

# A Review on *Plumbago zeylanica* : A Compelling Herb

Richa Tyagi\*<sup>1</sup>, Ekta Menghani<sup>2</sup>

1. Suresh Gyan Vihar University, Jaipur India

2. JECRC University, Jaipur India

richatyagi31@gmail.com

Ph.no: 09460940911

**Abstract:** Herbal medicines are always in great demand, they are in use since the time of immortal. People all around the globe are dependent on herbal medicines because of their non-violent and non-toxic nature. All though there are so many alternative methods available but still people depend on herbal plants for their day to day life. Therapeutic plants are the solution to sinister and incapacitating effect of synthetic medicines. Herbal plants always prove them self as the primary product for synthetic drugs. *Plumbago zeylanica* is one such plant of great medicinal importance. *Plumbago zeylanica* is widely used plant for its therapeutic practises in traditional system of medicine. Especially the rural people in India are entirely reliant on herbal plants. With the revitalisation of herbal plants across the world, *Plumbago zeylanica* is broadly used for commercial preparation of medicines due to its biological activities. So the present study précises our existing information on *Plumbago zeylanica*, its major bioactive, traditional and medicinal uses of *Plumbago zeylanica*, as an advance to additional study on this valuable plant.

**Keywords:** *Plumbago zeylanica*, chitrak, therapeutic uses, chemical constituents, traditional values, medicinal plant.

## 1. Introduction

*Plumbago zeylanica* L, commonly known as chitrak or lead wort-white flowered is innate to South Asia. It is dispersed in tropical and subtropical countries of the world. Budding in deciduous woodland, savannahs, scrublands from sea level up to 2000 m altitude [1, 2]. In India it is sprinkled in central India to West Bengal, Maharashtra, and Uttar Pradesh to some parts of South India. The plant also enjoys regional names in different state **Gujarati:** Agni / vahini, **Kannada:**chitramula, **Malayalam:** chitrakmula/ bilichitramula, **Punjabi:** Veellakeduveli, **Bangali:** chitra, **Tamil:** chita, **Telugu:** kodiveli/ chitramoolam, **Hindi:** chitraka/chitramol, **Sanskrit:** chitra [3]. But commonly used name persisted to be chitraka [4, 5]. *Plumbago* is from Plumbaginaceae family comprises of 10 genera and 280 species. The genus *Plumbago* take account of 3 species that is *Plumbago indica* L. (*P. rosea* L.) *P. capensis* L., and *P. zeylanica* L., in all these 3 species *Plumbago zeylanica* is most cultivated because of its high therapeutic uses. It is an oldest herb that was used in Ayurveda for several disorders over thousands of years. It grows wild in India and also refined commercially

### 1.1 Morphology

There is no uniformity in literature that states *P. zeylanica* is herb or shrub. It is a perennial bushy shrub but in some of the works it is also defined as herb [6, 7] while some has given the class of shrub [8]. *P. zeylanica* plant accomplishes a height of about 0.5–2 m. Leaves are dark green in colour with the thickness of 1.5 inch and distance of leaf is roughly up to 3 inch The leaves are alternate, simple, ovate or ovate-lanceolate, elliptical or oblong and they consume hairy margin, The stipules are inattentive and petiole is thin with a tallness of approx. 0-5 mm. The inflorescence is of terminal raceme-type, flowers are white in colour with the stalk measurement of 4 to 12 inch, the diameter of the flower is ½ to ¾ inch, These are existent in bunches or clusters, They are bisexual, regular, pentamerous, pedicellate and pleasant fragranced. The flowers come round the year and pollination process is completed with the help of insects. The mucilaginous glands supports the plant to trap the insects on it.

Calyx is dense and enclosed with stalked, some sticky glands are in existence in flower that makes the flower sticky, and Corolla is white in colour with slender and tubular. Stameus are 5 and free. Ovary is always superior, 5-gonous, one celled, ovule one, basal [9]. Light yellow roots were detected when the plant is garden-fresh, but bowed to reddish brown in colour when dried out, often initiate in the form of hard pieces, straight, long, unbranched or slightly branched root are always observed with or without secondary roots, the texture of the roots are unbroken and smooth, Roots are usually very strong and They have a distinctive odour with acrid and bitter taste.[6]

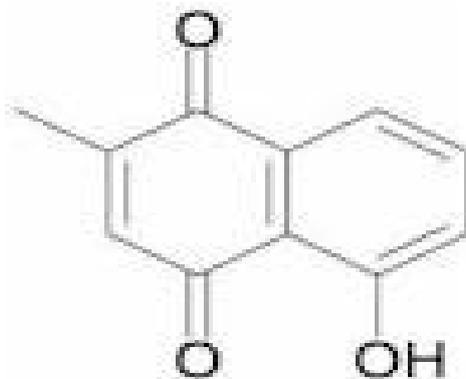


### 1.2 chemical composition

All herbal plants enclose some bioactive chemical compounds that illustrate innumerable imperative activities against diseases. So *P. zeylanica* also encompass imperative chemical compound that displays various actions, diverse parts of the plant enclose countless secondary metabolites like alkaloids, flavonoids, naphthaquinones, glycosides, steroids, saponins, triterpenoids, tannins, phenolic compounds, coumarins, carbohydrates, fixed oil and fats and proteins [1,10,11,12,13]. In all of these compounds the most imperative principle active compound is 'plumbagin'

#### Plumbagin

Plumbagin (5-hydroxy-2-methyl-1, 4- naphthoquinone-  $C_{11}-H_8-O_3$ ) is present in roots of the plants [14 ]. It self-contained 1% present in entire plant. So plumbagin store in root majorly, plumbagin is a rationally stirring yellow pigment that patents in members of Plumbaginaceae and that too customarily in roots [14]. The stem has a lesser volume and leaves has no plumabgin. It is natural yellow pigment because of existence of naphthoquinone pigment [15], and is existing in the form of needles. Plumbagin is soluble in alcohol, acetone, chloroform, benzene, and acetic acid and is exceedingly toxic compound with corrosive possessions.



#### Structure of Plumbagin

Plumbagin has antibacterial activity in contradiction of numerous pathogenic bacteria [16].The methanolic extract of plumbagin shows strong antibacterial activity against *Escherichia coli*, *Salmonella typhi* and *Staphylococcus aureus* [17].and inhibitory outcome in contradiction of *Klebsiella pneumoniae*, *Serratia marcescens* and moderate result in contradiction of *Bacillus subtilis*, and less lower effect contrary to *Proteus vulgaris* and *Pseudomonas aeruginosa*, and aqueous extract shows less antibacterial action as associated to organic extract. Plumbagin shown anticancer [18], antifungal [17] , antimicrobial activity [19], antibiotic effects [19]Five coumarins seselin[20], 5-methoxyseselin [21], suberosin [23], xanthyletin and xanthoxyletin were seized from the roots of *P. zeylanica* [22].A very little concentration of plumbagin parades antimitotic movement analogous to cholchicine.

### 1.3 Therapeutic uses

*P. zeylanica* is a widespread curative herb all over Africa and Asia. It has been cast-off as a cure for skin sicknesses, infections and intestinal worm's viz. leprosy, scabies, ringworm, hookworm, dermatitis, acne, sores and ulcers subsequently ancient times. The old systems of medicine in diverse parts of the landmasses have been employing all amounts of *P. zeylanica* for a diversity of treatments. The whole plant has medicinal effects but

the root of chitrak has ample therapeutic uses. Its Roots, bark and seed are used in variety of alignments. The fresh juice from roots is effective for internal piles, the roots of plant rise the digestion and promote appetite, and small doses excite central nervous system. Roots of the plant have abortifacient and vesicant effects. Paste prepared from roots of the plant is applied to the skin to treat abscesses, other skin diseases including ulcers and scabies also [24, 25]. Operative against chicken pox and acne. It is believed that paste from roots is effective against filarial leg. It is also used in contradiction of dysentery, diarrhoea, diuretic, and peptic ulcers and intestinal parasite [26]. If the paste from roots is taken with butter milk it relives in piles and non-bleeding piles also. If the dried powder of roots is taken with honey relives in hypercholostremi, the same is effective against anemia and helps the formation of blood cells. It is also reported that the dried powder of the roots is also effective against anemia. Many scientist believe that fever or malaria, rheumatism, intestinal parasites, anemia due to 'stagnant blood', internal and external trauma, toxic swelling and furunculous scabies can be treated with this plant. [25, 27, 28, 29]. In Africa it is also used in influenza and black water fever. Bark of the plant is cast-off to stop bleeding, to treat wound, gonorrhoea, syphilis, tuberculosis, rheumatic pain, swellings, root and bark is also used to treat obesity. It is found active against sore throat, running nose. In some rural parts it is used in the form of local application for leukoderma, leprosy, psoriasis.

Various pharmacological findings has indicated that *P. zeylanica* extract has s antiplasmodial [30], antimicrobial [31], antifungal [32], anti-inflammatory [33], antihyperglycemic [34], hypolipidaemic and antiatherosclerotic activities [35]. It is reported that it shows sufficient antidiarrheal [36], antiallergic [29], insecticidal, antidiabetic [34], hepatoprotective properties [37, 38]

## 2. Propagation

*P. zeylanica* is grown mostly by seeds, rooted shoots that is available at the bottom of the plant or by semi-ripe cuttings, preserved with growth regulators. Seeds sprout in 21–30 days and extended storing of seeds (over 3 months) consequences in a severe deterioration in germination rate. Propagating seeds in a nursery with consequent transplantation addicted to the ground at a density of 58 x 58cm is a favoured method of *P. zeylanica* plants proliferation. Though the plant can be developed in a range of soils, working from red soil to deep black soil; the plants favour fine profound sandy loam to clayey loam soil using great organic content. In natural habitats, the plants grow well in soggy soil with great organic content and moderately shaded positions with in-between warm temperatures.

Mostly traditional approaches of proliferation have confirmed to be problematic and insufficient to encounter the mounting requests of herbal plant on commercial scale.

The reason is largely recognized as deprived seed propagation and untimely demise of seedlings on plantation below standard circumstances. On the other hand, the method of *in vitro* proliferation is effectively exploited for mass multiplication of *P. zeylanica* by means of nodal explants, axillary buds, leaf or root explants and callus cultures

## 3. Chemical constituents of *Plumbago zeylanica*

*P. zeylanica* is greatly used for its chemical constituents that are present in various parts of the plants.

### 3.1 Leaf

Leaf of the plant contain mainly plumbagin that is the prime chemical component of the plant, along with **plumbagin** it contains

- Plubagic acid
- Beta-sitosterol 4-hydroxy-benzaldehyde
- Trans-cinnamic acid
- 2,5-dimethyl-7-hydroxy chromone
- Isoshinanolone
- Indole-3-carboxaldehyde
- Vanillic acid

### 3.2 Roots

Roots contain mainly **Napthoquinone** it includes

- 5,7-dihydroxy-8-methoxy-2-methyl-1,4-napthoquinone (plumbagin)
- Biplumbagin
- Chloroplumbagin
- Maritinone
- Elliptinone
- 2-(1-hydroxy-1-methyl-ethyl)-9-methoxy-1,8-dioxacylopenta (*b.g*)
- Naphthalene-4,10-dione, 9-hydroxy-2-isopropenyl-1,8-dioxacylopenta (*b.g*)
- Isoshinanolone

- 2-isopropeny,1-9-methoxy-1,8-di-oxadicyclopenta( b,g)
- Lapachol

**Coumarins**

- 5-methoxy seselin
- Seselin
- Suberosin
- Xanthylctin
- Xanthoxylctin

**Plumbic Acid**

- 3'-o- $\beta$ -glucopyranosyl plumbagic acid
- 3'-o- $\beta$ -glucopyranosyl plumabagic acid methyl ester

**Enzymes**

- Invertase
- Protease

**Other Compounds**

Zeylinone, glucose, fructose, isozeylinone, droscrone, plumbaginol

**3.3 Flower**

- Plumbagin
- Glucose
- Zeylanone

**3.4 Stem**

- Plumbagin
- Dihydroflavinol plumbaginol
- Sitosterol
- Isozeylanone

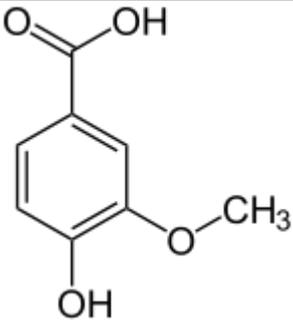
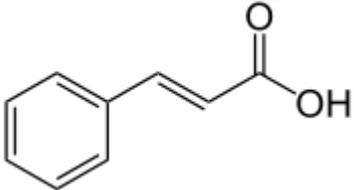
**3.5 Fruit**

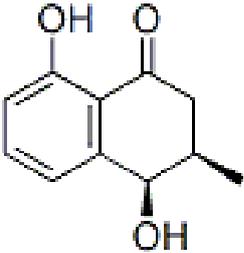
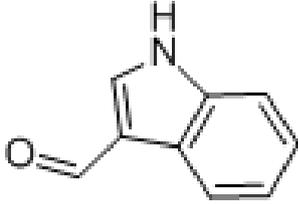
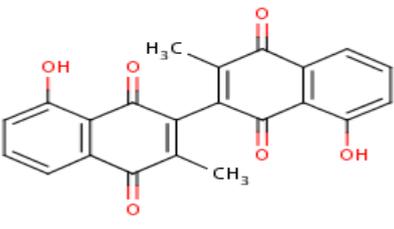
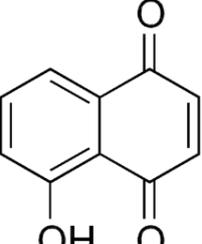
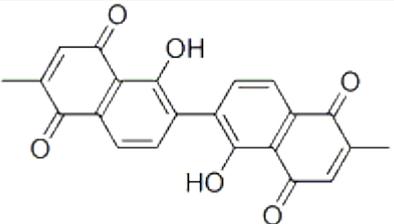
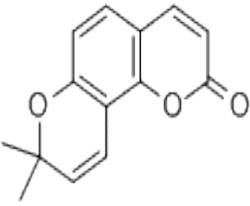
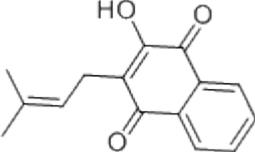
- Plumbagin
- Glucopyranoside
- Sitosterol

**3.6Seed**

- Plumbagin

**4. Chemical structures of some compounds present in *Plumbago zeylanica***

S.No	Name of Compound	Structure
1.	Vanillic acid	
2.	Cinnamic acid	

3.	Isoshinanolone	
4.	Indole-3-carboxaldehyde	
5.	3,3'-Biplumbagin	
6.	Napthoquinone	
7.	Elliptinone	
8.	Seselin	
9.	Lapachol	

## 5. Future Prospectus

Although *P. zeylanica* is an important plant in herbal manufacturing but still there is a need of strong determination to grow an alternative process for mass proliferation of the plant. Random sampling from the forest areas are on for *P. zeylanica*. This create a risk to the prevailing of *P. zeylanica* in nature. Fast development of *P. zeylanica* genotypes from micropropagation process and restricting the breeding procedure by means of marker-aided assortment definitely underwrites the crop development. Using *in vitro* practises at huge scale for development and successive ground plantations should be immeasurably valuable for the growing request *P. zeylanica*.

### Conclusion:

The review clearly shows the importance of *Plumbago zeylanica* as a useful medicinal plant. *Plumbago zeylanica* is used throughout the world for therapeutic purposes. The review encapsulates about the morphology of the plant along with its chemical composition, propagation, therapeutic use

### References:

- [1] Vijver LM. Antibacterial Activity in Roots of *Plumbago zeylanica*. *Planta Med*, 1971; 20: 8-13.
- [2] Aditi G. Medicinal plants used in traditional medicine in Jimma zone, South West. *Ethiopia Pharm. Biol.*, 1999; 37: 321-323.
- [3] Vishnukanta, Rana A.C. Evaluation of anticonvulsant activity of *Plumbago zeylanica* Linn leaf extract. *Asian Journal of Pharmaceutical and Clinical Research*, 2010;3(1): 76-78
- Nguyen AT, Malonne H, Duez P. Cytotoxic constituents from *Plumbago zeylanica* *Fitoterapia*,2004; 75(5): 500-504.
- [4] Yuvaraj D. Mandavkar and Sunil S. Jalalpure. A comprehensive review on *Plumbago zeylanica* Linn. *African journal of Pharmacy and Pharmacology African Journal of Pharmacy and Pharmacology*, 2011; 5(25): 2738-2747.
- [5] Chetty KM, Sivaji K, Sudarsanam G, Sekar PH. Pharmaceutical studies and therapeutic uses of *Plumbago zeylanica* L. root. *Ethnobotanical Leaflets*, 2006;10: 294-304
- [6] Kumar R, Kumar S, Patra A, Jayalakshmi S. Hepatoprotective activity of aerial parts of *Plumbago zeylanica* linn against carbon tetrachloride-induced hepatotoxicity in rats *Int J.Pharma Pharma Sci.*, 2009; 1:171-175.
- [7] Dhale, D.A, Markandeya SK. Antimicrobial and phytochemical screening of *Plumbago zeylanica* Linn.(Plumbaginaceae) Leaf. *Journal of Experimental Sciences*, 2011; 2(3): 4-6.
- [8] Bhattacharyya S, Hazra B, Sarkar R,Ghosh P.K, Chel G, Dinda B. Synthesis of plumbagin derivatives and their inhibitory activities against Ehrlich ascites carcinoma in vivo and *Leishmania donovani* Promastigotes in vitro. *Phytotherapy Research*, Volume 16, Issue 2, March 2002; pages 133–137
- [9] Ahmad I, Aquil F. In vitro efficacy of bioactive extracts of 15 medicinal plants against Esbetal-producing multidrug-resistant enteric bacteria. *Microbiol Res.*,2006; 162(3): 264-275
- [10] Ravikumar VR et al. Phytochemical and antimicrobial studies on *Plumbago zeylanica* (L)(Plumbaginaceae). *International Journal of Research In Pharmacy and Chemistry*, 2011; 1(2): 185-188.
- [11] Kodati D R , Burra S, Kumar G. Evaluation of wound healing activity of methanolic root extract of *Plumbago zeylanica* L. in wistar albino rats. *Asian J. Plant Sci. Re.s*, 2011; 1(2):26-34.
- [12] Ming Y, Wang J, Yang J, Liu W. Chemical constituents of *Plumbago zeylanica*. *Advanced Materials Research*, 2011; 308-310:1662-1664
- [13] Van Der Vijver LM . Distribution of plumbagin in the Plumbaginaceae. *Phytochemistry* ,1974;11: 3247–3248.
- [14] Merck. Plumbagin. 7697. The Merck Index, 12<sup>th</sup> ed. on CD-ROM, New York, Chapman,1997
- [15] Gujar GT. Plumbagin, a naturally occurring naphtho- quinone. Its pharmacological and pesticidal activity. *Fitoterapia*,1990;59: 387–393
- [16] Beg AZ, and Ahmad I. Effect of *Plumbago zeylanica* extract and certain curing agents on multidrug resistant bacteria of clinical origin. *World Journal of Microbiology and Biotechnology*, 2000;16: 841–844.
- [17] Melo AM, Jardim ML, Santana CF, Lacet Y, Filho JL, Lima I, Eoncio OG. First observations on the topical and use of primin, plumbagin and mayteni in patients with skin cancer. *Revista do Instituto de Antibioticos.*, 1974; 14:9-16
- [18] Durga R, Sridhar P, and Polsa H. Effect of plumbagin on antibiotic resistance in bacteria. *Indian Journal of Medical Research*,1990; 91: 18–20.
- [19] Kostova I, Manolov I, Nicolova I, and Danchev ND. New metal complexes of 4-methyl-7-hydroxycoumarin sodium salt and their pharmacological activity. *Il Farmaco*,2001;56: 707–713
- [20] Kofinas C, Chinou I, Loukis A, Harvala C, Roussakis C, Maillard M, and Hostettmann K. Cytotoxic Coumarins from the aerial parts of *Tordylium apulum* and their effects on a non-small-cell bronchial carcinoma cell line. *Planta Medica*, 1998;64: 174–176
- [21] Lin LC, Yang LL, and Chou CJ. Cytotoxic naphthoquinones and plumbagic acid glucosides from *Plumbago zeylanica*. *Phytochemistry*, 2003; 62: 619–622.
- [22] Uchiyama T, Hara S, Makino M, and Fujimoto Y. Seco-Adianane-type triterpenoids from *Dorstenia brasiliensis* (Moraceae). *Phytochemistry*, 2002;60: 761–164
- [23] Arunachalam KD, Velmurugan P, Raja RB. Anti-inflammatory and cytotoxic effects of extract from *Plumbago zeylanica*. *Afri. J. Micriobiol. Res*, 2010; 4(12): 1239-1245
- [24] Olagunju JA, Fagbohunka BS, Oyedapo OO, Abdul AIA. Effects of an ethanolic root extract of *Plumbago zeylanica* Linn, on some serum parameters of the rats. *RPMP-Drug Dev. Mol.*, 2006;11: 268-276.
- [25] Chiu, N.Y. and K.H. Chang, the Illustrated Medicinal Plants of Taiwan; 5 ed. Vol. 2. Taipei: SMC Publishing Inc. 2003
- [26] Jeyachandran R, Mahesh A, Cindrella L, Sudhakar S, Pazhanichamy K . Antibacterial activity of Plumbagin and root extracts of *Plumbago zeylanica*. *Acta Biol. Cracoviensia Ser. Botan*, 2009;51(1): 17-22
- [27] Jiangsu New Medical College. *Zhonyao Dictionary (Encyclopedia of Chinese Materia)*. Scientific and Technological Press, Shanghai, pp 711-712,1979.
- [28] Dai Y, Hou L, Chan Y, Cheng L, But PP. Inhibition of immediate allergic reactions by ethanol extract from *Plumbago zeylanica* stems. *Biol. Pharmacol. Bull*, 2004; 27(3): 429-432
- [29] Simonsen HT, Nordskjold JB, Smitt UW, Nyman U, Palpu P, Joshi P, Varughese G. In vitro screening of Indian medicinal plants for antiplasmodial activity. *J. Ethnopharmacol*, 2001; 74: 195-204.

- [30] Ahmad I, Mehmood Z, Mohammad F, Ahmad S. Antimicrobial potency and synergistic activity of five traditionally used Indian medicinal plants. *J. Med. Arom. Plant Sci.* 2000; 23: 173-176.
- [31] Mehmood Z, Ahmad I, Mohammad F, Ahmad S. Indian medicinal plants: A potential source of anticandidal drugs. *Pharm.Biol.*, 1999; 37: 237-242.
- [32] Oyedapo OO. Studies on the bioactivity of the extract of *Plumbago zeylanica*. *Phytother. Res.*, 1996; 13: 346-348.
- [33] Olagunju JA, Jobi AA, Oyedapo OO. An investigation into the biochemical basis of the observed hyperglycaemia in rats treated with ethanolic root extract of *Plumbago zeylanica*. *Phytother. Res.*, 1999; 13: 346-348
- [34] Sharma I, Gusain D, and Dixit VP. Hypolipidaemic and antiatherosclerotic effects of plumbagin in rabbits. *Indian Journal of Physiology and Pharmacology*, 1991; 35: 10–14
- [35] The Wealth of India. A Dictionary of Indian Information Directorate, CSI, 302–5. Raw Material and Industrial Products, vol. VIII, New Delhi Publication. 2003
- [36] Kanchana N, Sadiq AM. Hepatoprotective effect of *Plumbago zeylanica* on paracetamol induced liver Toxicity in rats. *Int J Pharmacy Pharma Sci.*, 2011; 3: 151-54.
- [37] Gupta A, Gupta A, Singh J. New Naphthoquinones from *Plumbago zeylanica*. *Pharma Biol.*, 1999; 37: 321–3
- [38] Abdul KM, Ramchender RP. Modulatory effect of plumbagin (5-hydroxy-2-methyl-1,4-naphthoquinone) on macrophage functions in BALB/c mice. I. potentiation of macrophage bactericidal activity *Immunopharmacol.* 1995; 30(3): 231-236.
- [39] Hiradeve S, Danao K, Kharabe V, Mendhe B. Evaluation of anticancer activity of *Plumbago zeylanica* Linn. Leaf extract. *IJBR*, 2010; 1(2): 52
- [40] Chen, C.A, Chang HH, Kao CY, Tsai TH, Chen YJ. Plumbagin, isolated from *Plumbago zeylanica*, Induces cell death through apoptosis in human pancreatic cancer cells. *Pancreatology*, 2009; 9(6): 797-809
- [41] Poosarla A, Athota RR. Alleviation of collagen induced arthritis by *Plumbago zeylanica* in mice. *Pharma .Bio.*, 2007; 45:54-59
- [42] Mossa JS, El-Ferali FS, Muhammad I, Antimycobacterial constituents from *Juniperus procera*, *Ferula communis* and *Plumbago zeylanica* and their in vitro synergistic activity with isonicotinic acid hydrazide. *Phytother. Re.*, 2004; 18(11): 934-937.
- [43] Singh M, Kushagra Nagori, Shiv Iyer, Gaurav Khare, Gotmi Sharwan, D.K.Tripathi. Ethnomedicinal, traditional and pharmacological aspects of *Plumbago zeylanica* Linn. *Pharmacologyonline*. 2011; 3: 684-700.
- [44] Kofi A, Rita Dickson, Abraham Mensah, Theophilus Christian Fleischer. Acaricidal effect of *Plumbago zeylanica* L. against *Amblyoma variegatum*. *Pharmacog. J*, 2009; 1: 190-194.
- [45] Sathya S, Sudhagar S, Vidhya Priya M, Bharathi Raja R, Muthusamy VS, Niranjali Devaraj S, Lakshmi BS. 3 $\beta$ -Hydroxylup-20(29)-ene-27, 28-dioic acid dimethyl ester, a novel natural product from *Plumbago zeylanica* inhibits the proliferation and migration of MDA-MB-231 cells. *Chemico–Biological Interactions*, 2010; 188: 412-420.
- [46] Pendurkar S, Sudha R. Antihyperlipidemic effect of aqueous extract of *Plumbago zeylanica* roots in diet-induced hyperlipidemic rat. *Pharmaceutical Biology*, 2009; 47(10): 1004-1010.
- [47] Mariam TG, Neubert R, Schmidt PC, Wutzler P, Schmidtke M. Antiviral activity of some Ethiopian medicinal plants used for the treatment of dermatological disorders. *Journal of Ethnopharmacology*, 2006; 104(1-2): 182-187
- [48] Devarshi P, S Patil, A Kanase. Effect of *Plumbago zeylanica* root powder induced preimplantation loss and abortion on uterine luminal proteins in albino rats. *Indian J Exp Biol.*, 1991; 29(6): 521-522.
- [49] Edwin S, Siddeshwar B Joshi, Dharam C Jain. Antifertility activity of leaves of *Plumbago zeylanica* Linn. in female albino rats. *Eur.J.Contracept Reprod.Health Care*, 2009; 4(3): 233-239.
- [50] Bhargava SK. Effects of plumbagin on reproductive function of male dog. *Indian J. Exp. Biol.*, 1984; 22:153-156.
- [51] Lubaina A.S, Nair GM, Murugan K. Shoot multiplication and direct organogenesis of an important medicinal plant *Plumbago zeylanica* L. (*Plumbaginaceae*). *Journal of Research in Biology*, 2011; 6: 424-428.
- [52] Tilak JC, Adhikari S, Devasagayam PA. Antioxidant properties of *Plumbago zeylanica*, an Indian medicinal plant and its active ingredient, plumbagin *Redox Rep*, 2004; 9: 219-227.
- [53] Nile SH et al. Antioxidant activity and flavanoid derivatives of *Plumbago zeylanica*. *Journal of Natural Products*, 2010; 5:130-133.
- [54] Alpana R .Effect of *Plumbago zeylanica* in hyperlipidaemic rabbits and its modification by vitamin E *Indian J. Pharmaco*, 1996; 28: 161-166
- [55] Sakamoto S, Putalun W, Tsuchihashi R, Morimoto S, Kinjo J, Tanaka H . Development of an enzyme-linked immunosorbent assay (ELISA) using highly-specific monoclonal antibodies against plumbagin. *Anal. Chim. Acta*, 2008; 607(1): 100-105.
- [56] Checker R,D. Sharma, S. K. Sandur, S. Khanam, and T. B. Poduval. Anti-inflammatory effects of plumbagin are mediated by inhibition of NF-kappaB activation in lymphocytes. *Int.Immunopharmacol*, 2009; Vol- 9, issue 7-8, pg 949-958
- [57] Tsai WJ, Chen YC, Wu MH, Lin LC, Chuang KA, Chang SC, Kuo YC. Seselin from *Plumbago zeylanica* inhibits phytohemagglutinin (PHA) stimulated cell proliferation in human peripheral blood mononuclear cells. *J. Ethnopharmacol*, 2008; 119: 67-73.
- [58] Zahin M, Aqil F, Ahmad I. The in vitro antioxidant activity and phenolic content of four Indian medicinal plants. *Int.J.Pharma.Pharm.Sci*, 2009; 1:89-95.
- [59] Oyedapo OO .Study on the root extract of *Plumbago zeylanica* *Pharmaceutical Biology*, 1996; 34(5): 365-369
- [60] Arunachalam KO, P.Velmurugan, R.Balaji Raja. Anti-inflammatory and cytotoxic effects of extracts from *Plumbago zeylanica*. *African journal Microbiology Research*, 2010; 4(12):1239-1245

Table 1. Therapeutic uses of *Plumbago zeylanica* with references

S. No	Therapeutic uses	Reference No.
1	Antibacterial activity	39,27,19
2	Anticancer activity	40,41
3	Antiarthritic	42
4	Antimycotic	27,43
5	Anti-diabetic	44
6	Acaricidal	45
7	Anticandidal	32
8	Anti-invasive	46
9	Artherosclerotic	47
10	Antiallergic	29
11	Antiviral	48
12	Anti-fertility	49,50,51
13	Anticonvulsant	52
14	Cardiotonic	53,54
15	Hyperlipidaemic	55
16	Immunomodulatory	56,57,58
17	Antioxidant	59,53,54
18	Anti Inflammation	60,61
19	Cytotoxicity	4
20	Antiplasmodial	30
21	Neuroprotective	53,54
22	CNS stimulant	3