

## Review Article

### **An Overview on Herbal Medicines as Diuretics with Scientific Evidence**

Mishra Snigdha\*, Sharma Satish Kumar., Mohapatra Sharmistha, Singh Lalit, Singh Tanuja

Sunder Deep Pharmacy College, Ghaziabad UP India-201001

#### **Corresponding author**

**Mishra Snigdha**

E-mail: [snigdha2112@gmail.com](mailto:snigdha2112@gmail.com)

**Abstract:** In the most ancient Indian traditional system of medicines (Ayurveda) diuretics are called as Muttra – Virechanya dravya. These agents are widely explored in Indian ancient system of medicines. Diuretics basically causes increase in the rate of urine flow thus being used to treat various disorders like diabetes mellitus, cardiovascular disorders, anxiety, hypertension, liver degeneration diseases. The main aim of this review article is to highlight the work on diuretics of plant origin and to identify which extract promotes diuresis, which has been assessed in terms of urine excreted and urinary sodium, potassium, and chloride excretion. In most of the study Na<sup>+</sup> and K<sup>+</sup> estimation was done by the Flame photometer and Cl<sup>-</sup> estimation was done by argenometric titration method. This study is to identify the research needed area. In this article we have identified number of genus and species recently reported as diuretic effects, some of them are Xanthium Strumarium L., Samanea Saman, Morinda Citrifolia, Holarrhena antidysenterica, Euphorbia thymifolia, Bryophyllum Calycinum, Achyranthes aspera. However, there the number of studies is limited and we recommend that further studies be conducted to confirm reported effects. Such evidence is needed to provide scientific credence to the folklore use of traditional medicines and even be helpful in the development of future medicines, treatments and treatment guidelines.

**Keywords:** Diuretic activity, Medicinal plants

#### **INTRODUCTION**

Herbal and natural products of folk medicines have been used for centuries in every culture throughout world. Scientists and medical professionals have shown increased interest in the field as they recognized the true health benefits of these remedies. “Let food be your medicine and let medicine be your food” was advised by father of medicine, Hippocrates, over the millennia ago. Various medicinal plants discovered by the ancestors; as traditional folk medicine as diuretic. Diuretic compounds that stimulate the excretion of water are potentially useful in many disorders including most of those exhibiting oedema such as congestive heart failure, nephritis, toxemia of pregnancy, premenstrual tension, hypertension and also play an important role in hypertensive patients and pulmonary congestion [1]. Diuretics like Mannitol, Thiazides, Furosemide and Ethacrinic acid are used in now a days. Among these diuretics, had some toxic effects. These synthetic diuretics typically inhibits potassium retention [2]. The crud drug being always available easily in abundance, comparatively cheaper with negligible side effects and have frequently been described to patients of all age groups. The multiple therapeutic actions and uses of these drugs are sufficiently described in classical literatures on indigenous medicines in many medicinal plant books and Pharmacopoeias [3-4]. Therefore the present study, review the following plants, which has been recently shown to exhibit diuretic activity.

#### **A. Xanthium strumarium**

Xanthium Strumarium is a common weed found in India belonging to the family Compositae, the whole plant specially roots and fruits are used as medicine.

#### **Pharmacological Activity**

Xanthium strumarium L. grows as weed throughout on waste lands. Locally it is known as Gokharu and Kutta zad. Inter views with local hakims revealed that whole plant is used as blood purifier and in treatment of scabies [5]. Ayurveda it is called ‘Shankeshwara’ and ‘Arishta’, and is considered anthelmintic, antipyretic, diuretic, cooling, laxative, alexiteric, tonic, digestive, appetizer, improves voice, complexion, used in epilepsy, leucoderma and as antidote for insect bite [6], diuretic activity [7].

#### **Diuretic activity**

P. Shravani et al. [7] studied the diuretic activity of Xanthium Strumarium L. in albino rats. The extract was administered at 250 and 500 mg/kg b.w. Furosemide at the dose of 5 mg/kg b.w. was used as the standard. The graded dose of petroleum ether extract in normal saline showed significant increase in diuresis, natriuresis, kaliuresis, Glomerular filtration rate. All extract causes increase in urine elimination and increase in Na<sup>+</sup>, K<sup>+</sup>, Cl<sup>-</sup> excretion compared to normal saline. They reported that the diuretic activity of the extract may be due to the presence of Flavanoides, Saponins, and Organic acid. It is also possible that defect of water could be due to another secondary active metabolites ; or it may be

indirect change of some physiological parameters before filtration step.

#### **B. Samanea saman (jacq) Merr**

Samanea Saman (jacq) Merr is a large umbraculiform tree growing over 20 meters height with a stout trunk about 1.5m in diameter and large spreading canopy providing shade, bark is rough and furrowed. Alkaloid's are said to be abundant in bark stem, leaves seeds; Leaves and stem have saponins and tannin, gum is present in trunk. Additionally steroids, cardiac glycosides, terpenoides are also present [8].

#### **Pharmacological activity**

The plant is being used in acute bacillary dysentery, enteritis, diarrhoea, cold, sore throats and head ache [9, 10]. Root decoction is used in hot bath for stomach cancer. The alcoholic extracts of leaves are used to treat Tuberculosis; fruit decoction is used as a sedative in Columbia.

#### **Diuretic activity**

Evaluation of diuretic activity of Samanea saman (Jacq) Merr bark in Albino Rats was performed by B. Komarapalayam *et. al.* [8]. Diuretic potential of methanol extract of the bark was performed by using in-vivo Lipschitz test model. Results indicated that methanolic extract at a concentration of 200 mg/kg and 400 mg/kg body weight shows an increase in the urine volume and electrolyte excretion when compared to control. Furosemide at a dose of 20 mg/kg b.w. was used as the standard. It was reported that It shows that the methanol extract of Samanea saman (Jacq) Merr, at high doses, may have equipotent diuretic activity as that of the standard drug furosemide. Diuresis was accompanied by marked increase in urine volume and urinary Na<sup>+</sup>, K<sup>+</sup> and Cl<sup>-</sup>.

#### **C. Morinda citrifolia (Linn)**

Morinda Citrifolia Linn (Rubiaceae) also known as Noni or Indian Mulberry, cultivated throughout the world, is a small evergreen tree. It is identifiable by its straight trunk, large bright green and elliptical leaves, tubular flower, Ovoid Yellow fruit. The mature fruit has a foul taste and odour [11].

#### **Pharmacological activity**

It has been reported to have a broad range of health benefits for cancer [12] infection, arthritis, diabetes, asthma, hypertension and pain [13], immune enhancing [14]; antithrombotic [15], antioxidant [16], analgesic [17], anti-inflammatory and xanthenes oxidase inhibitory [18], Blood pressure lowering [19] and diuretic [20] properties.

#### **Diuretic activity**

Preethi G Pai *et. al.* [20] reported diuretic activity of Morinda Citrifolia Linn. The study was conducted in saline primed Wistar albino rats using frusemide (10 mg/kg) as the standard drug. Two oral doses, 5mg/kg

and 10mg/kg of the fruit juice were administered. Urine volume and electrolytes (Sodium, Potassium and Chloride) excretion was estimated at the end of 24 hours and data was analyzed by Kruskal Wallis and Mann Whitney tests. Noni fruit juice statistically increased the volume of urine in a dose dependent manner increasing the diuretic index to 2.04 and 2.36 for 5ml/kg and 10ml/kg dose ranges respectively. There was a statistical significant decrease in sodium ion excretion. Though there was a similar decrease in potassium excretion it was not statistically significant. These findings indicate that the probable increase in urine formation might be due an aquaretic action of Noni fruit rather than a natruretic effect and further studies with larger doses and longer duration are warranted.

#### **D. HOLARRHENA ANTIDYSENTERICA**

Holarrhena Antidysenterica belonging to the family Apocyanaceae, commonly known as bitter oleander and locally as Kurchi, it is a small deciduous tree found at Himalaya and sub Himalaya tract [22].

#### **Pharmacological activity**

Traditionally H. antidysentrica is in various disorders like colic, diarrhea, dysentery and fever [21]. It is also used as carminative, astringent, lithontriptic, tonic, aphro-disiac, cardio suppressant, diuretic and antihypertensive [22-24].

#### **Diuretic activity**

Anwarul-Hassan Gilani *et al.* [25] studied the crude extract of H. antidysentrica seeds and its fractions, n-hexane, n-butanol and aqueous, for their diuretic effect in Wistar rats. Hydrochlorothiazide at the dose of 10 mg/kg b.w. was used as the standard. Crude aqueous ethanolic extract caused dose-dependent (30 and 100 mg/kg) increase in urine output, indicating the diuretic effect. In addition, crude extract increased urine contents of Na<sup>+</sup> and K<sup>+</sup>, increased urine volume, pH value and electrolytes level indicating the diuretic effects. None of the fractions exhibited diuretic effect comparable to that of the parent crude extract. Hexane extract was devoid of diuretic effect, Butanol extract exhibited a mild diuretic effect at 30 mg/kg, whereas, Aqueous extract caused a significant increase in urine output only at 100 mg/kg, indicating that the diuretic activity is distributed among fractions in an order of increasing polarity of the solvent. The study reported that diuretic activity in the H. antidysentrica possibly mediated through its saluretic effect, which rationalizes its medicinal use as diuretic.

#### **E. EUPHORBIA THYMIFOLIA**

Euphorbia thymifolia Linn belonging to the family Euphorbiaceae is one of the important multipurpose species of desert and arid regions of Indian subcontinent. It provides vegetative cover in dry, hot and sandy desert areas where little else grows and is an extremely hardy species.

### Pharmacological activity

In Sanskrit *Euphorbia thymifolia* means "Laghu dudhika or Raktavindachada". It is widely used in the Ayurveda to cure many remedies. Leaves and seeds are given in worm case and in certain bowel affection of children. In India they are considered as stimulant and laxative also use in many diseases [26]. It also possesses anthelmintic properties [27], antioxidant and antiviral activity [28].

### Diuretic activity

Sandeep R. Kane *et al.* [26] investigated the diuretic activity of crude ethanolic extract and fractions of *Euphorbia Thymifolia* linn in albino rats and was compared with standard drugs Furosemide (10mg/kg, p.o.). The extracts was administered at the doses of 200 and 400mg/kg b.w. The extract was found to exhibit significant diuretic in dose dependant manner. Fractions of the extract potentiated the diuretic activity. The activities may be contributed to the phytoconstituents present ethanolic extract of *Euphorbia Thymifolia* Linn. It increased urine output as well as electrolyte concentration at higher dose tested 400mg/kg p.o.; Diethyl ether fraction was most effective.

### F. NYCTANTHES ARBOTRITIS

*Nyctanthes arbotritis* belongs to the family Oleaceae. *Nyctanthes arbor-tristis* is well known in India and its neighboring countries as one of the most versatile medicinal plants having a wide range of biological activities. It is widely cultivated in tropical and subtropical regions all over the world. It is usually a shrub or a small tree having brilliant, highly fragrant flowers, which bloom at night and fall off before sunrise. Thus, during the day the plant loses all its brightness and hence is called "Tree of sadness" (*arbor-tristis*). It is also known as Coral Jasmine, Harsinghar, Parijat, queen of the night and night flowering jasmine [29]. Folk people of Tripura predict the rainfall variation through flowering phenology which help them to plan agroforestry activities and disaster prevention [30]. Every part of the tree has been used as traditional medicine for household remedies against various human ailments from antiquity [31, 32].

### Pharmacological activity

The various parts of the plant was found to possess diverse pharmacological activities like antibacterial, anthelmintic, anti-inflammatory, hepatoprotective, immunopotential, anti-pyretic, antioxidant, antifungal, anti-bilious, sedative, antifilarial, immunomodulatory, antileishmanial, antipyretic etc [33].

### Diuretic Activity

D. Sasma *et al.* [34] studied the diuretic activity of the water-soluble portions of the ethanolic extracts of its flowers, barks, seeds and leaves. The ethanolic extracts of different parts possess significant diuretic activity as reflected by rise in urine volume with cation excretion.

The ethanolic extracts of the seeds and leaves found to possess higher electrolyte excretion at higher dose level. The extracts were showed to be safe up to the dose of 2.0 gm/kg. From these, doses of 200, 400 and 600 mg/kg body weight were selected for the evaluation of diuretic activity.

### G. ERYTHRINA INDICA LAM.

*Erythrina Indica* Lam. is a medium sized, spiny, deciduous tree normally growing to 6-9 m tall and 60 cm young stem and branches are thickly armed with stout conical spines up to 8mm long. Leaves trifoliate, alternate, bright emerald green on long petiolate 6-15cm, rachis 5-30 cm long, prickly leaflets smooth, shiny, broader than long, 8-20 by 5-15cm ovate to acuminate with an obtusely pointed end.

### Pharmacological activity

It is being used traditionally for treatment of liver trouble, joint pain, dysentery, laxatives and anthelmintics [35- 37].

### Diuretic activity

*Erythrina indica* Lam is used in the traditional medicine as diuretic. M. Jesupillai *et al.* [38] evaluated the diuretic activity of Ethanol, Chloroform and Ethyl acetate extract of leaves of *Erythrina indica* Lam. in Albino rats. The results were compared with furosemide as standard at 20 mg/kg b.w.. All extracts exhibited significant diuretic activity as evidenced by increased total urine volume and the urine concentration of Na<sup>+</sup>, K<sup>+</sup> and Cl<sup>-</sup> at the dose of 250 mg/kg.

### H. ACHYRANTHES ASPERA LINN

*Achyranthes aspera* Linn is commonly known as Apamarga in Ayurveda is a weed, in Hindi as Latjeera; belongs to the family Amaranthaceae, is an erect or procumbent, annual or perennial herb, found on road sides, fields boundaries and waste places as weed throughout the India up to an altitude of 2100m [39, 40].

### Pharmacological activity

It is widely used as traditional medicines as alternative and antiperiodic, purgative, antiphlogmatic, rheumatism, scabies and other skin disorders [41, 42]. The plant is also known as for its spermicidal, hypoglycaemic, hepatoprotective, anti inflammatory, analgesic, antipyretic, and anti arrhythmic activity [43-47].

### Diuretic Activity

Saurabh Srivastav *et al.* [48] reported diuretic activity of *Achyranthes aspera* methanolic extract of whole plant of *Achyranthes aspera*. The diuretic effect was found out by Lipschitz *et al* method using furosemide (100 mg/kg b.w.) as standard drug. The study was conducted using dose level of 400 mg/kg b.w. The results had shown diuretic effects in rats when compared with control but this effect was less than

furosemide. Significant increase in renal clearance of Na<sup>+</sup>, K<sup>+</sup> and Cl<sup>-</sup> ion excretion was observed in treated and standard groups.

## CONCLUSION

The current review is intended to provide an overview of the current knowledge surrounding the use of herbal medicines as diuretics. Indeed, there are more than a 100 extracts purporting diuretic effects. Extracts which we regard as being potentially the most efficacious include species belonging to the genus *Xanthium Strumarium* as having a high level of efficacy. Others include *Achyranthes aspera*, *Erythrina Indica Lam*, *Nyctanthes Arbo-Tritis*. So what is the relevance of the current findings? We think the present findings are of interest where herbal medicines are used according to folklore. This is extremely important and potentially very useful in countries that have limited resources for the production and importation of modern medicines as they are accessible, cheap and applicable to the local population. Another areas where the current knowledge can be applied include the substantiation of marketed products, where the evidence can be quite limited. The last issue for us to raise here is whether these results are relevant to the wider population? We have already outlined that diuretics are used to lower blood pressure in hypertension. What we have not dealt with is the safety of natural medicines when ingested for long periods, such as in the treatment of chronic diseases like hypertension. Indeed, some of the extracts we reviewed are recommended for acute disorders like urinary tract infections rather than ongoing diseases. This would also be required to compile monographs and recommendations for such extracts. In a clinical setting, we speculate that these extracts could, one day, offer another possible treatment to existing drug regimes. One benefit could be the offer of a more natural treatment or milder effects and fewer side effects. Milder effects are quite interesting as they could offer a first line of therapy or as an add-on to conventional medicines as their lower potency could improve tolerance to more potent drugs.

## REFERENCES:

- Butler J, Forman DE and Abraham WT; A relationship between heart failure treatment and development of worsening renal function among hospitalized patients. *Am Heart J.*, 2004; 147: 331-338
- Ellison DH; The Physiological basis of diuretic synergism; its role in treating diuretic resistance. *Ann Intern Med*, 1991; 114: 886-894
- Chopra RN and Chopra IC; A review of work on Indian medicinal Plants including indigenous drugs and poisonous plants-30. Indian Council of Medicinal Research, Special research series, 1955: 27.
- Nadkarni KM and Nadkarni AK; *Indian Materia Medica-2*. 3<sup>rd</sup> edition, Popular Prakasan, Bombay; 2000: 37-39.
- Agharkar SP; *Medicinal Plants of Bombay Presidency*. FBI Science Publication, Jodhpur, 1991: 230.
- Ahmad SA; Taxonomic and Pharmacognostic studies of some local Unani medicinal plants. Ph.D Thesis, Sant Gadge Baba Amravati University, Amravati, 2003.
- Shravani P, Laxmi M and Kumar S; Evaluation of diuretic activity of *Xanthium Strumarium*. *International Journal of Preclinical and Pharmaceutical Research*, 2010; 1 (1): 31 -34.
- Suresh A, Senthil Velan S, Suresh V, Senthil kumar N and Phani kumar A; Evaluation of Diuretic Activity of *Samanea saman* (Jacq) Merr bark in albino rats. *Journal of Global trends in Pharmaceutical science*, 2010; 1(1): 61-67.
- Kokate CK, Purohith AR and Gokhale CB; *Pharmacognosy*. 27<sup>th</sup> edition, Nirali Prakashan, 2004: 344.
- Finar IL; *Organic chemistry stereochemistry and the chemistry of natural products*. 5<sup>th</sup> edition, Singapore: Pearson Education Ltd; 1975: 518.
- Swanholm CE, St John H and Scheuer PJ; A survey of alkaloids in Hawaiian plants. *Pacific Science*, 1959; 13: 295-305.
- Hirazumi A and Furusawa E; An immune modulatory polysaccharide rich substance from the fruit juice of Noni with antitumour activity. *Phytother Res*, 1999; 13: 380-387.
- Whistler W; *Tongan herbal medicine*. *Isle Botanica*, Honolulu, Hawaii, 1992: 89-90.
- Hiramatsu T, Imoto M, Koyano T and Umezawa K; Induction of normal phenotypes in ras-transformed cells by damnacanthol from *Morinda citrifolia*. *Cancer Lett*, 1993; 73:161-166.
- Ayanblu F, Wang MY, Peng L, Nowicki J, Anderson G and Nowiciki D; Antithrombotic effect of *Morinda citrifolia* (Noni) fruit juice on the jugular vein thrombosis induced by ferric chloride in male adult SD rats. *Arteriosclerosis Thrombosis and Vascular Biology*, 2006; 26: E104.
- Zin ZM, Abdul-Hamid A and Osman A. Antioxidative activity of extracts from Menkudu (*Morinda citrifolia*) root, fruit and leaf. *Food Chemistry*, 2002; 78: 227-233.
- Basar S, Uhlenhut K, Hogger P, Schone F and Westendorf J: Analgesic and antiinflammatory activity of *Morinda citrifolia* L. (Noni) fruit. *Phytother Res*, 2010; 24(1):38-42.
- Palu A, Deng S, West B and Jensen J; Xanthine oxidase inhibiting effects of noni

- (*Morinda citrifolia*) fruit juice. *Phytother Res*, 2009; 23(12):1790-1791.
19. Dang-Van-Ho; Treatment and prevention of hypertension and its cerebral complications by total root extracts of *Morinda citrifolia*. *Presse Med.* 1955; 63(72):1478.
  20. Shenoy JP, Pai PG, Shoeb A, Gokul P, Kulkarni A and Kotian MS; An Evaluation of Diuretic Activity of *Morinda Citrifolia* (Linn) (Noni) Fruit Juice in Normal Rats. *International Journal of Pharmacy and Pharmaceutical Sciences*, 2011; 3 (2): 119-121.
  21. Bajrai AA; Prevalence of crude drugs used in Arab folk medicine available in Makkah Al-Mukarramah Area. *Int. JMMS*, 2010; 2: 256-262.
  22. Baquar SR; *Medicinal and Poisonous Plants of Pakistan*. Printas, Karachi, 1989: 233.
  23. Usmanghani K, Saeed A and Alam MT; *Indusynic Medicine: Traditional medicine of herbal animal and mineral origin in Pakistan*. Karachi Department of Pharmacognosy, Faculty of Pharmacy, University of Karachi, Pakistan, 1997; 363-364.
  24. Duke JA; *Handbook of medicinal herbs*. CRC Press, Boca Taton, LA. 2002: 936.
  25. Anwarul-Hassan, Khan GA and Bashir S; An in vivo study on the diuretic activity of *Holarrhena antidysenterica*. *African Journal of Pharmacy and Pharmacology*, 2012; 6(7): 454-458.,
  26. Kane SR, Apte VA, Todkar SS and Mohite SK; Diuretic and laxative activity of ethanolic extract and its fractions of *Euphorbia Thymifolia* Linn. *International Journal of Chem Tech Research*, 2009; 1(2):149 -152.
  27. Gupta B, Srivastava R S. and Goyal R, *Therapeutic Uses of Euphorbia thymifolia: A Review*, 1(2): 299-304.
  28. Lin CC, Cheng HY, Yeng CM and Lin TC; Antioxidant and antiviral activity of *Euphorbia Thymifolia* L. *J Biomed Sci*, 2002; 9: 656-664.
  29. Kiew R & Baas P; *Nyctanthes* is a member of *Oleaceae*, *Proc Indian Acad Sci (Plant Sc.)*, 1984; 93(3): 349-358.
  30. Acharya S; Prediction of rainfall variation through flowering phenology of night-flowering jasmine (*Nyctanthes arbor-tristis* L.) in Tripura, *Indian J Traditional Knowledge* , 2011; 10: 96-101.
  31. Kirtikar KR and Basu BD; *Indian Medicinal Plants*, Vol. VII, LM Basu Publishers, Allahabad, India, 2110-2113.
  32. Sasmal D, Das S and Basu SP; Phytoconstituents and therapeutic potential of *Nyctanthes arbor-tristis* Linn. *Pharmacog Rev*, 2007; 1 (2): 344-349.
  33. Rani C, Chawla S, Mangal M, Mangal AK, Kajla S and Dhawan AK; *Nyctanthes arbor-tristis* Linn. (Night Jasmine): sacred ornamental plant with immense medicinal potentials, *Indian Journal of Traditional Knowledge*, 2012; 11 (3): 427-435.
  34. Sasmal D, Das S and Basu SP; Diuretic activity of *Nyctanthes arbor-tristis* Linn. *Ancient Science of Life*, 2007; XXVII (2): 19-23.
  35. Farnsworth NR, Akerele O, Bingel AS, Soejarto DD and Guo ZG; *Medicinal plants in therapy*. Bull. World Health Org., 1985; 63: 83-97.
  36. Nadkarni KM; *The Indian Materia Medica*, 3<sup>rd</sup> Edition, Dhootapa-peshwar Prakashan Ltd., Panvel, India. 1954: 736-737.
  37. Chopra RN, Nayar SL and Chopra LC; *Glossary of Indian Medicinal Plants (Including the supplement)*, Council of Scientific and Industrial Research, New Delhi, India, 1986; 845-846.
  38. Jesupillai M, Jasemine S and Palanivelu M; Diuretic activity of leaves of *Erythrina indica* Lam. *Int J Green Pharm*, 2008; 2 (4): 218-219.
  39. *The Wealth of India: A Dictionary of Indian Raw Materials & Industrial Products (Raw Materials)*”, Revised edition, National Institute of Science Communication and Information Resources (NISCAIR), Council of Scientific & Industrial Research (CSIR), Dr K.S. Krishnan Marg, New Delhi, 2nd reprint, 2005; Vol.1(A): 55-57.
  40. Gupta RK; *Medicinal & Aromatic Plants*, 1<sup>st</sup> edition, CBS publishers & Distributors, 2010: 190.
  41. Nadkarni KM; *Indian Materia Medica*, 3<sup>rd</sup> edition reprinted, Bombay Popular Prakashan, 2009; 1: 21.
  42. Khare CP; *Indian Medicinal Plants*, Springer, 2007: 11-13.
  43. Paul D, De D, Ali K.M, Chatterjee K, Nandi DK and Ghosh D; Comparative study on the spermicidal activity of organic solvent fractions from hydroethanolic extracts of *Achyranthes aspera* and *Stephania hernandifolia* in human and rat sperm. *Contraception*, 2010; 81: (4): 355-361.
  44. Mathanghi SK, Sudha K; Traditional underutilized green leafy vegetables and its curative properties: *Int J Pharm*, 2012; 2(4): 786-793.
  45. Bafna AR, Mishra SH; Effect of methanol extract of *Achyranthes aspera* linn. on rifampicin-induced hepatotoxicity in rats. *Ars Pharmaceutica.*, 2004; 45(4): 343-351.
  46. Sutar NG, Sutar UN, Sharma YP, Shaikh IK and Kshirsagar SS; *Biosciences Biotechnology Research Asia.*, 2008; 5:(2): 841-844.
  47. Gokhale AB, Damre AS, Kulkarni KR and Saraf MN; Preliminary evaluation of anti-inflammatory and anti-arthritic activity of S.

- lappa, *A. speciosa* and *A. aspera*.  
Phytomedicine, 2002; 9(5):433-437.
48. Srivastav S, Singh P, Jha KK, Mishra G,  
Srivastava S, Karchuli MS and Khosa RL;  
Diuretic activity of whole plant extract of  
*Achyranthes aspera* Linn. European Journal of  
Experimental Biology, 2011; 1 (2):97-102 .