1. REVIEW OF LITERATURE

Over recent decades, a substantial number of the evidence has demonstrated a wide range of pharmacological activities for a number of medicinal plants. The investigation of crude plant extracts through ethno-pharmacological evaluation of plants with medicinal value, showed that a number of plants exhibit medicinal properties which may include anti-oxidant, anti-inflammatory and antitumorractivities, (Heras et al., 1998). The presence of various compounds like flavonoids, polyphenolics, tannins and steroids have been implicated in a number of medicinal properties of the plants (McClure 1975, Harborne and Baxter 1999, Hertog and Hollman 1998). *Rheum emodi* is commonly used worldwide herb and often known as "the wondrous drug" because of its extensive medicinal uses (Foust 1993). It includes dried rhizome and root of the rheum species and their hybrid of family polygonaceae. The genus Rheum consists of approximately 60 perennial species distribution throughout the world; and find application as medicine, culinary purpose and few others as ornament; about ten species occur in India (Rokaya et al., 2012, Anonymous 2003). Rhubarb contains a variety of compounds like flavonoids, anthraquinone glycosides, tannins, volatile oils and saponins (Aslam et al., 2012, Ye et al., 2007) and has long been used as an ingredient of purgative, laxative and stomachic (Anonymous 2003). Paradoxically, although larger doses were used as a laxative, small dose were used to treat dysentery and diarrhea (Kim et al., 2011). Rhubarb has also been used in jams, jelly and sauce by its tart flavor (Prior 2009). There are three main types of rhubarbs, viz. the Chinese Rhubarb, the Indian Rhubarb, and the Rhapontic Rhubarb (Anonymous 2003). Chinese Rhubarb comprises of dried rhizomes of *Rheum palmatum L.*, and *Rheum officinale* Baill (Qin et al., 2011). *Rheum emodi*, locally known as Indian or Himalayan Rhubarb, is official in Indian Pharmacopeia. Although *Podophyllum hexandrum* have received significant attention for its tumour necrotizing properties. It has been extensively exploited in Ayurvedic system of medicine for treatment of ailments like constipation, cold, biliary fever, septic wounds, inflammation, burning sensation, mental disorder, genital warts, monocytoid leukemia, Hodgkin’s and non Hodgkin’s lymphoma (Singh and Shah 1994). Podophyllotoxin is a secondary metabolite which is produced by *P.hexandrum*. Podophyllotoxin is a plant-based lignin, pharmacologically active compound which has been reported to possess cytotoxic activities (Imbert 1998). It is currently isolated from the rhizomes of *Podophyllum hexandrum*. A large number of plants have been evaluated for their novel, effective and non-toxic radio
protection against lethal dose of radiation including *P. hexandrum* (Goel et al., 1998, Rajesh et al., 2005) and it was found that pre-radiation administration of the extracts of *Podophyllum hexandrum* mitigated radiation induced postnatal and physiological alterations and showed positive results in control of both planned and unplanned radiation exposure (Goel et al., 2002). Recently *P. hexandrum* extracts have been demonstrated to provide radioprotection by modulating free radical flux because of the presence of lignans (Chawla et al., 2006). Due to its anticancerous property podophyllotoxin is in huge demand throughout the world. Total synthesis of podophyllotoxin is an extensive process and availability of compound from natural resource is major issue for pharmaceutical companies that manufacture these drugs (Canel et al., 2000). Only few studies have been done for its antimicrobial activity. *Podophyllum hexandrum* and *Rheum emodi* rhizome extracts were reported to have antifungal activity against pure cultures of clinical isolates of *Aspergillus niger* ATCC 1197 and *Candida albicans* ATCC 10231 (Gairola et al., 2014). *Podophyllum hexandrum* leaf has been found to be highly effective against *Bacillus subtilis* (Kumar et al., 2005). The phytochemical analysis of *Rheum emodi* showed the presence of steroids, flavonoids, saponins, terpenoids, amino acids and phenols. Anthraquinones are the major active constituents of this plant. Rhizomes of *Rheum emodi* contain several hydroxyanthraquinone derivatives including emodin, chrysophanol, aloe-emodin, physcion and their glycosides (Garcia-Sosa 2006, Swanbeck 1966). Phytochemical analysis of *Podophyllum hexandrum* showed the presence of tannins, steroids, flavonoids, saponins, terpenoids, amino acids and phenol (Malik et al., 2010, Nazir et al., 2013). The presence of antraquinones, flavonoids and tannins are indicative of presence of antimicrobial activity. Low MIC values with *Rheum emodi* extracts have been reported against *Candida albicans*, *Cryptococcus neoformans*, *Trichophyton mentagrophytes* and *Aspergillus fumigatus* (Aggarwal et al 2000). *Rheum emodi* (Rhubarb) is a perineal stout herb belonging to family polygonaceae and has been cultivated over 5000 years for its medicinal properties. It is distributed in the temperate and subtropical regions of the world, especially in Asia and can be cultivated at an altitude above 1800m. The herb is reported to possess antioxidant, antimicrobial, antifungal, anticancer, wound healing and immune enhancing activity and is commonly used worldwide herb and often known as "the wondrous drug" because of its extensive medicinal uses (Shieh et al., 2004, Zhang et al., 1995, Bilal et al., 2015 and Bilal et al., 2014). Rhubarb contains a variety of compounds like flavonoids, anthraquinone glycosides, tannins, volatile oils and saponins (Aslam et al., 2012 and
Ye et al., 2007) and has long been used as an ingredient of purgative, laxative and stomachic. Paradoxically, although larger doses were used as a laxative, small dose were used to treat dysentery and diarrhea (Qin et al., 2011). Rhubarb has also been used in jams, jelly and sauce by its tart flavor (Prior 2009). There are three main types of rhubarbs, viz. the Chinese Rhubarb, the Indian Rhubarb, and the Rhapontic Rhubarb (National Institute of Science Communication and Resources; 2003). Chinese Rhubarb comprises of dried rhizomes of Rheum palmatum L., and Rheum officinale Baill (Qin et al., 2011). Rheum emodi, commonly known as Indian or Himalayan Rhubarb, is official in Indian Pharmacopeia (Ibrahim et al., 2008). The use of this drug has been traced from early times in the medicine. The Chinese appear to have been acquainted with the properties of Rhubarb from a period long anterior to Christian era around 2700BC (Dymock et al., 2005). It was first documented in “The Shen Nong Ben Cao Jing”, the earliest book on materia medica in the world (Fanga et al., 2011). It was being imported in Greece and Rome for medicinal purposes in the 1st century. Dioscorides and Galen described the good medicinal properties of rhubarb in their manuscripts and Avicenna has quoted the use of rhubarb in almost all system of body (Najmul Ghani 2012, Ibn Baitar 2000 and Ibn Sina. 2010). By the 10th century this root became a major export of Asia (Elaine L. Rhubarb 2012) and gradually spreads to India, Russia, Europe and North America. In Europe it was a costlier drug than opium while in France (in 1542) its price was ten times more than the price of cinnamon and four times more than that of saffron (Elaine 2012 and Prior 2009). The word rhubarb has got its name from Latin word “rha” (river) and “barb” (barbarian land). In early times, Romans were importing rhubarb roots from barbarian lands which were beyond the Volga or Rha River. Imported from barbarians across the Rha, the plant became Rhabarbarum (Prior 2009 and Najmul Ghani 2012). According to Lindley's Treasury of Botany, some authorities derive the name from the Greek rheo (‘to flow’), in allusion to the purgative properties of the root (The Rhubarb compendium 2012).

2.1 PLANT DESCRIPTION

The botanical name of Himalayan rhubarb is Rheum emodi Wall. ex Meissn. (Kingdom: Plantae; division: Magnoliophyta; class: Magnoliopsida; order: Caryophyllales; family: Polygonaceae; genus: Rheum L.). Flowering occurs in June and July (Sharma. 2009). Rhubarb has been
cultivated for thousands of years for its medicinal properties, with origins from the mountains of the North-western provinces of China and Tibet. It is first mentioned in the Chinese herbal Pen-King, which listed it as a purgative and stomachic (Foust & Clifford, 1992). It soon found its way into the kitchen, where its tart flavour became popular in desserts such as rhubarb crumble, as well as in jams, jellies and sauces. Rhubarb is a vegetable but is often thought to be a fruit (Lloyd, 2008; Newby, 2005). Rheum emodi a stout herb found in the Himalayan region and is distributed in the temperate and subtropical region from Kashmir to Sikkim at an elevation of 2800-3000m in India. It grows in the alpine zone on rocky soils, moraines and cervices

2.1.1 Different names in different Languages

*Rheum emodi* or Himalayan rhubarb is known by different names in different geographical regions or system. Detail is mentioned in below Table.

<table>
<thead>
<tr>
<th>Language/System</th>
<th>Name</th>
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<tbody>
<tr>
<td>English</td>
<td>Indian Rhubarb or Himalayan Rhubarb (Nadkarni 2009)</td>
</tr>
<tr>
<td>Sanskrit</td>
<td>Gandhini, Revatchini Hindi Dolu, Pita, (National Institute of Science Communication and Resources; 2003 and The Unani Pharmacopoeia of India. 2007)</td>
</tr>
<tr>
<td>Kashmiri</td>
<td>Pumbehakh (CCRUM; 2001)</td>
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<tr>
<td>Tamil</td>
<td>Nattu-ireval-chini, Nattu-manjal-chinni-kizhangu (The Unani Pharmacopoeia of India. 2007)</td>
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<tr>
<td>Telgu</td>
<td>Nattu-revalchini (Nadkarni 2009)</td>
</tr>
<tr>
<td>Arabic</td>
<td>Rewand (The Unani Pharmacopoeia of India. 2007)</td>
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<tr>
<td>Persian</td>
<td>Rewandchini (The Unani Pharmacopoeia of India. 2007)</td>
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<tr>
<td>Ayurvedic</td>
<td>Amlaparni, pitamuuli, Gandhini Revatikka (Khare 2007)</td>
</tr>
<tr>
<td>Siddha</td>
<td>Revalchinikattai, Nattirevaichini (Khare 2007)</td>
</tr>
<tr>
<td>Unani</td>
<td>Revandchini (CCRUM; 2001)</td>
</tr>
<tr>
<td>Synonym</td>
<td>Rheum austral D. Don (Khare 2007)</td>
</tr>
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2.1.2 Botanical description
Rheum emodi Wall.ex Meissn, is a leafy perennial herb (Rajkumar et al., 2011) 1.5-3.0 m in height (National Institute of Science Communication and Resources; 2003). Roots are very stout with large radical leaves longpetioled often having the size of 60 cm in diameter, orbicular or broadly ovate obtuse, base cordate 5-7 nerved, papillose beneath, scaberulous above; petiole 30-45 cm, very strong, scaberulous. Panicle is 0.6-0.9 m, papillosely puberulous, fastigiately branched and leafy with erect strict branches; flowers small 3 mm diameter, dark purple or pale red, in axillary panicles. Fruit ovoid-oblong, 13 mm long, purple, base cordate, apex notched, wings narrower than the disk (Kirtikar et al., 2009, Kandri et al., 2012). The main parts used as drug are roots and rhizomes which are collected in October to November. Root of Indian Rhubarb is darker, inferior in smell, coarser and untrimmed, is not decorticated. Fresh rhizome is 6 to 12 inches long, and the freshly fractured surface is dull orange to yellowish brown (Aslam et al., 2012, Ruchi et al., 2017).

2.1.3 TRADITIONAL USES

Many plant species belonging to different families have so far been reported to have a traditional medicinal use by different communities of India. However these days new and different drugs are used for these ailments, which unfortunately are accompanied by various toxic effects. So, there is a dire need to identify the active principals of natural origin which can be used for the treatment or cure of diseases/infections with no toxic effects. Thus, there has been a growing demand in natural plant products as these are more compatible to the human body with little or no side effects. Rheum emodi is considered as purgative, stomachic, and astringent tonic (Nadkarni 2009 and Rajkumar et al., 2011). It also possesses aperient, emmenagogue and diuretic properties (Rajkumar et al., 2011). Root is regarded as expectorant and appetizer. Anti-inflammatory, anti-dysentery and alexentric actions have also been ascribed (Rajkumar et al., 2011, Kounsar et al., 2011). Rhubarb is widely used in various traditional systems such as, Unani, Ayurveda, and Chinese etc. Indian rhubarb is used as a purgative and astringent tonic. Its primary action is of mild purgation; but it has also astringent properties, so that its secondary effect is to confine the bowels, hence it has been used in the treatment of simple diarrhoea, but not in constipation or any affection in which a continuous laxative action is necessary. It is useful remedy in ailments of children. For the errors in diet of children and for the diarrhoea set up by undigested food, it is given incombined with sodium bicarbonate or magnesia. Rhubarb is an essential ingredient of a large variety of compound. Combined with ginger it may be given in the
form of pills in cases where the bowels are sluggish (Nadkarni 2009). Root is regarded as panacea in local home remedies and is used in stomach problems, cuts, wound, and muscular swelling, tonsillitis and mumps (CCRUM; 2001). Some persons chew the root, and to them this is a very good way of taking it (Nadkarni 2009). Powdered roots are used for cleaning teeth and sprinkled over ulcers for quick healing. Ethno-medically leaf-stalk, leaves and flowers are consumed as vegetables after cooking (Parvaiz et al., 2009). In Assam its leaves consumed as vegetables and cultivated for this purpose. The dried leaves are stored and consumed along with other foods, or made into a preserve. It is however stated that cooked stalks act as a powerful purgative. Besides the medicinal uses, it is also used for coloration of textile and wooden material (Das 2008).

### 2.1.4 PHYTOCHEMISTRY

*Rheum emodi* possess a number of phytoconstituents and these are: anthraquinones, anthrones, stilbenes, oxanthrone ethers and esters, flavonoids, lignans, phenols, carbohydrate and oxalic acid (Parvaiz et al., 2009). The most important phytoconstituents of *Rheum emodi* are anthraquinone and stilbene. Anthraquinones include rhein, chrysophanol, aloe-emodin, emodin, physcion (emodin monomethyl ether), chrysophanein and emodin glycoside. Stilbene includes picetannol, resveratrol and their glycosides (Malik et al., 2010). Different derivatives of oxanthrone include oxanthrone ether (revandchinone-4), oxanthrone esters (revandchinone-1 and revandchinone-2), and revandchinone-3 (Babu et al., 2003; Singh et al., 2005). Other complex compounds have also been reported, including torachrysone 8-O-b-D-glucoside, sulfated anthraquinone glycoside sulfemodin 8-O-b-D-glucoside b-asarone and rhein 11-O-b-D-glucoside (Krenn et al., 2004). Tannins are also present in rhubarb which includes hydrolysable tannins, containing ester or glycosidic bonds composed of gallic acid, glucose and other monosaccharides and condensed tannins, derived primarily from the flavone derivatives catechin and leucocyanidin (Aslam et al., 2012). The trace elements reported to be present in *Rheum emodi* are K, Ca, Fe, Mn, Na, Zn, Co, Li and Cu (Singh et al. 2010).

### 2.1.5 PHARMACOLOGICAL STUDIES

Recent studies have reported that *Rheum emodi* exhibit a wide range of pharmacological activities and have revealed the presence of ninety eight compounds include five flavonoids, twelve anthraquinones, ten stilbenes, sixteen polyphenols and twenty three anthraglycosides and
rest others (Agarwal et al., 2001). The Phytochemical constituents from *R. emodi* have been reported to possess antioxidant activity by scavenging free radicals (Ozturck et al., 2007, Ibrahim et al., 2016), anti-inflammatory activity by attenuating the activity of TNF-α, NFκB, IL-2 and IL-6 (Moon et al., 2006, Ahmad et al., 2017), anticancer activity by inhibiting the cellular proliferation, induction of apoptosis and prevention of metastasis (Huang et al., 2007, Min et al., 2017), antidiabetic activity by decreasing the activity of glucose-6-phosphatase, fructose-1,6-diphosphatase, aldolase and increase in the activity of phosphohexoisomerase and hexokinase in tissue (Radhika et al., 2010, Arvindekar et al., 2015), hepatoprotective activity by restoring the levels of alanine transaminase (ALT), aspartate transaminase (AST), bilirubin, albumin and whole liver homogenate (Doreswamy and Sharma 1995, Evans et al., 2002, Akhtar et al., 2009), nephroprotective effect on all the proximal tubule segments (S1, S2 and S3) possibly through antioxidant action by monitoring the levels of urea, nitrogen and creatinine in serum (Alam et al., 2005, Mapanga and Musabayane 2010), immune enhancing through the release of various cytokines (Kounser and Zargar 2010, Yu et al., 2012). The *Rheum emodi* has also been reported to have a role in the treatment of severe acute respiratory syndrome (SARS). The main phytoconstituents have been found to inhibit the SARS-CoV S protein and ACE2 interaction and infectivity of S protein-pseudotyped retrovirus to Vero E6 cells suggesting that phytoconstituent emodin as a potential therapeutic agent in the treatment of SARS (Ho et al., 2007). There are a number of reports about its antifungal, antimicrobial, regulation of blood fat, hepatitis and in the prevention and treatment of Parkinson’s disease (Maurya et al., 2010, Khan et al., 2012, Clementi and Mistis 2010, Kong et al., 2004).
Rheum Emodi

Fig. 2.1 Rheum emodi plant
2.2 *Podophyllum hexandrum*

*Podophyllum hexandrum* Royle (Himalayan Mayapple) also known as Aindri in ancient times. The name of the plant in Hindi and Ayurveda is bantrapushi or Giriparpat. The perennial herb *Podophyllum hexandrum* also bears the common names of Himalayan May apple or Indian May apple, is found in the lower elevations of Himalayan countries like Afghanistan, Pakistan, India, Nepal, Bhutan, and in S. W. China (Airi *et al*., 1997, Gupta *et al*., 1983, Giri *et al*., 2000 and Choudhary *et al*., 1998). In India *Podophyllum hexandrum* is mostly found in Alpine Himalayas (3000-4000 m) of Jammu and Kashmir, Himachal Pradesh, Sikkim, Uttaranchal and Arunachal Pradesh (Nayar *et al*., 1951, Uniyal 1977 and Kumar *et al*., 1997). In Kashmir it has found its use in traditional system of medicine from ancient times and is locally known as Banwangun, because its red colour fruit (berry) which has the size of a small brinjal. Indian *Podophyllum* has a long history of usage as a medicine amongst natives of the Himalayas, an aqueous extract of the roots being used as a cathartic. It has also been used as a remedy for the treatment of ophthalmia. In 1890 Thomson analyzed the Resin from the Indian plant and reported 56% podophyllotoxin content. Podwyssotzki was first to show that Podophyllotoxin is the active principle of podophyllin and obtained it in a pure state in 1880. The rhizomes of *Podophyllum hexandrum* are known to contain several lignans which are dimerisation products of phenylpropanoid pathway intermediates linked by central carbons of their side chain (Kamil *et al*., 1986, Jackson *et al*., 1984). It grows low to the ground with glossy green colour, stiff branches bearing lobed leaves and it bears a light pink flower and bright red-orange bulbous fruit. It can be propagated by seed. It is resistant to cold temperatures, as would be expected of a Himalayan plant, but is not tolerant to dry conditions.

The *Podophyllum hexandrum* grows from 12 to 18 inches high with deeply lobed leaves, fleshy stems, which rise straight up from the soil. The name *Podophyllum* is taken from podos, a foot, and phyllon, a leaf having the shape of a foot and refers to the resemblance of the leaves to a duck’s foot. The plant contains beautiful leaves which are divided into 3 lobes. They are completely unrolled after the plant has fully bloomed and are dark green splotched with brown. In the spring, white or pale pink coloured 6-petaled flowers are borne at the ends of stout stems; followed by fleshy, oval, red berries. The flower in May-August contains six petals and six
stamens for which it derived its species name hexandrum, meaning six stamens. Leaves are rounded with 10-25 cm long, deeply cut into 3 ovate, toothed lobes, sometimes further lobed. Fruit is a large scarlet or reddish berry, 2.5-5 cm, with many seeds embedded in pulp. It can be cultivated by seed or by dividing the rhizome. It is found at an elevation of 2800 - 3000 m in the Indian Himalayas, in the pastures of mountains, in organic rich and shaded localities or on the banks of river streams as an under growth along with other herbs. Plants containing lignans have been since ancient times as folk remedies in indigenous medicine of many diverse cultures. Plants with high lignin content have widely been used in Chinese, Japanese, and the Eastern world folk medicine, for example, Kadsura coccinea (Schizandraceae), Fraxinus sp. and Olea europaea (Oleaceae). The extensive use in traditional medicine makes the lignans an essential component for starting product for the development of new therapeutic agents based on structural modifications of such compounds. *Podophyllum hexandrum*, also being rich in lignin content has been reported to be used through ancient and modern times. It has been extensively used in traditional system of medicine for treatment of a number of diseases like Condyloma acuminata, Taenia capitis, monocytoid leukemia, Hodgkin’s disease, non-Hodgkin’s Lymphoma, cancer of brain, lung, bladder and venereal warts. (Gowdey *et al.*, 1995, Cobb 1990, Beutner *et al.*, 1990).

### 2.2.1 Podophyllotoxin derivatives

Three semisynthetic derivatives of podophyllotoxin etoposide, teniposide and etopophos are widely as used anticancer drugs and show good clinical effects against several types of neoplasms, including testicular and small cell lung cancers, lymphoma, leukemia, Kaposi’s sarcoma, etc. Podophyllotoxin shares the property with the anticancer drugs paclitaxel and camptothecin of being virtually insoluble in water (Greenwald *et al.*, 1999). Being hydrophilic in nature the glucosides are less toxic than aglucons, but their cytostatic activity also reduces to the same degree. Therefore, research efforts were made to perform numerous modifications on the basic podophyllotoxin skeleton, in order to avoid several side-effects; and this resulted in the clinical introduction of etoposide and teniposide, which are cytostatic (antimitotic) glucosides. Both are 4-glucopyranosyl derivatives of epipodophyllo-toxin, a distereoisomer of podophyllotoxin (Stahelin *et al.*, 1991). These semi-synthetic derivatives of podophyllotoxin play an important role in the treatment of lung cancer, a variety of leukemia and other solid tumors. (Uden *et al.*, 1989, Holthuis 1988 and Pelter *et al.*, 1994)
However, they have certain limitations, such as water insolubility, metabolic inactivation and the development of resistance to drugs. Etoposide is used in combination therapy in refractory testicular lymphoid and myeloid leukemia and in stomach, ovarian, brain, breast, pancreatic, and both small and large-cell lung cancers. Teniposide has found less use than etoposide and is mainly used for the treatment of lymphomas. Numerous derivatives varying the topside basic structure have been proposed, synthesized and clinically tested. The successful derivatization of podophyllotoxin into etoposide and teniposide has generated interest in structure optimization to produce new derivatives with a superior pharmacological profile and broader therapeutic uses (Pelter et al., 1994).

Fig. 2.2 Podophyllum hexandrum plant

2.2.2 Pharmacological properties

In old days *P. hexadrum* was famous as Aindri (a divine drug). Podophyllotoxin a natural plant secondary metabolite which is mainly obtained from the root of *P. hexandrum* as well as its congeners and it is known to have importance in pharmacology and therapeutics as it contains anticancer, antineoplastic as well as anti HIV activities (Giri et al., 2000 and Chen et al., 2007). *Podophyllum hexandrum* obtained from India is better than its American counterpart, *P.*
This is because the dried roots of Indian plant contain 4% as against 0.25% in *P. peltatum*. Podophyllotoxin is present in this plant as mentioned above, and it is also known as a natural lignin and most importantly this lignin contains cytotoxic activity. The cytotoxic activity is said to act in metaphase of mitosis by attaching the microtubules and hence block their proliferation (Canel *et al*., 2000). Podophyllotoxin is the component of many pharmacopoeias and is being used as an antiviral agent due to its antiviral activity. It is used for curing a viral disease called condyloma acuminatum which results by human papilloma virus or some other viruses. The podophyllotoxin is widely used to kill all types of warts and the most beneficial thing is that it has very little toxic effects and takes less time. Some of the famous categories of viruses like cytomegalovirus and Sindbis virus are also inhibited by podophyllotoxin and its related compounds. It can also be used for treatment against viruses affecting the anogenital track of the children. There are self limiting benign disease known as molluscum contagiosum that affects mostly children, young adults, and HIV patients. Podophyllotoxin has also been used for the treatment of this disease. In the field of dermatology, podophyllotoxin is used to cure psoriasis vulgaris. Podophyllotoxin has superb pharmacological activities because of its antitumor activity as it inhibits the proliferation in the metaphase of mitosis. The forms of tumors which can be treated by podophyllotoxin are Wilms’ tumors and various types of genital tumors (e.g. carcinoma verrucous). It is also used for treating the ailments of non-Hodgkin lymphoma and other lymphomas. Podophyllotoxin can also penetrate into human skin and lead to acantholysis and cytolysis which was studied by using human bioengineered skin. Podophyllotoxin may be used in cosmetology as its intrinsic activity shows many features related which can be proved beneficial in this case (Datt *et al*., 2000). Etoposide, teniposide and etopophos are the semisynthetic derivative products of podophyllotoxin and they are commonly used in the treatment of cancer and also known to be effective in the treatment of many types of neoplasms, including small cell lung cancers, lymphoma, leukemia, Kaposi’s sarcoma, etc. Refractory testicular lymph and myeloid leukemia and leukemia in stomach, ovarian, brain, breast, pancreatic, and large-cell lung cancers can all be cured by using etoposide, combined with other drugs. Teniposide is less beneficial than etoposide but still used for the treatment of lymphoblasts (Van Uden *et al*., 1989 and Henderson 2000).

**AIM & OBJECTIVIES**
To check the traditional claim that these plants have significant antimicrobial activities (as is reported in the traditional knowledge of the indigenous people as both the plants are used in the treatment of gastrointestinal infections, respiratory infections, liver and skin infections), the present work has been planned as a pilot study with the following objectives.

- **To study the antibacterial & antifungal activities of Rheum emodi and Podophyllum hexandrum.**

- **Phytochemical screening of crude extracts of Rheum emodi & Podophyllum hexandrum for antibacterial & antifungal activity.**

- **To compare the antibacterial & antifungal activities of Rheumemodi and Podophyllum hexandrum**