



## NATURAL PRODUCTS: AN IMPORTANT LEADS FOR ANTICANCER DRUG DISCOVERY

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**Abstract:** Plants have played a significant role in maintaining human health and improving the quality of human life from many years. In recent times, focus on plant research has increased all over the world and a large body of evidence has collected to show immense potential of medicinal plants used in various traditional systems. There are many herbs, which are used to treat cardiovascular problems, liver disorders, cancer and many disorders. In any cancer drug discovery program, a paradigm based on ethnobotanical and ethnopharmacological data would be more economical and beneficial in identifying potential anticancer molecules than mass screening of plant species. Therefore, this review strives to describe the literature on the traditional plants/potent molecules those have been proved to have anticancer activity and to provide an important platform to accelerate the anticancer drug discovery process. The plants were selected for this review based on Literature survey was performed via electronic search using pub med and Google, also based on the field survey and discussion with South Indian traditional health practitioners (THPS). The present review focuses on the important traditional plants which are having good anticancer potential can be a good bioprospecting tools for novel anticancer drug discovery. Hence the current review is focused on the important ethnopharmacological uses of important plants.

**Keywords:** Drug discovery, Bioprospecting, anticancer, traditional health practitioners.

### 1. Introduction :

As the nature is an important library for various novel compounds because of enormous chemical diversity present in millions of species

of plants, animals, marine organisms, and microorganisms<sup>[1]</sup>. Today, cancer is one of the leading causes of death worldwide. Cancer chemoprevention was first defined as “a strategy of cancer control by administration of synthetic or natural compounds to reverse or suppress the process of carcinogenesis”<sup>[2]</sup>. Now-a-days phytochemicals obtained from medicinal plants play a crucial role in the treatment of cancer and most of the plant secondary

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metabolites and their derivatives have been applied to combat cancer <sup>[3,4]</sup>. Plant natural product chemistry has played an active role in generating a significant number of drug candidates in a drug discovery program. Recently, it has been reported that approximately 49 % of 877 small molecules that were introduced as new pharmaceuticals between 1981 and 2002 by New Chemicals Entities were either natural products or semi-synthetic analogs or synthetic products based on natural product models <sup>[5]</sup>. The old saying "Prevention is always better than cure" is particularly true in the case of cancer where a cure, if at all possible, is associated with high cytotoxic loads and/or invasive procedures. A recent survey shows that more than 60% of cancer patients use vitamins or herbs as therapy <sup>[6,7]</sup>.

### 1.1 Glimpses on Indian Medicinal Plants as Anticancer aids or sources for new anticancer leads.

Based on the literature survey and interaction, with traditional health practitioners, a data of important medicinal plants have been collected which can be sources for novel lead molecules discovery. The literature survey has carried out by using electronic search tools such as pub med and Google search engine included "peer-reviewed papers, thesis, books, abstracts, and articles from academic publishers' sites, professional societies, preprint repositories, universities and other scholarly organizations". The table1 gives a glimpse on the various anticancer medicinal plants, their ethno-pharmacology and reported cytotoxic values.

**Table 1: - List of the collected Indian Medicinal Plants used for treatment of cancer.**

Sl No	Vernacular Name and Family	Parts used	Pharmacology	Cytotoxicity	Ref no
1	<i>Abrus precatorius</i> (Fabaceae)	Leaves	Antioxidant and antiproliferative property	EAC cell lines IC <sub>50</sub> 200µg/ml	8, 60
2	<i>Bacopa monnieri</i> (Scrophulariaceae)	Aerial parts	nucleotoxic and cytotoxic effect by inhibiting cell mitosis	DLA cell lines IC <sub>50</sub> 400µg/ml	9, 61
3	<i>Centella asiatica</i> (Apiaceae)	Leaves	Antioxidant, Antiproliferative property	MCF-7 cell lines IC <sub>50</sub> 66µg/ml	10, 62
4	<i>Curculigo orchoides</i> (Amaryllidaceae)	Rhizomes	Antioxidant	Vero cells IC <sub>50</sub> 800 µg / ml.	11, 63
5	<i>Glycyrrhiza glabra</i> (Fabaceae)	Rhizomes	Antioxidant	MCF-7 cell lines IC <sub>50</sub> 44µg/ml	12, 64
6	<i>Gentiana lutea</i> (Gentianeae)	Roots	Antioxidant, cytotoxic property	Carcinoma cell lines IC <sub>50</sub> 25µg/ml	13, 65
7	<i>Ficus bengalensis</i> (Moraceae)	Bark	Antioxidant apoptotic potential	MCF-7 cell lines IC <sub>50</sub> 121µg/ml	14, 66
8	<i>Pterocarpus marsupium</i> (Pteridaceae)	Wood	Antiproliferative and cytotoxic property	Hep-G2 cell line IC <sub>50</sub> of 4.09µg/mL	15, 67
9	<i>Trichosanthus dioica</i> (Cucurbitaceae)	Aerial parts	Antiproliferative property	EAC cell lines IC <sub>50</sub> 26µg/ml	16, 68
10	<i>Terminalia arjuna</i> (Combretaceae)	Leaves	Antioxidant, Antiproliferative property	K562 cell line IC <sub>50</sub> 74µg/ml	17, 69
11	<i>Valeriana wallichii</i> (Valerianaceae)	Rhizome	Antioxidant	SH-SY5Y cells. IC <sub>50</sub> 22µg/ml	18, 70

12	<i>Woodfordia fruticosa</i> (Lythraceae)	Flowers	Antiproliferative	Hep-G2 cell line IC <sub>50</sub> 51µg/ml	19, 71
13	<i>Lantana camara</i> (Verbenaceae)	Flower, Fruits	Antioxidant, Antiproliferative property	Huh-7 cell lines IC <sub>50</sub> 44.1µg/ml	20, 72
14	<i>Dendrobium formosum</i> (Orchidaceae)	Aerial parts	Antioxidant apoptotic potential	DLA cell lines IC <sub>50</sub> 350µg/ml	21, 73
15	<i>Argemone Mexicana</i> (Papavaraceae)	Leaves	apoptotic potential	MCF cell lines IC <sub>50</sub> 103µg/ml	22, 74
16	<i>Glochidion zeylanicum</i> (Euphorbiaceae)	Stem bark	Antioxidant	PC3 Cell lines IC <sub>50</sub> 30µg/ml	23, 75
17	<i>Calendula officinalis</i> (Asteraceae)	Flowers	Immunostimulant, Antioxidant property	A549 Cell lines IC <sub>50</sub> 10µg/ml	24,76
18	<i>Calea pinnatifida</i> (Asteraceae)	Aerial parts	Antioxidant property	HT-29 Cell lines IC <sub>50</sub> 80µg/ml	25
19	<i>Semecarpus anacardium</i> (Anacardiaceae)	Seeds	Antiproliferative property	Hela Cell lines IC <sub>50</sub> 46.8µg/ml	26
20	<i>Oroxylum indicum</i> (Bignoniaceae)	Stem bark	Antiproliferative, apoptotic property	Hela Cell lines IC <sub>50</sub> 22.7µg/ml	27

Thorough literature survey of 112 literatures was collected via electronic search using pub med and Google according to inclusion criteria. Out of 112 collected literatures the above mentioned literatures which showed good anticancer activity were listed out.

Inclusion criteria: Reasearch, Review anticancer literatures, literatures which showed good

cytotoxicity activity. Literatures from journals having impact factor above 1.5.

Exclusion criteria: Literatures from journals having impact factor below 1.0.

The table 2 gives a glimpses on the important ethno medicinal plants used by different Indian tribal people for the treatment of cancer based on their traditional documentation.

**Table 2: - List of the Indian Plants used by the tribal people for cancer**

<b>Sl no</b>	<b>Vernacular Name And Family</b>	<b>Tribe name</b>	<b>Parts used</b>	<b>Ref no</b>
1.	<i>Catharanthus roseus</i> (Apocynaceae)	Vaidhya tribe in Adilabad District, Andhra Pradesh, India	Leaves	28
2.	<i>Acorus calamus</i> (Araceae)	Shaukas tribe, Uttarakand, India	Root	29
3.	<i>Calotropis procera</i> (Asclepiadaceae)	Shaukas tribe, Uttarakand, India	Root	29
4.	<i>Cayratia pedata</i> (Vitaceae)	Tribes of Thiashola, Manjoor, Nilgiris	Whole plant	30
5.	<i>Vigna mungo</i> (Fabaceae)	Irula tribes, Vellore, TN	Seeds	31
6.	<i>Glycomis cochincinensis</i> (Rutaceae)	Badaga Community in Nilgiris, TN	Root	32
7.	<i>Senecio scandens</i> (Asteraceae)	Melghat tribe, Mizoram, India	Leaves/aerial parts	33
8.	<i>Blumea lanceolaria</i> (Asteraceae)	Melghat tribe, Mizoram, India	Leaves	33
9.	<i>Zizipus abyssinica</i>	Tribes Of Bolampatty Valley,	Tree bark	34

	(Rhamnaceae)	Nilgiri, TN		
10.	<i>Mikania micrantha</i> (Asteraceae)	Thadou tribe of Manipur, India	Whole plant	35
11.	<i>Phyllanthus emblica</i> (Euphorbiaceae)	Thadou tribe of Manipur, India	Fruit, bark	35
12.	<i>Habenaria roxburghii</i> (Orchidaceae)	Gadabas tribe Visakhapatnam, Andhra Pradesh	Tuber paste	36
13.	<i>Meyna spinosa</i> (Rubiaceae)	Tinsukia community, Assam, India	Leaf, fruit, seed	37
14.	<i>Annona reticulata</i> (Annonaceae)	Dantewada tribes, Chhatisgarh. India	Leaf, fruit, seed	38
15.	<i>Jatropha curcas</i> (Euphorbiaceae)	Dantewada tribes, Chhatisgarh. India	Leaves	38

A field survey was carried out with 20 traditional health practitioners (THPS) in South India and collected information in regard with medicinal plants/medication commonly prescribed in case of cancer.

The objective of the survey was to provide an important data base of anticancer plants used by THPS, where the scientific validation is still lacking, so these plants can be an important source of discovery of new leads against cancer.

**1.2 In Siddha System:** The few medicinal plants prescribed by the Siddha practitioner during the survey are listed below, which are usually used for cancer.

**a. *Trichosanthus palmita* (Cucurbitaceae):-**

**Description:** - A large perennial, branched, woody, tendril climber. The leaves are variable, palmately 3-5 lobed with a cordate base, and the lobes are ovate with serrate or dentate margins. Male flowers are in axillary 5-10 flowered racemes with large bracts, while the female flowers are solitary. The corolla petals are wedge-shaped, fringed and white in color. The fruits are globose, and when ripe with orange streaks.

**Major chemical constituents:** - Tricuspidatin, 2-o-cucurbitacin, dihydrocucurbitacin B.<sup>39</sup>

**Pharmacodynamic Uses:** - It is used to cure jaundice, asthma, skin ailments, ulcers, breast cancer, urinary disorders, cyst.<sup>39</sup>

**b. *Foeniculum vulgare* (Umbelliferae):-**

**Description:** - Fennel grows erect with a thick root and stout stems. It can grow to 4 - 5 feet or

more in height. The leaves grow to 40cm long and are finely dissected into fronds. The bright golden flowers, produced in large, flat terminal umbels, 4-8cm in diameter, terminal and leaf-opposed, rays 10-30, Glaucous. Petals bright yellow. Fruit 4-8 mm long.

**Major chemical constituents:** - The essential oil is made up predominantly of anethole (50 to 80%), limonene, fenchone, and estragole. The seeds also contain fiber and complex carbohydrates.<sup>40</sup>

**Pharmacodynamic Uses:** - It is used to increase urine flow, promote menstruation, improve the digestive system, anxiety, depression, arthritis, amenorrhoea, angina, asthma, cancer, lower blood pressure, boost libido, respiratory congestion, coughs.<sup>40</sup>

**c. *Terminalia chebula* (Combretaceae):-**

**Description:** - Terminalia chebula is a much branched, medium sized tree. Leaves elliptic-obovate, densely woolly beneath, with 2 basal glands. All flowers yellowish-white, in axillary spikes. Drupe obovoid, orange-brown hermaphrodite in terminal spikes, pendulous drupes, glabrous, more or less 5 - ribbed when dried.

**Major chemical constituents:-** Flowers contain chebulin, a glycoside. Fruits contain phenolic compounds, punicalagin, terflavin A, ellagitannin, tercheulin, terchebin. The tree yields a gum. Kernels yield fatty oil. It contains tannic acid up to 40% and Chebulic acid. Gallic and anthraquinone like principle.<sup>41</sup>

**Pharmacodynamic Uses:** - The dried fruits of the tree constitute the drug commonly known as Chebulic Myrobalan or Harra. Myrobalan can be applied externally on chronic ulcers, wounds and scalds or used as a gargle in inflammation of the mucous membrane of mouth. They are used as a laxative, they have also been found to have some effect on blood pressure as cardiac tonics. The powder of the fruit is used as a dentifrice in carious teeth and bleeding gums. Bark diuretic and cardiogenic. Powdered fruit, smoked in asthma. Fruit pulp is used in dentifrices. It responds well to gastrointestinal ailments, tumors, ascites, piles, enlargement of liver-spleen, worms and colitis.<sup>41</sup>

**1.3 In Ayurveda System:** The few medicinal plants prescribed by the Ayurvedic practitioner during the survey are listed below, which are usually used for cancer.

**a. *Withania somnifera* (Solanaceae):-**

**Description:** - Ashwagandha is a small, branched, perennial woody shrub that grows usually about 2 feet in height. It has sessile, axillary, greenish or lurid yellow flowers. The fruit is Orange-red berry, smooth, oblong, rounded or somewhat produced at the base. It has a more or less tuberous root. The seeds are yellow and scurfy. The fruit is harvested in the late fall and the bright yellow seeds are dried for planting in the following spring.

**Major chemical constituents:-** Ashwagandha are reported to contain alkaloids, amino acids, steroids, volatile oil, starch, reducing sugars, and glycosides like tropine, pseudotropine, withananine, withananinine, somnine, somniferine, somniferinine.<sup>42</sup>

**Pharmacodynamic Uses:-** According to Ayurveda, the root is bitter, acrid, heating, aphrodisiac, tonic, alternative, anthelmintic and useful in treatment of inflammations, psoriasis, bronchitis, asthma, consumption, ulcers, scabies, marasmus of children, insomnia, senile debility etc.<sup>42</sup>

**b. *Celastrus paniculata* (Celastraceae):-**

**Description:** - *Celastrus paniculatus* is a deciduous climbing shrub that can grow very large in size. The base stem of this shrub will grow up to 10 inches (25 cm) in diameter and produce many woody branches that cling to surrounding flora for support. The inner bark is light and cork like, with yellow sapwood. The leaves are oval shaped and grow on singular stems, ranging in color from light to dark green. The flowers are tiny, whitish green to yellow green, and grow on the top of the main stalk. *Celastrus* is prized by native peoples throughout India for its seeds, which grow in round pods that gradually change from a light yellow to a deep red color as they mature. The seeds are small, oval shaped and grow six per seedpod.

**Major chemical constituents:-** The seeds contain the alkaloids celastrene and paniculatin, which give the herb its therapeutic properties. Also, they have sesquiterpene alkaloids polyol ester malkanguniol, malkangunin, celapanine, celapanigine.<sup>43</sup>

**Pharmacodynamic Uses:** - According to Ayurveda, leaves are emmenagogue whereas the seeds are acrid, bitter, hot, appetizer, laxative, emetic, aphrodisiac, powerful brain tonic, cause burning sensation. Oil enriches blood and cures abdominal complaints.<sup>43</sup>

**c. *Phyllanthus emblica* (Euphorbiaceae)**

**Description:** - A small to medium-sized, deciduous tree. Branchlets feathery with distichous leaves, resembling a pinnate leaf, leaves small, bluntish, 0.6-1.3 cm long. Flowers small, greenish yellow, monoecious, in axillary clusters. Fruit a globose drupe, about 2.5 cm across, obscurely 6-lobed disc, enlarged to give an appearance of fleshy yellowish-green, indehiscent berry.

**Major chemical constituents:** - Fruit is a rich natural source of vitamin C. It also contains tannins and colloidal substances, phyllembic acid, lipids, Gallic acid, ellagic acid, trigalloylglucose, terchebin, corilagin and emblicol. Phyllembin and mucic acid have been isolated from the fruit pulp. Seeds contain fixed



oil, phosphatides, tannins and essential oil. Bark, fruits and leaves are rich in tannin. They also contain lupeol,  $\beta$ -sitosterol and ellagic acid. The bark also contains leucodelphinidin. Seed oil also contains linoleic acid, closely resembled linseed oil.<sup>44</sup>

**Pharmacodynamic Uses:** - Emblica exhibits strong antioxidant activity. It is one of the most important plants in the traditional Ayurvedic medical system as well as in other traditional health systems for immunomodulatory, anti-inflammatory, antiulcer, hepatoprotective, and anticancer actions. However, there is very limited clinical evidence to support the use of emblica for any indication.<sup>45</sup>

**d. *Commiphora wightii* (Burseraceae):-**

**Description:** - *Commiphora wightii* is a much-branched, dioecious, up to 6 m tall with brown colored, spine scented knotty, crooked and spirally ascending branches ending in sharp spines. Bark shiny, ash to yellowish white coming off in rough flakes exposing the greenish underbark, which also peels off in thin papery rolls. Leaves small, sessile, rhomboid-(ob) ovate, 1-3 leaflets, highly aromatic, leathery, shining green on top and greyish below with irregularly toothed edges. Flowers small, unisexual, sessile, brownish red, occurring singly or in groups of 2-3, 8-10 lobed disc and an oblong-ovoid ovary, stamen 8-10. Fruit an ovoid green berry like drupe, reddish, 6-8 mm in diameter.

**Major chemical constituents:** - The oleo resin of Guggul contains essential oils Myrcene, dimyrcene and polymyrcene. Also it contains diterpenoids, Guggulsterol, Guggul sterol-II, Guggul sterol-III, Guggul sterol-IV, Guggul sterol-V, Guggul sterol.<sup>46</sup>

**Pharmacodynamic Uses:** - Guggul helps reduce body cholesterol. It helps prevent blood platelet aggregation and breaks up already formed blood clots. Thus, it helps prevent heart disease and stroke. It is widely promoted as a weight loss agent that supposedly enhances thyroid function. Guggul lipid stimulates the activity of white blood cells in the body,

contributing to the build-up of the immune system. Guggul lipid also helps eliminate and expel dead tissues, wastes, and toxins from the body. Guggul lipid may also be used to treat arthritis and reduce inflammation of the joints.<sup>47</sup>

**e. *Tinospora cordifolia* (Memispermaceae):-**

**Description:-** Guduchi is a glabrous climbing shrub with a succulent stem and papery bark that is creamy white to grey in color. The shrub shoots out aerial roots, usually on neem and mango trees, which could be as long as 30 meters. It bears heart-shaped leaves. The yellow flowers are axillary and long-stalked racemes. The fruit is pea-sized, subglobose drupe and red colored on maturity. Flowers can be seen in June, while fruits occur in November. Guduchi is found in deciduous and dry forests throughout India.

**Major chemical constituents:-** *Tinospora cordifolia* includes sesquiterpene glycoside named tinocordiside, tinosporine, tinosporide, tinosporaside, cordifolide, cordifol, heptacosanol, clerodane furano diterpene, diterpenoid furanolactone tinosporidine, columbin and  $\beta$ -sitosterol. Berberine, Palmatine, Tembertarine, Magniflorine, Choline, and Tinosporin are reported from its stem.<sup>48</sup>

**Pharmacodynamic Uses:-** The herb has a long history in use by practitioners of Ayurveda. Known by its practitioners to treat convalescence from severe illness, arthritis, liver disease, eye diseases, urinary problems, anemia, cancer, diarrhea, and diabetes. Also, help remove toxins from the body. The herb is known to have a sweet, bitter and acid taste. Extracted from the stem and root is a nutrient starch used to treat chronic diarrhea and dysentery.<sup>49</sup>

**1.4 In Homeopathy System:-** The few medicinal plants prescribed by the ayurvedic practitioner during the survey are listed below, which are usually used to treat cancer

**a. *Holarrhena antidysenterica***

**(Apocynaceae):-**

**Description:-** A small shrub or deciduous tree, up to 13 m in height, with a milky latex. The

bark peels off in flakes and is grey to pale brown in colour. The leaves are shiny on the upper surface, dull and hairy on the lower, opposite, subsessile and elliptic. The flowers are white, in terminal corymbose cymes, the fruits are cylindrical, dark grey with white specks, and occur in pairs, the seeds are light brown, 0.5-1.5 cm long, with long tufts of hair.

**Major chemical constituents:-** Kurchi contains alkaloids like conessine (about 0.4%), conessimine, kurchine, conamine, conimine, conessidine, conarrhimine, holarrhimine, holarrhine and kurchicine.<sup>50</sup>

**Pharmacodynamic Uses:-** According to Ayurveda, the bark is useful in treatment of piles, skin diseases and biliousness. The bark is used externally in case of skin troubles. The bark is mostly mixed with cow urine and applied it on affected parts. In treatment of urinary troubles, the bark is given with cow milk. The fresh juice of bark is considered good to check the diarrhoea. In bleeding piles Decoction of Kutaj bark with sunthi checks mucus & blood. Application of this herb is useful in Arthritis & Osteoarthritis. The bark is used in chest affections and as a remedy in diseases of the skin and spleen. It is a well known herb for amoebic dysentery and other gastric disorders.<sup>51</sup>

**b. *Myristica fragrans* (Myristicaceae):-**

**Description:-** *Myristica fragrans* is also called as nutmeg. It is a aromatic evergreen tree grows to 9 to 12 in height with spreading branches. The flowers are cream-colored and up to 1 cm in length. They develop into yellow fleshy fruits, 6 to 9 cm in length that is somewhat similar in appearance to apricots. The ripe fruit splits to expose a single glossy purple-brown ~2.5 cm nut (seed) enclosed by a scarlet aril. The seed, after its coat is removed, is the nutmeg spice. The aril is the mace spice, which, after drying, turns brown. The tree produces fruit year-round, but the harvest usually occurs in April and November.

**Major chemical constituents:-** The main chemical components of nutmeg oil are a-

pinene, camphene, b-pinene, sabinene, myrcene, a-phellandrene, a-terpinene, limonene, 1,8-cineole, γ-terpinene, linalool, terpinen-4-ol, safrole, methyl eugenol and myristicin.<sup>52</sup>

**Pharmacodynamic Uses:-** Nutmeg oil stimulates the heart and circulation, activates the mind and revives people from fainting spells, while stimulating the digestive system and fighting wind, nausea, chronic vomiting and diarrhea. It encourages appetite and averts constipation, fights gallstones and is a tonic for the reproductive system, while relieving frigidity and impotence. It can aid births by strengthening contractions. The oil has shown good anti-inflammatory action, and is also successful in relieving pain, especially muscular aches and pain, as well as rheumatism.<sup>52</sup>

**c. *Conium Maculatum* (Apiaceae):-**

**Description:-** *Conium Maculatum* is also called Poison hemlock. It is a coarse biennial herb with a smooth, purple-spotted, hollow stem and leaves like parsley. It grows 3 to 6 feet tall and in late summer has many small white flowers in showy umbels. Its leaves are extremely nauseating when tasted. It is confused with water hemlock, poison hemlock can be distinguished by its leaves and its roots. The leaf veins of the poison hemlock run to the tips of the teeth, those of the water hemlock run to the notches between the teeth. The poison hemlock root is long, white, and fleshy. It is usually unbranched and can be easily distinguished from the root of water hemlock, which is made up of several tubers.

**Major chemical constituents:-** The most important constituent of hemlock leaves is the alkaloid Coniine, when pure, Coniine is a volatile, colourless, oily liquid, strongly alkaline, with poisonous properties and having a bitter taste and a disagreeable, penetrating, mouse-like odour. The other alkaloids are, Methyl-coniine, Conhydrine, Pseudoconhydrine, Ethyl piperidine, mucilage, a fixed oil and 12 per cent of ash.<sup>53</sup>

**Pharmacodynamic Uses:-** As a medicine, Conium is sedative and antispasmodic, and in

sufficient doses acts as a paralyser to the centres of motion. In its action it is, therefore, directly antagonistic to that of Strychnine, and hence it has been recommended as an antidote to Strychnine poisoning, and in other poisons of the same class, and in tetanus, hydrophobia, etc. As an inhalation it is said to relieve cough in bronchitis, whooping-cough, asthma, etc.<sup>53</sup>

**d. *Pinus Nigra* (Pinaceae):-**

**Description:-** A tree to 25-45 m tall with Stem straight, bark on entire trunk thick, scaly-plated, grey-brown, to pinkish on some very old trees. Crown with stout level branches with upswept tips, dense ovoid-conic when young and becoming rounded to flat-topped with age. Branching, uninodal leaves in fascicles of two, thick, dark green, often curved and slightly twisted, margins finely serrulate, leaf sheath blackish-grey, Cones 5-10 cm long, conic, symmetrical, green ripening grey-buff to shiny yellow-buff. Seeds dark grey, 5-6 mm, with a 15-22 mm wing.

**Major chemical constituents:-** Pinus contains sesquiterpenes hydrocarbons, manool oxide, germacrene D, d-cadinene, (E)-caryophyllene, a-cad-inol, limonene, a-pinene.<sup>54</sup>

**Pharmacodynamic Uses:-** According to homeopathy pinus is used as rubefacient, diuretic, irritant. A valuable remedy in bladder, kidney, and rheumatic affections and diseases of the mucous membrane, cancer and respiratory complaints, externally in the form of liniment plasters and inhalants.<sup>54</sup>

**e. *Thuja occidentalis* (Cupressaceae):-**

**Description:-** It is a monoecious trees upto 25 m tall, usually with a single straight stem and a conical crown, but can reproduce by layering and this may yield multiple stems. Bark red-brown, turning gray with age, 6-9 mm thick, fibrous, fissured, coming away in long, thin strips. Branchlets flattened, bearing foliage in flattened, fan-shaped sprays. Leaves scale-like, 1-4 mm long and 1-2 mm wide, pointed, dull yellow-green on both top and bottom, with conspicuous glands on lateral leaves near branchlet tips. Seed cones ovoid, 9-14 mm long,

green maturing to brown, with two pairs of woody fertile scales yielding a total of 8 seeds. Seeds red-brown, 4-7 mm long (including wings).

**Major chemical constituents:-** It contains terpenoids thujone, isothujone, fenchone, sabinens and  $\alpha$ -pinene and monoterpenes, namely carvotanacetone, origanol, origanes, myrcen and camphen.<sup>55</sup>

**Pharmacodynamic Uses:-** According to ayurveda thuja stimulates immune function. Also used to treat nasal swelling (sinusitis). Sore throat (tonsillitis), Bronchitis, Pneumonia, Skin infections, Arthritis, Cancer, Skin diseases, Muscle aches, Warts. Also used as an insect repellent.<sup>56</sup>

**f. *Veronica Officinalis* (Plantaginaceae):-**

**Description:-** It is a herbaceous perennial with hairy green stems 10-50 cm long that cover the ground in mats and send up short vertical shoots which bear soft violet flowers. The leaves are 1.5-5 cm long and 1-3 cm broad, and softly hairy. Fruits are obcordate, flat, 4-5 mm long capsule, longer than calyx, approx. as long as broad, with glandular hairs.

**Major chemical constituents:-** The chief constituent of Sage and its active principle is a yellow or greenish-yellow volatile oil with a penetrating odour. Tannin and resin are also present in the leaves, 0.5 to 1.0 per cent of the oil is yielded from the leaves and twigs when fresh, and about three times this quantity when dry.<sup>57</sup>

**Pharmacodynamic Uses:-** This herb is used as a tonic alterant of relaxing and somewhat diaphoretic powers, and was used in old coughs, pulmonary weakness of all classes, skin diseases, jaundice, affections of the kidneys, and scrofula. Being scarce with us, it is probable that attention might be directed with profit to the most abundant species of the genus.<sup>58</sup>

**g. *Rhus Aromatica* (Anacardiaceae):-**

**Description:-** This is a small, bushy shrub, growing from 2 to 6 feet high, and found in clumps in rocky situations. The leaves are



trifoliate, and on stalks. The 3 leaflets are sessile, and covered with a short velvety pubescence when young. The terminal leaflet is considerably larger than the lateral leaflets. They are entire and tapering at the base, acute, and have 8 or 10 crenate teeth at the apex. The flowers are small, greenish-yellow, they are in stalked, spiked. The sepals, petals, and stamens are in fives, and the pistil is a 1-ovuled ovary, with 3 short styles. The fruit is a small red drupe, about the size of a pea, covered with dense, white pubescence. They are produced in clusters of about a dozen, and are on stalks, each one contains a single flattened seed.

**Major chemical constituents:** - The berries contain free malic acid and acid, calcium malate coexist, with tannic and Gallic acids, fixed oil, extractive, red coloring matter, and a little volatile oil. The active properties of both bark and berries yield of water.<sup>59</sup>

**Pharmacodynamic Uses:** - The bark is tonic, astringent, and antiseptic, the berries refrigerant and diuretic. The bark, in decoction or syrup, has been found useful in gonorrhoea, leucorrhoea, diarrhea, dysentery, hectic fever, scrofula and profuse perspiration from debility. Combined with the barks of slippery elm and white pine and taken freely, the decoction is said to have been greatly beneficial in syphilis. The berries may be used in infusion in diabetes and febrile diseases, also as a gargle in quinsy and ulcerations of the mouth and throat, and as a wash for ringworm, tetter, offensive ulcers, etc. The mucilaginous exudation, if the bark be punctured in hot weather, has been used advantageously in gleet and several urinary difficulties.<sup>59</sup>

**2. Conclusion:** This review will be an important tool for the drug discovery of newer anticancer molecules, if a proper bioprospecting and reverse pharmacology approach is used by the researcher. Based on the collected data, we started the research on these selected plants in our laboratory using high throughput screening in order to find out potent plants, extracts, fractions for discovery of anticancer lead

molecule having potent dual human topo poison I & II activity.

### 3. Abbreviations:

THPS: Traditional health practitioners

EAC cell lines: Ehrlich Ascites Carcinoma cell lines

DLA cell lines: Dalton's lymphoma ascetic cell lines

MCF-7 cell lines: Michigan Cancer Foundation-7 cell lines

Hep G-2 cell lines: Human hepatocellular carcinoma cell lines

K562 cell lines: human erythromyeloblastoid leukemia cell lines.

SH-SY5Y cell lines: neuroblastoma cell lines

Huh-7 cell lines: Human hepatoma cell lines

PC-3 cell lines: human prostate cancer cell lines

A549 cell lines: human lung adenocarcinoma epithelial cell lines

HT-29 cell lines: Human colon adenocarcinoma cell lines

Hela cell lines: Cervical cancer cell lines

Tn: Tamilnadu

IC50: Half maximal inhibitory concentration

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