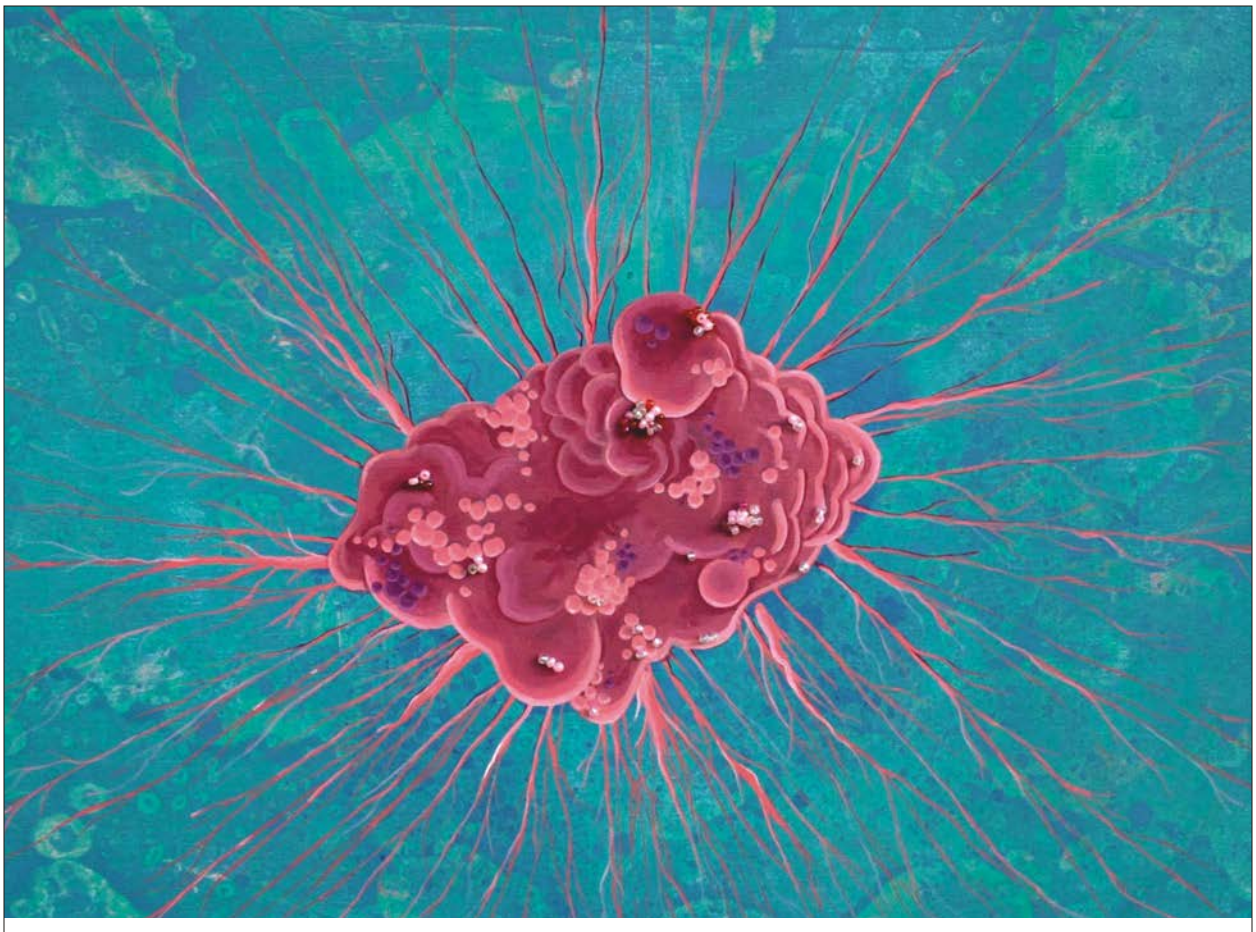

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Anti-cancerous Plants of Uttarakhand Himalaya: A Review

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ABSTRACT

Cancer is one of the leading causes of death worldwide. Anti-cancerous activity is the effects of natural, synthetic or biological chemical agents to reverse, suppress or prevent carcinogenic progression. Several synthetic agents are used to cure the disease but they have their toxicity and hence the research is going on to investigate the plant derived chemotherapeutic agents. An attempt has been made to review important medicinal plants used for the treatment and prevention of neoplasm from Uttarakhand. This article considered 24 plants from the state having anti-cancerous property. These plants contain several anti-cancerous bioactives such as saponins, flavonoids, polyphenols, tannins and alkaloids etc. This study also incorporates the ethno-botany and biological activities of these important plants.

Key words: Anti-cancerous plants, Uttarakhand, chemical constituents, biological activities, ethno-botany, taxanes

INTRODUCTION

Anti-neoplasm (anti-cancerous) activity is defined as effects of natural, synthetic or biological chemical agents used to reverse, suppress or prevent carcinogenic progression (Madhuri and Pandey, 2009). Worldwide, cancer is the second largest cause of death after cardiovascular disease and kills about 3500 million people annually (Turgay *et al*., 2005). Several synthetic or natural chemo-preventive agents are used worldwide to cure the disease. Chemically synthesized agents have their toxicity and DNA damage induction potential which prevents their uses (Sasaki *et al*., 2002). Because of the serious side effects of synthetic chemo-preventive agents, the research is going on to investigate the plant derived chemotherapeutic agents. Hence plant derived compounds plays important role as clinically useful anti-cancer agents without toxicity. Bio-prospecting for plants with anti-cancer activity has been a major focus in the search for plant based cures (Raskin *et al*., 2002). Taxol and Camptothecin were among the most important anti-cancer compounds derived from plants available today (Suhas *et al*., 2007).

India has a rich history of using plants for health care in general (Misra *et al*., 2008) and treatment of cancer in particular without causing toxicity (Madhuri and Pandey, 2009). Cancer has become an important Public Health Problem with over 800,000 new cases occurring every year and is one of the ten leading causes of death in India. It has been reported that there are nearly 2.5 million cases in the country with nearly 400,000 deaths occurring due to cancer. Cancer incidence in India is estimated to be around 70-90 per 100,000 populations (Devi, 2009).

Uttarakhand state (20° 26' and 31° 38' N latitude and 77° 49' and 80° 6' E longitude), covering an area of 53,483 km^2 is rich in diversity of medicinal plants. Since, medicinal plants represent an

important health component to the state, it is essential to furnish the important plants being used as anti-cancerous. However, there are only few plants which are so far being investigated. Hence, an attempt has been made to review important medicinal plants used for prevention and treatment of cancer in the state.

RESULTS AND DISCUSSION

Data on different plant species having anticancerous values have been gathered. A total of 24 plants have been recognized for their anti-cancerous activity. These include *Acorus calamus, Aegle marmelos, Aloe vera andrographis paniculata, Asparagus racemosus, Betula utilis, Bidens bipinnata, Cassia fistula, Catharanthus roseus, Centella asiatica, Cleome viscosa, Curcuma domestica, Nelumbo nucifera, Ocimum tenuiflorum, Phyllanthus amarus, Piper longum, Plumbago zeylanica, Podophyllum hexandrum, Rubia cordifolia, Taxus baccata, Terminalia arjuna, Tinospora cordifolia, Trigonella foenum-graecum* and *Withania somnifera*. These plants are used for the treatment of various types of tumour/cancer such as sarcoma, lymphoma, carcinoma and leukaemia. Many of these plants are found effective in experimental as well as clinical cases of cancers.

***Acorus calamus*:** *Acorus calamus* has a long history of usage in many countries. The ethanolic extract inhibited proliferation of mitogen (phytohaemagglutinin) and antigen (purified protein derivative)-stimulated human Peripheral Blood Mononuclear Cells (PBMCs). In addition, *A. calamus* extract inhibited growth of several cell lines of mouse and human origin (Mehrotra *et al*., 2003). Beside anti-cancerous activity, *Acorus calamus* also possesses Central nervous system depression and antifungal activities (Rana *et al*., 2004; Pandy *et al*., 2009; Begum *et al*., 2004).

***Aegle marmelos*:** The extract showed inhibitory effect in the *in vitro* proliferation of human tumor cell lines such as leukemic K562, T-lymphoid Jurkat, Blymphoid Raji and Breast cancer MCF7 (Lambole *et al*., 2010). The compound lupeol, was found to stimulate and increase the expression of Era gene in MDA-MB-231 Era-negative breast cancer cells and also inhibited cell proliferation. Phytoconstituents present in the fruit of *Aegle marmelos* were found to have strong anti-cancer activity against thyroid cancer (Lampronti *et al*., 2003). Similarly Butyl p-tolyl sulfide, 6-methly-4-chromanone and butylated hydroxyanisole also showed significant activity in inhibiting *in vitro* cell growth of human K562 cells (Lambole *et al*., 2010). Latica and Costa (2005) reported that the extract was found to exhibit toxicity on sea urchin eggs assy, MTT assay using tumor cell and brine shrimp lethality. Same results were also noted by Jagethia *et al*. (2005) as hydroalcoholic extract shows anticancer activity against *Ehrlich ascites* carcinoma.

***Aloe vera*:** Barbaloin, aloe-emodin and aloesin showed significant inhibitory effects on *Ehrlich ascites* carcinoma cell (Joseph and Raj, 2010). Aloe induced anticancer activity through stimulating the scavenging white blood cells. Lectin derived from *Aloe*, activated the immune system to attack the cancer, when injected directly into tumors (Akev *et al*., 2007). Similarly, trypan blue cells showed significant cytotoxicity against acute myeloid leukemia and acute lymphocytes leukemia cancerous cells (Joseph and Raj, 2010). Extract of *Aloe* has been prove to activate macrophages (white blood cells which "swallow" antigens), causing the release of anticancer substances such as interferons, interleukins and tumor necrosis factor. In addition, it was found

to promote the growth of normal (non-cancerous) cells and halt the growth of tumors (Choi and Chung, 2003). This plant also inhibits metastases.

***Andrographis paniculata*:** The dichloromethane fraction of the methanolic extract of *A. paniculata* found to retains the anticancer activity (Mishra *et al.*, 2007). Likewise andrographolide also showed inhibition property on different tumor cell, representing various types of cancers. The compound exerts direct anticancer activity on cancer cells by cell cycle arrest at G0/G1 phase through induction of cell cycle inhibitory protein p27 and decreased expression of Cyclin Dependent Kinase 4 (Rajagopal *et al.*, 2003). Andrographolide also enhanced the tumor necrosis factor-α production, resulting in increased cytotoxic activity of lymphocytes against cancer cells which may contribute for its indirect anticancer activity (Kumar *et al.*, 2004).

***Asparagus racemosus*:** The phytoestrogens present in the plants are estimated 100-500 times less potent in their estrogen effect than human estrogen. These were found to maintain a hormonal balance by acting as anti-estrogen (Bopana and Saxena, 2007). Cancer cells also use estrogen to promote their growth (Adlercreutz *et al.*, 1995). Diwanay *et al.* (2004) reported that *Asparagus* has been used to treat various forms of cancer. In addition, extract of *Asparagus* contained a protein called histone that can be believed to control cell growth (Davies *et al.*, 1996).

***Betula utilis*:** The compound betulin present in the plant shows anticancer activity by suppressing growth of malignant melanoma and cancer of liver and lung (Kikuzaki and Nakatani, 1993).

***Bidens bipinnata*:** Bidens bipinnata is well known for anti-cancerous activity. The ethyl extract have a strong inhibitory effect on proliferation in human umbilical vein endothelium cells and tube formation (Wu *et al.*, 2004). Similarly, it was found significant on leukemic cell lines with the doses of 100, 250 and 500 μ mL^{-1}.

***Cassia fistula*:** *C. fistula* reported to indicates anticancerous activity and actively involved in the pathogenesis of a wide number of diseases including atherosclerosis, cardiac and cerebral ischemia and carcinogenesis (Lopez and Casado, 2001; Galati and O'Brien, 2004).

***Catharanthus roseus*:** Vincristine extracted from *C. roseus* was found to be used to treat many solid tumours like breast, colon, cervical and neck and head cancers (Huang *et al.*, 2004).

***Centella asiatica*:** It is used for treatment of psoriasis and found to be effective in destroying cultured cancer cells (Maquart *et al.*, 1990). It protects from cancer by enhancing immune functions of the body (Punturee *et al.*, 2007). Similarly, Ullah *et al.* (2009) reported the cytotoxic effect of n-hexane, carbon tetrachloride, chloroform and methanol extract of *C. asiatica*. Likewise, Yu *et al.* (2006) also found that the extract of the whole plant has strong anticancer activity. In Brazil, *C. asiatica* is used to treat the uterine cancer (Yoshida *et al.*, 2005). The presence of several bioactive components in the extract may possess anticancer activity.

***Cleome viscosa*:** The methanolic extract of *C. viscosa* exhibited significant antinociceptive and cytotoxic effect in acetic acid induced writhing in mice at an dose of 250 and 500 mg kg^{-1} body weight. Likewise, the crude extract also has a prominent cytotoxic effect against brine shrimp (Bose *et al.*, 2011).

***Curcuma domestica*:** Curcumin, one of the most studied chemopreventive agent, is a compound extracted from this plant suppress, retard and invasion on carcinogenesis (Zhang *et al*., 2004). This compound inhibits growth of cancer by preventing production on harmful eicosanoid viz. PGE-2 (Srivastava *et al*., 1995). The anticancer effect of curcumin has been demonstrated in all the steps of cancer development, i.e., initiation, promotion and progression of cancer (Mahady *et al*., 2002). In addition to inhibition of the genesis of cancer, curcumin promotes the regression of cancer (Duvoix *et al*., 2005). The extract causes apoptosis in various cancer cell types including skin, colon, fore-stomach, duodenum and ovary. Curcumin is used to treat squamous cell carcinoma of the skin and the ulcerating oral cancer. *C. domestica* also prevents malignant transformation of leukoplakia (Cheng *et al*., 2001). Turmeric has also been reported to inhibit the development of stomach, breast, lungs and skin tumors (Nagabhushan and Bhide, 1992).

***Nelumbo nucifera*:** The ethanolic extracts of lotus were found to inhibit the cell proliferation and cytokines in primary human peripheral blood mononuclear cell (Liu *et al*., 2004).

***Ocimum tanuiflorum*:** Anticancer and chemopreventive properties of *Ocimum* have been reported and have a fewer side effects than synthesized compounds (Ranga *et al*., 2005). Topical application of *Ocimum* extract significantly reduced the cumulative number of papillomas in 7,12-dimethylbenz (a) anthracene-induced skin papillomagenesis in rats (Prashar *et al*., 1998). The ethanolic extract of leaf inhibit the proliferation and angiogenesis related protein through the down-modulation of Bcl-2 and VEGF expression and over expression of capase-3 during N-methyl-N"-nitro-N-nitrosoguanidine induced gastric cancer bearing rates (Manikandan *et al*., 2007). Similar effects were also noted with reduction in tumor cell size and an increase in lifespan of mice having Sarcoma-180 solid tumors (Nakamura *et al*., 2004). Urosolic acid and oleanlic acid present in the plants have been reported to posses anticancer property (Singh *et al*., 2010a). The extract have been reported to shown increased activities of cytochrome p450, cytochrome b5, aryl hydrocarbon hydroxylase and glutathione S-transferase, all of which are important in the detoxification of carcinogens and mutagens (Prashar *et al*., 1998).

***Phyllanthus amarus*:** It is reported that *P. amarus* inhibit several enzyme processes peculiar to cancer cells and posses cytotoxic ability to kill cancer cells (Rajeshkumar *et al*., 2002). It also assisted cell protective properties (Unandr *et al*., 1995). The extract of plant was found to significantly inhibit cell proliferation and hence suppress the active division of cells (Leng *et al*., 2003). This plant was also involved in many aspects of carcinogenesis that include growth and development of tumors and in inhibiting apoptosis (Sureban *et al*., 2006).

***Piper longum*:** The extract of *Piper longum* was found to inhibit significantly (50.6%) the number of tumor-directed capillaries induced by injecting B16F-10 melanoma cells. Similarly the ethyl acetate extract shows to inhibit leukaemic cell lines K562 (Joy *et al*., 2010). Administration of the methanolic extract of the plant was found to differentially regulate the level of proinflammatory cytokines like IL-1β, IL-6, TNF-α, GM-and CSF which were found to be at elevated levels during the development of cancer. Moreover, *P. longum* was also able to inhibit the VEGF-induced proliferation, cell migration and capillary-like tube formation of primary cultured human endothelial cells (Sunila and Kuttan, 2006).

***Plumbago zeylanica*:** Plumbagin inhibited NF-κB activation induced by TNF and other carcinogens and inflammatory stimuli and also suppressed constitutive NF-κB activation in certain tumor cells (Sandur *et al.*, 2006). Plumbagin down-regulated the expression and activity of NF-κB-regulated expressions of anti-apoptotic genes and angiogenic. This led to potentiation of apoptosis induced by TNF and paclitaxel and inhibited cell invasion (Hsu *et al.*, 2006).

***Podophyllum hexandrum*:** The plant contains podophyllin which has an antimiotic effect, it interferes with cell division and can thus prevent the growth of cells (Chattopadhyay *et al.*, 2004). This chemical checks the multiplication of cancer cells. It is, therefore, a possible drug for the treatment of cancer, especially in the treatment of ovarian cancer (Kumar *et al.*, 2003). The compound podphyllotoxin is the most active cytotoxic natural product isolated from this plant. It has been used as starting material for the synthesis of the anticancer drug etoposide and teniposide. Podophyllotoxin acts as an inhibitor of microtubule assembly (Giri and Narasu, 2000).

***Rubia manjith*:** The extract of this plant shows anti-cancer activity against a spectrum of tumor models such as leukemia, ascitic carcinoma, large intestinal and lung tumors, melanoma etc., (Adwankar and Chitinis, 1982). The extract of this plant has been reported to contain a number of cyclic hexapeptides with potent anti tumor activity (Wakita *et al.*, 2001). The methanol extract of the herb has 80% inhibitory rate against ascitic S180 murine tumor (Kinghorn *et al.*, 1999). *In vitro* test showed that water extract of the herb has 100% inhibitory rate against human cervical carcinoma JTC-26 cell line (Balachandran and Govindarajan, 2005).

***Taxus baccata*:** The plant contains taxanes (taxol and taxotere) have same mode of action as of podophyllin. It controls the division of cancerous cells and hence checks the cancer. Taxanes used for the treatment of several cancer such as leukaemia and cancer of breast, ovary, colon and lungs (Sakarkar and Deshmukh, 2011).

***Terminalia arjuna*:** It was found out that the flavones and luteolin isolated from *T. arjuna* has a well established record of inhibiting various cancer cell lines (Pettit *et al.*, 1996). The chemical Casuarinin isolated from the bark inhibited breast cancer cell growth. Furthermore, this could induce apoptosis and cell cycle arrest in human breast adenocarcinoma MCF-7 cells (Kuo *et al.*, 2005).

***Tinospora cordifolia*:** The species has been reported to treat throat cancer (Chauhan, 1995). Administration of the polysaccharide fraction from *T. cordifolia* was found to be very effective in reducing the metastatic potential of B16F-10 melanoma cells. The positive effect of *T. cordifolia* on leucocytes suggests its use as an adjuvant in cancer therapy (Leyon and Kuttan, 2004). Alcoholic extract of this plant also shows significant anticancer activity on tumor associated macrophages derived dendritic cells (Singh *et al.*, 2005) furthermore, *T. cordifolia* extract has anti-tumor potential in a two-stage skin carcinogenesis mouse model (Chaudhary *et al.*, 2008).

***Trigonella foenum-graecum*:** The ethanolic extract of the leaves shows anticancer activity against mice inoculated with *Ehrlich ascites* carcinoma cells (Prabhu and Krishnamoorthy, 2010).

Epidemiological studies also implicate apoptosis as a mechanism that might mediate the Fenugreek's antibreast cancer protective effects (Amin *et al*., 2005).

***Withania somnifera*:** *W. somnifera* is reported to have anti-carcinogenic effects by its capacity to fight cancers by reducing tumor size (Singh *et al*, 2010b). The antitumor effects of this herb in urethane induced lung tumors in adult male mice are also evaluated. Withaferin A and Withanolide D found in *W. somnifera* was reported to inhibit growth of cancer (Mathur *et al*., 2006). Likewise, Wattenberg *et al*. (1980) reported that the extract of this plant inhibited benzo (a) pyrene-induced forestomach papillomagenesis, showing up to 60 and 92% inhibition in tumor incidence and multiplicity, respectively. Similarly, *Withania* inhibited 7,12-dimethylbenzanthracene-induced skin papillomagenesis, showing up to 5 and 71% inhibition in tumor incidence and multiplicity (Padmavathi *et al*., 2005). Oza *et al*. (2010) reported that L-asparaginase present in the plant has antitumor activity. *Aloe vera, Toona* and *Sonchus brachyotus* also possessed anti-cancerous property (Bhandari *et al*., 2010; Negi *et al*., 2011a; Bisht and Purohit, 2010). Anti-tumorous plant Asparagus has been analyzed by RP-HPLC (Negi *et al*., 2011b).

In this review, important anti-cancerous medicinal plants of the state have been presented with their respective family, habit, common name, vernacular name and distributional range (Table 1) and ethno-botanical, chemical constituents and biological activities (Table 2).

Table 1: Anticancerous plants of uttarakhand

Name of the plant	Family	Habit	Common name	Local name	Distribution range (m)
Acorus calamus L.	Araceae	H	Sweet Flag	Bauj	Upto 2000
Aegle marmelos (L.) Corr.	Rutaceae	T	Indian Bael	Bael	Upto 1200
Aloe vera (L.) Burm. f.	Aloaceae	H	Aloe	Ghrit-Kumari	Upto 500
Andrographis paniculata	Acanthaceae	H	Kalmegh	Kalmegh	Upto 500
Asparagus racemosus Willd.	Liliaceae	S	Wild Asparagus	Satawari	Upto 1500
Betula utilis D. Don	Betulaceae	T	Himalayan Birch	Bhojpatra	2000-3200
Bidens bipinnata L.	Asteraceae	H	Bur-Merigold	Kumur, Kurei	Upto 1500
Cassia fistula L.	Caesalpiniaceae	T	Cassia, Golden Shower	Amaltas, Semara	Upto 1400
Catharanthus roseus (L.) G. Don	Apocynaceae	H	Medagascar Periwinkle	Sadabahar	Upto 1200
Centella asiatica (L.) Urban	Apiaceae	H	Indian Penny Wort	Brahmi	Upto 2500
Cleome viscosa L.	Cleomaceae	H	Patharchur	Jakhiya	Upto 1800
Curcuma domestica Valeton	Zingiberaceae	H	Turmeric	Haldi	Upto 1800
Nelumbo nucifera Gaertn.	Nelumbonaceae	H	Indian Lotus	Kamal	Upto 300
Ocimum tanuiflorum L.	Lamiaceae	H	Holy Basil	Tulsi	Upto 1800
Phyllanthus amarus Schum. and Thonn.	Euphorbiaceae	H	Bhui-Aonla	Bhui-Aonla	Upto 1300
Piper longum L.	Piperaceae	H	Indian Long Pepper	Pipalli	Upto 2500
Plumbago zeylenica L.	Plumbaginaceae	H	Chittraka	Chittraka	Upto 2500
Podophyllum hexandrum Royle	Berberidaceae	H	Himalayan May Apple	Ban-Kakri	Above 2800
Rubia manjith Roxb. ex Flemming	Rubiaceae	DC	Indian Madder	Manjith	Upto 2500
Taxus baccata L.	Taxaceae	T	Yew Tree	Thuner	Above 2400
Terminalia arjuna (Roxb. ex DC.) Wight and Arn.	Combretaceae	T	Arjun	Arjun, Kowa	Upto 500
Tinospora cordifolia (Willd.) Hook. f.	Menispermaceae	CS	Guduchi, Giloe	Giloe	Upto 1300
Trigonella foenum-graecum L.	Papilionaceae	H	Fenugreek	Methi	Upto 1800
Withania somnifera (L.) Dunal	Solanaceae	S	Indian Ginseng	Ashwagandha	Upto 1200

H: Herb, T: Trees, S: Shrub, DC: Deciduous climber, CS: Climber shrub

Table 2: Ethno-botany, chemical constituents and biological activities of anticancerous plants of Uttarakhand

Name of the plant	Ethno-botany	Chemical constituents	Biological activities
Acorus calamus	Appetite loss, diarrhoea, colic, cramps, sedative, chest pain, digestive disorders, nervous disorders, rheumatism, gas, vascular disorders	α and β-asarone, caryophyllene, isoasarone, methyl isoeugenol, safrol (Venskutonis and Dagilyte, 2003)	Antimicrobial, anticellular, antifungal, antibacterial, allelopathic, anaesthetic, antioxidants, (Mehrotra *et al*., 2003; Devi and Ganjewala, 2009)
Aegle marmalos	Digestive, stomachic, diarrhoea, dysentery, dyspepsia, asthma, anaemia, fracture, wounds, typhoid, sacred	Lupeol, pyranocoumarin, scoparome, scopoletin, marmesin, skimming, b-sitosterol, cumarinaegelinol, xanthotoxin, psoralen, tembamide, mermin, skimmianine (Lambertini *et al*., 2005; Lambole *et al*., 2010)	Antiviral, antiinflammatory, antianalgesic, antidiabetic, hepatoprotective, antipyretic, antifungal, radioprotective, antispermatogenic, antiulcer (Jagethia *et al*., 2005; Sharma *et al*., 2011)
Aloe vera	Constipation, burns, fever, blood purifier, cough and cold, asthma, jaundice, piles	Aloe-emodin, acemannan, lectin, barbaloin, isobarbaloin, anthrone-C-glycosides, sitasterol, campesterol, lupeol, butyl-p-tolyl sulphide, 6-methly-4-chromanone, butylated hydrooxyanisole (Joseph and Raj, 2010; Lambole *et al*., 2010)	Anti-inflammatory, arthritis, antioxidant, astringent, antiseptic, antibacterial, haemostatic (Saada *et al*., 2003; Joseph and Raj, 2010)
Andrographis paniculata	Gastro-intestinal, respiratory infection, fever, herpes, sore throat	Andrographolide, neoandrographolide, deoxyandrographolide andro-graphoside, 14-deoxyandrographolide, 14-deoxy-11,12-didehyandrographoside, deoxyandrographoside, hemoandro-grapholide andrographam andrographon andrographostein, stigmastorol (Mishra *et al*., 2007)	Antityphoid, antifungal, antimalarial, antivenom, anti-inflammatory, immunostimualant, antidiabetic, anti-HIV, antifertility, hepatoprotective (Trivedi and Rawal, 2001; Niranjan *et al*., 2010)
Asparagus racemosus	Tonic, leukemia, dysentery, diabetes, appetizer, leprosy, night blindness, neuroblastoma, epilepsy (Negi *et al*, 2010)	Glutathione, phytoestrogen, shatawarine I,II,III,IV, asparagines, arginine, tyrosine, kaempferol, quercetin, rutin (Negi *et al*, 2010)	Antiestrogen, antioxidant, anticarcinogenic, antibacterial, antidiabetic, immunostimulant, antihepatoprotective, gastroduodenal ulcer protective (Bopana and Saxena, 2007; Negi *et al*., 2010)
Betula utilis	Timber, sacred, spermicidal, fungal infection (Gaur, 1999)	Betulin, lupeol, oleanolic acid, acetyloheanolic acid, betulitic acid, lupenone, sitasterol, methyl betulonate, methyl betulate, triterpenoid (Salvam, 2008)	Antibacterial, antiseptic, carmiantive, contraceptive (Umamaheswari *et al*., 2008)
Bidens bipinnata	Leprosy,flu, fever, cold, jaundice, hepatitis, cuts (Gaur, 1999	Polyacetylenes, polyacetylenic glycosides, aurons, aurons glycosides, sesquiterpenes, acetylacetone, glucosides, phenylheptadiynol, phenylpropanoid pehophytins, diterpenes (Li *et al*., 2008)	Antipyretic, anti-malarial and anti-bacterial, antimicrobial, IFN-a promoter, antidiabetic, antiallergic, antioxidative (Sundararajan *et al*., 2006; Chiang *et al*., 2007;
Cassia fistula	Antiseptic, antidote to snake bite, asthma, bronchitis, skin disease (Gaur, 1999)	Glycerides, caprylic and myristic acids, cephalin, lecithin phospholipids, Lupeol, hexacosanol and ß-sitosterol, Fistucacidin,	Mild laxative Bahorun *et al*., 2005), purgative, antiulcer, antipyretic, analgesic, anti-inflammatory, hypoglycaemic, antidiabetic,

Table 2: Continued

Name of the plant	Ethno-botany	Chemical constituents	Biological activities
		proanthocyanidin, epiafzelechin 3-O-B-D-glucopyranoside, 7 biflavonoids, triflavonoids, epicatechin, procyanidin B-2, sennoside, rhein, rhamnetin 3-O-gentibioside (Vaishnav and Gupta, 1996; Abu *et al*., 1999).	antipruritus, antileucoderm, anti-rheumatic, anti-tussive, antifertility, antioxidant (Elujoba *et al*., 1999; Yadav and Jain, 1999; Ali *et al*.., 2003; Gobianand *et al*., 2010)
Catharanthus roseus	Blood pressure, diabetes mellitus	Vinblastine, vincristine, vindesine and vinorelbine (Pearce, 1990)	Anti-microtubule, anti-mitotic activities, leukaemia, rhabdomysacrcoma, neuroblastoma and (Johnson *et al*., 1968)
Centilla	Ulcer, wounds, gynaecological, jaundice, brain tonic	Vallarine, asiaticosides, sitosterol, centelloside, oxyasiaticoside, asiatic acid, madecassoside (Leung and Foster, 1998; Brinkhaus *et al*., 2000)	Antidiabetic, anxiety, blood pressure, antimicrobial (Ullah *et al*., 2009)
Curcuma domestica	Condiment, dye, blood purifier, skin disease, rituals, digestion	Curcumin, glucuronide	Antioxidant, anti-inflammatory, antiviral, antifungal, antibacterial, (Duvoix *et al*., 2005; Babu *et al*., 2007)
Nelumbo nucifera	Diarrhoea, tissue inflammation, leprosy, fever	Dauricine, lotusine, muciferine, pronuciferine, liensinine, isoliensinine, roemerine, neferine, nelumbine, antisteroids, Procyanidins (Sridhar and Bhat, 2007).	Anti-diabetic, anti-pyretic, anti-steroidogenic, antifertility, antioxidant, antiviral, astringent, anti-hyperdipsia, dermatopathy, halitosis, menorrhagia, sedative, antispasmodic (Sridhar and Bhat, 2007)
Ocimum tanuiflorum	Cough, respiratory tract infection, stress syndrome, worm infestations, fungal infections, diuretic, bronchitis, rheumatism, pyrexia (Nadkarni, 1993)	Ursolic acid, palmitic, stearic, oleic, linoleic and linolenic acid, apigemin, leteolin, ocimumosides A and B, ocimarin, apigenin, cerebrosides, cerobrosides, 7-O-B-D-glucuronic acid, 6"-methly ester, selinene,pinenes, camphene, eugenol, eugenal, oleanlic acid (Nadig and Laxmi, 2005; Gupta *et al*., 2007; Singh *et al*, 2010a)	Anti-microbial, anti-inflammatory, anti-asthmatic, antioxidant, antipyretic, analgesic, hypotensive, immunomodulatory, antifertility, antidiabetic (Williamson, 2002; Yanpallewar *et al*., 2004)
Phyllanthus amarus	Urinary troubles, kidney and gallbladder stone, hepatitis, cold, flu, tuberculosis, jaundice, liver disease	Phyllanthin, hypophyllanthin, lignansniranthin, nirtetralin, quercetin, phylletralin (Amir *et al*., 2003)	Antiviral, antibacterial, antidiabetic, hypertension, antianalgesic, antispasmodic, antistomachic (Unandr *et al*., 1995; Nishiura *et al*., 2004)
Piper longum	Respiratoy disorder, cardiac disorder	Piperine, piperlonguminine, sylvatine, guineensine, piperlongumine, filfiline, sitosterol, methly-piperate (Nakatani *et al*., 1986)	Antiamoebic, anti-giardial, antiulcer, antioxidant. anti-inflammatory, immunostimualatory (Ghoshal and Lakshmi, 2002)

Table 2: Continued

Name of the plant	Ethno-botany	Chemical constituents	Biological activities
Plumbago zeylenica	Diarrhoea, dysentery, piles	B-sitosterol, B-sitosteryl-3, B-glucopyranoside, lupeol acetate, lupenone, plumbagin, trilinolein (Nguyen *et al*., 2004)	Abortifacient, antiinflammatoyy
Podophyllum hexandrum	Cholagogue, cytostatic and purgative, lung, testicular, meuroblastoma, hepatoma (Giri and Narasu, 2000).	Podophyllotoxin, berberine, podophyllin, podophyllotoxin phorbol 12-myristate 13-acetate, interleukin-1ß, lipopolysaccharide, okadaic acid (Giri and Narasu, 2000).	Vermicidal, immunostimulatory, antimalarial, liver tonic, antioxidant (Kumar *et al*., 2006)
Rubia manjith	Dye, tonic, astringent, antidote to snakebite (Gaur, 1999)	Rubiadin, rubierythrinic acid, purpurin, pseudopurpurin, olizarin, munjistin (Tripathi *et al*., 1997)	Antioxidant, immunomodulatory (Joharapurkar *et al*., 2003)
Taxus baccata	Sedative, gastric complaints, asthma (Singh, 1995)	Phenylpropyl, phenylbutyl, cutin, taxine alkaloids, taxoids such as tasusin, baccatin VI, baccatin III, 1ß-hydroxybaccatin I, lignans such as lariciresinol, taxiresinol, isolariciresinol, 3-demethyl- isolariciresinol, 3'-de-methyl-isolariciresinol-9'-hydroxyisopropyl ether, (Wilson *et al*., 2001; Jetter *et al*, 2002; Gurbuz *et al*., 2004)	Anti-inflammatory, anti-nociceptive, anti-malarial and antirheumatic, emmenagoque, anti-spasmodic, aphrodisiac, anti-inflammatory (Appendino, 1993; Baytop, 1999; Kupeli *et al*., 2003)
Terminalia arjuna	Heart disease, fracture, tonic, asthma, anaemia, urinary discharge, excessive perspiration etc.	Arjunetin, arjunone, cerasidin, friedlin, sitosterol, methyl oleanolate, gallic, ellagic, arjunetosides I, arjnetosides II, arjnetosides III, arjnetosides IV, Luteolin, Casuarinin (Pettit *et al*, 1996, Kuo *et al*, 2005)	Alexiteric, styptic, anthelmintic, anti-asthmatic, anti-leucodermatic, anti-anaemiac (Kapoor, 1990)
Tinospora cordifolia	Tonic, anaemia, fever, jaundice, dysentery, diarrhoea, diuretic, bone fracture, asthma	Giloin, gilenin, gelosterol, tinosporin, tinosporic acid, tinosporol, berberine, tinosporidine, sitosterol, tinosporide (Singh *et al*., 2003).	Immunostimulatory, antidiabetic, spleenic disorder, anti-inflammatory, anthelmintic, nervine tonic, antipyretic, antispasmodic, antimalarial, antileprotic (Thatte *et al*., 1992; Singh *et al*., 2003)
Trigonella foenum-graecum	Dysentery, diarrhoea, gas, inflammatory colic (Gaur, 1999)	Disogenin, gitogenin, neogitogenin, hemorientin, saponaretin, neogigogerin, Cyclophophamide, L-buthionine-SR-sulfoximine trigogenin (Rastogi and Mehrotra, 1990)	Anti-microbial, anti-bacterial, anti-diabetic, anti-parasitic, hypocholesterolaemic, lactation stimulant, anti-pyretic, anthelmentic, carminative, aphrodisiac, anti-oxidant, immunomodulatory (Wagh *et al*., 2007; Toppo *et al*., 2009)
Withania somnifera	Increase longevity, vitality, tonic, sedative, aphrodisiac, skin disease, cough	Anahygrine, anaferine, ß-sisterol, chlorogenic acid, cysteine, scopoletin, somniferimine, somniferiene, tropanol, withanine, withananine, withanolides A-Y (Elsakka *et al*., 1990)	Immunomodulatory, antistress, antioxidant, anti-inflammatory, antiaging, diuretic, hypoglycaemic, hypothyroid, antimicrobial (Singh *et al*., 2010b)

CONCLUSION

In uttarakhand, several plants were used for maintaining the health and treatment of several ailments including cancer without toxicity. These plants possess various compounds having anti-cancerous activity. Beside anti-cancerous activity these plants also possesses various other biological activities such as antimicrobial, antioxidant, anti-diabetic, radio-protective, anti-HIV, anti-hepatoprotective and contraceptive. The medicinal plants presented in this article have versatile remedial properties against tumour which still require a detailed research. Thus, there is a great need in searching for and manufacturing newer herbal drugs from medicinal plants which possesses remarkable anti-cancerous activities.

REFERENCES

Abu, S.M., A.M. Abbas, A.M. Khan and M.S. Rahman, 1999. Studies on the characterization and glyceride composition of *Cassia fistula* seed oil. Bangladesh J. Sci. Ind. Res., 34: 144-148.

Adlercreutz, C.H., B.R. Goldin, S.L. Gorbach, K.A. Hockerstedt and S. Watanabe *et al*., 1995. Soybean phytoestrogen intake and cancer risk. J. Nutr., 125: 757S-770S.

Adwankar, M.K. and M.P. Chitinis, 1982. *In vivo* anticancer activity of RC-18: A plant isolate from *Rubia cordifolia* Linn. against a spectrum of experimental tumor model. Chemotherapy, 28: 291-293.

Akev, N., G. Turkay, A. Can, A. Gurel and F. Yildiz *et al*., 2007. Tumour preventive effect of *Aloe vera* leaf pulp lectin (Aloctin I) on *Ehrlich ascites* tumours in mice. Phytother. Res., 21: 1070-1075.

Ali, M.A., M.A. Sayeed and N. Absar, 2003. Antibacterial activity and cytotoxicity of three lectins purified from *Cassia fistula* Linn. Seeds. J. Medical Sci., 3: 240-244.

Amin, A., A. Alkaabi, S. Al-Falasi and S.A. Daoud, 2005. Chemopreventive activities of *Trigonella foenum graecum* (Fenugreek) against breast cancer. Cell Biol. Int., 29: 687-694.

Amir, M., S. Kumar and S.K. Singh, 2003. Chemical and biological review of *Phyllanthus amarus*. Ind. J. Nat. Prod., 19: 3-13.

Appendino, G., 1993. Taxol (Paclitaxel): Historical and ecological aspects. Fitoterapia, 64: 5-25.

Babu, G.D.K., V. Shanmugam, S.D. Ravindranath and V.P. Joshi, 2007. Comparison of chemical composition and antifungal activity of *Curcuma longa* L. leaf oils produced by different water distillation techniques. Flavour Fragrance J., 22: 191-196.

Bahorun, T., V.S. Neergheen and O.I. Aruoma, 2005. Phytochemical constituents of *Cassia fistula*. Afr. J. Biotechnol., 4: 1530-1540.

Balachandran, P. and R. Govindarajan, 2005. Cancer-an ayurvedic perspective. Pharmacol. Res., 51: 19-30.

Baytop, T., 1999. Therapy with Medicinal Plants in Turkey. 2nd Edn., Nobel Tip Kitabevleri, Istanbul, Turkey.

Begum, J., H. Sohrab, M. Yusuf, J.U. Chowdury, M.M. Husain, H.A. Begum and M.N. Anwar, 2004. *In vitro* antifungal activity of azaron isolated from the rhizome extract of *Acorus calamus* L. Pak. J. Biol. Sci., 7: 1376-1379.

Bhandari, A.K., J.S. Negi, V.K. Bisht and M.K. Bharti, 2010. *In vitro* propagation of *Aloe vera*: A plant with medicinal properties. Nat. Sci., 8: 174-176.

Bisht, V.K. and V. Purohit, 2010. Medicinal and aromatic plants diversity of asteraceae in Uttarakhand. Nat. Sci., 8: 121-128.

Bopana, P. and S. Saxena, 2007. *Asparagus racemosus*-Ethnopharmacological evaluation and conservation needs. J. Ethnopharmacol., 110: 1-15.

Bose, U., V. Bala, T.N. Ghose, K. Gunasekaran and A.A. Rahman, 2011. Antinociceptive, cytotoxic and antibacterial activities of *Cleome viscosa* leaves. Braz. J. Pharmacol., 21: 165-169.

Brinkhaus, B., M. Lindner, D. Schuppan and E.G. Hahn, 2000. Chemical, pharmacological and clinical profile of the East Asian medical plant *Centella asiatica*. Phytomedicine, 7: 427-448.

Chattopadhyay, S., V.S. Bisaria, A.K. Panda and A.K. Srivastava, 2004. Cytotoxicity of *in vitro* produced podophyllotoxin from *Podophyllum hexandrum* on human cancer cell line. Nat. Prod. Res., 18: 51-57.

Chaudhary, R., S. Jahan and P.K. Goyal, 2008. Chemopreventive potential of an Indian medicinal plant (*Tinospora cordifolia*) on skin carcinogenesis in mice. J. Environ. Pathol. Toxicol. Oncol., 27: 233-243.

Chauhan, K., 1995. Successful treatment of throat cancer with Ayurvedic drugs. Suchitra Ayurved, 47: 840-842.

Cheng, A.L., C.H. Hsu, J.K. Lin, M.M. Hsu and Y.F. Ho *et al.*, 2001. Phase I clinical trial of curcumin, a chemopreventive agent, in patients with high-risk or pre-malignant lesions. Anticancer Res., 21: 2895-2900..

Chiang, Y.M., C.L.T. Chang, S.L. Chang, W.C. Yang and L.F. Shyur, 2007. Cytopiloyne, a novel polyacetylenic glucoside from *Bidens pilosa*, functions as a T helper cell modulator. J. Ethnopharmocol., 110: 532-538.

Choi, S. and M.H. Chung, 2003. A review on the relationship between *Aloe vera* components and their biologic effects. Semin. Integr. Med., 1: 53-62.

Davies, K.M., J.F. Seelye, D.E. Irving, W.M. Borst, P.L. Hurst and G.A. King, 1996. Sugar regulation of harvest-related genes in asparagus. Plant Physiol., 111: 877-883.

Devi, K.U., 2009. Current status of gynecological cancer care in India. J. Gynecol. Oncol., 20: 77-80.

Devi, S.A. and D. Ganjewala, 2009. Antimicrobial activity of *Acorus calamus* (L.) rhizome and leaf extract. Acta Biol. Szegediensis, 53: 45-49.

Diwanay, S., D. Chitre and B. Patwardhan, 2004. Immunoprotection by botanical drugs in cancer chemotherapy. J. Ethnopharmacol., 90: 49-55.

Duvoix, A., R. Blasius, S. Delhalle, M. Schnekenburger and F. Morceau *et al.*, 2005. Chemopreventive and therapeutic effects of curcumin. Cancer Lett., 223: 181-190.

Elsakka, M., E. Grigorescu, U. Stanescu, U. Stanescu and V. Dorneanu, 1990. New data referring to chemistry of *Withania somnifera* species. Rev. Med. Chir Soc. Med. Nat. Iasi, 94: 385-387.

Elujoba, A.A., A.T. Abere and S.A. Adelusi, 1999. Laxative activities of *Cassia* pods sourced from Nigeria. Niger. J. Nat. Prod. Med., 3: 51-53.

Galati, G. and P.J. O'Brien, 2004. Potential toxicity of flavonoids and other dietary phenolics: Significance for their chemopreventive and anticancer properties. Free Radical Biol. Med., 37: 287-303.

Gaur, R.D., 1999. Flora of the District Garhwal North West Himalaya: With Ethnobotanical Notes. TransMedia Publication, Srinagar Garhwal, India, Pages: 811.

Ghoshal, S. and V. Lakshmi, 2002. Potential antiamoebic property of the roots of *Piper longum* Linn. Phytother. Res., 16: 689-691.

Giri, A. and M.L. Narasu, 2000. Production of podophyllotoxin from *Podophyllum hexandrum*: A potential natural product for clinically useful anticancer drugs. Cytotechnology, 34: 17-26.

Gobianand, K., P. Vivekanandan, K. Pradeep, C.V.R. Mohan and S. Karthikeyan, 2010. Anti-inflammatory and antipyretic activities of indian medicinal plant *Cassia fistula* Linn. (golden shower) in wistar albino rats. Int. J. Pharmacol., 6: 719-725.

Gupta, P., D.K. Yadav, K.B. Siripurapu, G. Palit and R. Maurya, 2007. Constituents of *Ocimum tanuiflorum* with antistress activity. J. Nat. Prod., 70: 1410-1416.

Gurbuz, I., N. Erdemoglu, E. Yesilada and B. Sener, 2004. Anti-ulcerogenic lignans from *Taxus baccata* L. Z. Naturforsch., 59c: 233-236.

Hsu, Y.L., C.Y. Cho, P.L. Kuo, Y.T. Huang and C.C. Lin, 2006. Plumbagin (5-Hydroxy-2-methyl-1,4-naphthoquinone) induces apoptosis and cell cycle arrest in A549 cells through p53 accumulation via c-jun NH_2-terminal kinase-mediated phosphorylation at serine 15 *in vitro* and *in vivo*. J. Pharmacol. Exp. Ther., 318: 484-494.

Huang, Y., Y. Fang, J. Wu, J.M. Dziadyk, X. Zhu, M. Sui and W. Fan, 2004. Regulation of *Vinca* alkaloid-induced apoptosis by NF-kB/IkB pathway in human tumor cells. Mol. Cancer Ther., 3: 271-277.

Jagethia, G.C., P. Venkatesh and M.S. Baliga, 2005. *Aegle marmelos* (L.) Correa inhibits the proliferation of transplanted Erlich Ascites Carcinoma in mice. Biol. Pharm. Bull., 28: 58-64.

Jetter, R., A. Klinger and S. Schaffer, 2002. Very long-chain phenylpropyl and phenylbutyl esters from *Taxus baccata* needle cuticular waxes. Phytochemistry, 61: 579-587.

Joharapurkar, A.A., S.P. Zambad, M.M. Wanjari and S.N. Umathe, 2003. *In vivo* evaluation of antioxidant activity of alcoholic extract of *Rubia cordifolia* Linn. and its influence on ethanol-induced immunosuppression. Ind. J. Pharmacol., 35: 232-236.

Johnson, I.S., 1968. Historical background of *Vinca alkaloid* research and areas of future interest. Cancer Chemother. Rep., 52: 455-4561.

Joseph, B. and S.J. Raj, 2010. Pharmacognostic and phytochemical properties of *Aleo vera* Linn: An overview. Int. J. Pharma. Sci. Rev. Res., 4: 106-110.

Joy, B., C.P. Sandhya and K.R. Remitha, 2010. Comparison and bioevaluation of *Piper longum* fruits extracts. J. Chem. Pharm. Res., 2: 696-706.

Kapoor, L., 1990. Handbook of Ayurvedic Medicinal Plants. CRC Press, Boca Raton, FL.

Kikuzaki, H. and N. Nakatani, 1993. Antioxidant effects of some ginger constituents. J. Food Sci., 58: 1407-1410.

Kinghorn, A.D., N.R. Farnsworth, D.D. Soejarto, G.A. Cordell and J.M. Pezzuto *et al*., 1999. Novel strategies for the discovery of plantderived anticancer agents. Pure Applied Chem., 71: 1611-1618.

Kumar, P.I., S.V. Rana, N. Samanta and H.C. Goel, 2003. Enhancement of radiation-induced apoptosis by *Podophyllum hexandrum*. J. Pharm. Pharmacol., 55: 1267-1273.

Kumar, R.A., K. Sridevi, N.V. Kumar, S. Nanduri and S. Rajagopal, 2004. Anticancer and immunostimulatory compounds from *Andrographis paniculata*. J. Ethnopharm., 92: 291-295.

Kumar, R., P.K. Singh, A.K. Sharma, K. Prasad and R.K. Sagar *et al*., 2006. Modulation of Vital Protein Expression in Intestine of Mice by *Podophyllum hexandrum*: Implications in Radiation Protection. In: Recent Progress in Medicinal Plants. Vol. 16: Phytomedicine, Govil, J.N., V.K. Singh and R. Bhardwaj (Eds.). Studium Press, Texas, USA., pp: 236-264.

Kuo, P.L., Y.L. Hsu, T.C. Lin, L.T. Lin, J.K. Chang and C.C. Lin, 2005. Casuarinin from the bark of *Terminalia arjuna* induces apoptosis and cell cycle arrest in human breast adenocarcinoma MCF-7 cells. Planta Med., 71: 237-243.

Kupeli, E., N. Erdemoglu, E. Yesilada and B. Sener, 2003. Anti-inflammatory and antinociceptive activity of taxoids and lignans from the heartwood of *Taxus baccata* L. J. Ethnoparmacol., 89: 123-129.

Lambertini, E., I. Lampronti, L. Penolazzi, M.T.H. Khan and A. Ather *et al.*, 2005. Expression of estrogen receptorα gene in breast cancer cells treated with transcription factor decoy is modulated by Bangladeshi natural plant extracts. Oncol. Res. Featuring Preclin. Clin. Cancer Ther., 15: 69-79.

Lambole, V.B., K. Murti, U. Kumar, B. Sandipkumar and V. Gajera, 2010. Phytopharmacological properties of *Aegle marmelos* as a potential medicinal tree: An overview. Int. J. Pharma. Sci. Rev. Res., 5: 67-72.

Lampronti, I., D. Martello, N. Bianchi, M. Borgatti and E. Lambertini *et al.*, 2003. *In vitro* antiproliferative effects on human tumor cell lines of extracts from the Bangladeshi medicinal plant *Aegle marmelos* Correa. Phytomedicine, 10: 300-308.

Latica, V. and L. Costa, 2005. Evaluation of anticancer potential used in Bangladeshi folk medicine. J. Ethnopharmacol., 99: 21-38.

Leng, J., C. Han, A.J. Demetris, G.K. Michalopoulos and T. Wu, 2003. Cyclooxygenase-2 promotes hepatocellular carcinoma cell growth through Akt activation: Evidence for AKT inhibition in celecoxib-induced apoptosis. Hepatology, 38: 756-768.

Leung, A.Y. and S. Foster, 1998. Encyclopedia of Common Natural Ingredients used in Food, Drugs and Cosmetics. 2nd Edn., John Wiley and Sons, New York, pp: 284.

Leyon, P.V. and G. Kuttan, 2004. Effect of *Tinospora cordifolia* on the cytokine profile of angiogenesis-induced animals. Int. Immunopharmacol., 4: 1569-1575.

Li, Y.L., J. Li, N.L. Wang and X.S. Yao, 2008. Flavonoids and new polyacetylene from *Bidens parviflora* Willd. Molecules, 13: 1931-1941.

Liu, C.P., W.J. Tsai, Y.L. Lin, J.F. Liao, C.F. Chen and Y.C. Kuo, 2004. The extracts from *Nelumbo nucifera* suppress cell cycle progression, cytokine genes expression and cell proliferation in human peripheral blood mononuclear cells. Life Sci., 75: 699-716.

Lopez, F.A. and S. Casado, 2001. Heart failure, redox alterations and endothelial dysfunction. Hypertension, 38: 1400-1405.

Madhuri, S. and G. Pandey, 2009. Some anticancer medicinal plants of foreign origin. Curr. Sci., 96: 779-783.

Mahady, G.B., S.L. Pendland, G. Yun and Z.Z. Lu, 2002. Turmeric (*Curcuma longa*) and curcumin inhibit the growth of *Helicobacter pylori*, of group 1 carcinogen. Anticancer Res., 22: 4179-4181.

Manikandan, P., P.V. Letchoumy, D. Prathiba and S. Nagini, 2007. Proliferation, angiogenesis and apoptosis-associated proteins are molecular targets for chemoprevention of MNNG-induced gastric carcinogenesis by ethanolic *Ocimum sanctum* leaf extract. Singapore Med. J., 48: 645-651.

Maquart, F.X., G. Bellon, P. Gillery, Y. Wegrowski and J.P. Borel, 1990. Stimulation of collagen synthesis in fibroblast cultures by a triterpene extracted from *Centella asiatica*. Conn. Tiss. Res., 24: 107-120.

Mathur, R., S.K. Gupta, N. Singh, S. Mathur, V. Kochupillai and T. Velpandian, 2006. Evaluation of the effect of *Withania somnifera* root extracts on cell cycle and angiogenesis. J. Ethnopharmacol., 105: 336-341.

Mehrotra, S., K.P. Mishra, R. Maurya, R.C. Srimal, V.S. Yadav, R. Pandey and V.K. Singh, 2003. Anticellular and immunosuppressive properties of ethanolic extract of *Acorus calamus* rhizome. Int. Immunopharmacol., 3: 53-61.

Mishra, S.K., N.S. Sangwan and R.S. Sangwan, 2007. *Andrographis paniculata* (Kalmegh): A review. Pharmacog. Rev., 1: 283-298.

Misra, S., R.K. Maikhuri, C.P. Kala, K.S. Rao and K.G. Saxena, 2008. Wild leafy vegetables: A study of their subsistence dietetic support to the inhabitants of Nanda Devi Biosphere Reserve, India. J. Ethnobiol. Ethnomed., 4: 15-23.

Nadig, P.D. and S. Laxmi, 2005. Study of anti-tussive activity of *Ocimum sanctum* Linn. in guinea pigs. Indian J. Physiol. Pharmacol., 49: 243-245.

Nadkarni, K.M., 1993. Indian Materia Medica. 1st Edn., Popular Prakashan Pvt. Ltd., Bombay, pp: 1089.

Nagabhushan, M. and S.V. Bhide, 1992. Curcumin as an inhibitor of cancer. J. Am. Coll. Nutri., 11: 192-198.

Nakamura, C.V., K. Ishida, L.C. Faccin, B.P.D. Filho and D.A.G. Cortez *et al.*, 2004. *In vitro* activity of essential oil from *Ocimum gratissimum* L. against four *Candida* species. Res. Microbiol., 155: 579-586.

Nakatani, N., R. Inatani, H. Ohta and A. Nishioka, 1986. Chemical constituents of peppers (*Piper* spp.) and application to food preservation: Naturally occurring antioxidative compounds. Environ. Health Perspect., 67: 135-142.

Negi, J.S., P. Singh, G.J. Pant, M.S.M. Rawat and V.K. Bisht, 2010. Chemical constituents of *Asparagus*. Pharm. Rev., 4: 215-220.

Negi, J.S., P. Singh, G.J. nee Pant and M.S.M. Rawat, 2011a. High performance liquid chromatographic analysis of derivatized sapogenin of Asparagus (RP-HPLC analysis of derivatized sapogenin of Asparagus). J. Med. Plants Res., 5: 1900-1904.

Negi, J.S., V.K. Bisht, A.K. Bhandari, M.K. Bharti and R.C. Sundriyal, 2011b. Chemical and pharmacological aspects of *Toona* (Meliaceae). Res. J. Phytochem., 5: 14-21.

Nguyen, A.T., H. Malonne, P. Duez, R. Vanhaelen-Fastre, M. Vanhaelen and J. Fontaine, 2004. Cytotoxic constituents from *Plumbago zeylanica*. Fitoterapia, 75: 500-504.

Niranjan, A., S.K. Tewari and A. Lehri, 2010. Biological activities of Kalmegh (*Andrographis paniculata* Nees) and its active principles: A review. Ind. J. Nat. Prod. Resourc., 1: 125-135.

Nishiura, J.L., A.H. Campos, M.A. Boim, I.P. Heilberg and N. Schor, 2004. *Phyllanthus niruri* normalizes elevated urinary calcium levels in calcium stone forming (CSF) patients. Urol. Res., 32: 362-366.

Oza, V.P., P.P. Parmar, S. Kumar and R.B. Subramanian, 2010. Anticancer properties of highly purified l-asparaginase from *Withania somnifera* L. against acute lymphoblastic leukemia. Applied Biochem. Biotechnol., 160: 1833-1840.

Padmavathi, B., P.C. Rath, A.R. Rao and R.P. Singh, 2005. Roots of *Withania somnifera* inhibit forestomach and skin carcinogenesis in mice. Evidence-Based Complement Altern. Med., 2: 99-105.

Pandy, V., N. Jose and H. Subhash, 2009. CNS activity of methanol and acetone extracts of *Acorus calamus* leaves in mice. J. Pharmacol. Toxicol. 4: 79-86.

Pearce, H.L., 1990. Medicine chemistry of bisindole alkaloids from catharanthus. Alkaloids: Chem. Pharmacol., 37: 145-204.

Pettit, G.R., M.S. Hoard, D.L. Doubek, J.M. Schmidt, R.K. Pettit, L.P. Tackett and J.C. Chapuis, 1996. Antineoplastic agents 338. The cancer cell growth inhibitory. Constituents of *Terminalia arjuna* (Combretaceae). J. Ethnopharmacol., 53: 57-63.

Prabhu, A. and M. Krishnamoorthy, 2010. Anticancer activity of trigonella foenum-graecum on ehrlich ascites carcinoma in mus musculus system. J. Pharm. Res., 3: 1183-1186.

Prashar, R., A. Kumar, A. Hewer, K.J. Cole, W. Davis and D.H. Phillips, 1998. Inhibition by an extract of *Ocimum sanctum* of DNA-binding activity of 7,12-dimethylbenz[a]anthracene in rat hepatocytes *in vitro*. Cancer Lett., 128: 155-160.

Punturee, K., C.P. Wild, W. Kasinrerk and U. Vinitketkumnuen, 2007. Immunomodulatory activities of *Centella asiatica* and *Rhinacanthus nasutus* extracts. J. Allergy Clin. Immunol., 120: 293-299.

Rajagopal, S., R.A. Kumar, D.S. Deevi, C. Satyanarayana and R. Rajagopalan, 2003. Andrographolide, a potential cancer therapeutic agent isolated from *Andrographis paniculata*. J. Exp. Ther. Oncol., 3: 147-158.

Rajeshkumar, N.V., K.L. Joy, G. Kuttan, R.S. Ramsewak, M.G. Nair and R. Kuttan, 2002. Antitumor and anticarcinogenic activity of *Phyllanthus amarus* extract. J. Ethnopharmacol., 87: 17-22.

Rana, A.Y.K.M.M., J.A. Khanam and M. Asad-Ud-Daula, 2004. Antineoplastic screening of some medicinal plants against ehrlich ascites carcinoma in mice. J. Med. Sci., 4: 142-145.

Ranga, R.S., S. Sowmyalakshmi, R. Burikhanov, M.A. Akbarsha and D. Chendil, 2005. A herbal medicine for the treatment of lung cancer. Mol. Cell Biochem., 280: 125-133.

Raskin, I., D.M. Ribnicky, S. Komarnytsky, N. Ilic, A. Poulev and N. Borisjuk *et al.*, 2002. Plants and human health in the twenty-first century. Trends Biotechnol., 20: 522-531.

Rastogi, R.P. and B.N. Mehrotra, 1990. Compendium of Indian Medicinal Plants. Vol. 2, CDRI and PID, New Delhi, pp: 422.

Saada, H.N., Z.S. Ussama and A.M. Mahdy, 2003. Effectiveness of *Aloe vera* on the antioxidant status of different tissues in irradiated rats. Pharmazie, 58: 929-931.

Sakarkar, D.M. and V.N. Deshmukh, 2011. Ethnopharmacological review of traditional medicinal plants for anticancer activity. Int. J. Pharm. Tech. Res., 3: 298-308.

Salvam, A.B.D., 2008. Inventory of vegetable crude drug samples housed in botanical survey of India, Howrah. Pharmacogn. Rev., 2: 61-94.

Sandur, S.K., H. Ichikawa, G. Sethi, K.S. Ahn and B.B. Aggarwal, 2006. Plumbagin (5-hydroxy-2-methyl-1,4-naphthoquinone) suppresses NF-kappaB activation and NF-kappaB-regulated gene products through modulation of p65 and IkappaBalpha kinase activation, leading to potentiation of apoptosis induced by cytokine and chemotherapeutic agents. J. Biol. Chem., 281: 17023-17033.

Sasaki, Y.F., S. Kawaguchi, A. Kamaya, M. Ohshita and K. Kabasawa *et al.*, 2002. The comet assay with 8 mouse organs: results with 39 currently used food additives. Mutat. Res./Gen. Toxicol. Envrion. Mutagenesis, 519: 103-119.

Sharma, G.N., S.K. Dubey, P. Sharma and N. Sati, 2011. Medicinal values of bael (*Aegle marmelos*) (L.) Corr.: A review. Int. J. Curr. Pharma. Rev. Res., 1: 12-22.

Singh, V., 1995. Traditional remedies to treat asthma in North West and Trans-Himalayan region in J. and K. state. Fitoterapia, 66: 507-509.

Singh, S.S., S.C. Pandey, S. Shrivastava, V.S Gupta and B. Palio, 2003. Chemistry and medicinal properties of *Tinospora cordifolia* (Guduchi). Ind. J. Pharmacol., 35: 38-91.

Singh, N., S.M. Singh and P. Shrivastava, 2005. Effect of *Tinospora cordifolia* on the antitumor activity of tumor-associated macrophages derived dendritic cells. Immunopharmacol. Immunotoxicol., 27: 1-14.

Singh, V., S. Amdekar and O. Verma, 2010a. *Ocimum tanuiflorum* (Tulsi): Bio-pharmacological activities. Pharmacology, Issue 1, No. 10.

Singh, G., P.K. Sharma, R. Dudhe and S. Singh, 2010b. Biological activities of *Withania somnifera*. Ann. Biol. Res., 1: 56-63.

Sridhar, K.R. and R. Bhat, 2007. Lotus: A potential nutraceutical source. J. Agric. Technol., 3: 143-155.

Srivastava, K.C., A. Bordia and S.K. Verma, 1995. Curcumin, a major component of food spice turmeric (*Curcuma longa*) inhibits aggregation and alters eicosanoid metabolism in human blood platelets. Prostaglandins Leukotrienes Essent. Fatty Acids, 52: 223-227.

Suhas, S., B.T. Ramesha, G. Ravikanth, R.P. Gunaga, R. Vasudera, K.N. Ganeshaiah and R. Umashankar, 2007. Chemical profiling of *Nothapodytes nimmoniana* population in the Western Ghats India for anticancer compound, camphothecin. Curr. Sci., 92: 1142-1147.

Sundararajan, P., A. Dey, A. Smith, A.G. Doss, M. Rajappan and S. Natarajan, 2006. Studies of anticancer and antipyretic activity of *Bidens pilosa* whole plant. Afr. Health Sci., 6: 27-30.

Sunila, E.S. and G. Kuttan, 2006. *Piper longum* inhibits VEGF and proinflammatory cytokines and tumor-induced angiogenesis in C57BL/6 mice. Int. Immunopharmacol., 6: 733-741.

Sureban, S.M., D. Subramaniam, P. Rajendran, R.P. Ramanujam, B.K. Dieckgraefe, C.W. Houchen and S. Anant, 2006. Therapeutic effects of *Phyllanthus* species: Induction of TNF-α-mediated apoptosis in HepG2 hepatocellular carcinoma cells. Am. J. Pharmacol. Toxicol., 1: 65-71.

Thatte, U.M., M.R. Kulkarni and S.A. Dahanukar, 1992. Immunotherapeutic modification of *Escherichia coli* peritonitis and bacteremia by *Tinospora cordifolia*. J. Postgrad. Med., 38: 13-15.

Toppo, F.A., R. Akhand and A.K. Pathak, 2009. Pharmacological actions and potential uses of *Trigonella foenum-graecum*: A review. Asian J. Pharm. Clin. Res., 2: 29-38.

Tripathi, Y.B., M. Sharma and M. Manickam, 1997. Rubiadin, a new antioxidant from *Rubia cordifolia*. Ind. J. Biochem. Biophys., 34: 302-306.

Trivedi, N.P. and U.M. Rawal, 2001. Hepatoprotective and antioxidant property of *Andrographis paniculata* (Nees) in BHC induced liver damage in mice. Ind. J. Exp. Biol., 39: 41-46.

Turgay, S., D. Sar and E. Turkistan, 2005. Knowledge, attitudes, risk factors and early detection of cancer relevant to the schoolteachers in Izmir. Prev. Med., 40: 636-641.

Ullah, M.O., S. Sultana, A. Haque and S. Tasmin, 2009. Antimicrobial, cytotoxic and antioxidant activity of *Centella asiatica*. Eur. J. Sci. Res., 2: 260-264.

Umamaheswari, A., R. Shreevidya and A. Nuni, 2008. *In vitro* antibacterial activity of *Bougainvillea spectabilis* leaves extracts. Adv. Biol. Res., 2: 1-5.

Unandr, D.W., L.W. Grady and B.S. Blumberg, 1995. Usage and bioassays in *Phyllanthus* (Euphorbiaceae). IV. Clustering of antiviral uses and other effects. Ethnopharmacology, 45: 1-8.

Vaishnav, M.M. and K.R. Gupta, 1996. Rhamnetin 3-O-gentiobioside from *Cassia fistula* roots. Fitoterapia, 67: 78-79.

Venskutonis, P.R. and A. Dagilyte, 2003. Composition of essential oil of sweet flag (*Acorus calamus* L.) leaves at different growing phases. J. Essent. Oil Res., 15: 313-318.

Wagh, P., M. Rai, S.K. Deshmukh and M.C.T. Durate, 2007. Bio-activity of oils of *Trigonella foenum-graecum* and *Pongamia pinnata*. Afr. J. Biotech., 6: 1592-1596.

Wakita, K., M. Minami, A. Venkateswarlu, V.M. Sharma, M. Ramesh and K. Akahane, 2001. Antitumor bicyclic hexapeptide RA-VII modulates cyclin D1 protein level. Anti-Cancer Drugs, 12: 433-439.

Wattenberg, L.W., J.B. Coccia and L.K.T. Lam, 1980. Inhibitory effects of phenolic compounds on benzo(a)pyrene induced neoplasia. Cancer Res., 40: 2820-2823.

Williamson, E.M., 2002. *Ocimum tanuiflorum*. In: Major Herbs of Ayurveda, Williamson, E.M. (Ed.). Churchill Livingstone Publication, London, pp: 201-205.

Wilson, C.R., J. Sauer and S.B. Hooser, 2001. Taxines: A review of the mechanism and toxicity of yew (*Taxus* spp.) alkaloids. Toxicon, 39: 175-185.

Wu, L.W., Y.M. Chiang, H.C. Chuang, S.Y. Wang and G.W. Yang *et al*., 2004. Polyacetylenes function as anti-angiogenic agents. Pharm. Res., 21: 2112-2119.

Yadav, R. and G.C. Jain, 1999. Antifertility effect of aqueous extract of seeds of *Cassia fistula* in female rats. Adv. Contracept., 15: 293-301.

Yanpallewar, S.U., S. Rai, M. Kumar and S.B. Acharya, 2004. Evaluation of antioxidant and neuroprotective effect of *Ocimum sanctum* on transient cerebral ischemia and long-term cerebral hypoperfusion. Pharmacol. Biochem. Behav., 79: 155-164.

Yoshida, M., M. Fuchigami, T. Nagao, H. Okabe and K. Matsunaga *et al*., 2005. Antiproliferative constituents from Umbelliferae plants VII.(1)active triterpenes and rosmarinic acid from *Centella asiatica*. Biol. Pharm. Bull., 28: 173-175.

Yu, Q.L., H.Q. Duan, Y. Takaishi and W.Y. Gao, 2006. A novel triterpene from *Centella asiatica*. Molecules, 11: 661-665.

Zhang, J., H. Qi and C. Wu, 2004. Research of anti-proliferation of curcumin on A549 human lung cancer cells and its mechanism. Zhong Yao Cai, 27: 923-927.