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"Potent Anti-cancer Medicinal Plants of Garhwal Himalaya"

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ABSTRACT
Now day's cancer is a common disease and affects a large number of populations in the world. Much scientific research and treatment are available to treat cancer at one point. Some of them are very useful and some show many toxic and harmful effects. At present natural occurring substances like herbal drugs are trending for the treatment of every type of diseases. These are non-toxic and give maximum efficacy and affinity. In this review paper, we can study some anticancer herbal agents and their chemical compounds to treat cancer, available in Uttarakhand.

Keywords: - Anticancer compounds, Herbs, Therapeutic agents and Uttarakhand.

INTRODUCTION
Anticancer medicinal plants have a large scope to treat breast, prostate, lung, liver, pancreatic, radio, colon and hepatocellular carcinoma etc [1]. Cancer is a group of diseases involving abnormal cell growth with the potential to invade or spread to another part of body [2, 3 & 6].

MATERIALS AND METHODS
In Uttarakhand there are a large number of medicinal plants are available having anti-cancer properties. Due to the presence of rich biodiversity, the following important plants having anti-cancer properties and are collected from different data.

Acorus calams
It belongs to the family Araceae. It is commonly known as the sweet flag. The α-asarone, β-asarone, caryophyllene, methyl isoeugenol and safrol are the active compounds present in this plant [11]. The essential oil of *A. calams* rhizome inhibits the proliferation of cancer cells at 120µg/ml. *A. calams* have anti-proliferation and anti-angiogenic effects on cancer cells [10].

Aegle marmelos
Belonging to the Rutaceae family. It is commonly known as Indian bael. Its leaves extract showed and reported potent anticancer activity and isolated compounds are lupeol, eugenol, ciyral cineol and limonene [11]. *A. marmelos* methanolic extract showed anticancer activity on tumor cells such as MDA-MB-231 and HEP-2 by spering normal vero cells [11].

Aloe vera
A. vera commonly known as ghrit kumara is distributed at the range of 500m, belonging to Asphodelaceae family. The leaves isolated compounds are acemannan (polysaccharide), emodin, lectin and alexin-B [11]. The ethanolic extract of *A. vera* is used in the treatment of a different kind of cancer. It showed the highest cytotoxic effects and inhibited tumor growth [12].

Andrographis paniculata
It belongs to the Acanthaceae family and is commonly known as green chiretta or king of bitters. The whole plant extract is used for different diseases. Its isolated compounds like andrographolide [11]. The ethanolic and acetone extract of *A. peniculata* leaves shows anti-cancer properties to treat IMR-32 and HT-29 cancer cells [13].

Asparagus racemosus
It belongs to the Liliaceae family. This shrub is commonly known as wild aspergus (Shatavari) and is distributed up to 1500m. [11]. Glutathione, phytoestrogens, satawarine-1, 2, 3 & 4, asparagine, tyrosine, routine and quercetin are the active compounds available in this plant. Various types of steroids are present in *A. racemosus* leaves. *A. racemosus* stops the growth of renal cell carcinoma UOK-146 cells. So we can say that it has some antitumor activity. Saponins are the main bioactive compound present in it [14].

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Catharanthus roseus
Family Apocynaceae, commonly known as sadabahar. The whole plant isolated compounds are vinblastine, vincristine, vindesine and vinorelbine [11]. These compounds are potent and inhibit the growth of MCF-7 cells. Vinblastine is the most active compound, which is present in it and makes it a more potent anti-cancer plant [15].

Plumbaqe zeylanica
Plumbaginaceae family, commonly known as chitrak or wild leadwort. The leaves extract's active compound is plumbagin [11]. The hydroalcoholic extract of *P. zeylanica* inhibits the HCT-15 cell and aqueous extracts inhibit the growth of MCF-7 breast cancer cells [16].

Ternospora cardifolia
It belongs to Menispermaceae family and is commonly called guduchi or giloy. The stem is the plant's most used part. These compounds are most active in this plant e.g. are sesquiterpenes, diterpenes, syringine, cardiol, choline, tinosporin, colambin, isocolumbin, and palatine [11]. The methanolic extract of *T. cordifolia* inhibits the growth of the MDA-MB-231 human breast cancer cell line [17].

Artocarpus obusus
Belongs to the Moraceae family. The isolated compounds are xanthones, pyrancyloartobiloxanth-one-A, duhydroatoindoesiamin-C, pyrancyloartobiloxanth-B [4]. *A. obusus* extract shows very high anti-cancer activity against HL-60 cells with IC-50 and chloroform extract of *A. obtusus* also shows cytotoxic activity towards MCF-7 cells with IC-50 values of 22.60µg/mL [18].

Betula utilis
Belongs to the Betulaceae family, it is a tree and commonly known as Himalayan Birch or Bhojpatra, distributed up to 2000 to 3500m. The isolated compounds found in this plant are mainly betulin, lupeol, oleanolic acid, acetylohealoic acid, lupenone, sistarol, and triterpenoids [5]. In *B. utilis* triterpenes are the main active compound that shows cytotoxic activity against 6 different cancer cell lines where UA was found to be selective for breast cancer cells over non-tumorigenic breast epithelial cells (MCF-10A) [19].

Biden bipinnata
family Asteraceae, it is an herb commonly known as Burmerigold or Kumur and is distributed up to 1500m. Generally, polyacetylenese, aurons, sesquiterpenes, acetylacetone and glycosides are isolated from this plant [5]. The extract from the whole plant was extracted with n-hexane, chloroform, and methanol extracts (E-1–E-3). The extracts were fractioned by the column chromatography method and fractioned with ethyl acetate, acetone and water (F-1-F-3). All the extracts and fractions were tested for anticancer and antipyretic activity [20].

Cassia fistula
Cassia fistula belongs to the Caesalpiniaceae family, commonly known as the Golden Shower or Amaltas, and is found at up to 1400m. These potent compounds are isolated from this plant e.g. are glyceride, caprylic, myristic acid, lupeol, cephalin and fistucacidin [5]. The rhein isolated from ethyl acetate extract was found to be cytotoxic toward COLO-320 DM cells. This is mainly used in colon cancer [21].

Cantella asiatica
It belongs to the Apiaceae family and is found at up to 2500m. Commonly known as Indian pennywort (Brahmi). vallarine, sitosterol, asiaticoside, oxyasiaticoside, madecassoside are the active components that can be extracted from this plant [5]. The water extract of *C. asiatica* leaves is generally used to reduce the formation of a tumor, mainly in bronchioles and alveolar septa [22].

Cleome viscosa
It belongs to Cleomaceae family and is commonly known as patharchur (Jakhiya) and is distributed up to 1800m [5 & 6]. The methanolic extract of *C. viscosa* shows anti-cancer properties [23].

Curcuma domestica
Belongs to Zingiberaceae family and is commonly known as turmeric (Haldi) and is distributed up to 1800m. Curcumin and glucuronide are the active compounds present in it [5 & 8]. Curcumin exhibits anticancer ability by targeting different cell signaling pathways including growth factors, cytokines, transcription factors & genes modulating cellular proliferation and apoptosis [24].

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Nelumabo nucifera
Nelumbonaceae family, herb distributed up to 300m and commonly known as Indian lotus (Kamal). Dauricin, lotasine, muciferine, roemerine, neferine, antisteroids, procyanidins are the active compounds that can be extracted from Indian lotus [5]. The extract of Lotus stamen can be used to inhibit the growth of human HCT-116 colon cancer cells [25].

Ocimum tanuiflorum
Belongs to Lamiaceae. It is a herb distributed up to 1800m and commonly known as Holy basil(Tulsi). Ursolic acid, palmitic, stearic, oleic, apigenin, luteolin, cerebrosides, camphene, eugenol, eugenal, oleanolic acid are the active compounds available in it [5]. The methanolic leaves extract and aqueous extract of *O. tanuiflorum* can be used in the human cancer cell lines (MCF-7 and MDA-MB-231) and the non-cancerous cell line (HS-27) [26].

Phyllanthus amarus
Euphorbiaceae family herb commonly known as Bhui-aonla and distributed up to 1300m. Phyllanthin, hypophyllanthin, quercetin are the active compounds present in it [5]. It shows anticancer antitumor activity by inhibition of metabolic activation of carcinogens as well as the inhibition of cell cycle regulators and DNA repair [27].

Piper longum
Belongs to Piperaceae family, it is a herb that's commonly known as Indian long pepper(pipalli). Piperine, piperlonguminine, sylvatine, guineensine, filfiline, sistosol, methyl-piperate can be extracted from this plant [5]. The *P. longum* fruit extract viz... Hexane, benzene and acetone exhibited significant growth inhibitory potential (up to 95%) against lung, ovary, breast, leukemia and prostate cancer cell lines [28].

Rubia manjith
Belongs to Rubiaceae family. Distributed up to 2500m and commonly known as Indian madder (Manjith). Rubiadin, rubierythrine acid, purpurin, olizarin, munjistin are the active compounds present in this plant [5]. Methanol extract of *R. manjith* shows high potent activity for inhibition of human cervical cancer cell line and Human larynx carcinoma cell line [29].

Taxus baccata
Taxaceae family, which is a tree distributed at above 2400m and commonly known as the yew tree (thunder). The phenylpropyl, phenylbutyl, cutin, taxine alkaloids, tasusin, baccatin-4 and baccatin-3 can be extracted from it [5]. The methanolic extract of *T. baccata* leaves and seed had better activity on HCT-116 cells [30].

Trigonella foenum-graecum
Belongs to Papilionaceae family, is a herb commonly known as Fenugreek (Methi) and distributed up to 1800m. Disogenin, gitogenin, neogitogenin and cyclophosphamide are the active compounds available in this plant [5]. The methanolic seed extract of frenugreek can be used to treat SK-BR3 breast cancer cells [31].

Results and Conclusions
On the behalf of above data and their information in Uttarakhand, there are a large range of plants that contain anticancer properties without giving any toxic or side effects. In Uttarakhand, their traditional health care system is the most important and valuable part, which is connected with philosophies and cultural origins. We can fight and cure cancer by various traditional methods. Many of the naturally occurring active compounds from herbal plants can be used to treat cancer.

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Table:-1.1

Plant name	Common name	Family	Chemical Compounds	Anticancer activities	Other P'cological activities	Refer-ences
Acorus calams	Sweet flag	Areceae	Alpha-beta asarone, caryophyllene, methyl isoeugenol and safrol.	Essential oil of rhizome of *A. calams* inhibits the proliferation of cancer cell at 120µg/ml.	Antibacterial, antioxidant and antifungal.	[4] [10]
Agle marmelos	Indian bel	Rutaceae	Lupeol, eugenol, ciyral, cineol and limonene.	*A. marmelos* showed anticancer activities by its methanolic extract and inhibit the tumor cell such as MDA-MB-231 and HEP-2 by spering normal vero cells.	Antioxidant, antimicrobial and anti-inflammatory.	[4] [11]
Aloe vera	Ghrit kumari	Asphodelaceae	Acemannan, emodin, lectin and alexin-B.	Ethanolic extract of *Aloe vera* is used in the treatment of cancer cells. It shows highest cytotoxic effects and inhibits the tumor growth.	Antibacterial, antioxidant and prevent vitamin deficiency.	[4] [12]
Andrographis paniculata	Chiretta	Acanthaceae	Andrographolide	Ethanolic and acetone extract of *A. peniculata* leaves showed potent anticancer properties with IMR- 32 and HT -29 cancer cells.	Antidiabetic, antimicrobial, analgesics and hypertension.	[4] [13]
Aspergus racemosus	Satavari	Liliacea	Glutathione, phytoestroges, satawarine-1,2,3,4, asparagine, tyrosine, routine and Quercetin.	*A. racemosus* stops the growth of renal cell carcinoma UOK-146 cells.	Antiulcer, antioxidant, antimicrobial and antiseptic.	[4] [14]
Cantharanthus roseus	Sadabahar	Apocynaceae	Vinblastine, vincristine, vindesine and vinorelbine.	It inhibited the growth of MCF-7 cells.	Antioxidant and reduced muscle pain.	[4] [15]
Plumbage zeylanica	Chitrak	Plumbaginaceae	Plumbagin	Hydroalcholic extract of *P. zeylanica* inhibit the HCT-15 cell and aqueous extracts inhibit the growth of MCF-7 Breast Cancer cells.	Antiartheritic, antimicrobial, antioxidant and skin diseases.	[4] [16]
Ternospora cardifolia	Gudchi	Menispermaceae	Sesquiterpenes, diterpenes, syringine, cardiol, choline, tinosporin, colambin, isocolumbin and palatine.	The methanolic extract of *T. cordifolia* inhibits the growth of MDA-MB-231 human breast cancer cell line.	Antidiabetic, antiallergic, anticholergenic, antigout, antioxidant and antimicrobial.	[4] [17]
Artocarpus obtusus		Moraceae	Xanthones, pyrancyloartobiloxanth one-A, duhydroatoindoesiamin-C and pyrancyloartobiloxanth-B.	Potent anticancer activity against HL-60 cells with IC-50 and chloroform extract of *A. obtusus* also showed cytotoxic activity towards MCF-7 cells with IC50 values 22.60 µg/mL.	Antioxidant and antibacterial.	[4] [18]
Betula utilis	Himalayan brich	Betulaceae	Betulin, lupeol, oleanolic acid, acetylohealoic acid, lupenone, sistarol and triterpinoids.	*B. utilis* isolated triterpene are main active compounds, which showed cytotoxic activity against six different cancer cell lines.	Antiseptic, anticonvulsant, antimicrobial, antioxidant and wound healing.	[4] [19]
Biden bipinnata	Kummr	Asteraceae	Polyacetylenese, aurons, sesquiterpenes, acetylaceton and glycosides	*B. bipinnata* all extracts and fractions are potent anticancer.	Antioxidant and antimicrobial.	[5] [20]
Cassia fistula	Amaltas	Caesalpiniaceae	Glyceride, caprylic, myristic acid, lupeol, cephalin and fistucacidin.	The isolated compound rhein was found to be cytotoxic toward COLO-320 DM cells and mainly	Antiseptic, antimicrobial and anti-inflammatory.	[5] [21]

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				used in colon cancer.		
Cantella asiatica	Brahmi	Apiaceae	Vallarine, sistosterol, asiaticoside, oxyasiaticoside and madecassoside.	The water extract of *C. asiatica* leaves are generally used to reduce the formation of a tumor, mainly in bronchioles and alveolar septa.	Antiseptic, antileprosy, antiulcer, antidiarrheal, analgesic and antioxidant.	[5] [22]
Cleome viscosa	Jakhiya	Cleomaceae	Fatty acids and methyl esters.	The methanolic extract of *C. viscosa* showed potent anticancer activity.	Antidepressant, antibacterial, antiarthritis, antioxidant, antimalarial and wound healing.	[5] [6] [23]
Curcuma domestica	Haldi	Zingiberaceae	Curcumin, demethoxycurcumin and bisdemethoxycurcumin.	Curcumin exhibits the anticancer ability by targeting different cell signaling pathways.	Anti-inflammatory, antioxidant, antibacterial, joint pain and skin inflammation.	[5] [8] [24]
Nelumabo nucifera	Kamal	Nelumbonaceae	Dauricin, lotasine, muciferine, roemerine, neferine, antisteroids and procyanidins.	The extracts of Lotus stamen have used to inhibit the growth of human HCT-116 colon cancer cells.	Antidiabetic, antidiarrheal, antioxidant and antimicrobial.	[5] [25]
Ocium tanuiflorum	Tulshi	Lamiaceae	Vrsolic acid, palmitic, stearic, oleic, apigemin, leteolin, cerobrosides, camphene, eugenol, eugenal and oleanolic.	Methanolic and aqueous leaves extract of *O. tanuiflorum* used in the human cancer cell lines (MCF-7 and MDA-MB-231) and the non-cancerous cell line (HS-27).	Antiseptic, analgesics, antimicrobial and antioxidant.	[5] [26]
Phyllanthus amarus	Bhui-aonla	Euphorbiaceae	Phyllanthin, hypophyllanthin and quercetin.	It showed antitumor activity by inhibition of metabolic activation of carcinogen as well as the inhibition of cell cycle regulators and DNA repair.	Antimicrobial, antioxidant, antiseptic and digestive disorders.	[5] [27]
Piper longum	Pipalli	Piperaceae	Piperine, piperlonguminine, sylvatine, guineensine, filfiline, sistosol and methyl-piperate.	*P. longum* fruit all extracts exhibited significant growth inhibitory potential (up to 95%) against lung, ovary, breast, leukemia and prostate cancer cell lines.	Antimalarial, antiviral, anticold, antioxidant, antimicrobial and used to treat chronic bronchitis, asthma, constipation, gonorrhea and paralysis of the tongue.	[5] [28]

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