cervix,breast cancer	Jafarian *et al*., 2014

Medicinal plant parts and in vitro anticancer agents

Medicinal plants are the most commonly used in fold medicines throughout the world and contain different kind of phytochemicals, which act as an important source of anticancer agents. In our anticancer plant documentation, most of the anticancer agents are purified from the various part of the plant like Flower, flower stigmas, pericarp, sprouts, fruits, seeds, roots, rhizomes, stem, leaves, embryo and bark. Among the plant parts leaves consist of 23% of ethnomedicinal anticancer components. Leaves are the important parts of the plant is easily accessible and effective in cancer treatment followed by root (17%), all parts (13%), bark (11%), fruit (9%), seed (9%), flowers (5%), rhizomes (4%) and 9% of ethnomedicines were made up of pods, gum, bulb, juice, resin, thorns, lichen, corms, sap, needle, pericarp, kernel, aerial parts, peel, latex, twings and oil (Figure No. 2). Leaves are the most focused plant part of anticancer agents of Indian, Chinese and African medicine because of easy harvesting process and less side effect (Bhat *et al*., 2013). Present review showed that the plant's leaves contain a variety of primary and secondary metabolites such as alkaloids, alkynes, terpenoids and phenolic compounds, roots and barks contain terpenoids and phenolic compounds.

In-vitro cancer methods are cancer cell lines are less expensive and less time consuming as compared to *in-vivo* assays. At the end of in-vitro cancer cell lines lead to the characterization of the action of specific cancer entities responding to drug or extract. That *in vitro* analysis data is used for selection of active components and concentration of extracts for *in-vivo* analysis can be carried out (Zips *et al*., 2005). *In-vitro* methods are used to test the

plant phytochemicals against cancer cell lines in the form of extract or pure compound. There are various assays used for measuring the cancer reduction rate of anticancer medicinal plants like lactic dehydrogenase assay, Tryphan blue dye exclusion assay, MTT assay, Sulforhodamine B assay and XTT (Chanda & Nagani, 2013). Breast cancer was the most studied cancer cell lines among others with a 159 plants having a anti breast cancer activity followed by colorectal cancer (94), lung cancer (76), leukemia (59), liver cancer (47), cervical cancer (39), prostate cancer (32), gastric cancer (32), skin cancer (27), ovarian cancer (25), pancreatic cancer (12), lymphoma (10), bladder cancer (10) and 81 other type of cancer. Figure No. 3 shows the *in vitro* anticancer activity of medicinal plants in cancer cell lines.

CONCLUSION

The use of chemical drugs for the cancer treatment can cause worst side effects to the body. And no drug is totally effective or safe for the human body. These problems can be solved by phytochemical drugs derived from various medicinal plants. The present review has studied about 364 different varieties of medicinal plant parts with anticancerous activity. And the above-mentioned plant compounds play crucial roles in inhibiting the cancers or activating the proteins. The same component present in various plant species shows effects on the same cancer type but at various percentages. However, they still have not been able to claim its position in herbal market. We hope this study can benefit the lives of millions of cancer patients.

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Figure No. 2
Medicinal plant part based anticancer activity in cancer cell lines

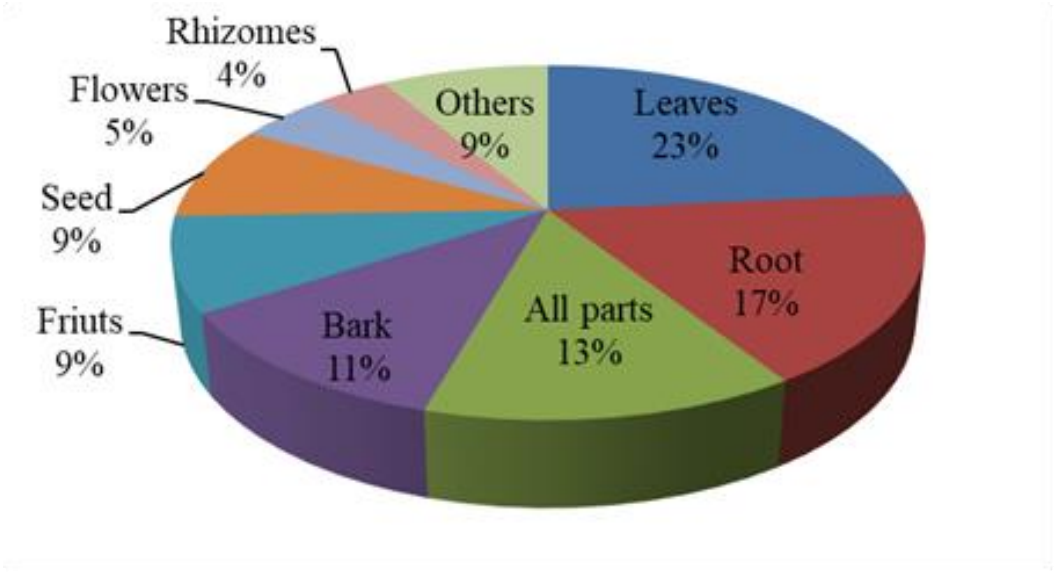
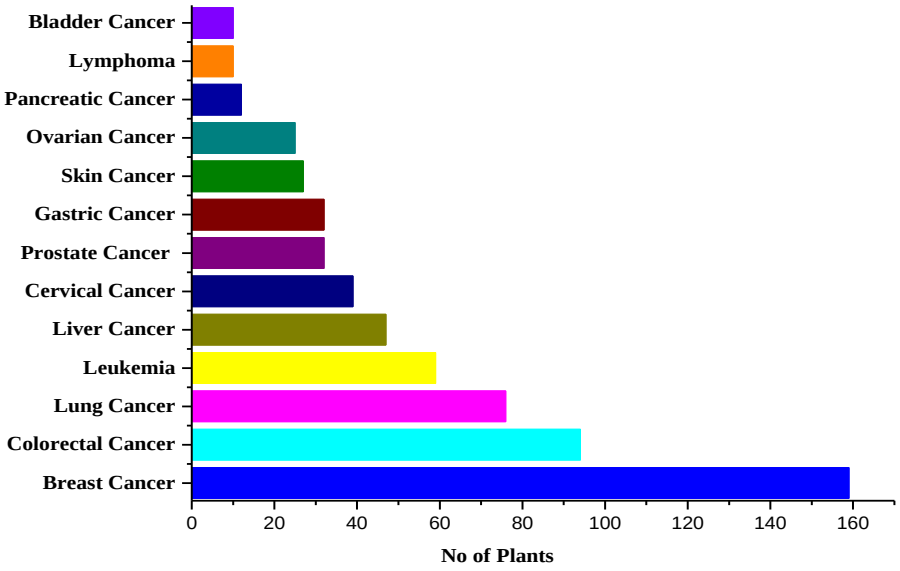


Figure No. 3
***In vitro* anticancer activity of medicinal plants**



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