



Characterization and Phytochemical Analysis of *Aerva lanata* for Anti Urolithiatic Activity

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ABSTRACT:

Aerva lanata is a well-known medicinal plant extensively used in traditional systems of medicine for the treatment of urinary tract disorders, particularly urolithiasis. The present study aims to carry out the characterization and phytochemical analysis of *Aerva lanata* to evaluate its potential anti-urolithiatic activity. The plant material was subjected to detailed pharmacognostic characterization, including macroscopic, microscopic, and physicochemical evaluations, to establish its identity, purity, and quality. Various extracts of the plant were prepared using suitable solvents and screened for preliminary phytochemical constituents. The analysis revealed the presence of biologically active compounds such as flavonoids, alkaloids, phenolic compounds, saponins, tannins, glycosides, and terpenoids, which are known to play a significant role in preventing kidney stone formation. The anti-urolithiatic activity was assessed using in vitro models of calcium oxalate crystallization, nucleation, growth, and aggregation. The extracts exhibited significant inhibitory effects on crystal formation and aggregation, suggesting their role in reducing stone formation. The findings of this study scientifically validate the traditional use of *Aerva lanata* and highlight its potential as a natural and effective therapeutic agent for the management and prevention of urolithiasis.

Keywords: Phytochemical Analysis, *Aerva lanata*, Anti Urolithiatic Activity

INTRODUCTION:

Aerva lanata commonly referred to as Gorakha Ganga, is a member of the Amaranthaceae family and falls under the genus *Aerva* and species *lanata*. The situation native origins can be traced back to India, Africa and Australia. This medicinal plant has been used for centuries in traditional system of medicine.

Aerva lanata, known as polpala in Sri Lanka, is a medicinal plant belonging to the Amaranthaceae family. It is widely spreading the drier parts of the tropics and the sub tropics of the world.

It is used in the treatment of lithiasis, cough, asthma, and headache and as an antidote for rat poisoning. This herb is used as decoction or as an herbal tea with or without other herbs in Ayurveda. It is believed that long-term ingestion of *Aerva lanata* is harmful, as it has adverse effects on the urinary tract. Alkaloids, terpenoids, sterols, several flavonoid glycosides and polyphenols have been isolated from *Aerva lanata* by researchers in Russia and India. Many plant extracts and different fractions possessing these active constituents have been screened. Diuretic effect of *Aerva lanata* has been investigated by three research groups in Sri Lanka during the last century. When it was given to humans in concentrations of 50g/200 ml and 100 g/200 ml, a significant increase in the urine volume was observed when compared with controls in one study in which the diuretic property was determined by measuring the urine output. A more comprehensive study by Goonaratna et al., measured electrolyte excretion (Na^+ and K^+), as most diuretics increase urine output and electrolyte excretion.

Urolithiasis:

Urolithiasis is derived from the Greek words "ouron" (urine), "lithos" (stone), and "iasis" (condition). It essentially describes the process of stone formation within the urinary tract. Urolithiasis refers to the formation or presence of stones in the urinary tract, including the kidneys, ureters, bladder, and urethra. It is a condition characterized by the development of calculi (stones) within the urinary system. These stones can vary in size and composition, and their presence can lead to various symptoms, including pain, urinary obstruction, and even kidney damage if left untreated. Urolithiasis, also known as kidney stone disease, refers to the



formation of stones in the urinary tract, including the kidneys, ureters, bladder, and urethra. These stones are hard, crystalline masses formed from minerals and salts in the urine. Common types of kidney stones include calcium oxalate, uric acid, struvite, and cystine stones. Stone formation occurs when the urine contains too much of certain substances, leading to crystal formation and eventual aggregation into larger stones

TYPES OF KIDNEYS STONES; CALCIUM STONES:

Most kidney stones are calcium stones. They're usually made of the chemical compound calcium oxalate. Oxalate is a substance made daily by the liver or absorbed from diet. Some fruits and vegetables, as well as nuts and chocolate, have high amounts of oxalate

URIC ACID STONES

Uric acid stones can form in people who lose too much fluid because of ongoing diarrhea or people who have trouble absorbing nutrients from food; those who eat a high-protein diet or lots of organ meats or shellfish; and those with diabetes mellitus or metabolic syndrome. Some genetic factors also may raise the risk of uric acid stones.

STRUVITE STONES

Struvite stones form in response to a urinary tract infection. These stones can grow quickly and become quite large, sometimes with few symptoms or little warning.

CYSTINE STONES

These stones form in people with a rare genetic condition called cystinuria that causes the kidneys to leak too much of a protein building block called cystine

PLANT PROFILE:

SCIENTIFIC CLASSIFICATION:

Family: Amaranthaceae

Kingdom: Plantae (Plants)

Sub-kingdom: Tracheobionta (Vascular plants)

Class: Magnoliopsida (Dicotyledones)

Subclass: Caryophyllidae

Order: Caryophyllales

Genus: Aerva





AERVA LANATA:

Aerva lanata, also known as mountain knotgrass, typically reaches its full height of 30-80 cm within a few months of growth, with plants typically reaching maturity in 3-4 months. However, the exact time can vary based on factors like growing conditions, soil quality, and sunlight availability.

The plant then enters a phase of vegetative growth, developing its stems, leaves, and roots. This phase can take a few months, with plants reaching a height of 30-80 cm. Once the plant reaches its full height and size, it will begin to flower and produce seeds, marking the final stage of its life cycle. However, the exact time can vary based on factors like growing conditions, soil quality, and sunlight availability.

MATERIALS AND METHOD:

COLLECTION AND DRYING:

The whole plant of Aerva lanata was collected from a suitable natural habitat. The plant material was authenticated by a qualified botanist, and a voucher specimen was deposited in the institutional herbarium.

Macroscopic Characterization

Macroscopic evaluation was carried out by observing the morphological features such as size, shape, color, texture, odor, and taste of different parts of the plant.

2.3 Microscopic Characterization

Transverse sections of stem and root were prepared, stained with appropriate reagents, and examined under a light microscope. Diagnostic features such as epidermis, cortex, vascular bundles, xylem, phloem, and trichomes were recorded.

EXTRACT OF PHYTOCONSTITUENT:

PHYTOCHEMICAL SCREENING

Qualitative phytochemical screening was performed on different extracts to detect the presence of alkaloids, flavonoids, tannins, phenols, saponins, glycosides, steroids, and terpenoids using standard chemical tests.

Anti-urolithiatic (Anti-kidney stone) Activity

Action: Prevents formation and helps dissolution of kidney stones.

Mechanism:

Reduces calcium oxalate crystal formation.

Increases urine output and decreases urinary calcium/oxalate.

Protects renal tubular cells from oxidative damage.

Active compounds: Quercetin, Betulin, β -sitosterol, Aervine, and Aervoside.

Evidence: Ethanolic and aqueous extracts show significant protection in ethylene glycol-induced urolithiasis in rats.

MECHANISMS OF ACTION:

Antioxidant Activity

Quercetin neutralizes reactive oxygen species (ROS) generated during calcium oxalate (CaOx) crystal formation.

Prevents oxidative damage to renal tubular cells, which otherwise promote crystal adhesion and aggregation.

Anti-inflammatory Action



Suppresses inflammatory mediators like TNF- α , IL-1 β , and COX-2 in renal tissues.

Reduces tissue injury and inhibits nidus formation (initial site of stone formation).

Inhibition of Crystal Nucleation and Aggregation

Interferes with nucleation and growth of calcium oxalate crystals.

Reduces the size and adhesion of crystals to renal epithelial cells.

Diuretic Effect

Enhances urine flow, diluting urinary solutes and reducing crystal supersaturation.

1. Regulation of Mineral Balance

- Decreases urinary calcium and oxalate excretion.
- Increases magnesium excretion, which inhibits crystal formation.

BETULIN –



Anti-Urolithiatic Action Betulin is a triterpenoid compound present in *Aerva lanata* and *Betula alba* (birch bark), known for renal protective and anti-lithiatic effects.

MECHANISMS OF ACTION:

Membrane Stabilizing and Antioxidant Activity

- Prevents lipid peroxidation and oxidative injury of renal epithelial membranes.
- Maintains integrity of renal cells, reducing crystal adhesion.

Anti-inflammatory and Anti-fibrotic Effects

- Inhibits NF- κ B signaling, reducing inflammation in kidney tissue.
- Prevents fibrotic changes caused by oxalate toxicity.

Reduction of Crystal Deposition

- Betulin and its derivatives lower calcium oxalate crystal deposition by inhibiting crystal aggregation and retention.



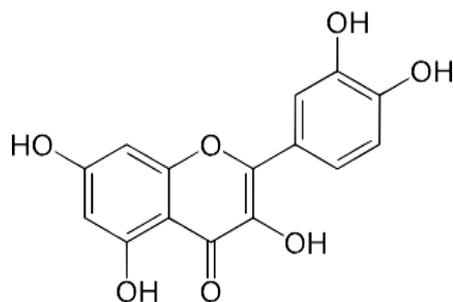
Reno protective Effect

- Improves kidney function markers (serum creatinine, urea, uric acid).

Diuretic and Detoxifying Action

- Promotes urine excretion and helps flush out crystals. Aids in detoxification of oxalate and uric acid metabolites.

Quercetin:



Mechanism of Anti-urolithiatic Action of Quercetin

Inhibition of Calcium Oxalate Crystal Formation

- Quercetin inhibits **nucleation, growth, and aggregation** of calcium oxalate crystals, which are the primary constituents of kidney stones.
- It interferes with crystal-crystal and crystal-cell interactions, reducing stone enlargement and retention in renal tubules.

Antioxidant and Free Radical Scavenging Activity

- Quercetin effectively scavenges reactive oxygen species (ROS) generated during crystal-induced renal injury.
- By reducing oxidative stress, it prevents lipid peroxidation and maintains the integrity of renal epithelial cell membranes.
- This limits crystal adhesion to damaged renal epithelium, a key step in stone formation.

Anti-inflammatory Effect

- Quercetin suppresses inflammatory mediators such as TNF- α , IL-1 β , and COX-2 induced by crystal deposition.
- Reduction of inflammation minimizes tubular injury and prevents the formation of a favorable environment for crystal retention.

Nephroprotective Action

- Quercetin protects renal tissues from oxalate-induced toxicity by preserving normal renal histoarchitecture.
- It reduces epithelial cell apoptosis and promotes cellular repair, thereby preventing crystal attachment and stone growth.

Regulation of Urinary Biochemical Parameters

- Quercetin reduces urinary excretion of calcium and oxalate while increasing levels of natural crystallization inhibitors such as citrate.
- This helps decrease urinary supersaturation, thereby preventing stone formation.



Modulation of Renal Transporters

- Quercetin modulates renal oxalate transporters, reducing oxalate accumulation in renal tissues.
- This action further limits crystal formation and deposition.

REPORT:

The present study provides pharmacognostic and phytochemical evidence supporting the traditional use of *Aerva lanata* in the management of urolithiasis. The presence of bioactive phytoconstituents validates its anti-urolithiatic activity. Further studies involving in vitro and in vivo evaluations are required to confirm its therapeutic efficacy and mechanism of action.

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Conflict of Interest Statement: All authors have nothing else to disclose.

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