Review Article

PLANTS AND ITS PARTS AS A SOURCE OF ANTI- CANCER COMPOUNDS: A REVIEW

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ABSTRACT

Plant has been used in the treatment of many diseases and now it has shown tremendous potential in the treatment of cancer. Various parts of plant including whole plant, leaves, bark, roots and fruits yield compounds which show greater prospective of treating cancer cells in the biological system. This review gives an insight about the anti- cancer compounds isolated from plants and its parts. The compounds described consist of marketed drugs, drugs under clinical trials, and herbs which have been not tested on human models. This review also illustrates that which drug is effective against the type of cancer. The review concludes with the future prospects of these compounds which could be marketed for the better health of the patients.

Keywords: Plants, Cancer, Anti- Cancer Property, Drugs, Treatment.

INTRODUCTION

Cell is a basic structural unit of every living organism whether unicellular or multicellular. It is independent machinery which already has set of instructions incorporated in it and it initiates those set of instruction according to its requirement. Those set of instruction includes a cascade of reactions which performs various function like energy production through mitochondria or chloroplast, producing hormones or enzyme, giving mechanical support or to form a whole organism. It consist instructions for its own growth and development. But what if this machinery goes wrong? What if a cell starts performing haphazard functions? What if it starts initiating wrong set of instructions? These answer to these question would be, that it would create a huge havoc in the body. The consequence of this situation would be production of damaged cells that would result in death of individual cells or uncontrolled cell proliferation resulting in the formation of tumor leading to cancer. Cell cycle is defined as a process by which a cell divides and multiplies in number. The process is responsible for the development of various organisms. As described earlier, the cell consists of instructions for cell division which are controlled by various molecules like enzymes, protein molecules and the whole cell cycle machinery. The cycle consists of 3 broad phases- (i) Interphase, during which cell grows and enlarges itself by accumulating all the materials needed for next phase-(ii) Mitotic phase. It includes S phase, the synthetic phase which involves duplication of DNA. After this phase the cell divides into 2 daughter cells. The mitotic phase includes the third phase (iii) cytokinesis where the cytoplasm divides into two daughter cells to form mature new cells. During this division there are various checkpoints which regulate the division at a proper rate and carry out the division in a systematic way. Cancer which is the result of uncontrolled proliferation of cell occurs due to disturbance in the division process like the checkpoint machinery fails to identify the flaw during division. The cancer cells do not undergo apoptosis and start infecting healthy cells by metastasis. This disrupts the complete cell cycle machinery causing collapse of the system. Cancer is a catastrophic event in human body,

disturbing the physiological, physical, social and mental well- being¹. It is a pandemic disease inflicting the human beings since 1600 B.C. and has been a puzzle till date. Though we have put some pieces of the puzzle together but till now we are not able to create the clear picture. This unclear picture has given rise to present day therapies like radio therapy which has a recovery rate of 33 %, insisting the need of an adjuvant therapy called as chemotherapy¹. Though we have treatment procedure for the disease but the global death toll has increased. According to the press release (December 2013) by International Agency for Research on Cancer (WHO), the global cancer burden has increased to 14.1 million new cases in 2012 and 8.2 million cancer deaths in 2012. There has been a marked increase in breast cancer and cervical cancer globally. The most commonly diagnosed cancer was lung cancer (1.8 million, 13 % of the total), breast cancer (1.7 million, 11.9 %) and colorectum cancer (1.4 million, 9.7 %). The widespread cause of cancer death were lung cancer (1.6 million, 19.4 % of total), liver cancer (0.8 million, 9.1 %) and stomach cancer (0.7 million, 8.8 %). It has been estimated that there would be significantly increase to 19.3 million new cancer cases per year by 2025²⁻⁴. Looking at the above statistics we understand that there is a dire need of introducing efficient treatments and potential drugs. A large group of compounds have been tested for their anti- cancer activity on the tumor systems^{1,4}. US National Cancer Institute endorsed a large scale screening programs which led to the identification of potential anti- cancer products from various natural sources involving plants, microbes, marine organisms and animals^{1,5}. This review throws light on variety of compounds isolated from the plants and its parts. The compounds described in this review include marketed drug compounds and the compounds which are under clinical trials.

Plant as a Source of Anti-cancer Compounds

Plant derived compounds, which are the important source of clinically useful anti- cancer drug, has shown to have potential for treatment or prevention of cancer in humans. In the treatment of cancer, plant has a long history^{6,7}, more than

3000 plant species have been reported by Hartwell which are used in treatment of cancer⁶. (Table 1 and 2)

Vinca alkaloids

Numerous plant- derived compounds are successfully in use for treatment of cancer such as vinca alkaloid family isolated from the Periwinkle *Catharanthus roseus*, also known as vincaroseus are found in the rain forests of Madagascar⁸. The dimeric and asymmetrical compound, Vinca alkaloids contains two multi- ringed subunits which are vindoline and catharanthine, connected with carbon- carbon linkage. Vinca alkaloid inhibits cell division by binding with tubulin. Vincaroseus extracts possess anti tumor activity and the first vinca alkaloids identified with anti tumor activity were vinblastine, vincristine and vindesine, which constitute first generation vinca alkaloid. These vinca alkaloids were released in market in 1961, 1962 and 1974 respectively, are used for the treatment of leukemia and soft tissue tumors¹⁰.

Vincristine

Vincristine a mitotic inhibitor used in cancer chemotherapy, created by coupling of indole alkaloids vindoline and catharanthine in the vinca plant¹¹.

Vinblastine

Vinblastine treats non-small cell lung cancer, breast cancer, head and neck cancer, and testicular cancer. The assembly of two alkaloids catharanthine and vindoline produces vinblastine¹¹. Basically it acts by two mechanisms. At very low concentrations they suppress the microtubule dynamics and at higher concentrations they reduce microtubule polymer mass.

Vindesine

Vindesine is used as a remedy for leukaemia, lymphoma, melanoma, breast cancer, and lung cancer.

Vinorelbin

Vinorelbin is a derivative of vinblastine, which emerged from structural modification studies in velbanamine and upper portion of the vinblastine structure⁹. It is first second generation vinca alkaloid released into the market in 1990s and is used for the treatment of breast cancer and non-small cell lung cancer presently. Vinorelbin is the only alkaloid which is administered orally as a single dose weekly. It is mostly used for the treatment of metastatic breast cancer and non- small cell lung cancer. It is less neurotoxic than other vinca alkaloids and granulocytopenia with only modest thrombocytopenia is the chief noxious effect.

Vinflunine

Vinflunine is produced by superacid chemistry and is a bis-fluorinated derivative of vinorelbin. It is broadly studied in phase I- III clinical trials because of its preclinical anti- tumor action also it disrupts microtubule dynamics, anti-angiogenesis and development of prolonged multidrug resistance¹². It is used in the treatment of non- small cell lung and breast cancer and also in the treatment of bladder. It also has some side effects such as myelo suppression and constipation but these side effects are controllable as compared to the other vinca alkaloids¹².

Epipodophyllo toxins

Epipodophyllo toxins act as topoisomerase II inhibitor and the derivatives are etoposide and teniposide⁹. These

compounds do not influence micro tubular structure or function at concentrations used in clinic. In 1966, etoposide was first synthesized and in 1983 it was approved by U.S Food and Drug Administration. It binds with DNA and topoisomerase II enzyme and forms ternary complex due to which the re- ligation of the DNA strands is averted, eventually causing break in DNA strands. Hence, this leads to error in DNA synthesis and helps in apoptosis of the cancerous cell. It is mainly used in the treatment of lung cancer, choriocarcinoma, ovarian and testicular cancers, lymphoma and acute myeloid leukaemia⁹. It is administered intravenously or orally in capsule form. Teniposide slows the growth of cancerous cells by causing break in single and double stranded DNA and DNA- protein cross links. It is mainly used in the treatment of central nervous system tumors, malignant lymphoma, and bladder cancer. It is administered by injecting through a vein and burns if it leaks under the skin.

Taxanes

The derivative of this group is Paclitaxel which was extracted initially from the bark of *Taxus brevifolia*. Nowadays the above drug is administered in semi synthetic form, from 10-deacetylbaccatin III which is extracted from the needles of the European yew tree, *Taxusbaccata*. Similarly, another semi- synthetic taxane, Docetaxel is directly obtained from 10-deacetylbaccatin III¹³. Taxanes stabilize microtubules and avert de polymerization of microtubules. Therefore, interfere with normal cellular functions depending on the physiological balance between tubulin and microtubules. Paclitaxel and docetaxel are used in the treatment of solid tumors in case of ovarian, breast, lung, head and neck, gastro oesophageal, bladder, testis, endometrium neoplasms and also in some haematological and paediatric malignancies. Paclitaxel is cytoskeletal drug which steadies the microtubule polymer and defends it from disassembly due to which a metaphase spindle configuration of chromosome is enabled. This result in blocking of the mitosis progression due to protracted activation of mitotic checkpoint¹³ i.e. cell cycle transverse at G2- M phase junction is inhibited. Docetaxel is anti- mitotic chemotherapy treatment mainly used to treat breast, ovarian, prostate, and non-small cell lung cancer¹⁴. In the S phase, docetaxel produces maximum cell killing effect against cells.

Camptothecins

Camptothecins inhibits topoisomerase I enzyme and is a cytotoxic quinolone alkaloid. The bark and stem of *Camptotheca acuminata* which is a tree native to china was used to isolate camptothecin. In 1966, two semi synthetic analogues of camptothecins, irinotecan and topotecan were introduced in the market mainly for the treatment of colorectal and ovarian cancer.

Homoharringtonine

Cephalotaxus harringtonia is a chinese tree from where Homoharringtonine which is a semi synthetic alkaloid is isolated. Its basic mechanism is to inhibit protein synthesis and hence blocks the cell- cycle progression. It is employed for the treatment of chronic myelogenous leukemia (CML). In phase I studies, small number of patient showed advantage in treating myelodysplastic syndrome, acute myelogenousleukaemia and Homoharringtonine did not showed any advantage in treatment of solid tumors.

Elliptinium acetate

Elliptinium acetate belonging to the ellipticine family is an intercalating agent and has shown a potential clinical activity as salvage treatment in breast cancer. The compound is sold with the trade name Celiptium® and is used as a weekly course of therapy. But the clinical use was disadvantaged due to its toxic effects like xerostomia and immune-mediated haemolytic reactions owing to the development of anti-elliptinium IgM antibodies. Rouëssé *et al* studied 83 patients treated for metastatic cancer beforehand using elliptinium acetate with different schedule. They found out the overall objective response rate as 14/80 (18 %, 95 % confidence interval = 10-26 %). They confirmed the modest but definite activity of elliptinium acetate as salvage treatment of breast cancer. Their study also stated that the 3-week schedule appears to be active and less toxic than the weekly schedule.

Anti- cancer Compounds from Fruits and Traditional Herbs

Flavonoids

Among all the naturally derived compounds, flavonoids along with anti- cancer activity has shown noteworthy range of other pharmacological activity also such as antioxidant, anti mutagenic, antibacterial, anti angiogenic, anti-inflammatory and anti allergic. Flavonoids have phenyl benzopyrone structure and are poly phenolic. It mainly is classified into flavones, flavanols, isoflavones, flavonols, flavanones, flavanonols and chalcones based on the saturation level, C-ring substitution pattern and opening of the central pyran ring .

Flavones

Flavones exists maximum in the skin of fruit with apigenin and luteolin¹⁶. It was found from the study of 22 citrus compounds that glycogen synthase kinase-3 β was inhibited highly by the help of apigenin and luteolin. Hence, leads to decrease in proliferation of cancer cells by revoking NF- κ B activity. In pancreatic cancer cells, apigenin was found to inhibit HIF-1 α , GLUT-1, and VEGF mRNA and protein expression. This indicates apigenin's anti- proliferative and anti-angiogenic effect and makes angiogenesis as future chemo preventive agent for pancreatic cancer¹⁷. Apigenin and luteolin along with chemotherapeutic drugs for example, gemcitabine, cisplatin, 5-fluorouracil and oxaliplatin has advanced anti-proliferative and pro-apoptotic effect on pancreatic cancer cells. In addition, apigenin induce G1 or G2/M arrest and apoptosis in human prostate carcinoma cells, human cervical carcinoma cells and human hepatoma cells in a p53-dependent manner.

Flavonols

The phytochemical compound Flavonols¹⁸, have the two benzene rings joined by a linear three carbon chain, represented as the C6-C3-C6 system¹⁶. High concentrations of flavonols are found in apples, apricots, beans, broad beans, broccoli, cherry tomatoes, chives, cranberries, kale, leeks, pear, onions, red grapes, sweet cherries, and white currants. Quercetin, kaempferol, and myricetin are the compounds of Flavonol¹⁸⁻²⁰. Quercetin and kaempferol inhibit topoisomerase I-catalyzed DNA re- ligation. Quercetin shows tremendous anti- oxidant activity²⁰, strong anti- inflammatory and anti-proliferative properties, inhibits pancreatic tumor growth by increasing the rate of apoptosis in both *in- vivo* and *in- vitro* condition. Kaempferol associates to G2 block. Kaempferol, a

poly phenol antioxidant found in fruits and vegetables such as tea, broccoli, apples, strawberries and beans. It is established to bring in action various mechanisms in regulation of cancer cells. It is a potential promoter of apoptosis, alters cellular signaling pathways and is less toxic to normal cells in contrast to standard chemotherapy drugs. Kaempferol basically reduces cyclin-dependent kinase 1(CDK1) levels which is very important to initiate mitosis. Accordingly, kaempferol obstructs proliferation by interrupting the cell cycle at the G₂ checkpoint. This was evidently seen in human breast cancer MDA-MB-453 cells. In addition, when administered with chemotherapy drug cisplatin, it lowers the cMyc mRNA levels and successfully induces apoptosis. Myricetin, a flavanoid, occurs in many grapes, berries, fruits, vegetables, herbs as well as other plants, including walnut as a rich dietary source. A study conducted by K. Shiomi *et al*, shows that a 24 h treatment does-dependently, concealed the HCT116 cell growth, with 50 % lethal dose, which suggests that myricetin is able to infiltrate the cell membrane and reach the nucleus where it inhibits the activity of Polymerase and topoisomerase II resulting in cell growth suppression.

Flavanones

Citrus fruits oranges, tangerines (mandarins), tangors, tangelos, grapefruit, lemons, limes and tomatoes are rich in Flavanones, relates to lower risk of colorectal²¹, esophageal, gastric²² and stomach cancers²³. These fruits contain naringenin, hesperetin and alpinetin as the representative compounds. Naringenin which is chief Flavanone in grapefruit inhibits TGF- β 1/Smad3 signal pathway which results in down regulation of EMT markers expression in both mRNA and protein levels in pancreatic cancer cells. It also has anti-oxidant activity, anti- inflammatory activity and anti-proliferative activity on pancreatic cancer cells. Hesperetin *in vitro* has found to inhibit the growth of various cancers such as colon cancer, cervical cancer, and breast cancer²⁴. Alpinetin isolated from Alpinia (Alpinikatumadae Hayata), is a phytochemical that possess strong anti- cancer¹⁶.

Isoflavones

Isoflavones are mostly found in leguminous fruits such as soya bean and soy products and the main representative compounds are daidzein and genistein^{25,19}. Daidzen have anti-oxidant property. In a dose and time- dependent manner it inhibits pancreatic cancer cell growth. The predominant and biologically active Isoflavones is genistein and without any prior metabolic activation it is taken up by cell to utilize its effects. Genistein combined with gemcitabine is linked with pancreatic cancer by inhibiting it by various mechanisms involving pro- apoptotic and potent chemo sensitization agent and inhibits TGF- β 1 induced invasion and metastasis in Panc-1 cells.

Flavanols

Flavanols are mostly found in fruits such as grape, apricots and cherries. The main representative compound of Flavanols is catechins. Catechins have been used for treatment and prevention of various cancers. It is major poly phenol in green tea and has shown effectiveness against prostate cancer. It basically interferes with signal transduction pathways responsible for cell death and survival. Out of all catechinsepicatechingallate (ECG) and catechingallate (CG) are found to have strong anti- proliferative activity than other catechins and were also found to inhibit pancreatic cell

proliferation in dose and time dependent treatment¹⁶. (Table 3)

Anthocyanins

Anthocyanins derived from anthocyanidins are water soluble pigment which is responsible for fruit color. Darker the color of the fruit more is the anthocyanin present such as such as black berries, blueberries and cherries contain high levels of anthocyanins¹⁶. They are mostly linked with anti- cancer activity of oral, colon and gastric cancers¹⁶.

Traditional Herbs

The above described compounds are the most popular compounds studied for the anti-cancer properties all over the world. But there have been many traditional herbs used since time immemorial for various treatments. Upon intensive research it has been found that those traditional herbs do have an anti-cancer property. Some of these herbs are used in food as spices or food additive to bring taste to the food. The most popular herb used in food is turmeric, which contains anti-oxidant curcumin may prevent or slow the growth of many cancers like esophagus, stomach, breast cancer. Also, coriander, which is a potent herb, contains anti-cancer properties due to the fact that it contains antioxidants viz. beta-carotene, quercetin and rutin which remove free radicals from body in 2 weeks, which is one of the reasons for cancer. Garlic has been accepted by National Cancer Institute (NCI), affiliated to NIH, to have anti-cancer properties. It holds this property because of the presence of sulphhydryl compounds, which have the ability to block the formation of cancer causing substances. Some strong substances present in ginger have anti-oxidant properties. It contains 6-gingerol and 6-paradol and shogaols and zingerone which are responsible for the anticancer properties of ginger. Along with these there is Basil, which has been known to have medicinal properties for a long time. It has been found to have chemo-protective

ability for colon cancer. A study has found that there was a reduction of tumors in colon in experimental animals when administered with basil. But no human trials have been conducted to confirm the above study. In addition, Oregano, a dried herb is the one which perhaps has the highest anti-oxidant levels. The compound present in oregano which has a strong anti-oxidant activity is Rosmarinic acid. An Indian study states that supplementation of oregano in concentration of 40 mg per kg of body weight has an important role on tissue lipid peroxidation in colon cancer-bearing experimental rodents. These herbs have also been a part of Indian medicine since ancient times. Some of them like Indian Aloe which consists of various compounds like Acemannan, Emodin, Lectin and Alexin B. These compounds have a considerable anti-cancer properties and show activity against specific cancers like stomach cancer, neuroectodermal tumors, leukemia and liver cancer. *Berberis vulgaris*'s root includes berberine, berbamine, chelidonic acid, citric acid and others which have an ability to arrest the cell cycle at G1 phase and induces apoptosis. Strong anti-cancer property is possessed against prostate cancer, liver cancer and leukemia. Indian mulberry, contains Damcanthol possess activity against lung cancer and sarcomas²⁶. *Bauhinia variegata* inhibits growth of cancer such as cancers of breast, lung, liver, oral cavity. This ability is acquired because of the presence of cyanidineglucoside, malvidinglucoside, peonidinglucoside and kaempferol. The above illustrated examples are few of the many herbs used conventionally in food and medicine. The study regarding anticancer properties of these herbs has been done only on animal models and need more confirmed experiments for human use. But these herbs and the compounds can be a potential option as an anti-cancer drug in contrast to existing chemical drugs²⁷. (Table 5)

Table 1: Vinca- alkaloids compounds and their action

S. No.	Vinca-alkaloids	Formula	Administration	Action
1	Vinblastine	C ₄₆ H ₅₈ N ₄ O ₉	Intravenous	Anti-microtubule
2	Vincristine	C ₄₆ H ₅₆ N ₄ O ₁₀	Intravenous	Mitotic inhibitor
3	Vindesine	C ₄₃ H ₅₃ N ₅ O ₇	Intravenous	Mitotic inhibitor
4	Vinorelbine	C ₄₅ H ₅₄ N ₄ O ₈	Intravenous and oral	Mitotic inhibitor

Table 2: List of anti- cancer compound from plants used in several cancer treatment

Class	Compound	Sources	Treatment	Status	References
Vinca alkaloids	Vinblastine(VLB) Vincristine(VCR)	<i>Cantharanthus roseus</i> (Masagascara periwinkle)	non-small cell lung cancer, breast cancer, head, neck cancer, and testicular cancer, Leukemia, lymphoma, lungpediatric solid cancers and others	Phase III/IV	8
	Vinorelbine (VRLB) Vindesine (Combination)	Semi-synthetic, analog of VLB and VCR	Leukamias, lymphomas, testicular cancer, breast, lung and Kaposi's sarcoma		7
Epipodophyl- lotoxins	Etoposide (VM 26) and Teniposide (VP 16-213)	Semi-synthetic derived from <i>Podophyllum</i> species	Skin cancer and wart, lymphomas, bronchial and testicular cancer		
Taxanes	Paclitaxel, Docetaxel(semi-synthetic)	From bark of <i>Taxus</i> species	Breast, ovarian, and non-small cell lung cancer(NSCLC), sclerosis and rheumatoid arthritis	Paclitaxel- Phase III/IV Docetaxel- Phase III	8
Camptothec-ins	Triptecan and Irinotecan	<i>Camptotheca acuminata</i>	Ovarian and small cell lung cancer, Colorectal cancers	Phase II/III	8
Erythrina Alkaloids	Homoharringtonine	<i>Cephalotaxus harringtonine</i> (Chinese plant)	Acute myelogenous leukemia and chronic myelogenous leukemia (Sieb and Zuce)	Phase II	8
Ellipticine	Elliptinium	<i>Bleekeria vitensis</i>	Breast cancer		7

Table 3: List of Flavonoids and its anti- cancer activity

Flavonoids	Compound	Fruits	Action	References
Flavones	Apigenin and luteolin	Skin of citrus fruits	pancreatic cancer	16, 17
Flavonols	Quercetin, kaempferol and myricetin	apples, apricots, beans, broad beans, broccoli, cherry tomatoes, chives, cranberries, kale, leeks, pear, onions, red grapes, sweet cherries, and white currants	anti- inflammatory and anti-proliferative properties and also inhibits pancreatic tumor growth	19, 20
Flavanones	naringenin, hesperetin and alpinetin	Citrus fruits, tomatoes	colon cancer, cervical cancer , and breast cancer	21,22
Isoflavones	daidzein and genistein	Leguminous fruits	pancreatic cancer	24,19
Flavanols	Catechins	grape, apricots and cherries	Human lung cancer and Pancreatic cancer	16

Table 4: Botanical name of selected plants and their parts traditionally used as remedies for ailments by Indigenous communities in Australia

Latin name/ Family	Aboriginal name	Parts used	Preparation and traditional use	Reported anti- cancer activity
<i>Avicennia marina</i> (Forsskal) Vierh./Verbanaceae	Maanyarr	Leaves	Young shoots are chewed and mixed with saliva applied to site of puncture to relieve pain caused by the sting of stone-fish/sting-rays	Inhibition of breast cancer cells
<i>Calytrix brownii</i> (Schauer) Craven/Myrtaceae	Alunkwaluwa	Leaves	Young leaves are crushed and boiled in water. Steam is inhaled to relieve congestion of the nasal and bronchial passages.	Inhibition of malignant melanoma and colon carcinoma
<i>Citrullus colocynthis</i> (L.) Schrader/Cucurbitaceae		Fruits	The pulp of the ripe fruit is directly applied to scabies or tinea	Inhibit hepatoma cell line, breast cancer cells
<i>Diospyros maritima</i> Blume/ Ebenaceae	Glumunyu	Fruit	Fruit is placed on hot ashes and heated gently until soft and black, then mashed with water and applied on tinea- form lesions	Cytotoxicity against hepatoma, nasopharynx, colon and cervical carcinomas
<i>Flueggea virosa</i> (Roxb.Ex Wild.) Voigtssp. Melanyhesoides (F. Muell.) Webster/Euphorbiaceae	Kudjung	Seeds	Seeds are boiled with water and liquid is applied to pruritic skin conditions	Inhibition of breast and lung carcinoma cell lines
<i>Morinda citrifolia</i> L./Rubiaceae	Gununyi	Fruit	Soft ripe fruit is eaten was a remedy for coughs, colds and sore throat	Prevention of lung and cervical cancers ¹⁶

Table 5: List of some traditional plant showing anti- cancer activity

Common name	Botanical name	Part used	Properties	Uses
May apple	<i>Podophyllum peltatum</i>	Dried Rhizome	Anti- cancer	Lung and testicular cancer
Ginger	<i>Zingiber officinalis</i>	Rhizome	Anti- oxidant, Anti- inflammatory, Anti- cancer	Gastric cancer
Turmeric	<i>Curcuma longa</i>	Rhizome	Anti- oxidant Curcumin, Anti- cancer	Breast and skin cancer
Indian mulberry	<i>Morinda citrifolia</i>	fruit	Anti- cancer	
Arjuna Bark	<i>Terminalia arjuna</i>	Bark	Anti- cancer	Breast cancer
Kalmegh	<i>Andrographis paniculata</i>	Dried leaves	Anti- cancer	breast, cervical, melanoma, lymphocytic leukemia
Oregano	<i>Origanum vulgare</i>		Anti- oxidant, Anti- cancer, Anti- microbial	Colon cancer
Garlic	<i>Allium sativum</i>		Anti- cancer	stomach, colon, esophagus, pancreas, breast cancer and prostate cancer
Indian aloe	<i>Aloe barbadensis</i>	Leaves	Anti- cancer	stomach cancer, neuroectodermaltumors, leukemia and liver cancer
Basil	<i>Ocimum basilicum</i>		Anti- cancer	colon cancer

CONCLUSION AND FUTURE ASPECTS

Plants have numerous compounds in it from which the therapeutic agents derived have shown remarkable effect in inhibiting cancer cells. Many of them are available in the market for the treatment and prevention of different types of cancer. Vinca alkaloids comprise of many compounds which have been used in the treatment of various cancers and most of the derivatives of its compounds are under clinical phase. Also compounds from plant parts such as fruits and leaves have shown potential in treatment of several cancers especially pancreatic cancer. In traditional herbs, anticancer properties have been identified but these traditional herbs have not been tested on human models or have undergone clinical phases. Therefore, these herbs if taken in diet

regularly can help in preventing cancer but for taking it as a treatment option the patient should consult the doctor. These traditional herbs and other compounds should verify by systematic experiments so that they could be formulated into drugs for the cancer patients.

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