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EXPLORING THE THERAPEUTIC POTENTIAL OF AERVA LANATA: PHYTOCHEMISTRY, ETHNOPHARMACOLOGY AND MEDICINAL APPLICATIONS

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ABSTRACT

Aerva lanata, commonly known as "Bui", is a versatile plant belonging to the Amaranthaceae family, widely distributed across tropical regions including India, Africa, and Southeast Asia. It is utilized extensively in traditional medicine due to its diverse pharmacological properties. The plant exhibits diuretic effects attributed to its alkaloids and flavonoids, which include canthin-6-one derivatives and compounds like kaempferol and quercetin. Various parts of Aerva lanata, such as roots, stems, leaves, and seeds, have been investigated for their bioactive constituents and therapeutic potential. Pharmacological studies highlight its efficacy in treating conditions such as urolithiasis, diabetes, infertility, and respiratory ailments. Phytochemical analysis through methods like High Pressure Liquid Chromatography [HPLC] and Soxhlet extraction has identified key compounds supporting its medicinal applications. This review consolidates the ethnobotanical knowledge and scientific findings on Aerva lanata, underscoring its significance as a valuable resource in traditional and modern medicine.

KEYWORDS: Aerva lanata, Anti-urolithiatic activity, Ervine, Soxhlet, ervoside, High Pressure Liquid Chromatography, MehtylErvine.

INTRODUCTION

Aerva lanata Juss. (Amaranthaceae) known as "Bui", is an erect or prostrate undershrub, found as a common weed in fields and waste places in India. The plant is diuretic and is used in lithiasis. The root is said to be a demulcent and a diuretic, a medicine for a headache and cough, also as a vermifuge for children and for strangury. The plant is in general use as a demulcent in the Malabar coast region.[1]

The Meena tribals of the Sawaimadhopur district Rajasthan give the juice of the roots of this plant orally for liver congestion, jaundice and dyspepsia. They also give decoction of the whole plant to cure pneumonia, typhoid and other prolonged fevers.[2] Aerva lanata was found growing in tropical Africa, Madagascar, Egypt, Saudi Arabia and Yemen, Indian subcontinent, Vietnam, Malaysia and the Philippines. The species occur in open forests on mountain slopes, on waste and disturbed ground, deserted cultivations from sea level to 900m altitude. It is a common weed in cultivated fields and bare places. (figure 1)

MORPHOLOGY

This herbaceous plant can grow either upright or along the ground, and has a long taproot that subdivides at a relatively high point. The stems are soft, hairy, and striped, and they divide into many branches.

The small leaves are on the stems alternatively. They are elliptical or obovate, with a rounded or pointed tip which has a flare out. The hairy upper surface has a woolly, white underneath. They have petioles that are 3-6 mm long, rigid, and mostly unobservable. Flowers are typically bisexual, bearing small whitish green petals. They are sessile (without stalks) and arranged in tight clusters of axillary heads or spikelet, sepals that may have small tips, and are silky-haired on the back. Each side of the stigmas is attached to smooth black seeds approximately 0.85mm wide.[3][4][5]

Figure 1: Aerva lanata.

MATERIALS AND METHODS

Phytochemistry

Alkaloids

Plant has bioactive compounds canthin-6-one alkaloids including 10-methoxcanthin-6-one, 10-hydroxy-canthin-6-one, 10-O-β-D-glucopyranosyloxy canthin-6-one, methoxycanthin-6-one, and aervoside among others. Other alkaloids present include β-carboline-1-propionic acid, 6-methoxy-β-carboline-1-propionic acid, 6-methoxy-β-carbolin-1-ylpropionic acid, and aervolanine.[6][7][8]

Flavonoids

As the source of flavonoids, Aerva lanata has the following names kaempferol, quercetin, isorhamnetin, galactoside, and glucoside, persinol, persinosides A and B, and 7-O-β-D-glucopyranoside, 5, 4'-hydroxy-3, 6, 7-trimethoxyflavone, 5-hydroxy-3, 6, 7, 4-tetramethoxy and other derivatives of flavones with high number of hydroxyl groups in position 2', 3, 5', 6, and 7 compared to tetramethoxyl groups that are attached in other positions.[9][10][11]

Miscellaneous phytoconstituents

Alongside, Aerva lanata contains methyl grevillate, lupeol, β-sitosteryl acetate, and tannic acid.[12]

Nutritive value

The leaves of Aerva lanata are rich in carbohydrates, protein, and ash, comprising 26.6 g/100g, 22.6 g/100gb, and 31.2 g/100g, respectively. Mineral composition showed the leaves to be rich in PO4 (187), and moderately-rich in other minerals such as potassium (39.4), calcium (51.7), magnesium (41.5), zinc (44.7), ferrous (11.0).[12]

RESULTS AND DISCUSSION

(Experimental section)

Plant material

In September, leaves of Aerva lanata just were harvested from naganakallu, kartagi (tq) and preserved in paper bags for about 30 days, shield from sunlight. Following the drying period, the leaves were ground into powder using a mortar. The resulting powder were subjected to extraction using a Soxhlet apparatus to isolate phytochemical components. The solution obtained from the extraction was collected in a conical flask and allowed to undergo solvent evaporation the resulting residue underwent characterization through various analytical techniques, including, HPLC, TLC, mass spectra analysis, and assessment of anti -bacterial activity.[13]

Preparation of the extract (By soxhlet method)

Prior to the Soxhlet extraction method, there is a need to select and prepare the plant samples.

The solved problem involves identifying the selected plant aided with ethnobotanical groundwork from available literature. Literature is rich in studies covering plant's leaves, stems, roots, and flowers of Aerva lanata. Our focus was the leaves from which we isolated some macromolecules of noteworthy biomedical relevance. The following criteria are essential to be followed before extraction.[14]

Requirement on Selection and Collection of plant materials

Efficient isolation of phytoconstituents relies on the careful selection and collection of plant materials. Only plant disease free and healthy plants are selected for extraction and guarded from weeds and insects. Numerous factors influence the collection. The NRCS (Natural Resources Conservation Survey) has a plants materials program that collects guidelines on plant materials collection procedures involving seeds and vegetative collections. These guidelines include detail on the timing and methods of collection as well as the processing and storage of the materials post collection.[15]

Drying of plant materials

Active enzymes that aid in the formation of active constituents and metabolic reactions within the plant are preserved in fresh plant materials. Hence, drying is vital during the preparation of plant materials prior to extraction. Some sensitive plant materials that are light

sensitive and prone to degradation are dried in dark rooms to avoid any negative consequences.[16]

Procedure

The round-bottom flask is also affiliated with the Soxhlet apparatus in example coolant. siphon tube, heat exchanger, stirrer, and water jacket. Each of the components works fabricates a finely coordinated machine which sets the rounds arrangement on top of a pot where the heater is situated alongside a delicate hot plate that can be switched on prior to starting extraction.

As stated earlier, two rounds correspond to one cycle, during which every scrub double batches out freshly boiled solvent and condenses it into the thimble located at the endpoint of the side tube, located above the pot.

The double break configure on every round starts new extraction for the next phase after the target has been cleared of color from soaked lever so the upper heater only has to raise the bottom's supply to lye's boiling point and to break the syrupy bond between the raw materials and the remaining phases to remove water free subs, while increase the basalens lower till having steer forward set throttle.

Mass HPLC Analysis

At first, we used a Soxhlet apparatus along with the entire range of solvents. We utilized a Soxhlet apparatus with the following

Solvents: non-polar hexane and ethyl acetate, methanol and water which are more polar. The crude samples sobtained were analyzed using LCMS to identify the components and mass of the sample. The identity confirmation process showed that molecular weight of the compound was 220 g/mol, confirming canthin-6-alkaloid with a retention time of 1.002 minutes. Equally important was a molecular weight of 286.23 g/mol confirming the presence of kaempferol with a retention time of 6.713 minutes. Analysis of the sample later showed a molecular weight of 610.517 g/mol which confirmed for rutin at a retention time of 19.497 minutes. In negative mode, molecular weight of 316.26 g/mol supported the idea of the presence of iso-rhamnetin with a retention time of 13.233 minutes.[17] (figure 2)

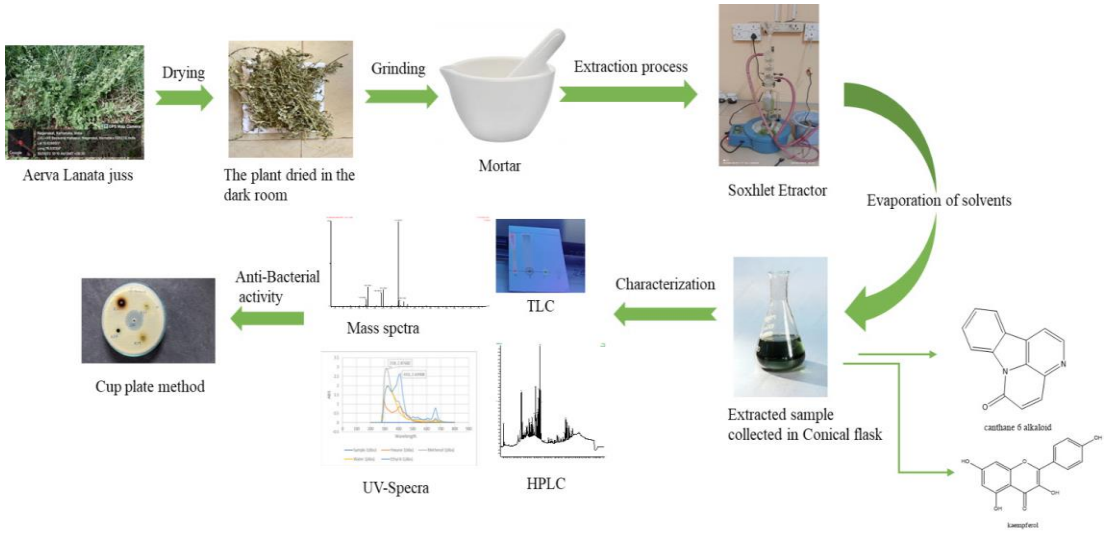


Figure 2: Schematic representation of formation of plant products.

Analysis and Quantification of major compounds

Figure 3 depicts the percentage yield of the crude extract yielded from phytoconstituents after the different solvents used in the Soxhlet apparatus. The number of cycles for each solvent was 940 cycles for hexane, 1080 cycles for ethyl acetate, 11140 cycles for methanol, and 1740 cycles for water. Active constituents of phytochemicals that were successfully isolated included Canthine-6-alkaloid, Rutin, Iso-Rhamnetin, and Kaempferol. The graph presented is illustrates phytoconstituents quantified graphically.[18]

Analysis of ethyl acetate extract

Absorbance is plotted against retention time and the elevation of the peak denotes a greater concentration of the compound in question. The peak area is a direct measure of the amount of compound that passes through the detector. The greatest absorption peak is recorded at a retention time of 11.58 minutes(S1). To corroborate, the following molecular weights were used: the presence of canthin-6-alkaloid was validated at retention time 1.002 minutes(S3) with 220 g/mol, the presence of rutin at 19.497 minutes(S4) was confirmed with 610.517 g/mol, and the presence of iso-rhamnetin at 13.233 minutes(S5) in negative mode was affirmed with 316.26 g/mol.[19]

Analysis of methanol extract

The figure presented illustrates the results of the HPLC analysis of the methanol extraction from Aerva Lanata Juss. In the chromatogram, absorbance is plotted against retention time and a higher peak value indicates larger concentration of the analyzed compound. The area of the peak corresponds with the amount of the compound that was measured. Especially

important are the peaks of absorption that are greater than the set limit at 7.95, 8.64, and 10.13 minutes.[20] (figure 3)

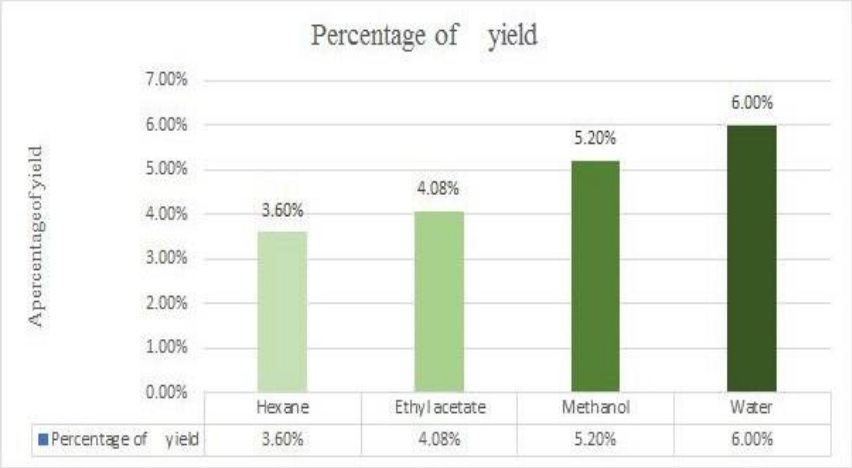
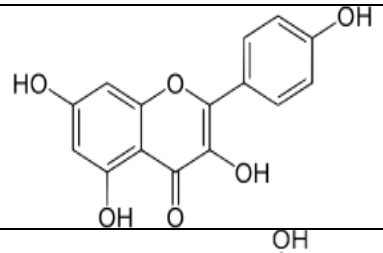
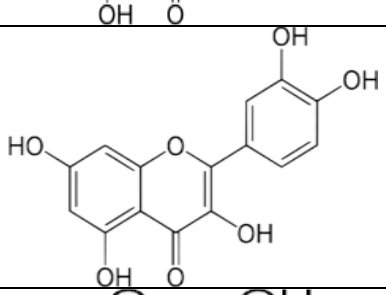
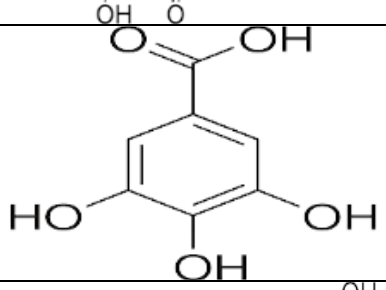
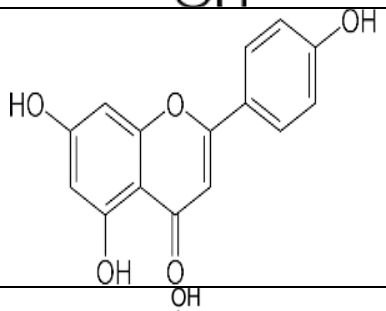
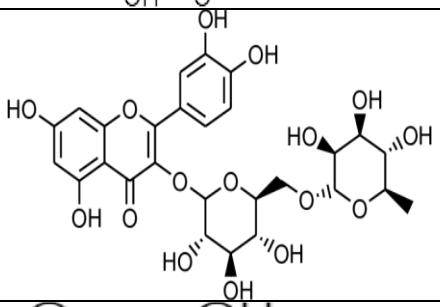
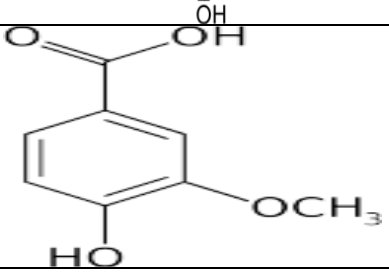


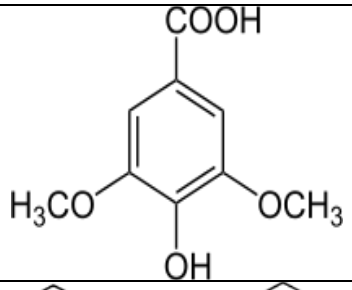
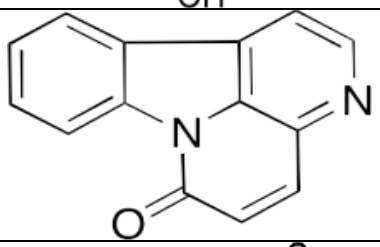
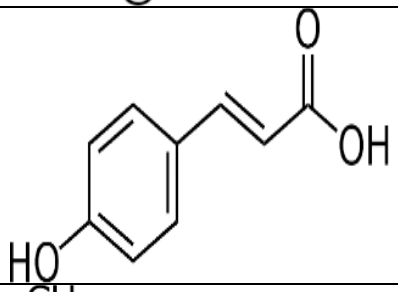
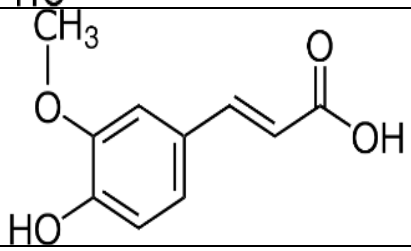
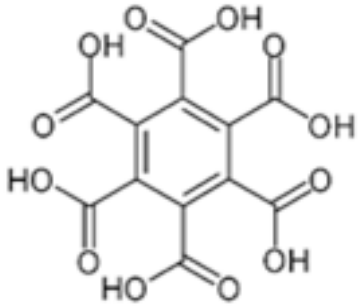
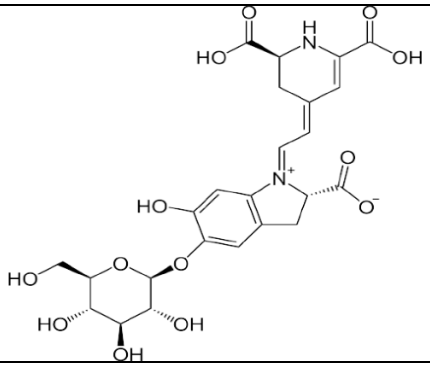
Figure 3: Extraction of Aerva lanata leaves with different solvents.

Table 1: Phytochemical constituents and pharmacological uses of different plant of Aerva lanata.

S. No.	Parts	Phytochemical constituents	Pharmacological activities	Reference
1	Seeds	Docosane, Dotriacontane, Dctadecenoic acid, etc.	Anti-urolithiatic activity	[21]
2	Roots	Gallic acid, Quinones, Phenols, Triterpenoids, Phytosterols and Phlobatannins, etc.	Antidiabetic, Diuretic, Antifertility, Hepatoprotective activity, Anti-HIV	[22]
3	Stems	Gallic acid, Apigenin, Myricetin, Rutin, Vanillic acid, Syringic acid, etc.	Antioxidant, Anti-inflammatory, Antineoplastic properties, Anti-allergic, Fever, Blood clotting, GIT distress, Diabetes, Ischemia, Neuro, and liver damage	[23]
4	Leaves	Crude Proteins, Carbohydrates, Mineral Composition (Orthophosphates, Potassium, Calcium, Manganese, Iron, Zinc, Magnesium), etc.	Nutrition, bolster your immune system, heal wounds.	[24]
5	Flowers	Calcium, Phosphate, Flavonoid, Total phenols, Tannin, Carotenoids and Lycopene, etc.	Anti-urolithiatic, Diuretic, Antimicrobial, Analgesic and Anti-inflammatory.	[25]

Table 2: Schematic representation of aerva lanata derivatives.

Name	Structure
Kaempferol	
Quercetin	
Gallic acid	
Apigenin	
Rutin	
Vallinic acid	

Syringic acid	
Canthin-6- alkaloids	
p-coumaric acid	
Ferulic acid	
Mellitic acid	
Betaine	

Pharmacological activities

1. Urolithiatic activity

Formation of stones in the urinary bladder or urinary tract is termed as urolithiasis. Aerva Lanata is the common Indian name and PASHANABHEDA (Stone breaking) is the Ayurvedic name given to it. This plant is used as anti urolithiatic drug. The plant suspension has been shown to lessen the effect of oxalate synthesizing enzyme. Quercetin and Betulin isolated from Aerva Lanata have been found to be active against ethylene glycol induced calculi in male Wistar albino rats.[26] The plant extract aids in stone size reduction and increases the excretion of calcium phosphate, oxalate and magnesium, the latter known as one of the kidney stones inhibiting factors. The anti urolithiatic effect was also evaluated by single diffusion gel growth technique in the shoot extract of Aerva Lanata.[27]

2. Anti-diuretic activity

Treatment of diuresis with antibiotics usually results in blood glucose lowering, heart diseases, hypertension etc. An alcoholic extract Aerva Lanata was previously studied and showed significant increase the urine volume as well as sodium, potassium and chloride levels in the urine.[28] In another study, the Kuwaiti Aerva Lanata plant was compared to the concentrated ethanolic extract of Aerva Lanata, where frusemide was the control drug, but it was found to have lower diuretic activity compared to frusemide.[29]

3. Anti-infertility

Dozens of plant extracts have been screened for anti-infertility activity but only a handful showed a favorable result. For women who are unable to use hormonal contraceptives, herbal remedies are an option.[30] Only limited research has been done on the impact of Aerva lanata on reproductive parameters and the majority is focused on male infertility. Administration of crude extract of the plant at different doses during the critical period of organogenesis during gestation yielded positive outcomes in testicular health.[31] That said, more research, including clinical studies, is needed.

4. Anti-diabetic

Diabetes Mellitus (DM) is a widespread condition that affects the body due to its metabolism. The use of insulin, as well as oral glycemic medications, remains the keystone of DM management.[32] Type 2 Diabetes Mellitus (DM) has been characterized due to its anti-hyperglycemic properties towards Streptozotocin nicotinamide induced type 2 diabetes in rats.[33] Comparison of the two depicts basal metformin hold did not exceed four weeks when

then experimental alloxan diabetic rats were treated with Aerva lanata ethanolic extract fell to the level where blood glucose metformin level.[34]

CONCLUSION

Aerva Lanata has been ethnomedicinally used as a Therapeutic agent for a variety of diseases. Moreover, numerous research works have proven its uses beyond the ethnomedical ones in experimental animals. Alkaloids and flavonoids which were isolated from this plant may be responsible for its pharmacological activities. The road ahead is to establish specific bioactive molecules, which might be responsible for these actions. Therefore, the cultivation, and further Pharmacological exploration of Aerva Lanata are essential.

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