REVIEW ARTICLE

# Pharmacological and Phytochemical Potential of *Andropogon muricatus*: A Review

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## ABSTRACT

Many medicinal plants have been utilized as medications since ages ago. Chemical components extracted from such plants have been used historically in traditional Unani medicine, the Siddha and other medical systems for a variety of ailments. Among them is *Andropogon muricatus*, a member of the family Poaceae, better known by its common name, vetiver. It contains a variety of organic components with significant therapeutic benefits for a range of illnesses, including mosquito repellent, anxiolytic, acaricidal, hypoglycaemic, antidepressant, antidiuretic, sedative, antifungal, and nervine effects. This plant's roots serve as cooling. When it comes to oil extraction—which is used in food and beverages, spas, home appliances, and medicine—root systems are the most valuable parts of the plant. It is indigenous in Bangladesh, China, Japan, the Bonin Islands, Nepal, the Philippines, and Sri Lanka in the Asian continent. Australia and Spain were first exposed to it in Europe and Oceania. Substances of a chemical nature that have been extracted from the plant's overall various sections have previously been the subject of numerous pharmacologic and medicinal studies.

**Keywords:** *Andropogon muricatus*, Vetiver, Phytochemistry, Pharmacological activities, Khusimone.

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## INTRODUCTION

*Andropogon muricatus* is an element of the forms-diversified Poaceae family, which has 11,337 species and 707 taxa.[1] The perennial herb *A. muricatus* is perpetually green and grows to a height of 1 to 3 m, with some bunches reaching up to 3 m.[2] When growing circumstances are right, its roots are able to descend three to 5 m at the initial season of growth, which will further aid in their ability to withstand both flooding and drought.[3] Out of the entire plant, root systems are most useful for oil extraction, which is employed in meals and drinks, spa facilities, household appliances, and for therapeutic purposes. In 2019, 408.8 tonnes of *A. muricatus* oil were sold worldwide; between 2021 and 2028, It is anticipated that this sector of the economy will grow by 7%.[4] Perennial herb *A. muricatus* is utilized in the industry to extract aroma oils and its therapeutic qualities. As *A. muricatus* is valued for producing aromatic oil, it is claimed to have originated in the South India peninsula and spread throughout the world. The botanical species *A. muricatus*, which means the Tamil word "vetiver" is the source of the term "vetiver." Since prehistoric times, India has used vetiver for both its aromatic oil and historical therapeutic uses[5] and its hedging has been used for generations in India to safeguard boundaries.[6] Sesquiterpene substances like acetate of vetivene, vetivenol, vetivenic acidic substances and vetivenyl have been identified in the herb after analytical examination.[7] *A. muricatus* represents a single of these species that, except from a few functions like antioxidants, has never been investigated for pharmacological evaluation,[8] also antispasmodic, low in blood pressure.[9] The species possesses root buds for proliferation and is impotent in the most widely used economic varieties. Pruning is done to encourage the formation of the leaves and roots because this grass thrives well in any type of environment and type of soil. Based on reports, nearly all vetiver planted globally is one particular replica (regardless of difference within the genome evaluated) named Sun in the USA, which is named for the city of Sunshine, the state of Louisiana, where sunshine or very similar cultivars are used for the purpose of oil-based production.[10] Although it has morphological traits with other aromatic grasses like Citronella [*Citronella nardus* (L.)], lemongrass [*Cymbopogon citratus*], and palmarosa [*Citronella martinii*], vetiver is firmly linked to sorghum. Based on the fact that genetics and examination of morphology overlap, both genera of *Chrysopogon* and *Sorghum* are closely linked to one

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another (Table 1). As a result, *Vetiver* and *Chrysopogon nardus* have been united beneath *Andropogon*[11] and as a result, *A. muricatus* (L.) Robert was accepted as a legitimate designation for *A. muricatus* (L.) Nash.[12]

Throughout the Vedic era, vetiver oil production from turf has been recognized in India. Using the steam extraction method, oil is thick and ranges in color from bright brown to deep brown. In its new root weight base, vetiver generates between 0.3 and 2% of vital components, according to biotype, customs, root conditions, process, as well as the time required for distillation. Based on the source, both color and smell could differ.[13] This is discovered that two morphologically different vetiver complexes live in geographically isolated parts of India, producing oil with various properties: The Bharatpur or North Indian variety is widespread, has a thin leaf with strong roots and an elevated establishment of seeds, and produces exceptional caliber levorotatory base oils (khas oils) at minimal levels. The Southern Indian or cultivated variety is late blooming, low pollen sterile, not sowing seeds, and has broader branches that resemble Java vetiver and produce inferior rotatory in nature base oil (vetiver oil). This can be observed on the Indian Peninsula's eastern and western coasts. Both of these differ regarding output and the oil's purity it produces.[14] In trading, khas oils is commonly referred to as "vetiver oil." It also goes by the name "Oil of peacefulness" and has a distinct scent for which there isn't an artificial analog. Approximately 250 tonnes of vetiver oil are traded year worldwide.[15]

### Botanical Features

#### *Plant morphology*

The fragrant turf known as "*A. muricatus*" stands up to 1200 m high, mostly on the grasslands of India.[17] It is densely tufted. Most of this turf is cultivated through the help of the trims process, which is crucial since it further encourages the rapid growth of both roots and foliage.[18] This densely growing plant, which can grow in any type of soil, has roughly 2 m in size roots that vary in hue from milky to light yellow and sometimes nearly brownish. The roots are also somewhat fragrant, flavorful, organized, and caustic (Figure 1). These roots have oil-producing cells located underground that are challenging to access.[19] The cortical layer of the interior peel, then the spilled oil is stored in the lysigen lacunae.[20] The foliage

**Table 1:** Taxonomical classification[16]

| *Domain* | *Eukaryota* |
|---|---|
| Kingdom | Plantae |
| Phylum: | Spermatophyta |
| Subphylum | Angiospermae |
| Class | Monocotyledonae |
| Order | Cyperales |
| Family: | Poaceae |
| Genus: | *Chrysopogon* |
| Species: | *zizanioides* |

**Figure 1:** Roots of *A. muricatus*

is extreme green in color, tapering, erect, angled, and have rougher or crusty borders. There are at least every edge has six leaflets., measuring approximately 4 and 10 mm in width and 30 to 90 cm in length. This florescence can be found in groups of six to ten with up to twenty rays, expanding slanted to erect, proliferating, thin clusters around 7.5 cm in size. About 6 mm length, sessile spikelets with a greyish to violet color with medial compaction; the callus itself is small and paired.[21] Under a microscope, parenchymal cells rich in starch grains and oil clumps were identified in the shoots of the Indian *A. muricatus*. Trichomes and fibrous cells make up the exterior section, and bordering pored, eroded, and reconstituted vessels make up the inside layer. Crystals of calcium oxalate with lacunar cells from collenchyma scattered throughout the cells make up the outermost skin layer.[22]

#### *Geographical distribution*

The introduction of *Chrysopogon festucoides* as an entirely novel benchmark of wide distribution, together with *A. muricatus*. Later, it dispersed around the globe. It's brought to Bangladesh, China, Japan, the Bonin Islands, Nepal, the Philippines, and Sri Lanka in the Asian continent. Australia and Spain were first exposed to it in Europe and Oceania. Subsequently, more places in the continents of North and South America were added to it. Amongst the Indian states where it is grown are the states of Kerala, Karnataka, the state of Andhra Pradesh, Tamil Nadu, the Indian state of Kashmir Rajasthan, however, Odisa, MP and UP.[23] Habitat With its broad range of seasonal change, *A. muricatus* grows in a variety of environments, including deserts, flood zones, wetlands, frost zones in the foothills of the Himalayas, and coastal regions exposed to salty spray. It is able to flourish with a range of soil types and has been reported to thrive in bauxite, a substance that is toxic to almost all other circulatory vegetation types.[3]

#### *Physiological characteristics*

Adaptability for severe weather shifts, including extended droughts, floods, submersion, and extremely cold temperatures—from -10 to 48°C at Australian countries and substantially greater in Indian and African countries. The capacity to recover swiftly from severe soil chemical conditions, such as salinity, drought, or frost, provided that the weather clears up or soil ameliorants are applied. Ability to tolerate a broad pH range (3.0–10.5) of both pH values in soil high degree of resistance against elevated magnesium, sodality, and salinity levels in the soil. Extremely resilient to soil-borne mercury, selenium, zinc, aluminum, manganese, cadmium, chromium, nickel, copper and lead. Exceptionally effective at drawing up the element's nitrogen, phosphorous, mercury, cadmium, as well as lead immersed from contaminated water regulating the formation of algae.[24]

*Ecological characteristics*

While *A. muricatus* can withstand harsh soil and climate circumstances, it is quite sensitive to shade. Darkening may slow down the plant's development and, in severe situations, may eventually cause vetiver to disappear. Vegetables grow best in the open, so weed management may be necessary while the plant is developing. In disturbed lands, vetiver can also be regarded as an innovative plant due to these traits. Vetiver first improves the microenvironment of the erodible earth (especially steeper hillsides) to allow other seeded or donated plants to be established later. Elevated natural vegetation, including the shrubs and trees that have been established or invaded in the area could shadow out vetiver and slow down its development. If desired, vetiver could eventually be substituted by these plants as the primary stabilizing agent. Results from Australia and other countries have demonstrated that local species can significantly inhibit vetiver development in less than 2 years. Therefore, when combined with native plants, vetiver is a highly ideal plant for land restoration.[24]

*Conservation*

One of the main factors contributing to land deterioration is soil erosion, which also lowers fertility in the soil and, ultimately, agricultural productivity and production. In emerging economies like Ethiopia, this issue gets worse. Preservation of both land and aquatic resources alongside appropriate initiating with the first line of defense to reduce difficulty. Vetiver grass was introduced to farmlands as a grassland strip and a means of bund stabilization through community involvement. As a result, as a step to stabilize the soiled bundle, greater than 45 km, there was vetiver grass covering 20% of the watershed. In just two years, the hedge attained full maturity and created an average elevated platform measuring 36 cm. The study's findings demonstrated that, after just two years, almost 36 cm of earth had piled above the hedge. The average yearly soil loss in lack of a vetiver hedgerow row acting as an erosion hurdle was calculated using the average soil accumulation per year and the average bulk density of the reservoir. Furthermore, the soil deposition above the *Vetiver* hedge decreased the field slope by a norm of 2.5%. Additionally, it was discovered that the availability of phosphorus was higher above the hedgerow than below it, and that the watershed's interchangeable acidity is lower greater than the hedgerow of vetiver than below it, suggesting an improvement in soil fertility. For farmlands and steep slopes, vetiver hedgerows are advised as an instant mitigation strategy for soil erosion. These can be put into place by community organizing.[25]

*Phytochemistry*

Vetiverol, vetivone, ß-vetivone, khusimone, khusimol, vetivene, khositone, terpenes, benzoic acid, tripene-4-ol, ß-humulene, epizizianal, vetivenyl vetivenate, vetivazulene, levojunenol, vanillin, vetivenic acid, zizaene, and zizanol are among the medicinal components of the plant. The main ingredients of an Argentinean vetiver oil sample (yield: 1.5%) were vetivenol, vetivenyl vetevenate, and $\alpha$ and $\beta$-vetivones.[26]

Depending on the variety, vetiver plants have different chemistry of soil they grow in, their surroundings, and their place of origin. Its chemical composition varies characteristically depending on the type of soil it is cultivated in normal, normal with additional microorganisms, and semi-hydroponic soil, for example. The optimal result of the vetiver's reaction with regular soil that has more bacteria in it is sesquiterpenes as well as their aldehydes, ethanol, and acetone. These saturated substances infuse vetiver oil with aroma, which expands its application in the nutritional and aroma sectors. Furthermore, the level of purity of the oil is influenced by the roots' maturation and the amount of time they were distilled.[27] On the other hand, the oils derived from the cleaned root are found to be devoid of fungal compounds such as α-amorphene and β-vetispirene and to be full of alkanes that have a link length ranging from 19 to 29. However, when the chemical composition is examined using gas chromatography–mass spectrometry (GC–MS) analysis and the randomly generated polymorphic DNA approach, the surroundings and address also cause variance within the structure. Hence, the structure and positioning of essential oils can have a significant impact on their scent.[28]

Given that most essential oil products, *A. muricatus* oil have an elaborate structure is composed of more than a hundred analogues of sesquiterpene constituents.[29] Fortunately, Sesquiterpenoids C15, which boil at temperatures above 200°C, make up the bulk of the lubricating component.[27] Such sesquiterpenoids can be found in various kinds, including ester derivatives, hydrocarbons despite carbonyl derivatives, and alcohol compounds vetiverols, comprising khusimol, epiglobulol, spathulenol, and khusinol, varies in percentage from 3.4–13.7% to 45–80%. The carbonyl equivalents (1.3–7.8%) are also made up of α-vetivones, β-vetivone, khusimone, and ester counterparts, including khusinol acetate. Additionally, traces of benzoic acid are thought to have been found in vetiver hydrocarbons such as valencene, selinene, khusemene, khusimone, ß-humulene, vetivene, furfurol, and so forth.[30] Of such, the majority responsible for the vetiver's aroma are khusimone, β-vetivone, as well as α-vetivone[31] and, so recognised as the oil's "fingerprint."[32] The scent of α-Vetivone is superior to that of its primary isomer, nordihydro β-vetivone, that smells rich, powerful, and woodsy. Among components, both individually and collectively, adds to the distinctive vetiver scent.[28]

*Chemical composition*

Numerous factors affect the chemical makeup of *A. muricatus* oil. Variations in cultivation techniques have a major impact on the content and production% of vetiver oils. The system that used microbes produced the essential oil yield and had a higher concentration of γ-vetivenene and certain among the three grown procedures, consisting of small-molecule volatiles such as 2-norzizaene and its analogs. The volatile component characteristics of oils produced through hydroponic and conventional soil growing, however, were discovered to be comparable.[26]

Likewise, compared to vetiver plants that had not been cleansed of fungi and bacteria using tissue culture, cleaned vetiver produced very little crude oil in order and were radically dissimilar in nature. Oil's GC-MS examination showed that the cleaned vetiver generated a substantial quantity of numerous alkanol of C19–C29 alkaline compounds and usual components of vetiver oil, yet it was devoid of metabolites thought to be produced by fungi, such as β-funebrene, prezizaene, α-amorphene, and β-vetispirene. The vetiver oil profile of the unclean vetiver was typical. It appears that biological variables improve the produce creation of unique oil molecules in regular vetiver, which both increase oil output.[33] Vetiver oil is one of the most complex essential oils, with a unique woody balsamic tone dominating its aroma. This tone suggested the existence of a few volatile substances, primarily hydrocarbons, sesquiterpenoids, and their oxygenated derivatives. Veterinarian oils have long posed a challenge for chemical analysts, as about 100 to 200 compounds containing skeletons of cedrane, bisabolane, eudesmane, eremophilane, and zizaane have been discovered and reported in the literature. Most of these are sesquiterpenic, the use of derivatives including alcohols, hydrocarbons, aldehydes, ketones, and acids. Nevertheless, vetiver oil was additionally observed to contain minor levels of phenols and nitrogen-containing substances.[34]

The chemicals khusimol, vetivinine, viteverol, khusimone are main contributors to the distinctive vetiver smell.[35] Up to 35% of the oil included the sesquiterpenoids -vetivone, -vetivone, and khusimol. Therefore, even if they lack the trademark vetiver scent, these are nevertheless regarded as the oil's fingerprint.[36] The main constituents of vetiver extract are sesquiterpene hydrocarbons, which include cadenene, amorphine and aroma dendrine. Its alcoholic swaps, vetiverols, include khusinol, khusimol, and khusol. Additionally, carbonyl compounds such as khusimone, vetivones such as α- and β-vetivone, nootkatone acidic counterparts such as khusenic acid, and ester variants such as khusinol acetate have been identified in the majority of the samples.[37]

*Pharmacological properties*

- *Anticancer activity*

The study investigated the results of *A. muricatus* rhizome crude within two different types of DNA for carcinoma of the breast research. The cell lines were employed at concentrations of 1.44×106 and 1.44×104 per well plate, respectively. Tingenone (100 µg/mL) and DMSO served as the positive and negative controls for the MTT assay, and the essential oil was taken at a concentration of 0.01% w/v as the test sample. Following the essential oil immunization, there was a rapid decrease in cell viability, indicating greater anticancer effectiveness against both breast cancer cell lines with $IC_{50}$ values of 23.9.0 and 36.2 µg/mL, respectively. The existence of a significant portion of sesquiterpene alcohols, such as (E)-isovalencenol (13.5%), khusimol (12.1%), and vetivone (5.4%), may be the cause of this higher potency.[38]

- *Anticonvulsant action*

Given convulsions of electric shock and pentylenetetrazole (PTZ)- induced epileptic fits, the anticonvulsant effect of *A. muricatus* root was observed.[39] To find the $LD_{50}$, the ethanolic extract was diluted in 1% Tween 80 and then given orally to rats at dosages of 100, 200, 300, 400, 500, and 600 mg/kg. The acute toxicity investigation was conducted in accordance with Organisation for Economic Co-operation and Development (OECD) guideline 425, and the $LD_{50}$ was determined to be 600 mg/kg. Given at safe levels, the herbal remedy delayed the formation of convulsions in MES-induced seizures, with no deaths recorded; in contrast, just 83% of animals in PTZ-induced seizures survived. Grandmal epilepsy and generalized tonic-clonic seizures are similar to MES-induced seizures, and medications that alleviate or diminish seizures must either increase GABA-inhibiting neurotransmitter levels or decrease sodium ion channel activity. Additionally, vetiver extracts demonstrated remarkable potential in preventing convulsions, indicating its function in raising GABA levels in partial and generalized tonic-clonic seizures. The roots are abundant in phytochemicals such as alkaloids, flavonoids, saponins, terpenoids, tannins, and phenolics. Therefore, the T extracts demonstrated adequate effectiveness.[40] Flavonoids and triterpenes, which are more likely to bind to GABA A receptors and documented anti-convulsive actions, are the most significant substances to which the activity is attributed. The phytochemical component in question that gives this substance its anticonvulsant properties has to be found in more research. Another possibility for the mechanism of action is its bounding strength and effectiveness on the GABA-A receptor.[41]

- *Antioxidant activity*

The beta carotene bleaching method was used to assess *A. muricatus's* antioxidant potential.[42] Which, in the absence of antioxidants, depends on the quick decolorization of β-carotene caused by free linoleic acid electrons. Nevertheless, when administered with 10 µg/mL of *A. muricatus* essential oils, a notable deceleration in the decrease of absorbance at 470 nm from 0 to 180 minutes was noted. In the lipid peroxidation assay, it exhibited antioxidant potential that was similar to that of conventional butylated hydroxy anisole (BHA). An additional crucial point to take into account is that the oil also activates the antioxidant enzyme system functions by raising amounts inside cells of glutathione (GSH), superoxide dismutase (SOD), and glutathione peroxidase, which reduces the threat of oxidative stress.[43]

- *Anti-allergic*

*A. muricatus* essential oil, or AM-EO, have been demonstrated in the RAW 264.7 murine macrophage cell culture. The essential oil was tested in 12 well-plates plated with 3 x 105 RAW cells for 20 hours at four different doses: 0, 5, 7.5, 10, and 12.5 and 1-µg/mL lipopolysaccharide (LPS) as the control. Following the incubation procedure, the essential oil had a strong anti-inflammatory effect that grew with dosage. It exhibits no toxicity while reducing the formation of nitric oxide at 7.5, 10 and 12.5 µg/mL, which is a favorable indicator of decreased swelling. Additionally, it showed a protective effect by increasing the number of LPS-stimulated RAW 264.7 macrophages through the upregulation of heme oxygenase-1, messenger RNA (mRNA) expression, and decreasing the release of nitric oxide (NO) from LPS-stimulated RAW 264.7 macrophages through dose-dependent inhibition of COX2 and ribose nucleic acid.[44]

- *Mosquito repellent*

The ability of lavender, cinnamon, and *A. muricatus* essential oils to repel mosquitoes when applied singly or in combination to both mature and larva house flies (*Musca domestica* L.). In order to administer undiluted vetiver oil locally and for fumigation, it was diluted in 5% Tween 20 at a concentration of 0.6%. This guaranteed 100% death of adults by ovicidal effect, but it was regrettably non-significant for the virucidal activity against RRV-T48 and entrance assay.[45] Its less volatile nature somewhat offsets the high cost, which limits its utilization even though earlier trials also indicated 100% efficacy against *Lucilia sericata*.[46] Additionally, vetiver was attempted in combination with sunflower oil serving as the carrier oil. Sadly, these blended mixes did not prove to be advantageous and instead only increased costs. However, since these oils can be used in situations where insecticides are not advised, cinnamon and vetiver have been tested to reduce flies and fly products.[47]

- *Anxiolytic effect*

It is commonly known that extract changes central nervous system function, which modifies brain activity. The study, therefore, intended to examine the c-fos protein gene alterations and assess the anxiolytic activity of vetiver essential oil using an elevated plus-maze model of anxiousness. In his investigation, rats were given 2.5% vetiver essential oil to inhale, and their behavior in an elevated plus-maze device was observed. The visit and time spent in the open arm were much higher soon after the oil inhalation than in the closed arm, which is a true sign of the anxiolytic effect. In addition, the central amygdaloid nucleus's c-fos expression is seen, and its hyperactivity may indicate the anxiety impact. Still, under stressful circumstances, the prefrontal cortex and hippocampus—two more anxiety-prone brain regions—need to be assessed. Even though vetiver oil has an impact close to that of the well-known anxiety medication diazepam, further research is necessary to identify the bioactive component causing this similarity.[48]

- *Acaricidal activity*

Various studies investigated the acaricidal (by killing parasites) properties of vetiver essential oil and proposed that khusimol is the primary ingredient.[49] It can function by a variety of processes, including as a decrease of the cycle of reproduction by depriving female arthropods of necessary elements like proteins, lipids, etc., at a rate that is somewhat greater than that offered by commercial products.[50] Elevation of acetylcholine levels through inhibition of degradation mediated by cholinesterase;[51] consequently, the acetylcholine becomes more concentrated, halting and killing the arthropods.[52]

- *Hypoglycemic activity*

Using a diabetic model caused by alloxan, the glycemic impact of *A. muricatus* roots was examined. All albino Wistar rats, both male and female, received an intravenous injection of alloxan at a concentration of 150 mg/kg to induce mellitus. The diabetic rats were identified by monitoring their blood sugar levels 48 hours later. After that, for a duration of 28 days, ethanol-based root extract and the prescription medication glibenclamide were given at various doses of 100, 250, 500, 750, and 10 mg/kg. Blood sugar levels were constantly measured during the trial in order to compare the antidiabetic efficacy of various group doses. Comparable action of vetiver extract (on the $7^{th}$, $21^{st}$, and $28^{th}$ day) and the conventional medication glibenclamide was shown by the acquired sugar ratios. Phytochemical analyses identified flavonoids, sterols, saponins, and polyphenolic substances.[53]

- *Antidepressant effect*

The induced swim and the tail suspension experiment paradigm are two in vivo depressive disorders models in which experiments using an ethanolic extract of *A. muricatus* showed beneficial effects on depression. In another study, the ethanolic extract of *A. muricatus* roots was also found to be beneficial in treating pre-induced stress in rats. It was administered at a dose of 100 mg/kg both alone and in combination with 10 mg/kg of fluoxetine. The mixture of the well-known medication fluoxetine and 100 mg/kg vetiver extraction showed a superior therapeutic effect in both models when compared to the immobility time data.[54]

- *Antidiuretic activity*

For the initial time, khusimone is separated with vetiver roots. Several scientific techniques, including mass spectrometry (for molecular weight determination), nuclear magnetic resonance (NMR) (for hydrogen and carbon numbers), and infrared spectroscopy (for functional group determination), were used to confirm the structure of the isolated sesquiterpene alcohol khusimol. Following the acquisition of the organisation, it is examined using [3 H]-Khusimol was discovered to be a rival blocker of vasopressin V1a receptors using the vasopressin-binding test. This V1a receptor inhibition may be used to provide an antidiuretic effect when osmolality is excessive.[55]

- *Sedative activity*

Male wistar rats of weight about 124 g were employed to evaluate the sedative properties of vetiver oil. Several oils were used in this study: 5% w/v vetiver and 5% w/v lavender, whose effectiveness was assessed after an hour of breathing by rats. They were given the remaining half an hour in a camera-equipped square block after an hour of nonstop inhalation. Following their five-minute rest period, their movements were watched intently to observe their rearing behaviors in the open field test. Following the viewing of every videotape that was captured, every value that was gathered was statistically examined to determine the outcome. They discovered that vetiver oil, in complete accordance with its conventional use, reduces rearing motility more effectively than lavender oil.[56]

- *Antifungal activity*

A wide variety of natural fungal killer effects against pathogens were demonstrated by vetiver oil. Using the spore germination inhibition approach, the antifungal efficacy of sesquiterpenoids converted products found in vetiver oil was evaluated *versus* two phytopathogenic fungus, *A. alternata* and *F. oxysporium*. Khusinodiol monobrosylate was discovered to be an efficient antifungal agent against both fungi out of all the substances examined.[57]

- *Nervine*

Shock, panic, and worry can all cause nerve damage that can be treated with vetiver oil. Additionally, it aids in the elimination of anxious diseases, ailments, hysteric and epileptic episodes, nervous and neurotic illnesses like Parkinson's disease, loss of limb control, etc.[58]

**Medicinal Uses**

The dose, 3 to 6 g powdery substances of roots, 50 to 100 mL tincture, and 25 to 50 mL solution. External application: Apply as a paste topically to treat skin conditions, discomfort from burning, and excessive perspiration. Fragrant gingergrass, or *A. muricatus*, has been extensively utilized in medicine for its antihypertensive and antispasmodic properties.[59] Additionally, it has been discovered that *A. muricatus* extract contains phosphodiesterase suppressive and calcium channel inhibitory properties, which account for its medical application in the treatment of respiratory conditions like bronchitis.[60] Furthermore, because of its incredibly calming qualities, *A. muricatus* essential oil is used in aromatic medicine.[61] The therapeutic potential of *A. muricatus*, often known as aromatic gingergrass, has been investigated. A pharmaceutical investigation found that *A. muricatus's* aqueous-methanolic crude extract possesses hypertensive and antispasmodic actions.[62] *A. muricatus's* essential oil, which has a reputation for being incredibly calming, is thought to have therapeutic promise in perfumery. The oil's fragrance is earthy, woodsy, and syrupy and it's commonly used in beauty products, perfumed soaps, and scents for both men and women. *A. muricatus* essential oil is widely utilized in aromatherapy for encouraging relaxation and relieving stress due to these qualities.[63] The production of an antibacterial agent for medical use as well as the creation in an asthetic element valued by fragrance along with enhanced antibacterial activities, seem to be suitable uses for vetiver essential oil.[64]

**Traditional Uses**

For colic, persistent vomiting, and bloating, vetiver oil is used as a carminative. It is recognized as a diaphoretic, coolant, and stimulant. As a diaphoretic, a leaf decoction is advised. Applying it locally to sprains, lumbago, and rheumatism provides relief and offers suitable consolation. Children can utilize the herb's insecticide properties. Applying Ushira externally eliminates boils brought on by excessive sweating. The root has cooling, alexiteric, and stomachic qualities and is beneficial for spermatorrhoea, bilious fevers, sweats, bad breath, ulcers, strangury, burning sensations, and blood disorders. The roots are infused and used as an emmenagogue and restorative. It can be combined in a processor with two aromatic woods, red sandalwood and padma kasta, in a bathtub of water to create a fragrant bath. Its essence, oil, or Otto is used in fragrance and also used in two minimal dosages to prevent cholera vomiting. Headache relief is achieved by smoking cigarettes made from grass infused with benzoin.[59]

## CONCLUSION

An essential medicinal plant used to treat a variety of illnesses and disorders is *A. muricatus*. *A. muricatus* origins are employed as stimulant medications, cooling agents, and diaphoretics. Experimental studies has demonstrated that plants possess a wide range of medicinal qualities, including anti-inflammatory, antioxidant, mosquito-repelling, anticancer, hypoglycemic, antidepressant, antidiuretic, sedative, antifungal, and nervine properties. Despite the shrub's high financial value, habitat destruction, road development, and other human activities have a negative impact on its availability. In order for generations yet to come to be able to use this plant sustainably, we must encourage its cultivation. Due to the pharmacological and therapeutic actions of some of its ingredients, *A. muricatus* has an interesting chemical composition. The present investigation aimed to investigate the pharmaceutical properties of *A. muricatus* and the chemical compounds that are connected with it. Its extractions significantly impact the botanical compounds and medicinal qualities. This review offers insightful information about *A. muricatus* that will aid scientists and other investigators in their additional research and exploration of the plant's attributes. Furthermore, comprehensive investigations are needed to clarify *A. muricatus*'s drug metabolism pharmacological and particular routes in order to guide their clinical applications and create effective medications.

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