Review Article

Medicinal plants as therapeutic agents for cancer treatment

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Abstract

Medicinal plants are potent natural sources of drugs to treat different human inflammations since ancient time. Many of anticancer lead bioactive molecules such as vinca alkaloid, vinblastine, vincristine, camptothecin, and taxanes have been characterized from different medicinal plants and are used as therapeutic agents in worldwide. Technical strategies based on the natural yield of drug innovation, ethnomedicines and traditional pharmacology is reemerging to caring good base as striking discovery train. The current declined in the number of new molecular entities from the medicinal industry, unique anticancer agents are being required from traditional medicines. According to recently published data, this article reports a detailed review of ethnomedicinally important anticancerous medicinal plants. It will provide a new way to explore the therapeutic value of plants and characterization of biologically active compounds from them that may lead towards developing anticancer drugs and proper treatment of cancer.

Keywords: Cancer, Anticancer, Medicinal plants, Pharmacological effects of herbs.


INTRODUCTION

Medicinal plants are a category of the plants that includes specific chemical compounds in their body and are useful for multifold directions. These are also variable in their habits like herbs, shrubs, trees, climber and creepers etc. (Patel, 2014). Natural medicinal plants provide an opportunity for a new medicinal an approach for new medicinal products. Traditional and alternative medicines are reemerging as novel scientifically practical options (Patwardhan and Mashelkar, 2009). Approximately 35,000 to 70,000 plant species have been used for medicinal purposes in the world. Out of them, 6,500 species are used in Asia alone as home remedies against different diseases (Amiri et al., 2014).

Medicinal plants variety, distribution, and native uses were recorded by Sharma and Samant (2014). Important medicinal plants of tehsil, Joginder Nagar district Mandi H.P., India was carried out by Kumar (2014). Indigenous knowledge of medicinal plants among tribals was focused by Geetha (2010) whereas plant biodiversity of Akola and Washim (Bhadange, 2011) district of M.H. for medicinal use was examined by Bhadange (2011). Exploration of ethnomedicinal values of imperative plants with shrubs was analyzed by Majeed et al. (2011). Phytochemical study of some famous plants belonging to Pakistan’s areas such as Dir, Kohistan valley, Khyber Pukhtunkhwa by Hazrat et al. (2011). Yashwant (2014) studied on endangered medicinal plant Caesalpinia bonduc, germination, and growth Status (Linn.) Roxb. Commercially Important Medicinal Plants of South Africa reviewed by Street and Prinsloo (2012). Bhat et al. (2013) focused on Need and importance of conservation of Tinospora cordifolia a threatened medicinal plant. Diversity, Ethnomedicinaluses Conservation of the medicinal plants studied by Adhikari (2010).

Current literature survey on “medicinal plant diversity and importance” provided the enormous beneficial health care aspects that increased the demand for medicinal plants in both developing and developed countries. According to the survey, more than 50000 species are used for therapeutic purposes; among them, 13 percent are flowering plants...
(Schippmann et al., 2002). Approximately 45000 plant species has been used in India and among them several thousand have been possessed medicinal properties. Current literature suggests that 80% drug components are natural products or natural compounds inspired (Harvey, 2008). However, 60% of anticancerous and 75% of anti-infective medicines accepted from 1981-2002 could be declared as herbal products (Gupta et al., 2005). From literature survey, it should be concluded that biologically active compounds of plants are used as a major source for treatment of many diseases.

Compounds of plants that normally used in traditional medicines present better tolerance and safety as compared to other chemical entities used (Patwardhan et al., 2004). Traditional medicine based bioprospecting offer supreme structural variety as potent for new leads (Koehn and Carter, 2005). Natural phytochemical constituents derived from medicinal herbs have played important role in organization of numerous human clinical aspects, such as cancer (Mehta et al., 2010; Desai et al., 2008; Guilford and Pezzuto, 2008).

Trade species over-exploitation, a collection of medicinal plants in a destructive way, susceptibility due to evolutionary pressure are major threats to the survival of medicinal plants. To achieve feasible yield of medicinal plants and other non-timber forest products (food i.e. wild edibles, fuel, lumber, agricultural tools, fiber and various other purposes), there must be a need of advanced approach which include socio-biological, ecological, socio-cultural and economic aspects of the species (Ghimire et al., 2004).

**Plant extracts evaluation as prophylactic agents**

Now a day, most research has been established to estimate the effect of medicinal plant extracts against cancer-causing agents. Altogether, the synergetic effects of the concoction of plant metabolites and numerous level of interference present higher effectiveness throughout chemoprevention regimens (Guilford and Pezzuto, 2008). The inhibition of tumor promotion process by natural bioactive compounds vary from the prevention of gene-damaging effects, elevated anti-inflammatory and antioxidants activities, proteases inhibition, cell proliferation and defense between intracellular connections to change signal transduction pathways and apoptosis (Soobrattee et al., 2006).

The clarification of effectiveness of plants could direct the establishment of an alternative and complementary technique against cancer. However, research on medicinal plants has recently been responsible for explosive advances in drug discovery, separation techniques, extract preparation methods, physicochemical measurements and new concepts. Numerous naturally occurring compounds from plants are being used as anticancerous agents and are currently undergoing medical development (Kim et al., 2015) as shown in table 1. *Artemisia* is a large and diverse genus have been used as food additives as well as antimalarial and antiparasitic toxic (Bora and Sharma, 2011; Gilani et al., 2005), anti-inflammatory (Abad et al., 2012), antimicrobial and antiviral agents (Aniya et al., 2000; Kordali et al., 2005a; Kordali et al., 2005b). Many plants like *Petasites japonicas* (Kim et al., 2015), *Amorphophallus campanulatus* (Ansil et al., 2012), *Curcuma aromatic* (Li et al., 2014), *Panax ginseng*, *Salvia miltiorrhiza* (Wang et al., 2012), *Tripterygium wilfordii* (Chen et al., 2012), *Astragalus* (Chen et al., 2011) and many other plants used as an anticancerous agents with minimum toxicity. *Dracocephalum kotschyi* has a selective effect on liver cancer cell mitochondria to activate apoptosis signaling (Talari et al., 2014).

*Graptopetalum paraguayense* may represent a therapeutic option for treating hepatic inflammation and fibrosis (Su et al., 2013). The root of *Cynanchum auriculatum* have number of biologically active compounds, C-21 steroidal glycosides, are of significant attention because of their bioactivities, with prevention and therapy of chronic hepatitis (Yin et al., 2007), hepatic fibrosis (Lv et al., 2009) and liver cancer (Wang et al., 2007; Bi et al., 2008). *Silybum marianum* is used against hepatoprotective and tumorigenic effects in vitro and in vivo conditions by suppressing oxidative stress and proliferation (Manuscript, 2013). *Nigella sativa* (NS) has been shown several pharmacological activities, including antioxidant, inhibit inflammation, chemotherapeutic and anti-tumor activities (Padhye et al., 2008), as well as hepatoprotective activity (Salama et al., 2006).

Most glycoproteins originating from *Zanthoxylum piperitum* DC (ZPDC) have immunorelated factors that work as anti-inflammatory, anti-apoptosis and anticancerous, and it is unspecified that ZPDC glycoprotein has potential against hepatocarcinogenesis in an animal model (Oh et al., 2009; Lee and Lim,
From Simaroubaceae plants, *Bruceajavanicaeis* extracted. It has low toxicity but high anti-cancer effectiveness (Chen et al., 2013; Gao et al., 2011). *Nigella sativa* seeds, oils, and extracts have been used against cancer. Current scientific research to investigate anticancer activity of *N. sativa*is a comparatively modern affair (Permalatha et al., 1997). *Cassia fistula* and *Picrorhiza scrophulariﬂora* are used as anticancerous on HCC patients (Rafiq et al., 2015). *Petasites japonicus* (PJ) is also known as anti-inﬂammatory and anti-allergenic (Lee et al., 2011; Lee et al., 2013). The methanolic extract of *Petasites japonicus* roots may alter molecular signaling pathways and inhibit HCC cells proliferation (Kim et al., 2015). It is reported that the *Amorphophallus campanulatus* have antioxidant and hepatoprotective activity (Ansil et al., 2012). *Curcuma aromatica*, with multiple ingredients, has been indicated as anti-inflammation, anti-oxidant and anticancer properties (Quiles et al., 2002).

**TYPICAL MEDICINAL PLANTS AND THEIR USES AS ANTICANCER AGENTS**

**Amorphophallus campanulatus**

**Common name: Elephant foot yam**

*Amorphophallus campanulatus*, a perennial herb belongs to *Araceae* family, and usually called as elephant foot yam. *A. campanulatus*, a tuber crop of South East Asian in origin mostly cultivated all over the plains of India and their rhizome used as a food product (Das et al., 2009). Its rhizome is extensively used in many Ayurvedic medicines and also against liver infections, bronchial infections, abdominal pain, asthma, dysentery, spleen enlargement, elephantiasis diseases due to vitiated blood and sore swellings. The important constituents of the rhizome are lupeol, sitosterol, stigmasterol, galactose, palmitic acid, betulinic acid, glucose, rhamnose and xylose (Khare, 2007). It is reported that rhizome possesses an antibacterial, antifungal and cytotoxic activities (Khan et al., 2007).

**Artemisia vulgaris**

**Common name: Mugwort**

Globally *Artemisia vulgaris* L. occurs in the climatic region and is reported to occur from the high mountainous regions of the Northern Himalayas to warm temperature regions of South America. In traditional ethnomedicine, leaves extract of *A. vulgaris* used as antiparasitic, anti-inflammation, antibacterial and also stimulant various disorders such as hepatitis (Duke et al., 2002).

Anticancer activity of *Artemisia vulgaris* aqueous extract against human breast carcinoma T47D cells, human prostate cancer PC-3 cells, and colon cancer RKO cells for 24, 48 and 72h treatment has been reported (Nawab et al., 2011). *Artemisia* species also showed good cytotoxicity against three human cancer cell lines, MCF7, A549 and HeLa (Sura et al., 2011). Emami et al. (2009) established study for the toxicity investigation of *Artemisia* sp. against human Caucasian hepatocyte carcinoma (HepG-2) and human Caucasian larynx carcinoma (Hep-2). In vitro, quantitative MTT assay and cytotoxic effects against two human tumor cell lines HepG2 and Hep2 were established (Emami et al., 2009).

**Astragalus hamosus**

**Common name: Milkvetch, locoweed, goat’s thorn**

Separation of new flavonol glycoside 7-O-methyl-kaempferol-D-galactopyranoside and known flavonols hyperoside isoquercitin and astragalin take place through phytochemical examination of the leaves of *A. hamosus* (Krasteva et al., 2007). In plants commonly occurring secondary metabolites are Flavanoids. The commonest groups of flavonoids are polyphonic compounds which are used by humans as dietary components. Polyphonic compounds work against allergic conditions, inflammation, microbial infections and cancerous activities (Yamamoto and Gaynor, 2001; Cushnie and Lamb, 2005). A flavonoid, rhamnocitrin 40-b-D-galactopyranoside (RGP) separated from *A. hamosus* L. leaves, possessed hepatoprotective activity (Saleem et al., 2013).

**Bergenia ciliata**

**Common Name: Winter begonia**

*Bergenia ciliata* belongs to family *Saxifragaceae* has various medicinal properties. These properties included antibacterial, antioxidant, anti-inflammatory, anti-diabetes and antiviral activities (Kumar et al., 2002; Rajbhandari et al., 2009; Ruby et al., 2012). Potential drugs that used against tumors for chemoprevention or chemotherapy are derived from *Bergenia ciliata* rhizome, methanolic and aqueous extract (Chauhan et al., 2012). *B. ciliata* have potential to work against neoplastic activities due to which it act as defensive medicine (Bhandari et al., 2008). It is reported
that rhizome of *B. ciliata* work against urolithiasis infections, inflammations, oxidative processes and bacterial infections (Sinha *et al*., 2001).

**Bryonia laciniosa**

**Common name:** Bryony, Snakeweed, Shivlingi

It is native to Europe, Mediterranean region and Central Asia (Kirtikar and Basu, 1987). As a folk medicine, the plant is used in the treatment of gastrointestinal disorders, respiratory infections, and metabolic diseases, as well as in hepatic infections (Gabrielian and Gevorgovich, 1997; Acharya and Shivlingi, 2007). Alpana *et al*., (2011) have tested *in vitro* to toxicity of *B. laciniosa* leaves the water, methanol, and chloroform extract on human Breast adenocarcinoma (Mcf-7), Human squamous cell carcinoma; cervix (SiHa) cell lines and one non-cancer normal cell line Vero (monkey kidney cell line). The results showed that aqueous extract possesses property to work against cancer cells and are able to kill all cancer cells without leaving residual population (Alpana *et al*., 2011).

### Table I: Anticancerous medicinal plants

<table>
<thead>
<tr>
<th>Botanical name of plants</th>
<th>Plants common name</th>
<th>Family name</th>
<th>Active components of main parts used</th>
<th>Origin of medicinal plant</th>
<th>Medicinal importance</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amorphophallus campanulatus</td>
<td>Elephant foot Yam</td>
<td>Araceae</td>
<td>Rhizome</td>
<td>South East Asian origin and plains of India</td>
<td>Having antioxidant and hepatoprotective activity</td>
<td>Ansil <em>et al</em>., 2012</td>
</tr>
<tr>
<td>Artemisia vulgaris</td>
<td>Mugwort</td>
<td>Compositae</td>
<td>Aerial parts</td>
<td>The Himalayas to warm temperature regions of South America</td>
<td>Mostly used against liver disorders</td>
<td>Gillani <em>et al</em>., 2011; Nawab <em>et al</em>., 2005</td>
</tr>
<tr>
<td>Astragalus hamosus</td>
<td>Milkvetch</td>
<td>Fabaceae</td>
<td>Aerial parts</td>
<td>Syrian Pasture</td>
<td>Having hepatoprotective and antioxidant activity</td>
<td>Saleem <em>et al</em>., 2013; Burdina <em>et al</em>., 2013</td>
</tr>
<tr>
<td>Bergenia ciliate</td>
<td>Winter begonia</td>
<td>Saxifragaceae</td>
<td>Rhizome</td>
<td>Nepalese origin</td>
<td>Antioxidant, anti-bacterial and anti-tussive properties</td>
<td>Rajkumar <em>et al</em>., 2010; Chauhan <em>et al</em>., 2012</td>
</tr>
<tr>
<td>Bryonia laciniosa</td>
<td>Bryony, Shivlingi, Snakeweed</td>
<td>Cucurbitaceae</td>
<td>Leaves</td>
<td>Europe, Mediterranean region, and Central Asia</td>
<td>Used in treatment of gastrointestinal, respiratory, rheumatic, metabolic disorders and liver’s infectious diseases</td>
<td>Acharya, 2007</td>
</tr>
<tr>
<td>Nigella sativa</td>
<td>Kalaunji, Black cumin</td>
<td>Ranunculaceae</td>
<td>Seeds</td>
<td>Widely grown in India and Pakistan</td>
<td>It has great medicinal value as a carminative, stimulant, analgesic, anti-inflammatory and diuretic.</td>
<td>Ayman and Elkady, 2012</td>
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<tr>
<td>Botanical name of plants</td>
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<tr>
<td>Oroxylum indicum</td>
<td>Indian trumpet tree</td>
<td>Bignoniaceae</td>
<td>Leaves</td>
<td>Indian deciduous forests</td>
<td>used for curing gastric ulcer, anti-cancerous, anti-inflammatory, anti-metastatic potentials and anti-microbial</td>
<td>Mao, 2002; Naveen et al., 2012</td>
</tr>
<tr>
<td>Petasites japonicas</td>
<td>Japanese butterbur</td>
<td>Asteraceae</td>
<td>Roots</td>
<td>Korea, China, Japan</td>
<td>anticancer</td>
<td>Kim et al., 2015</td>
</tr>
<tr>
<td>Rheum officinale</td>
<td>Chinese rhubarb</td>
<td>Polygonaceae</td>
<td>Whole plant</td>
<td>India, Russia, Europe</td>
<td>anti-tumor activity with hepatocarcinoma</td>
<td>Cao et al., 2005</td>
</tr>
<tr>
<td>Swertia chirayta</td>
<td>Chirata, Kirata-tikta</td>
<td>Gentianaceae</td>
<td>Whole plant</td>
<td>The Himalayas and in hills of Meghalaya</td>
<td>It possesses anti-helminthic, hypoglycemic, febrifuge, anti-malarial, anti-diarrheal and antipyretic properties</td>
<td>Nawab et al., 2011</td>
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**Nigella sativa**

**Common name:** Kalaunji, Black cumin  
The Prophet Muhammad (Sallalaho Alaihi Wasallam) said: "Black Cumin is the cure of all the diseases except Saam and “Saam is death" (Narrated by Abu Huraira, Bukhari, Muslim, Ibn Maja, Musnad Ahmad). *Nigella sativa* (NS), the common name is black seed or black cumin ‘Al-Habba Al-Sauda’ (in Arabic), is a seed of a capsulated plant that belongs to the Ranunculaceae family. *Nigella sativa* have a potential to work as a flavor and food additive, as well as a defensive and medicinal agents for numerous disorders (Sayed, 1980). *N. sativa*seed contains 36–38% fixed oils, alkaloids, proteins, saponin and 0.4–2.5% unsaturated fatty acids as an essential oil (Houghton et al., 1995). The chief active components are thymoquinone (TQ; 27.8–57.0%), q-cymene (7.1–15.5%), carvacrol (5.8–11.6%), tanethole (0.25–2.3%), 4-terpineol (2.0–6.6%) and longifoline (1.0–8.0%) (Burits and Bucar, 2000). TQ readily dimerizes to form dithymoquinone (DTQ), which is believed to be nigellone (Omar et al., 1999; Salem, 2005) and is a chief bioactive ingredient of the volatile oil of NS seeds. It has been shown to exert several pharmacological activities, including antioxidant, antiinflammation, chemotherapeutic and antitumor (Padhye et al., 2008), as well as hepatoprotective activity (Salama et al., 2006).

**Petasites japonicus**

**Common name:** Japanese butterbur  
*Petasites japonicus* cultivated in eastern Asia, it is also known as Butterbur and is used by a human as a vegetable and traditional drug. *Petasites japonicus* possess potential to work as anti-inflammatory and antiallergenic (Lee et al., 2011; Lee et al., 2013). It was investigated that rate of apoptosis and growth of Hep3B HCC cells is controlled by PJE methanol extract *in vitro* and *in vivo* conditions. In concentration dependent approach methanolic extract of *Petasites japonicus* was used to reduce the cell capability. The growth of Hep3B HCC cells through inhibiting the Akt/mTOR and Wnt signaling pathways is inhibited by methanol extract of *Petasites japonicus* and suggested as an anticancerous on Hep3B HCC cells (Kim et al., 2015).

**Oroxylum indicum**

**Common name:** Indian trumpet tree  
*Oroxylum indicum* are commonly colonized in Indian deciduous forests and moist areas. The roots possess sweet, astringent, bitter, acrid, refrigerant, expectorant, carminative, anti-inflammatory properties and used against microbial activities. Methanolic extract of *O. indicum* fruit repressed explosion of HL-60 cell line.
The induction of apoptosis in HL-60 cell line is caused by an active compound known as flavonoids baicalein (Roy et al., 2007). Nasopharyngeal cancer treatment is taking place through the use of boiling a mixture of O. indicum slab. Another beneficial aspect is used against gastric ulcer. The paste of the bark is used for the treatment of mouth cancer, tonsil soreness, scabies and other infections (Mao, 2002). Both in vitro and in vivo O. Indicum methanolic crude extract was successfully used to cure Dalton’s lymphoma disease (Brahma et al., 2011). Formulation organized by the diverse quantity of stem bark extract of O. indicum with Tecomella undulate, Buahinia variegate and leaves of Indigo feratintoria (SJT ONC-1) showed significant cytotoxicity against human breast adenocarcinoma (MCF-7) and human colon adenocarcinoma (Caco-2) cell lines as compared to control (Savjiyani et al., 2012). Therefore, effective cytotoxicity and distinctive apoptosis inducing abilities present in the non-ionic extract of O. indicum and also have antitumorous potential (Naveen et al., 2012).

**Rheum officinale**

**Common name: Chinese rhubarb**

The roots of *Rheum officinale* have been used in traditional Chinese and Tibetan medicine. Mostly it is extended to India, Russia, and Europe. The literature reported that it was used against the tumor in case of hepatocarcinoma (Cao et al., 2005). In human breast cancer, MCF-7 and human lungs adenocarcinoma A549 cells proliferation is repressed by *R. officinale* in vitro, confirmed through cell feasibility and colony formation assays. In both A549 and MCF-7 cell lines, aqueous extract treatment showed in inter-nucleosomal DNA damage, whereas the inter-nucleosomal DNA from untreated cancer cells remained undamaged (Li et al., 2009). Tumor growth in mice induced with pancreatic tumor cells is efficiently suppressed via treatment of gemcitabine combined with emodin, an anthraquinone derivatives from *R. officinale*. This treatment pattern increases apoptosis and destruction in mitochondria. Additionally, it decreased the phosphorylated-Akt (p-Akt) level, NF-κB activation, and Bcl-2/Bax ratio enhanced caspase-9 and -3 activations, Cytochrome C (CytC) release occurred in combination therapy (Wei et al., 2011).

**Swertia chirayta**

**Common name: Chirata, Kirata-tikta**

*Swertia chirayta* set up in the temperate Himalayas and in hills of Meghalaya. It has diverse therapeutic values and is extensively used a crude medicine. It possesses anti-helminthic, hypoglycemic, febrifuge, antimalarial, anti-diarrheal and antipyretic properties. Aqueous extract of *Swertia chirayta* (whole plant) exhibited 5-24% inhibition in human breast cancer cell T47D cells at 1.0 to 10% concentration for 24 h. Human colon cancer RKO cell inhibited to 8-28%, moreover, prostate cancer PC-3 cells exposed to *S. chirayta* exhibited 2-28% inhibition at similar doses for the 24 h dosage (Nawab et al., 2011).

**Conclusion and Future prospects of Medicinal Plants**

The paper reviewed the anticancerous, antioxidant, antimalarial, antihelminthic, anti-inflammatory, antimicrobial, antiviral and antichronic hepatitis effects of the medicinal plants agents with minimum toxicity. All the results are taken together, this comprehensive review can open a new door for their utilization in medical applications as a result of effectiveness and safety.

**REFERENCES**


AMIRI, K. L., BLUMENTHAL, G. M., XD, Q. C., ZHANG, L., TANG, S.W., HA, L., WEINBERG, W.C., CHI, B., CANDAU-CHACON, R., HUGHES,


KORDALI, S., CAKIR, A., MAVI, A., KILIC, H. AND YILDIRIM, A., 2005a. Screening of chemical composition and...


