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 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 km² 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 cell lines such as leukemic K562, T-lymphoid Jurkat, Blymphoid Raji and Breast cancer MCP7 (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-methyl-4-chromanone and butylated hydroxyanisole also showed significant activity in inhibiting in vitro cell growth of human K562 cells (Lambole et al., 2010). Latice 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 aloeisin 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). Diwaney *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 (Punteuce *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.* (2008) 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 agents, 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 tenuiflorum:** 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-regulation of Bcl-2 and VEGF expression and over expression of capase-3 during N-methyl-N'-nitro-N-nitrosoguanidine induced gastric cancer bearing rats (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 oleanolic acid present in the plants have been reported to possess 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 leukaesic 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

<table>
<thead>
<tr>
<th>Name of the plant</th>
<th>Family</th>
<th>Habit</th>
<th>Common name</th>
<th>Local name</th>
<th>Distribution range (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acorus calamus L.</td>
<td>Araceae</td>
<td>H</td>
<td>Sweet Flag</td>
<td>Bag</td>
<td>Upto 2000</td>
</tr>
<tr>
<td>Aegle marmelos (L.) Corr.</td>
<td>Rutaceae</td>
<td>T</td>
<td>Indian Bael</td>
<td>Bael</td>
<td>Upto 1200</td>
</tr>
<tr>
<td>Aloe vera (L.) Burm. f.</td>
<td>Aloeaceae</td>
<td>H</td>
<td>Aloe</td>
<td>Ghrit-Kumari</td>
<td>Upto 500</td>
</tr>
<tr>
<td>Andrographis paniculata</td>
<td>Acanthaceae</td>
<td>H</td>
<td>Kalmegh</td>
<td>Kalamegh</td>
<td>Upto 500</td>
</tr>
<tr>
<td>Asparagus racemosus Willd.</td>
<td>Liliaceae</td>
<td>S</td>
<td>Wild Asparagus</td>
<td>Satawari</td>
<td>Upto 1500</td>
</tr>
<tr>
<td>Betula utilis D. Don</td>
<td>Betulaceae</td>
<td>T</td>
<td>Himalayan Birch</td>
<td>Bhopatra</td>
<td>3000-3200</td>
</tr>
<tr>
<td>Bidens bipinnata L.</td>
<td>Asteraceae</td>
<td>H</td>
<td>Bur-Merigold</td>
<td>Kuma, Kurei</td>
<td>Upto 1500</td>
</tr>
<tr>
<td>Cassia fistula L.</td>
<td>Cassalpinaceae</td>
<td>T</td>
<td>Cassia, Golden Shower</td>
<td>Amalats, Semara</td>
<td>Upto 1400</td>
</tr>
<tr>
<td>Catharanthus roseus (L.) G. Don</td>
<td>Apocynaceae</td>
<td>H</td>
<td>Madagascar Periwinkle</td>
<td>Sadhahar</td>
<td>Upto 1200</td>
</tr>
<tr>
<td>Centella asiatica (L.) Urban</td>
<td>Apiceae</td>
<td>H</td>
<td>Indian Penny Wort</td>
<td>Brahami</td>
<td>Upto 2500</td>
</tr>
<tr>
<td>Cleome viscosa L.</td>
<td>Cleomeaceae</td>
<td>H</td>
<td>Patharchar</td>
<td>Jakhya</td>
<td>Upto 1800</td>
</tr>
<tr>
<td>Curcuma domestica Valt.</td>
<td>Zingiberaceae</td>
<td>H</td>
<td>Turmeric</td>
<td>Haldi</td>
<td>Upto 1800</td>
</tr>
<tr>
<td>Nelumbo nucifera Gaertn.</td>
<td>Neltumboaceae</td>
<td>H</td>
<td>Indian Lotus</td>
<td>Kamal</td>
<td>Upto 500</td>
</tr>
<tr>
<td>Ocinum tenuiflorum L.</td>
<td>Lamiaceae</td>
<td>H</td>
<td>Holy Basil</td>
<td>Tuki</td>
<td>Upto 1800</td>
</tr>
<tr>
<td>Phyllanthus amarus</td>
<td>Euphorbiaceae</td>
<td>H</td>
<td>Bhiu-Aonla</td>
<td>Bhiu-Aonla</td>
<td>Upto 1300</td>
</tr>
<tr>
<td>Schum. and Thonn.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Piper longum L.</td>
<td>Piperaceae</td>
<td>H</td>
<td>Indian Long Pepper</td>
<td>Pipalli</td>
<td>Upto 2500</td>
</tr>
<tr>
<td>Plumbago azelina L.</td>
<td>Plumbaginaceae</td>
<td>H</td>
<td>Chitraka</td>
<td>Chitraka</td>
<td>Upto 2500</td>
</tr>
<tr>
<td>Podophyllum hexandrum Royle</td>
<td>Berberidaceae</td>
<td>H</td>
<td>Himalayan May Apple</td>
<td>Ban-Kakri</td>
<td>Above 2800</td>
</tr>
<tr>
<td>Rubia manjith Roxb. ex Fleming</td>
<td>Rubiaceae</td>
<td>DC</td>
<td>Indian Madder</td>
<td>Manjith</td>
<td>Upto 2500</td>
</tr>
<tr>
<td>Taxus boivata L.</td>
<td>Taxaceae</td>
<td>T</td>
<td>Yew Tree</td>
<td>Thamer</td>
<td>Above 2400</td>
</tr>
<tr>
<td>Terminalia arjuna (Roxb. ex DC) Wight and Arn.</td>
<td>Combretaceae</td>
<td>T</td>
<td>Arjun</td>
<td>Arjun, Kowa</td>
<td>Upto 500</td>
</tr>
<tr>
<td><em>Tinospora cordifolia</em> (Wildl.) Hook. f. Menispermaceae</td>
<td>CS</td>
<td>Chuduchi, Giloe</td>
<td>Giloe</td>
<td>Upto 1300</td>
<td></td>
</tr>
<tr>
<td><em>Trigonella foemum-graecum</em> L.</td>
<td>Papilionaceae</td>
<td>H</td>
<td>Fenugreek</td>
<td>Methi</td>
<td>Upto 1800</td>
</tr>
<tr>
<td>Withania somnifera (L) Durian</td>
<td>Solanaceae</td>
<td>S</td>
<td>Indian Ginseng</td>
<td>Ashwagandha</td>
<td>Upto 1200</td>
</tr>
</tbody>
</table>

H: Herb; T: Trees; S: Shrub; DC: Deciduous climber; CS: Climber shrub
<table>
<thead>
<tr>
<th>Name of the plant</th>
<th>Ethnobotany</th>
<th>Chemical constituents</th>
<th>Biological activities</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Acorus calamus</em></td>
<td>Appetite loss, diarrhoea, colic, cramps, sedative, chest pain, digestive disorders, nervous disorders, rheumatism, gas, vascular disorders</td>
<td>α and β-aracene, caryophyllene, isocarvone, methyl isoeugenol, safrol (Venskusiatas and Duglyte, 2003)</td>
<td>Antimicrobial, antiecellular, antifungal, antibacterial, allelopathic, anaesthetic, antioxidants, (Mehrotra et al., 2003; Devi and Gangewala, 2009)</td>
</tr>
<tr>
<td><em>Aegle marmelos</em></td>
<td>Digestive, stomachic, diarhoea, dysentery, dyspepsia, asthma, anaemia, fracture, wounds, typhoid, sacred</td>
<td>Lupeol, pyranocoumarin, scopoarome, scopoletin, marinesin, skimming, s-b-sitosterol, cumararagonolin, sathctosin, porsolen, temonamide, mermin, skimmianine (Lambertini et al., 2005; Lambol et al., 2010)</td>
<td>Antiviral, antiinflammatory, antiinflamgesic, anti diabetic, hepatoprotective, antipyretic, antifungal, radioprotective, antispermatogenic, antiulcer (Jagethia et al., 2005; Sharma et al., 2011)</td>
</tr>
<tr>
<td><em>Aloe vera</em></td>
<td>Constipation, burns, fever, blood purifier, cough and cold, asthma, jaundice, piles</td>
<td>Aloe-emodin, aemmannan, lectin, barbaloin, isobarbaloin, anthrone-C-glycosides, sitasterol, campesterol, lupeol, butyl-p-tolyl sulphide, 6-methyl-4-chromanone, butylated hydroxyanisole (Joseph and Raj, 2010; Lambol et al., 2010)</td>
<td>Anti-inflammatory, arthritis, antibiotic, astringent, antiseptic, antimicrobial, haemostatic (Saada et al., 2005; Joseph and Raj, 2010)</td>
</tr>
<tr>
<td><em>Andrographis paniculata</em></td>
<td>Gastro-intestinal, respiratory infection, fever, herpes, sore throat</td>
<td>Andrographolide, neandrographolide, deoxyandrographolide andro-graphoside, 14-deoxyandrographolide, 14-deoxy-11,12-didehydroandrographolide, deoxyandrogaphoside, hemandrographolide andrographan andrographosside, stigmastenol (Mishra et al., 2007)</td>
<td>Antipyretic, antifungal, antimalarial, antivenom, antiinflammatory, immunostimulant, antidiabetic, anti HIV, antifertility, hepatoprotective (Trivedi and Rawal, 2001; Niranjan et al., 2010)</td>
</tr>
<tr>
<td><em>Asparagus racemosus</em></td>
<td>Tonic, leukemia, dysentery, diabetes, appetizer, leprosy, night blindness, neuroblastoma, epilepsy (Neri et al., 2010)</td>
<td>Glutathione, phytoestrogen, shatavarine, LII,III,IV, asparagusines, arginine, tyrosine, kaempferol, quercetin, rutin (Neri et al., 2010)</td>
<td>Antiestrogen, antioxidant, anticarcinogenic, antibacterial, antidiabetic, immunostimulant, antihyperglycaemic, gastroprotective, ulcer protective (Bopana and Saseen, 2007; Neri et al., 2010)</td>
</tr>
<tr>
<td><em>Betula utilis</em></td>
<td>Timber, sacred, spermicidal, fungal infection (Gaur, 1989)</td>
<td>Betulin, lupeol, oleandric acid, acetylhexadecanal, betulic acid, lupenone, sitasterol, methyl betulonate, methyl betulate, triterpenoid (Salvam, 2008)</td>
<td>Antibacterial, antiseptic, carminative, contraceptive (Umamaheswari et al., 2008)</td>
</tr>
<tr>
<td><em>Bidens bipinnata</em></td>
<td>Leprosy, flu, fever, cold, jaundice, hepatitis, cuts (Gaur, 1999)</td>
<td>Polycytenol, polycytenol glycosides, auron, auron glycosides, sesquiterpenes, acetylaetone, glucosides, phenylebehadiynol, phenylpropanoid pelophyrtans, diterpenes (Li et al., 2008)</td>
<td>Antipyretic, anti-malarial and anti-bacterial, antimicrobial, IFN-a promoter, antidiabetic, antiallergy, antioxidants, (Sundararajan et al., 2006; Chiang et al., 2007; Mild laxative Bahorun et al., 2005), purgative, antiulcer, antipyretic, analgesic, anti-inflammatory, hypoglycaemic, antidiabetic,</td>
</tr>
<tr>
<td><em>Cassia fistula</em></td>
<td>Antiseptic, antidote to snake bite, asthma, bronchitis, skin disease (Gaur, 1989)</td>
<td>Glycerides, caprylic and myristic acids, cephalin, lecithin phospholipids, Lupeol, hexacosanol and β-sitosterol, Fistucacidin,</td>
<td></td>
</tr>
<tr>
<td>Name of the plant</td>
<td>Ethno-botany</td>
<td>Chemical constituents</td>
<td>Biological activities</td>
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<td>-------------------</td>
<td>--------------------------------------------</td>
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<tr>
<td>Catharanthus roseus</td>
<td>Blood pressure, diabetes mellitus</td>
<td>Proanthocyanidin, epicatechin, 3-O-B-D-glucopyranoside, 7-biflavonoids, triflavonoids,</td>
<td>Antipruritus, antileucocytosis, anti-rheumatic, anti-tussive, antifertility, antioxidant</td>
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<td></td>
<td></td>
<td>procyanidin B-2, semiside, rhin, rhamnetin 3-O-gentibioside (Vaishnav and Gupta, 1996;</td>
<td>(Elajobja et al., 1999; Yadav and Jain, 1999; Ali et al., 2003; Gebianand et al., 2010)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Vinblastine, vinciristine, vinidesine and vinorelbine (Pearce, 1990)</td>
<td>Anti-microtubule, anti-mitotic activities, leukaemia, rhabdomyosarcoma, neuroblastoma and (Johnson et al., 1968)</td>
</tr>
<tr>
<td>Centilla</td>
<td>Ulcer, wounds, gynaecological, jaundice, brain tonic</td>
<td>Vallerione, asiaticosides, sitosterol, centelloside, oxyasiaticoside, asiatic acid, madecassoside (Leung and Foster, 1998; Brinkhaus et al., 2000)</td>
<td>Antidiabetic, anxiety, blood pressure, antimicrobial (Ullah et al., 2009)</td>
</tr>
<tr>
<td>Curcuma domestica</td>
<td>Condiment, dye, blood purifier, skin disease, rituals, digestion</td>
<td>Curcumin, gheuronicid</td>
<td>Antioxidant, anti-inflammatory, antiviral, antifungal, antibacterial, (Duvoix et al., 2005; Babu et al., 2007)</td>
</tr>
<tr>
<td>Nelumbo nucifera</td>
<td>Diarrhoea, tissue inflammation, leprosy, fever</td>
<td>Dauricine, lotusine, muciferine, protoberberine, linsinosine, iso-linsinosine, rosemicine, nesiferine, nelumbine, antisthoroids, Procyanidins (Sridhar and Bhat, 2007).</td>
<td>Anti-diabetic, anti-pyretic, anti-steroidogenic, antifertility, antioxidative, antiviral, astringent, anti-hyperdipsia, dermatopathy, halitosis, menorrhagia, sedative, antispasmodic (Sridhar and Bhat, 2007)</td>
</tr>
<tr>
<td>Ocimum tenuiflorum</td>
<td>Cough, respiratory tract infection, stress syndrome, worm infestations, fungal infections, diuretic, bronchitis, rheumatism, pyrexia (Nadkarni, 1993)</td>
<td>Ursolic acid, palmitic, stearic, oleic, linoleic and linolenic acid, apigenin, luteolin, ocmimosides A and B, ocmarin, apigenin, cerberosides, cerberosides, 7-O-B-D-glucuronic acid, 6'-methyly ester, selinene pinenes, camphene, eugenol, euginal, deacetic acid (Nadig and Laski, 2006; Gupta et al., 2007; Singh et al., 2010a)</td>
<td>Anti-microbial, anti-inflammatory, anti-asthmatic, antioxidant, antipyretic, analgesic, hypotensive, immunomodulatory, antifertility, anti-diabetic (Williamson, 2002; Yanapallewar et al., 2004)</td>
</tr>
<tr>
<td>Phyllanthus amarus</td>
<td>Urinary troubles, kidney and gallbladder stone, hepatitis, cold, flu, tuberculosis, jaundice, liver disease</td>
<td>Phyllanthin, hypophyllanthin, ligamnosmircanthin, nirtetratin, quercetin, phyllotrin (Amir et al., 2003)</td>
<td>Antiviral, antibacterial, anti-diabetic, hypertension, antianalgesic, antispasmodic, antistomachic (Unamdr et al., 1995; Nishiura et al., 2004)</td>
</tr>
<tr>
<td>Piper longum</td>
<td>Respiratory disorder, cardiac disorder</td>
<td>Piperine, piperlongumidine, sylvatine, guainesine, piperlongumidine, fillline, sitosterol, methyl-piperate (Nakatani et al., 1986)</td>
<td>Antiamoebic, anti-giardial, antiseptic, antioxidant, anti-inflammatory, immunostimulatory (Ghoshal and Lakshmi, 2002)</td>
</tr>
<tr>
<td>Table 2: Continued</td>
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<tr>
<td><strong>Name of the plant</strong></td>
<td><strong>Chemical constituents</strong></td>
<td><strong>Biological activities</strong></td>
<td><strong>Ethno-botany</strong></td>
</tr>
<tr>
<td>--------------------------------------------------</td>
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<td></td>
</tr>
<tr>
<td>Pteleospermum angustifolium</td>
<td><strong>Dysentery, asthma, dysentery, pain, anemia, asthma, dysentery, pain, anemia</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rhoda angustifolia</td>
<td><strong>Dysentery, asthma, dysentery, pain, anemia, asthma, dysentery, pain, anemia</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Terminalia arjuna</td>
<td><strong>Dysentery, asthma, dysentery, pain, anemia, asthma, dysentery, pain, anemia</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trigonella foenum-graecum</td>
<td><strong>Dysentery, asthma, dysentery, pain, anemia, asthma, dysentery, pain, anemia</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Withania somnifera</td>
<td><strong>Dysentery, asthma, dysentery, pain, anemia, asthma, dysentery, pain, anemia</strong></td>
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</tbody>
</table>
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 possess 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


