International Journal of KIU

Journal home page : https: //ij.kiu.ac.lk/
DOI: https://10.37966/ijkiu2022031021

Original Article

Aerva lanata; A cure or a cause for kidney diseases; A brief overview

Deepthi Inoka Uluwaduge

Department of Basic Sciences, Faculty of Allied Health Sciences, University of Sri Jayewardenepura, 10250, Sri Lanka.

Article history:
Received 20.09.2021
Received in revised form 11.01.2022
Accepted 27.03.2022

Cite as:

#Corresponding author
Deepthi Inoka Uluwaduge
Department of Basic Sciences,
Faculty of Allied Health Sciences,
University of Sri Jayewardenepura,
10250, Sri Lanka, deepthi@sjp.ac.lk,
deepthiuluwaduge@yahoo.com

Abstract

At present the phyto-preparations are widely used in clinical practice and among them *Aerva lanata (A. lanata)* is commonly known as "Polpala" in Sinhalese, which is prescribed to alleviate kidney diseases in Complementary and Ayurvedic Medicine (CAM). The infusion of the plant extract has resolved urolithiasis and has induced diuresis in patients relying on CAM therapy. Scientific data supports this traditional claim. However, a controversy exists that the prolong use of the plant material may cause renal damage. Scientific literature also does not put forth the negative effects of using a long-term basis, though the dried plant preparations are readily available in the form of herbal tea in many countries. Therefore, this overview is a compilation of both the beneficial and detrimental effects of the use of plant material as a treatment in kidney diseases. Evaluation of the current literature supports the belief of nephrotoxicity in long term administration over its reported nephroprotection. Thus, the author reports that people who tend to self-medicate with *A. lanata* should be vigilant due to its possible adverse effects.

Key words: *Aerva lanata*, "Pashanabeda", Herbal diuretics, Anti urolithiatic herbs, Nephrotoxicity

Introduction

Aerva lanata is commonly known as " Polpala" in Sinhalese is a medicinal plant that belongs to the family Amaranthaceae (Figure 1). The plant is mostly adapted to grow in the drier parts of the tropics and the sub tropics of the world (Goyal et al., 2011). It is very much popular among natives of South Asian countries specially in India and Sri Lanka due to its versatile medicinal value. In Sri Lanka the plant has shown to be effective as an anti-inflammatory, anti-helminthic and anti-bacterial remedy (Gunatilake et al., 2012). Further it has been documented as a medicinal plant with mild-analgesic properties (Gunatilake et al., 2012). In Indian folk medicine *A. lanata* has shown to be effective in the treatment of diabetes mellitus, haematemesis, bronchitis, nasal bleeding, cough, scorpion stings and spermatorrhoea (Chowdhury et al., 2002).

Figure 1: Aerial parts of *A. lanata*

Among all its other medicinal uses, *A. lanata* is a trusted medication to alleviate the disease conditions associated with the urinary system in the countries where Complementary and Ayurvedic medicine (CAM) is in practice. Therefore, *A. lanata* is considered as a credible herb to restore the normal kidney function. Scientific evidences claim that the plant is shown to be effective in acute renal injury caused by nephrotoxins such as cisplatin and gentamicin (Shirwaikar et al., 2004). Furthermore, the plant has demonstrated anti urolithiatic and diuretic properties (Selvam et al., 2001; Soundararajan et al, 2006; Arthi et al., 2012).

"Pashanabeda" is a Sanskrit term that is cited to identify the group of plants extensively used in the Ayurvedic system of medicine, in order to dissolve the urinary calculi and stones (Gajalakshmi et al., 2012). Among herbal remedies with anti-urolthiatic property *A. lanata* is ranked at a top level in the group of "Pashanabeda". Allopathic medications and surgical interventions are available to combat the development of stones (Kumar and Clark, 2016).

However, these methods mostly failed to address the urolithiatic pathophysiology and therefore the underlying cause of calculi remains silent resulting in the repeated episodes of stones (Pareta et al., 2011). On account on the better safety, cultural acceptability and lesser side effects over the conventional counterparts, people tend to use *A. lanata* to attenuate kidney problems since antiquity (Jayaweera, 1981). Perhaps, this strong belief has led people to even self- medicate with dry or fresh plant material as a herbal drink or porridge according to their own interest (Priyashantha and Mahendranathan, 2020). In fact, the dried plant material is often sold by street vendors in the dry zone of Sri Lanka and across the country, furthermore, the dry matter is available in Ayurvedic outlets and pharmacies in a form of 'ready to use' sachet packets. Though *A. lanata* has shown to be credible in restoring the deteriorated kidney function in Sri Lankan Ayurvedic medicine, infusion of plant extract is not recommended over a long period due to the belief that it can have adverse effects on the urinary system (personnel communication).

Hence, in this review the author attempted to highlight the potential harmful effects of *A. lanata* over its documented beneficial effects on the urinary system. It is believed that the information presented may raise the awareness among the scientific community, perhaps to protect the public from the boundless use of *A. lanata* and other herbal remedies as a treatment for kidney diseases.

Search Methodology

In the first phase of this study, a bibliographic investigation was accomplished by analyzing worldwide scientific databases (PubMed, Scopus and Google Scholar) for the available information on clinical applications or uses of the plant. The plant was browsed along the key words *"Aerva lanata"*, "medicinal uses", "diuretic activity", "anti-urolithiatic" and "nephro toxicity". Available literature was screened and articles relevant to nephr-oprotection and nephrotoxicity were thoroughly scrutinized to collate the scientific evidences supporting the proposed title of the article. The plant is not extensively studied on this regard and therefore the available literature was minimal, to validate safety and efficacy on the urinary system. However, most of the literature cited that the plant possesses beneficiary effects on the urinary system. Nevertheless, few documentary evidences supported the belief of the Ayurvedic physicians of Sri Lanka claiming that the long-term use of the plant may produce harmful effects on kidney.

Beneficial effects of *A. lanata* on the urinary system

3.1. Anti - urolithiatic properties

The mechanism of stone formation proceeds through urinary saturation followed by super-saturation with stone forming constituents resulting in crystal nucleation and aggregation leading to crystal retention by the urinary epithelium over which the calculi progresses. Phyto-pharmaceutical agents capable of impeding the nucleation phase will interfere with further stages of stone formation thereby preventing lithiasis. *A. lanata* has demonstrated its ability to prevent crystal aggregation, growth and sedimentation, thereby combating urinary calculi (Alok et al., 2013).

3.1.1. In - vitro studies

In- vitro anti urolithiatic property of the flavonoid and phenol rich fractions of *A. lanata* was evaluated by Mandal et al., in 2017 and 2019. The investigators studied the effect of *A. lanata* on aggregation of stone forming components. Calcium oxalate crystals obtained were used for the study to evaluate the aggregation power of crystals in the absence (control) and presence of the inhibitor (flavonoid and phenol rich fraction of the plant). The results demonstrated that the fraction from the aerial parts composed of flavonoids and phenols was effective in inhibition of crystal aggregation (percentage inhibition: 67.14±1.84%).

The same group made an effort to evaluate the ability of *A. lanata* extract to hamper the growth of the existing calcium oxalate crystals (Mandal et al., 2017;2019). Interestingly the fraction rich in flavonoid and phenol effectively reduced the further growth of crystals. The observed findings explore the possible anti urolithiatic potential of *A. lanata* and explains the scientific rationale for prescribing the plant material to ameliorate the stones associated with the urinary system

3.1.2 In - vivo studies

Animal models were used to evaluate the in -vivo anti urolithiatic property in several studies. In all those studies, ethylene glycol in drinking water has been used to induce the renal calculi in animal models. The animals were treated with methanolic fraction of *A. lanata* flowers and noted that the serum and urine levels of stone forming substances such as calcium, phosphate, uric acid, oxalic acid and protein levels were significantly lower in test animals when compared to controls (Behera and Ghosh, 2018). The extract increased the urine volume, thereby reducing the solubility of calcium oxalate and other crystallizing salts such as uric acid, which may induce epitaxial deposition of calcium oxalate.

Potential anti urolithic activity of aqueous suspension of *A. lanata* was evaluated by Soundararajan et al., (2006). Oxalate synthesizing enzymes such as glycolic acid oxidase (liver) and lactate dehydrogenase (in liver and kidney) was significantly elevated in rats treated with ethylene

glycol. Administration of aqueous extract (2g/Kg body weight/ 28 days) to calcium oxalate urolithic rats demonstrated diminished levels of oxalate synthesizing enzymes. Further the test group showed reduced urinary excretion of stone forming substances such as calcium, oxalate, uric acid and phosphorus. On the contrary, increased concentration of inhibitors of stone formation such as citrate and magnesium were also evident in urine of urolithic rats treated with the extract. The study suggested that *A. lanata* could be used as a curative agent for urolithiasis.

Two isolated compounds (Quercetin and Betulin) of *A. lanata* were evaluated for anti-urolithiatic potential of calculi induced male Wistar albino rats by administering a test dose of 2 mg/kg BW orally for 28 days (Dinnimath et al., 2017). Urine microscopy revealed a significant reduction in the size of the calculi and significantly enhanced excretion of stone forming substances such as calcium, oxalate and phosphates in test animals. A significant reduction in the levels of blood urea and nitrogen was observed in rats of the test group exploring, that the kidney function of treated rats has presumed back to normal.

3.2 Diuretic effect

In CAM therapies, *A. lanata* is considered as a herbal plant with excellent diuretic properties (Jayaweera, 1981). In Sri Lanka, the plant's effectiveness as a diuretic has been studied by three research groups (Udupihille and Jiffry, 1986; Goonaratna et al., 1993, Herath et al., 2005).

When the plant extract was given to humans in concentrations of 50g /200 ml and 100g /200 ml, a significant increase in the urine volume was observed as compared with controls (Udupihille and Jiffry, 1986). In this study the diuretic property was determined by measuring the urine output.

Goonaratna et al., (1993) carried out a more descriptive study and measured the excretion of electrolytes (Na^+ and K^+) since most diuretics increase the electrolyte excretion together with urine output. However, contradictory results to the previous report were obtained by this study. The findings revealed that *A. lanata* does not produce diuresis, natriuresis, kaliuresis or change in urine osmoalar output although the reports did not mention the type of plant (dried or fresh) that was used to prepare the decoction.

Subsequently, Herath et al., (2005) conducted a preliminary study to investigate the diuretic effect of the fresh and dried parts of *A. lanata* by using rats. The concentrations of 50g/200 ml and 100g/200 ml of *A. lanata* were selected as therapeutic doses and the observed findings were in line with the first Sri Lankan study reported above (Udupihille and Jiffry, 1986). The findings showed that there was an increase in the urine output, urine osmolality and K^+ excretion in test rats during the four-hour observation period (Herath et al., 2005).

Another study from India reported that the isolated compounds Quercetin and Betulin from *A. lanata* can increase the urine output in urolithic rats and thereby shows the diuretic effect (Dinnimath et al., 2017).

3.3 Toxicological potential of *A. lanata* on kidney

Effect of isolated compounds Quercetin and Betulin on kidneys of urolithiatic rats were evaluated by Dinnimath et al., (2017). Electron microscopic examination of the kidney tissue of control (urolithiatic group) and test (urolithiatic rats treated with Quercetin and Betulin) rats were compared to ascertain the toxicological effects if any were produced by isolated compounds from *A. lanata.* Nevertheless, the treated group had shown intact histopathological features (glomeruli, proximal convoluted tubules and cellular organelles) when compared with deteriorated tissue architecture in calculi induced rats.

The first detailed experimental study to investigate the effect of *A. lanata* on the structure and function of the urinary tract was carried out by

a group of researchers from Sri Lanka using Sprague -Dawley rats (Gunatilake et al., 2012a; Gunatilake et al., 2012b). Two doses of dried *A. lanata* (25 g/200 ml and 100 g/ 200 ml) was used in the study. The authors justified that 25g/200 ml is the amount commonly prescribed by Ayurvedic physicians to prepare the infusion and that was selected as the low dose. The other dose was used as the high dose (four times the normal dose). The extract (dried whole plant) was administered orally for a period of one month. Light microscopic studies and electron microscopic studies were carried out to evaluate the effect of infusion on the structure of the kidney. Light microscopically visible changes were not seen in the glomeruli of kidney specimens when stained using hematoxylin and eosin, periodic acid schiff and silver methamine stains. However significant ultra-structural changes were observed in the epithelium of the proximal convoluted tubules when examined under the electron microscope. Disrupted brush border and altered mitochondria was observed in test rats and the authors claimed that this might affect the reabsorption of solutes from the tubular lumen leading to reduction in the passive absorption of water in the proximal convoluted tubule. Proximal convoluted tubule is responsible for reabsorption of 60-65% of the filtered water from the tubular lumen (Kumar and Clark, 2016). The authors suggested that increase in the urinary flow rate is correlated with damage to the epithelium of the proximal convoluted tubule. However, this study could be considered as an important study since the presence of ultra-structural changes is an early marker of the damage to the tubules. Electron microscopic changes are expected to occur prior to light microscopically detected histological changes.

In line with the evidences of the above study it is uncertain that diuresis produced by the extract of *A. lanata* is due to the damage which would occur in proximal convoluted tubule. In such a case the obligatory water resorption at the proximal convoluted tubule is impaired and therefore a diuretic effect is possible (Kumar and Clark, 2016).

The toxicological studies were carried out on rodent species and therefore the findings cannot be directly applied to humans. However, a human study of similar nature is also not feasible. Nevertheless, the findings of this important study cannot be neglected since, if a single study provides evidences of toxicity that has to be taken into consideration for the sake of the mankind.

Further, these information support the belief of the Ayurvedic physicians of not prescribing it for more than a week in the credence that it can damage the renal structure leading to renal failure in humans.

Another study conducted in Nigeria also reported the possible toxicological effects of prolong infusion of the plant extract to animal models (Kayode et al., 2017). In this study, the extract of *A. lanata* was orally administered to rats (daily at a dose of 40-1000 mg/kg for 90 days) to evaluate the sub chronic toxicity of the infusion. A significant increase in the weight of some organs such as lungs, brain and pancreas were reported in female rats. Haematological parameters were also altered (increased total leukocytes and neutrophils, reduced platelets) significantly in test rats. The extract has shown to be spermatotoxic (reduced sperm count and motility) in infused male rats exhibiting reduction in male reproductive capacity. The findings suggest that caution must therefore, be applied in its use on a long-term basis.

Conclusion

A. lanata has shown to inhibit stone formation and induce diuresis. Therefore, infusion of this plant for urinary incontinence and other disorders associated with urinary tract is very common in South Asian countries where Ayurvedic and traditional treatments prevail. Nevertheless, over nephro-protection, evidences are mounting towards its possible toxicity on kidneys and other tissues in animal models. Moreover, Chronic Kidney Diseases of Unknown Origin (CKDU) has become a significant health issue in many countries including Sri Lanka and greatly hamper the quality of life in elderly population. There

may be a greater possibility of use of *A. lanata* among these patients, though this fact has not been investigated scientifically. Therefore, those people who tend to self-medicate with *A. lanata* should be cautious in view of these findings, in a country like Sri Lanka where many people still depend on Ayurvedic and traditional systems of health care.

Conflicts of Interest: The author declares that there is no conflict of interest.

References

Alok, S., Jain, S.K., Verma, A., Kumar, M., & Sabharwal, M. (2013). Pathophysiology of kidney, gall bladder and urinary stones treatment with herbal and allopathic medicines: a review. *Asian Pacific Journal of Tropical Disease.* 3:496-504. https://doi.org/10.1016/S2222-1808(13)60107-3

Arthi, I., Ravichandiran, V., Kumar, S.K.P., & Subburaju, T. (2012). Antiurolithiatic effect of Aerva lanata Linn. extract on ethylene glycol induced urinary calculi model in rats. *International Journal of Pharmaceutical Science Research.* 17, 46-50.

Behera, P.C., & Ghosh, M. (2018). Evaluation of antioxidant, antimicrobial, and antiurolithiatic potential of different solvent extracts of Aerva lanata linn flowers. *Pharmacognosy Magazine.* 14,53-7

Chowdhury, D., Sayeed, A., Islam, A., Bhuiyan, S.A.M., & Khan, A.M. (2002). Antimicrobial activity and cytotoxic activity of Aerva lanata. *Fitoterapia.* 73:92-94.https://doi.org/10.1016/S0367-326X(01)00369-0

Dinnimath, B.M., Jalapure, S.S., & Patil, U. K. (2017). Anti-urolithiatic activity of natural constituents isolated from A. lanata. *Journal of Ayurveda and Integrative Medicine..* 8, 226-232. https://doi.org/10.1016/j.jaim.2016.11.006

Gajalakshmi, S., Vijajalakshmi, S., & Rajeswari, V.D. (2012). Pharmacological activities of Aerva lanata. A perspective review. *International Research Journal of Pharmacy.* 3 (1),28-30.

Goyal, M., Pareek, A., Nagori, B.P., & Sasmal, D. (2011). Aerva lanata; A review on phytochemistry and pharmacological aspects. *Pharmacognosy Review.* 5 (10), 195-198. 10.4103/0973-7847.91120

Goonaratna, C., Thabrew, I., & Wijewardena K. (1993). Does Aerva lanata have diuretic properties? *Indian Journal of Physiology and Pharmacology.* 37, 135-137.

Gunatilake, M., Lokuhetty, M.D., Bartholameuz, N.A., Edirisuriye, D.T., Kularatne, M.U., & Date A. (2012). Aerva lanata (Polpala): Its effects on the structure and function of the urinary tract. *Pharmacognosy Research.* 4 (4), 181–188. 10.4103/0974-8490.102259

Gunatilake, M., Lokuhetty, D., Herath, H.M.D.R., Edirisuriye, D.T., Bartholameuz, N.A., Wijayabandara, J., Kularatne, M.U., & Anand, D. (2012). Diuretic Vs toxic effects of Aerva lanata (Polpala) on kidney of Sprague Dawley rats. *Experimental Biology.* Meeting Abstracts. Pages 868.8-868.8 https://doi.org/10.1096/fasebj.26.1_supplement.868.8

Herath, H.M., Gunathilake, M., Lokuhetty, D., & Wijayabandara, J. (2005). A preliminary investigation on the effect of polpala (Aerva lanata) on the structure and function of urinary tract of rats. Ceylon *Journal of Medical Sciences.* 48, 33-41.

Jayaweera, D.M. (1981). Medicinal plants (indigenous and exotic) used in Ceylon -Part I. Colombo. *The National Science Council of Sri Lanka.*

Kayode, S., Omotoso, K.S., Flora, R., Aigbe, F.R., Olanrewaju, A., Salako, O.A., Chijioke, M. C., & Adeyemi, O.O. (2017). Toxicological Evaluation of the Aqueous Whole Plant Extract of Aerva Lanata (L.) Juss. Ex Schult (Amaranthaceae). *Journal of Ethnopharmacology.* 17(208), 174-184

Kumar, P., & Clark, M. (2016) *Kumar and Clark's Clinical Medicine,* 9th edition, Elsevier Saunders.

Mandal, B., Madan, S., & Ahmad, S. (2017). In vitro inhibition of calcium oxalate nucleation by extract -based fractions of aerial parts and roots of Aerva lanata (Linn.) Juss. Ex Schult. *Indian Journal of Pharmaceutical Sciences.* 79 (6), 957-964. 10.4172/pharmaceutical-sciences. 1000313

Mandal, B., Madan, S., Ahmad, S., & Zahiruddin, S. (2018). Suppression of the mechanisms of stone formation by a flavonoid -enriched ethyl acetate fraction of aerial and underground parts of Aerva lanata (Linn.) Juss. Ex Schult. *Pharmacognosy Magazine.* 14:S630-7. 10.4 103/pm. ≈pm_140_18

Pareta, S. K., Patra, K.C., Mazumder, P.M., & Sasmal D. (2011). Establishing the principle of herbal for anti-urolithiatic activity. A review. *Journal of Pharmacology and Toxicology;* 6, 321-332.

Priyashantha, A. K. H., & Mahendranathan, C. (2020). Traditional uses of medicinal plants in Sri Lanka with special reference to herbal drinks: A review. *Journal of Biology and Nature.* 11(2), 1-13

Selvam, R., Kalaiselvi, P., Govindaraj, A., Balamurugan, V., & Kumar, S. A.S. (2001). Effect of Aerva lanata leaf extract and Vediuppu chunam on the urinary risk factors of calcium oxalate urolithiasis during experimental hyperoxaluria. *Pharmacological Research.* 43 (1).

Shirwaikar, A., Issac, D., & Malini, S. (2004). Effect of Aerva lanata on cisplatin and gentamicin models of acute renal failure. *Journal of Ethnopharmacology.* 90, 81-86. https://doi.org/10.1016/j.jep.2003.09.033

Soundararajan, P., Mahesh, R., Ramesh, T., & Begum, V. H. (2006) Effect of Aerva lanata on calcium oxalate urolithiasis in rats. *Indian Journal of Experimental Biology.* 44, 981-6

Udupihille, M., & Jiffry, M.T. (1986). Diuretic effect of Aerva lanata with water, normal saline and coriander as controls. *Indian Journal of Physiology and Pharmacology.* 30, 91-7