



## ANTIGONON LEPTOPUS: AN REVIEW

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### ABSTRACT

*Antigonon leptopus* belonging to the flowering plant family Polygonaceae exhibited anti-diabetic, antimicrobial, analgesic, anti-inflammatory, hepatoprotective, anthelmintic activity etc.

**KEY WORDS:** Antigonon leptopus, analgesic, antimicrobial activity.

### INTRODUCTION

Symbiosis is the outstanding phenomenon of nature always stands as a golden mark to exemplify. Natural product derived from plants, minerals and animals are utilized as a treatment purpose of many disease. Over three – quarters of words population depends mainly on the plant extracts and also totally plants for health care. More than 30% of entire plant species were used for medicinal purposes. It is reported that world market for plant derived drug may account for approximately Rs. 2,00,000 cr. Currently, Indian contribution is less than Rs. 2000 cr. The World Health Organization (WHO) reported that more than 80% of the population of developing country depending on the traditional medicines. Day by day herbal medicines are currently in trend and their popularity is increasing continuously.<sup>[1-2]</sup> Medicinal plants have important contributions in the health care system because there is no doubt that plants are a reservoir of potentially needful chemical compounds which serves as drugs. Plants have been containing a major source of medicaments, either in the pure active forms or as traditional preparations. The medicinal plants broadly growing in worldwide because of the increasing price, toxicity and allergic manifestations of the synthetic drugs.<sup>[3-6]</sup> It is confirmed that herbal preparation have long been used remedy for the treatment of infectious and other diseases in several countries.<sup>[7]</sup>

Scientific Classification<sup>[8]</sup> And Synonyms<sup>[9]</sup>

Table (1): Scientific classification

Kingdom	Plantae
(unranked)	Angiosperms
Order	Caryophyllales
Family	Polygonaceae
Genus	<i>Antigonon</i>
Species	<i>leptopus</i>

Table (2): Synonyms

<i>Antigonon amabile</i>	K.Koch
<i>Antigonon cinerascens</i>	M.Martens & Galeotti
<i>Antigonon cordatum</i>	M.Martens & Galeotti
<i>Antigonon platypus</i>	Hook. & Arn.
<i>Corculum leptopus</i>	Stuntz

*Antigonon leptopus* Hook and Arn. belonging to the flowering plant family polygonaceae is a tender perennial vine. It is native of Mexico and commonly found in the America, Caribbean, Tropical Asia and Africa. It is a fast growing climbing vine which holds via tendrils and is able to reach 30 to 40 ft in length and the stem is slender. It has attractive green heart shaped leaves sometimes it is triangular and 2½ to 7½ cm long. The flowers, bright pink or white colour, are born in panicles, clustered along the rachis. It has underground and large rootstocks and the fruits is one -seeded, trigonous, hard nut let, compressed, biconvex.<sup>[10-12]</sup> *Antigonon leptopus* is traditionally used to treat diabetes, liver and spleen disorder, asthma, cough and throat constriction.<sup>[13-15]</sup> Roots possess antispasmodic and antithrombin activity.<sup>[16]</sup>

Table (3): General Information<sup>[17-18]</sup>

S. No.	Parameters	Description
1	Scientific name	<i>Antigonon leptopus</i>
2	Common name	Coral vine
3	Type	Vine
4	Family	Polygonaceae
5	Group	Dicot
6	Native	Mexico
7	Zone	8 to 11
8	Height	8.00 to 10.00
9	Spread	3.00 to 6.00
10	Duration	Perennial
11	Bloom Time	Seasonal bloomer
12	Bloom Description	Pink to red
13	Sun	Full sun
14	Water	Medium
15	Suggested use	Annual
16	Flower	Showy
17	Leaf	Evergreen
18	Tolerate	Drought

Figure: *A. leptopus* plant

### Pharmacognostical, Phytochemical and Anatomical Studies

Phytochemical studies deals with the investigation of plant chemicals known as natural products and also with alteration of the environmental condition which affect such chemical changes.<sup>[19]</sup> *Antigonon leptopus* can be used in fresh as well as dried form for the investigation of pharmacognostical, phytochemical and physicochemical properties. Stomata are mainly anisocytic type and diacytic stomata are present rarely on the lower surface of the leaf. Both type of trichome indices such as glandular and non-glandular are found. Vessel group of elements of roots contain one group is long and narrow and other group is very wide and short. Septate fibres in the root and the vascular bundles in petiole are observed. Petiole with 7 vascular bundles in 'U' shaped are found which can be used for the identification of this species of polygonaceae. The phytochemical tests of methanolic extract of it identified the important phytochemical groups are present, which is responsible for medicinal properties. The physical constant like moisture contents (76%), ash value (20.68%) and UV fluorescence characters of the powder was studies.<sup>[20-21]</sup>

**Table (4): Micrometry and shape of some cells**

Name of Cell	Shape/Type	Ratio/Indices /Diameter	Length in micrometer ( $\mu\text{m}$ )	Frequency (/mm <sup>2</sup> )
Epidermal cell- Upper Lower Palisade ratio	Irregular –	– 5.5	43.81× 37.62 45.25×25.11 –	947.14 596.92 –
Stomatal cell- Upper Lower Stomatal index- Upper Lower	Anisocytic Anisocytic & diacytic –	– 11.08 12.13	21.7×16.66 22.218×17.29 –	212.916 238.43 –
Trichomes- Glandular Non- glandular Trichome index-	Multicellular Uniseriate –	– 2.74	47.509×19.144 35.178×10.183 –	20.83 41.66 –
Crystals diameter-	Small, spherical	31.25 $\mu\text{m}$	–	26.04
Stem- Vessel element Fibre Tracheid diameter	Simple Libriform type Spiral	– – 32.95 $\mu\text{m}$	145.75×75.05 882.6×19.12 –	60.80 27.53 22.03

Root- Vessel element- Long	Very long with narrow width Short Very short with greater width	–	39.51×177.336	16.66
Short			136.64×134.42	
Fibre Tracheid diameter	Septate Very long	17.143µm	427.55×17.08	62.5 25

**Table (5): Shape of some cells**

S.No.	Name of cell	Shape/ type
1	Cortex	Collenchymatous
2	Pericycle	Wavy, sclerenchymatous
3	Vascular bundle	Collateral, conjoint and open type
4	Pith	Massive pith, very large, isodiametric and parenchymatous type
5	Petiols	‘U’ shaped with 7 vascular bundles

**Table (6): Preliminary phytochemical screening of powder**

S.N.	Parameters	Observation
1	Carbohydrates	+
2	Proteins	–
3	Alkaloids	+
4	Glycosides	+
5	Flavonoids	+
6	Volatile oils	+
7	Tannins	+
8	Anthraquinone	+
9	Terpenes	+
10	Saponin	+
11	Carboxylic acid	+

‘+’ indicate present, ‘–’ indicate absent

## PHARMACOLOGICAL INVESTIGATIONS

### Antidiabetic Activity

The *Antigonon leptopus* possess the anti-diabetic activity in several diabetic models. The alloxane- induce (alloxane monohydrate- 120 mg/kg) rats, oral administration of methanolic extract of the aerial part of *Antigonon leptopus* at the doses of 200 and 400 mg/kg over 15 days significantly decrease the plasma level of insulin. The fasting blood glucose levels were analysed on 0, 5, 10 and 15<sup>th</sup> days. The methanolic extract produce a dose dependence fall in

fasting blood glucose levels. The result of the study indicated that methanolic extract inhibit the cholesterol synthesis pathway and increased HDL/LDL ratio due to activation of LDL receptors in hepatocyte, which was responsible for taken up LDL into the liver and reduced the LDL level of serum.<sup>[22-23]</sup>

Hypoglycemic effect of the methanolic extract of the flowers of *Antigonon leptopus* at dose of 100, 200 and 400 mg/kg in normal, glucose fed and alloxane- induced diabetic rats was investigated. Diabetes was produced in rat by administration of a single dose of alloxane monohydrates (120 mg/kg i.p.). The methanol extract at dose of 200 mg/kg possessed better anti- hyperglycemic effect than other two test doses (100 and 400 mg), with regard to percent reduction of blood glucose level. In sub- acute study (21 days), the hypoglycemic effect of methanol extract at the dose 200 mg/kg was supported by the contrary of changes found in other parameters i.e. body weight, serum insulin, aspartate transaminase, alanine transaminase, serum triglycerides, serum cholesterol and total serum proteins, which are entangled in diabetes.<sup>[24-25]</sup>

The evaluation of anti- diabetic activity of the toluene, ethyl acetate and butadone fractions of methanolic extract of the leaves of *Antigonon leptopus* at the dose of 50 and 100 mg/kg on streptozocin- induced diabetic in neonatal rats was significantly reduced the fasting blood glucose level. The methanolic extract of the leaves of *Antigonon leptopus* exhibited significant oral glucose tolerance at 200 mg/kg. The result of the study claimed that the leaves of *A. Leptopus* was used in the treatment of hyperglycaemic conditions.<sup>[26]</sup>

### **Analgesic and Anti-inflammatory activity**

The methanolic extract of the roots of *Antigonon leptopus* Hook. et Arn was evaluated for analgesic and anti-inflammatory activity. The extract (200 and 400 mg/kg) produced dose related inhibition of carrageenan- induce paw edema in rat, which was an acute model, was used to evaluate the anti-inflammatory activity of *A. leptopus*. At the same doses, analgesic effect was analysed with hot plat latency assays maintain at (55<sup>0</sup> C) and acetic acid writhing in mice. The analgesic action is obtain against thermic (hot plate test) and chemical (writhing test) stimuli in dose depending manner indicating antinociceptive activity may be involved in the inhibition of pain by peripheral and central mechanisms. The result of above study possessed significant analgesic and anti-inflammatory activity.<sup>[27-28]</sup>

The anti-inflammatory activity of methanolic extract of roots of *Antigonon leptopus* in mice and rat was evaluated. In animals, the methanolic extract possessed a significant inhibition of peritoneal and cutaneous vascular permeability induced by acetic acid, granuloma induced by cotton-pellet and migration of leucocytes and neutrophils induced by carrageenan at the concentration of 100, 200 and 400 mg/kg. In further study on the rats, the same extract exhibited markedly inhibition of foot paw edema induced by formalin at the same concentration (100, 200 and 400 mg/kg).<sup>[29]</sup>

### Hepatoprotective activity

The anti-hepatoprotective activity of roots and rhizomes of *Antigonon leptopus* was exhibited by biochemical and pathological analysis in *in vivo* experimental models. In CCl<sub>4</sub>-induced (1ml/kg CCl<sub>4</sub> i.p. and 1ml/kg 5% acacia mucilage p.o. for 7 days) chronic hepatotoxic rats, oral administration of ethyl acetate and methanol extract of *Antigonon leptopus* root and rhizomes at doses of 100, 200 and 400 mg/kg for 7 days, decreased serum glutamic oxaloacetate transaminase (SGOT), serum glutamic pyruvate transaminase (SGPT), alkaline phosphatase (ALP) and total bilirubin (TB). Several pathological changes like centrilobular necrosis and vacuolization which was observed by induction of CCl<sub>4</sub>, could be treated by *A. leptopus*.<sup>[30-31]</sup>

### Antimicrobial Activity

The hexane, ethyl acetate and methanolic extract of root and rhizome of *Antigonon leptopus* possessed a marked antimicrobial activity against all microorganism. The antibacterial and minimal inhibitory concentration (MIC) were determined by dilution method. In comparison to all extract methanolic extract was active against *Escherichia coli*, *Proteus vulgaris*, *Bacillus subtilis*, *Bacillus pumilus*, *Staphylococcus aureus*, *Streptococcus faecalis* with the MIC 1.238, 1.053, 1.042, 1.273, 1.163, 1.019 mg/ml respectively. Interestingly, the same methanolic extract was shown to be potentially fatal to the fungus pathogens i.e *Aspergillus niger*, *Candida albicans* as a minimum fungicidal concentration (MFC) were established at 1.311 and 1.475 mg/ml respectively. The ethyl acetate extract showed antibacterial activity against *Bacillus subtilis*, *Bacillus pumilus* with the MIC 1.042, 1.273 mg/ml respectively. The antimicrobial activity of *Antigonon leptopus* is due to the presence of flavonoids.<sup>[32-35]</sup>

The antibacterial activity of ethanol and chloroform extracts of *Antigonon leptopus* flower were evaluated by using disc diffusion method against certain gram positive bacterial strain i.e *Bacillus subtilis*, *Bacillus peritolis* and *Salmonella typhi* at a dose of 500 µg/disc. Both

the flower extracts shown significant inhibition of microbes. Comparative study observed that the ethanol extract exhibited better antibacterial activity against these strains than chloroform extract. The result of all extract exhibited concentration dependence activity. Further work on *Antigonon leptopus* against certain microbial strains causing dental carries. Both extracts active against *Micrococcus albus*, *Staphylococcus aureus*, *Proteus vulgaris* and *Pseudomonas aeruginosa* by same method at same dose. The result was also found that the ethanolic extract showed better activity than chloroform.<sup>[36-37]</sup>

### **Anthelmintic activity**

The anthelmintic activity of activity of ethyl acetate and methanol extracts of roots and rhizomes of *Antigonon leptopus* against *pheretima posthuma* was evaluated. Various concentration were used as 10, 20, 40 and 80 mg/ml of both extracts were evaluated in bioassay involving determination of time of paralysis and time of death of worms. The result was found that the ethyl acetate and methanolic extracts significantly possessed paralysis in lower doses (10-80 mg/ml) and also caused death mainly at higher dose of 80 mg/ml as compared to standard drug piperazine hydrate. The above study indicated that the methanolic extract of *Antigonon leptopus* was more active than its ethyl acetate extract ( $p < 0.001$ ).<sup>[38-39]</sup>

The anthelmintic activity and phytochemical study of chloroform fraction methanolic extract of *Antigonon leptopus* leaves was evaluated. Anthelmintic activity was carried out of chloroform fraction methanolic extract of the plant leaves by using GC- MS equipment. The *Pheretima posthuma* have been used for screening of anthelmintic activity of *Antigonon leptopus*. The analysis of the chloroform fraction by GC-MS was involved the presence of various compounds including phenols, hydrocarbons, quinazolines, coumarins, steroids and terpenes like cadinene, juniper camphor etc. Mass spectral data of all 16 compounds is obtained and were identified from Wiley spectral library. The result of above study exhibited the significant anthelmintic activity of extract as compared with standard drug.<sup>[40-41]</sup>

### **Functional food components of *Antigonon leptopus* tea**

In many parts of the world, the tubers and the flowers of *Antigonon leptopus* are consumed as food components, used in the preparation of tea used as a cold remedy. So this indicated that it have qualitative functional food components. It was found that the methanolic extract of aerial part of *A. leptopus* inhibited lipid peroxidation 89% and cyclooxygenase enzymes COX-1 and COX-2 by 50.4% and 72.5%, respectively at 250 µg/ml. If purify the methanol extract of aerial part of *A. leptopus*, it yielded n- hentriacontane, ferulic acid, 4-

hydroxycinnamic acid, quercetin-3-rhamnoside and kaempferol-3-glucoside along with  $\beta$ -sitosterol,  $\beta$ -sitosterol-glucoside and d-mannitol. At the concentration of 5  $\mu$ g/ml, compounds 4-hydroxycinnamic acid, quercetin-3-rhamnoside and kaempferol-3-glucoside inhibited lipid peroxidation by 19.5%, 41.0% and 60.5% respectively. Similarly, compounds 4-hydroxycinnamic acid, quercetin-3-rhamnoside and kaempferol-3-glucoside showed inhibition of COX-1 enzyme by 64.7%, 16.9% and 38.5% and COX-2 enzyme by 87.4%, 88.8% and 90.2%, respectively at 25  $\mu$ g/ml. And these three compounds also exhibited 50% inhibition ( $IC_{50}$ ) of COX-1 at 17.4%, 68.9% and 36.3  $\mu$ g/ml and COX-2 at 8.57%, 7.86% and 6.78  $\mu$ g/ml, respectively.<sup>[42]</sup> Further study of these plant *Antigonon leptopus*, tea prepared from the aerial parts, can be used as a remedy for pain and cold relief. These tea was used for the evaluation of lipid peroxidation (LPO) and cyclooxygenase (COX-1 & COX-2) enzyme inhibitory activities. At the 100 microgram/ml, the tea as a dried extract inhibited LPO, COX-1 and COX-2 enzymes by 78%, 38% and 89% respectively.<sup>[43]</sup>

## REFERENCES

1. Chopra, R.N., Nayar, S.L. and Chopra, I.C. In Glossary of Indian medicinal plants. Council of Scientific and Industrial Research, New Delhi, 1956; 1: 197.
2. Thomas, J. 1997. Medicinal and aromatic plants research in India. In UNDP, 1997.
3. Krishnamurthi A. The wealth of India. Vol. I, CSIR, New Delhi, 2003; 92.
4. Evans WC Trease and Evans' Pharmacognosy, WB. Souders Company Singapore, 2002; 1.
5. Varier PS Indian Medicinal Plants, Vol. IV, Orient Longman Pvt. Ltd., Hyderabad, 1995; 149.
6. Udayaprakash NK, Bhuvanewari S, Jahnavi B, Abhinaya K, Rajalin AG, et al. A study on antibacterial activity of common weeds in Northern Districts of Tamil Nadu, India. Res J Med Plant, 2012; 6:341-345.
7. Sokmen, A., Jones, B.M., Erturk, M. The in vitro antibacterial activity of Turkish medicinal plants. J. Ethnopharmacol., 1999; 67:79–86.
8. "Taxon: *Antigonon leptopus* Hook. & Arn." Germplasm Resources Information Network. United States Department of Agriculture. 2007-06-06. Retrieved 2010-10-21.
9. "The Plant List: A Working List of All Plant Species". Retrieved May 16, 2014.
10. <http://www.jstor.org/discover/10.2307/3628552>
11. Madhava Chetty K, Sivaji K, Tulasi Rao K, Flowering plants of Chittoor district Andhra Pradesh, India. 2nd edition, Students offset Printers, Thirupati, 2008; 297.

12. Raju AJS, Raju VK, Victor P, Naidu SA, Floral ecology, breeding system and pollination in *Antigonon leptopus* L. (Polygonaceae), *Plant species Biology*, 2001; 16: 159-164.
13. Cheryl A Lans. Ethnomedicines used in Trinidad and Tobago for Urinary problems and Diabetes mellitus. *Journal of Ethnobiology and Ethnomedicine*, 2006; 2:1-11.
14. Idu M, Onyibe HI. Medicinal Plants of Edo State, Nigeria. *Research Journal of Medicinal Plant*, 2007; 1 (2): 32-41.
15. Mitchell SA, Ahmad MH. A Review of Medicinal plants Research at the University of the West Indies, Jamaica. *West Indian Med. J*, 2006; 55 (4): 243-269.
16. N. Chistokhodova, C. Nguyen, T. Calvin, I. Kachirskaia, G. Cunningham and D. Howard Miles, J. *Ethnopharmacol.*, 2002; 18: 277-280
17. [Plants:usda.gov/core/profile](http://plants.usda.gov/core/profile).
18. [www.missouribotanicalgarden.org/Plant Finder Detail.aspx](http://www.missouribotanicalgarden.org/Plant Finder Detail.aspx).
19. Zobel M.I., Glowniak K., Lynch J.E., Dudka S. and Alliota A. Chemistry, Trent University, Peterborough, ON, Canada. 1999, K9J- 7B8.
20. Sathi S, Habibur C.R. Pharmacognostical and Anatomical Studies of *Antigonon leptopus* Hook. and Arn.: A Promising Medical Climber. *Int. J. Res. in Ayurveda Parma*. Mar-Apr. 2013; 4(2):186- 190.
21. Kadam V.P, Deoda S.R, Shivatare S.R, Yadav N.K, Patil J.M. Pharmacognostic, phytochemical and physiochemical studies of *Mimusops Elengi* Linn stem bark (Sapotaceae). *Der Pharmacia Lettre*, 2012; 4 (2):607-613.
22. Angothu S, Lakshmi M.S, Kumar S.A, Reddy Y.K. Antidiabetic Activity of Aerial Parts of *Antigonon leptopus* Hook and Arn in Alloxan- Induce Diabetic Rats. *International Journal of Phytopharmacology*. 2010; 1:28-34.
23. Jin, X., Amitani, K., Zamami, Y., Takatori, S., Hobara, N., Kawamura, N., Hirata, T., Wada, A., Kitamura, Y., Kawasaki, H.. Ameliorative effect of *Eucommia ulmoides* Oliv. leaves extract on insulin resistance and abnormal perivascular innervation in fructose-drinking rats. *J. Ethnopharmacol*. 2010; 128: 672–678.
24. Sujatha S, Swaroopa R.V, Ravikumar B. Antidiabetic Effect of Flower Extract of *Antigonon leptopus* Hook & Arn in Alloxan-induced Diabetic Rats. *Ind J Pharm Edu Res*, Jan-Mar, 2012; 46(1):9-16.
25. Kumar Y.A, Kumar N.K, Handral M, Talwar S, Dhayabaran D. Hypoglycaemic and anti-diabetic activity of stem bark extracts *Erythrina indica* in normal and alloxan-induced diabetic rats. *Saudi Pharmaceutical Journal*, 2011; 19: 35.

26. Swaroopa R.V, Sujatha S, Krishna M.G, Ravi K.B. Antidiabetic Effect of Antigonon leptopus Hook and Arn Leaf on Streptozotocin- induced Diabetic Rats. Pharmacologyonline, 2010; 2: 922- 931.
27. Mamidipalli C.W, Nimmagadda R.V, Bobbala K.R, Gottumukkala M.K. Preliminary Studies of Analgesic and Anti-inflammatory Properties of Antigonon leptopus Hook et Arn Root in Experimental Models. Journal of Health Science, 2008; 54(3):281-286.
28. Owoyele B.V, Wuraola O.C, Soladoye O.A, Olaleye B.S. Studies on the Anti-inflammatory and Analgesic Properties of Tithonia diversifolia leaf extract. Journal of Ethanopharmacology, 2004; 90:317-321.
29. Carey M.W, Babu M.J, Rao V, Mohan K. Study of anti-inflammatory activity of Antigonon leptopus Hook. et Arn roots. Journal of Pharmacy and Chemistry, 2008; 2 (3): 133-138.
30. Raju J.N, Rao G.B. Investigation of hepatoprotective activity of roots & rhizomes of Antigonon leptopus Hook against carbon tetrachloride-induced hepatotoxicity in rats. Research Journal of Pharmaceutical, Biological and Chemical Sciences , 2010; 1(3): 600-607.
31. Huang, M.Y., Fu, T.Y., Shih, P.H., Lee, C.P., Yen, G.C.. Du-zhong (*Eucommia ulmoides* Oliv.) leaves inhibits CCl<sub>4</sub>-induced hepatic damage in rats. Food Chem. Toxicol, 2006; 44:1424–1431
32. Battu G, Raju J.N. Studies in Preliminary Phytochemical and Antimicrobial Activity of Antigonon leptopus Hook. Int. J. Chem. Sci. 2009;7(4):2900-2904.
33. Heyman, H.M., Hussein, A.A., Meyer, J.J.M., Lall, N.. Antibacterial activity of South African medicinal plants against methicillin resistant *Staphylococcus aureus*. Pharmaceut. Biol. 2009; 47: 67–71.
34. Chistokhodova, C. Nguyen, T. Calvin, I. Kachirskaia, G. Cunningham and D.Howard Miles. J. Ethanopharmacol., 2002; 18:277-280.
35. Bolla D.N, Bhogavalli K.P. Preliminary phytochemical screening and antibacterial studies of the flowers of Antigonon leptopus. Annals of Biological Research, 2010; 1(4):229-233.
36. Mottakin, A.K.M., Chowdhary, R., Haider, M.S., Rahman, K.M., Hasan, C.M. and Rashid, M.A. Fitoterapia, 2004; 75: 355.
37. Gupta A.V.N, Bandlamuri R.R, Jagarlamu J, Bhogavalli K.P. Studies on anti-microbial activity of flower extracts of Antigonon leptopus against common dental pathogens. Annals of Biological Research, 2011; 2 (2): 99-103.

38. Raju J.N, Rao G.B. Anthelmintic Activities of *Antigonon leptopus* Hooks and *Mussaenda erythrophylla* Lam. *International Journal of Pharmacy and Pharmaceutical Sciences* , 2011; 3(1):68 -69.
39. Chavan B.C, Hogade G.M, Bhinge D.S, Kumbhar M, Tamboli A. In vitro Anthelmintic Activity of Fruit Extract of *Barleeia prionitis* Linn. *International Journal of Pharmacy and Pharmaceutical Sciences*, 2010; 2(3):49.
40. Priya S.P, Satyavathi K, Bhojaraju P, Kumari R.Y, Prasad V.D, Durga S.S.M, Preeti M.P, Lovaraju P.K, Kanthal K.L. GC-MS Profiling and Anthelmintic Activity of *Antigonon leptopus* Leaves. *International Journal of Pharmaceutical Sciences and Research*, 2014; 5(5):1914- 18.
41. Dullu V. Anthelmintic Activity of Ethanolic Leaf Extract of *Jasminum mesnyi*. *Asian Pacific Journal of Tropical Disease*, 2014; 4(1): S273.
42. Vanisree M, Alexander-Lindo L.R, DeWitt L.D, Nair G.M. Functional food components of *Antigonon leptopus* tea. *Food Chemistry*, 2008; 106: 487-492.
43. Vanisree M, Alexander-Lindo L.R, DeWitt L.D, Nair G.M. Health-Beneficial Phenolic Aldehyde in *Antigonon leptopus* Tea. *Evidence-Based Complementary and Alternative Medicine*, 2011; Article ID 601249:1-6.