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REVIEW ON SOME ANTICANCER PLANTS OF GENUS *IPOMOEA*

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ABSTRACT

Cancer is a multistage process characterized by an abnormal, uncoordinated, and purposeless proliferation of cells. In both developed and developing countries, it is one of the most severe health problems. It is the leading cause of mortality and morbidity worldwide with a continuously increasing number of cases. It is estimated that there will be 21 million cancer cases by 2030. The treatment modalities for cancer include radiotherapy, chemotherapy, and chemically derived drugs. Due to the high death rate and serious side effects of treatment modalities, medicinal herbs and their derivative Phyto compounds are being increasingly recognized as useful alternative and complementary treatments for cancer. The genus *Ipomoea* is honored as the largest genus of the family Convolvulaceae and comprising of 600-700 species. Various species of genus *Ipomoea* are reported to possess antimicrobial, analgesic, spasmolytic, hypotensive, psychotomimetic, and anticancer activities. The present review deals with the anticancer properties of some species of genus *Ipomoea*.

Keywords: Anticancer activity, Convolvulaceae, *Ipomoea*, traditional uses, *in vitro*, *in vivo* methods

INTRODUCTION

The origin of the word cancer is credited to the Greek physician Hippocrates (460-370 BC), who coined the term “karkinos” for cancer of the breast [1]. The word ‘cancer’ means crab, thus reflecting the

true character of cancer since ‘it sticks to the part stubbornly like a crab [2]. Cancer is the name given to a large group of diseases. It is characterized by uncontrolled cellular proliferation, invasion of the abnormal cells

into adjacent tissues, and their spread to distant organs via blood and lymph vessels [3]. It is one of the most severe health problems and is the leading cause of mortality and morbidity worldwide with continuously increasing number of cases. It is estimated that there will be 21 million cancer cases by 2030 [4]. Lung cancer is the most common cancer diagnosed in men and breast cancer in women [5]. The development of cancer is associated with number of factors such as hormonal status of the individual, familial and genetic predisposition, environment and cultural factors, racial and geographic factors, age and sex [6].

The treatment modalities for cancer includes radiotherapy, chemotherapy and chemically derived drugs. Due to such therapies, patients are under lots of strain and can develop further health damage [7]. Natural products have played an important role in treatment of various diseases including cancer [8]. Scientists are concentrating on the herbal medicines to boost immune cells of the body against cancer. The herbal formulations can be designed to attack the cancerous cells without harming normal cells of the body by understanding the complex synergistic interaction of various constituents of anticancer herbs [9].

The genus *Ipomoea* is honored as largest genus of the family convolvulaceae and comprising of 600-700 species [10]. The genus *Ipomoea* is utilized for various purposes such as, nutritional, medicinal, ritual and agricultural. Various species of genus *ipomoea* are reported to possess antimicrobial, analgesic, spasmolytic, hypotensive, psychotomimetic and anticancer activities [11]. The present review deals with anticancer properties of some species of *Ipomoea*.

***Ipomoea aquatica*:**



The plant *Ipomoea aquatica* from family convolvulaceae is a trailing vine with milky sap and commonly known as water spinach, river spinach, water convolvulus. The plant is distributed widely and usually grows all-round the year. It grows in moist soils, side-lines of fresh water, ditches, lakes, ponds, marshes and wet rice field. It is generally consumed as a vegetable in different regions of the world. The plant is rich source of amino acids, vitamins and minerals. Preliminary phytochemical

screening of the plant reveals presence of flavonoids, alkaloids, lipids, steroids, saponin, phenols, reducing sugar, tannins, β -carotene and glycosides. The plant is also reported to contain aliphatic pyrrolidine amides, carotenoids, hentriacontane, β -sitosterol and its glycosides, prostaglandin, leukotriene. The major compounds of *Ipomoea aquatica* are N-trans and N-cis-feruloyltyramines, nortropane alkaloids calystegins B1, $3\alpha,7\beta$ -O-D-diglycopyranosyl-dihydroquercetin, isochlorogenic acid a, b and c. Polyphenols such as myricetin, luteolin, apigenin, and kaempferol also reported to be present in the plant [12]. In traditional system of medicine the plant is used in fever, jaundice, biliousness, bronchitis, liver complaints, as carminative, anti-inflammatory [13].

A study revealed that hydroalcoholic extract of *Ipomoea aquatica* and its isolated compounds showed significant anticancer activity. MTT assay was used as method for anticancer screening of the plant. The cell lines employed for the study was MCF – 7 for human breast cancer in women. The results demonstrated that extract and its isolated compounds were found to have significant inhibitory action on the proliferating cells [14].

Ipomoea alba



Ipomoea alba L. (convolvulaceae) is a tender perennial vine commonly called as moon flower or moonvine. The fresh leaves of plant are used as vegetables and also as medicines. Traditionally plant is used in treating snakebite, as purgative and in filariasis [15]. The plant is reported to contain indolizidine alkaloids, ipalbicine, ipalbidine, ipalbidinium, E-ipomine, Z-ipomine, methoxyipomine, dimethoxyipomine and ipohardine, calystegines A5, B1 and B2 albinosides [11].

Sims *et al.*, screened chloroform extract of plant for cytotoxic activity against Hs578T (human breast tumor cells) and MDA-MB-231 (human breast adenocarcinoma, estrogen receptor negative) cells. The method adopted for the study was MTT-based cytotoxicity assay. The results revealed that the chloroform extracts showed strong cytotoxic effects against both breast cancer cells Hs578T and MD-MBA-231 [16].

Ipomoea batatas

Sweet potato, *Ipomoea batatas* Lam., is a perennial food crop belonging to family Convolvulaceae [17]. In the world it ranks as sixth most important food crop. Traditionally the root tubers were used in diarrhea, and crushed leaves were used to treat acne and boils. It is a rich source of carbohydrate, vitamins, minerals and dietary fibres. Polyphenols, acylatedanthocyanins, phenolic acids, dicaffeoylquinic, and tricaffeoylquinic acids are found to be present in sweet potato. Sesquiterpenoids 6-myoporol, 4-hydroxydehydromyoporone and ipomoeamarone are also reported in sweet potato [18].

Oluyori Abimbola *et al.*, performed the chromatographic fractionation of ethanolic extract of pulverized peel of *Ipomoea batatas* Lam. From the resultant fractions the *n*-hexane one was further subjected to chromatographic fractionation. The subfractions so obtained were assessed for anticancer activity using Colon1-DLD-1, Colon-2-SW-620, Breast-1-MCF-7, Breast-2-MDA-MB-231, Lung-A549 and Head and

neck-FaDu cancer cell lines. Sulforhodamine-B assay was employed for investigation of anticancer activity. The results revealed that the fractions exhibited significant anticancer activity against all cell lines [19].

Ipomoea carnea

Ipomoea carnea Jacquin also known *Ipomoea carnea* spp. *fistulosa* (Mart. ex Choisy) D. Austin, belongs to the Convolvulaceae family. It is an ornamental tree and commonly called as pink morning glory or bush morning glory. This plant is a native woody perennial, aggressive weed in wetlands, toxic to cattle and difficult to eradicate. In folk medicine plant is used for healing wounds, skin infections, leucoderma, as topical antiseptic, antirheumatic, antihypertensive and also in treatment of AIDS [20]. The phytoconstituents reported in plant includes polyhydroxylated alkaloids characterized as 2-epi-lentiginosine, swainsonine, calystegines B1, B2, C1, B3 and *N*-methyl-*trans*-4-hydroxy-L-proline. Agro-

clavin and dihydrolysergolare also isolated from the leaves of the plant [11].

Hasan *et al.*, performed cytotoxic study on *Ipomoea carnea* Jacq using breast carcinoma cell line (MCF7) and liver carcinoma cell line (HepG2).SRB assay was performed on methanolic extract of leaves, flowers and seeds of plant to assess anticancer activity. Methanolic extract of leaves was more cytotoxic as compared to flowers and seeds in the HepG2 cell line. While *n*-butanol fraction showed the highest activity on both cell lines [20].

In another study the plant *Ipomoea carnea* was screened for anticancer activity using both *in vitro* and *in vivo* methods. *In vitro* anticancer activity was assessed by MTT assay using Ehrlich Ascites Carcinoma (EAC) cell lines and *in vivo* activity was evaluated by EAC tumor model. Hydroalcoholic extract of leaves were used for the study and result showed that it exhibited significant anticancer property both *in vitro* and *in vivo* in dose dependent manner [21].

Ipomoea hederacea



Ipomoea hederacea commonly known as Ivy-leaved morning-glory is an annual trailing vine (6–8 feet tall). It is found in abandoned fields, areas along roadsides and railroads, gardens and waste areas. Traditionally the seeds are used as diuretics, anthelmintics, aphrodisiacs, blood purifiers and anti-inflammatory. It is also used in constipation, menstruation and to produce abortion. The juice of leaves helps hearing, and cures ear noises also used in treatment of eye inflammations, cataracts and films over the eyes [22].

The secondary metabolites reported in plants were saponins, tannins, terpenes and alkaloids. Phytochemical studies of *Ipomoea hederacea* seeds have reported the presence of alkaloids, lysergol, chanoclavine, penniclavine, isopeniclavine and elymoclavine, stigmasterol 3-O- β -D-glucoside, β -sitosterol-3-O- β -D-glucoside, oleanolic acid, caffeic acid, ethylcaffeate in the plant [22].

Nam and Lee screened anticancer activity of 180 plants including *Ipomoea hederacea* on human lung (A549) and colon (Col 2) cancer cells out of which the methanolic extract of *I. hederacea* along with 17 other plants were found to be active [23].

Ipomoea horsfalliae



Aerial parts of *I. horsfalliae* were subjected to successive solvent extraction using soxhlet extraction method. The solvents employed for extraction were petroleum ether, chloroform, ethyl acetate, ethanol, and water. All the extracts were assessed for anticancer activity. The results of cell viability assay revealed that ethyl acetate extracts exhibited more cytotoxicity to cancer cell lines MCF-7, Hep-G2, A549, HT-29, MOLT-4 and Hela. Ethyl acetate extract was subjected for fractionation and resultant four fractions were evaluated for cytotoxicity on MCF-7 cell lines. The GC-MS analysis of ethyl acetate fraction showed the presence of gamma-sitosterol, phytol, 2, 4-bis (1-phenylethyl)-phenol, pyrrolidine 2, 4-dione [24].

Ipomoea obscura



Ipomoea obscura is slender, twinning perennial herb belonging to morning glory family Convolvulaceae. In Ayurveda it is commonly known as “Lakshmana”. It is used as anti-inflammatory, anti-cancer, stomachic, and antiseptic [25]. It contains various secondary metabolites such as alkaloids, flavonoids, tannins. *I. obscura* contains indole alkaloids, such as ipobscurines B-D, active calystegins B1, B2, B3, B4, and C1¹¹.

Srinivasan R *et al.*, studied anticancer activity of various extracts of whole plant of *Ipomoea obscura*. MTT and sulforhodamine B (SRB) assay were performed to determine *in vitro* cytotoxicity using both normal (Vero-African green monkey kidney, BRL-3A-normal rat liver and MDCK-normal dog kidney) and cancer cell cultures (HeLa-human cervical cancer cells, HEP-2-human larynx epithelial cancer cells and A-549-human small cell lung carcinoma cells). Amongst all extracts, the methanolic extract of plant was found to show significant cytotoxic activity [26].

Hamsa *et al.*, also investigated anti-tumor effect of methanolic extract of plant using *in vitro* and *in vivo* models. The cell lines used were Dalton’s lymphoma ascites (DLA) and Ehrlich ascites carcinoma (EAC). The results revealed that methanolic extract of plant inhibited tumor cell proliferation in a

dose and time-dependent manner. The life span of mice bearing EAC tumor was increased and solid tumor development was inhibited in mice induced with DLA cells [27].

Ipomoea orizabensis



Ipomoea orizabensis commonly known as Mexican Scammony belongs to family convolvulaceae [28]. It is used traditionally as purgative anthelmintic and to treat abdominal fever, dysentery, epilepsy, hydrocephaly, meningitis and tumors [11]. The roots of *Ipomoea orizabensis* contains resinoid jalapin. An extensive investigation of this resinoid lead to characterization of six glycosides, known as scammonins I and II and four new tetrasaccharides of jalapinolic acid, orizabins V-VIII. These isolates were cytotoxic toward human oral epidermoid carcinoma [28].

Ipomoea pes-caprae



Ipomoea pes-caprae commonly known as beach morning glory family convolvulaceae is a perennial creeping vine with milky sap. The plant is primary sand stabilizing species. The plant is reported to contain flavonoids, phenolic acids, resin glycosides such as pescapreins I-IX, stoloniferins III, pescaprosides A and B and pescapreins X-XVII. Traditionally it is used in boils, bedsores, antidote to jellyfish stings, diuretic, laxative stomachic and tonic [29].

Manigauha *et al.*, investigated petroleum ether, methanol and aqueous extract of whole herb of *Ipomoea pes-caprae* for *in-vivo* antitumor potential against melanoma cancer (B16F10) in male C57BL mice. The results obtained from tumor volume, and histo-pathological studies demonstrated that the plant extracts possess significant anticancer activity [30].

In another study Ganjir *et al.*, assessed cytotoxic potential of the plant. The methanol extract of plant was prepared and partitioned with n-hexane. Both the extracts at different doses were tested for cytotoxic activity using brine shrimp mortality assay. The results revealed that *Ipomoea pes-caprae* exhibited more activity at all the doses in non-polar extracts [31].

Ipomoea pes-tigridis

Ipomoea pes-tigridis L. commonly known as “Tiger Foot Morning Glory” is a twining, herbaceous, hairy, annual vine. The plant belongs to the family Convolvulaceae and the synonyms include *Ipomoea biloba* Forsk, *Convolvulus pes-caprae* L. It is used in sores, pimples, boils, carbuncles prevention of rabies, wound healing in headaches, swellings, poisonous stings, snake bites etc. The root and leaves of plant shows presence of presence of alkaloids, saponins, flavanoids and tannins [32].

The plant *Ipomoea pes-tigridis* was studied for anticancer activity against liver HEPG2 Cell line. 70% ethanolic extract of leaves was used for investigation of anticancer activity using MTT assay method. The results showed decrease in the cell count with increase concentration of the extract. *Ipomoea pes-tigridis* exhibited significant anti-cancer effect particularly for liver cancer [33].

Ipomoea quamoclit

Ipomoea quamoclit Linn. belonging to Convolvulaceae family is one of the most commonly seen plant in and around of the living area. It is also known as *Quamoclit pinnata*. It is commonly called as Cypress Vine, Indian Pink. Cardinal creeper, hummingbird vine and Cupid’s Flower. The plant is used in ayurveda due to its various therapeutic benefits [34]. The leaves, stem and seeds of the plant are extensively use in ayurveda for treatment of illness, physical weakness, chest pain, bleeding piles, haemorrhoids, carbuncles, fever, diabetes, bloody cough and in snake bites [35].

Ipomoea quamoclit is reported to possess many secondary metabolites such as alkaloids, cyanogenetic glycosides, quamoclins I-IV and jalapin. Pyrrolizidine alkaloids, ergoline alkaloids and anthocyanins were also found in plant [34].

Renuka *et al.*, investigated *in vitro* cytotoxic activity of ethanolic extract of plant against CaCo₂ (Colon cancer) cell line using

MTT assay and found that the selected extract inhibited CaCo₂ (colon cancer) cell viability in a dose dependent manner [36].

Ipomoea reiniformis



Ipomoea reiniformis Chois. (Convolvulaceae) also known as *Merremia emarginata* is a perennial, much branched herb. It is widely distributed all over India, Ceylon and Tropical Africa. It has been used traditionally for cough, headache, neuralgia, rheumatism, diuretic, inflammation, troubles of nose, and fever due to enlargement of liver and also in kidney diseases³⁷. The plant was found to contain resin, glycosides, amino acids, tannins, and esters of caffeic, p-coumaric, ferulic and sinapic acids [38].

Bothra *et al.*, investigated *in vivo* anticancer potential of *Ipomoea reiniformis* Chois. leaves against Ehrlich Ascites Carcinoma induced cancer in mice. The results revealed that alcoholic and aqueous extract of the plant possess good anticancer activity [38].

Purushoth *et al.*, evaluated different solvent fraction of *Ipomoea reiniformis* for *in*

vitro anticancer activity against human cervical and breast carcinoma. The study demonstrated that ethyl acetate fraction of the plant was found to be cytotoxic against both human cervical Hela cell lines and breast carcinoma MCF cell lines [39].

Ipomoea tricolor



Ipomoea tricolor Cav. belonging to family convolvulaceae is herbaceous liana, growing 2-5 m tall, with cordate-ovate leaves. It contains several ergoline alkaloids, coumarin and scopoletin [11]. Tricolorins A-J, natural tetrasaccharide macrolactones, linear tetraglycosides of jalapinolic acid were also isolated from *I. tricolor* [16].

The chloroform extract of plant *I. tricolor* was screened for cytotoxic activity against Hs578T (human breast tumor cells) and MDA-MB-231 (human breast adenocarcinoma, estrogen receptor negative) cells using MTT-based cytotoxicity assay and found that the chloroform extracts possess strong cytotoxic effects against both breast cancer cells (Hs578T and MD-MBA-231) [16].

Ipomoea tuba

Mangroves species are distributed widely in inter tidal zones of tropical and subtropical areas. These mangrove plants are rich in bioactive compounds which are used in various pharmacological conditions [40]. *Ipomoea tuba* is one of the mangrove species.

Chinna *et al.*, investigated methanol extract of the plant for *in vitro* cytotoxic activity against MCF-7 and HeLa cells using MTT assay. The result indicated that *Ipomoea tuba* leaf extract exhibited significant cytotoxic activity. The GC- MS analysis of methanol extract of leaves was also performed. Compounds such as docosanoic, octadecatrienoic and cis-9-octadecanoic acids, triterpenoid γ -sitosterol, and terpene alcohol were identified in the extract [41].

Ipomoea turpethum

Ipomoea turpethum (L.) R. Br is a synonym of *Operculina turpethum* (L.) Silva Manso and commonly known as Indian Jalap or Turpeth. There are two forms of Indian Jalap namely Sveta and krishna and commonly known as white and black respectively. Traditionally, roots and stems of *Ipomoea turpethum* have been used in wide range of ailments such as gastric ulcer, diarrhoea, constipation, cough, asthma, splenomegaly, anemia, tumors, raised lipid levels and obesity. Indian jalap is rich in different types of bioactive compounds such as alkaloids, coumarins, turpethin, α and β rahmnose, fructose, scopletin, β - sitosterol, betulin and lupeol. Triterpenoids like cysloartenol lanosta -5- ene and 24methylene- δ -5- lanosterol were also reported from the plant [42].

In a study the plant *I. turpethum* was explored for anti-breast cancer activity along with the comparative analysis of the cytotoxicity of the extracts from different

parts (aerial, whole and root). The anticancer activity was evaluated using (4,5-dimethylthiazol-2-Yl)-2,5-diphenyltetrazolium bromide (MTT) and lactate dehydrogenase (LDH) assay. The breast cancer cell lines used for the study were MCF-7 and MDA MB-231. The results revealed that the root extract possess the highest cytotoxicity among all other tested extracts toward both breast cancer cell lines (MCF-7 and MDA MB-231) [43].

CONCLUSION

The human population is severely affected by cancer. To prevent this life-threatening disease there is increasing demand of new therapies with lesser side effect. The genus ipomoea possess rich heritage of plants species with wide range of economical and medicinal importance. The genus ipomoea contains secondary metabolites which are responsible for anticancer activity. There exist a broad scope to derive the potent anticancer agents from other species of this genus with extensive research.

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