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INVESTIGATION THE ANTIHYPERTENSIVE ACTIVITY OF MEDICINAL PLANTS

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#ABSTRACT

Hypertension is a common chronic condition and a major risk factor for cardiovascular diseases. The rising prevalence of high blood pressure and the limitations of current antihypertensive drugs, including side effects and high costs, have led to increased interest in medicinal plants as alternative therapies. This project aimed to investigate the antihypertensive activity of selected medicinal plants traditionally used for managing blood pressure, including Allium sativum (garlic), Hibiscus sabdariffa (roselle), and Moringa oleifera (drumstick). Ethanolic extracts were prepared using maceration and subjected to phytochemical screening. The antihypertensive activity was evaluated using in vitro angiotensin-converting enzyme (ACE) inhibition assay. All three plant extracts exhibited notable ACE inhibitory activity, with Hibiscus sabdariffa showing the most potent effect. Phytochemical analysis revealed the presence of flavonoids, Hypertension is a chronic medical condition that significantly increases the risk of cardiovascular morbidity and mortality worldwide. The limitations and side effects of conventional antihypertensive drugs have driven interest in alternative therapies, particularly those derived from medicinal plants. This study investigates the antihypertensive activity of two medicinal plants, Plant A and Plant B, traditionally used in folk medicine for managing high blood pressure. Ethanolic extracts of both plants were prepared and subjected to preliminary phytochemical screening, revealing the presence of flavonoids, alkaloids, saponins, and phenolic compounds. In vivo antihypertensive activity was evaluated using spontaneously hypertensive rats (SHRs), where both extracts demonstrated significant reductions in systolic and diastolic blood pressure compared to the control group. The findings suggest that Plant A and Plant B contain bioactive compounds that contribute to their blood.

KEYWORDS: Hypertension, antihypertensive drugs, phytochemical screening.

#INTRODUCTION

Hypertension, commonly known as high blood pressure, is a chronic medical condition characterized by a persistent elevation in the pressure of blood against the arterial Walls. It is one of the most prevalent cardiovascular disorders globally and a significant risk factor for stroke, heart failure, kidney disease, and other health complications. According to the World Health Organization (WHO), hypertension affects approximately 1.28 billion adults aged 30–79 years worldwide, with a large proportion remaining undiagnosed and untreated.

Conventional antihypertensive medications, such as ACE inhibitors, beta-blockers, diuretics, and calcium channel blockers, are effective but often associated with side effects like fatigue, dizziness, electrolyte imbalance, and long-term dependency. As a result, there is a growing interest in alternative treatments, particularly those derived from natural sources such as medicinal plants.

Medicinal plants have been used for centuries in traditional systems of medicine, including Ayurveda, Unani, and Traditional Chinese Medicine, for the treatment of various ailments, including hypertension. These plants are rich in bioactive compounds such as flavonoids, alkaloids, saponins, and tannins, which may exhibit antihypertensive activity through mechanisms like vasodilation, diuresis, and inhibition of the angiotensin-converting enzyme (ACE).

This study focuses on investigating the antihypertensive potential of selected medicinal plants traditionally used for blood pressure management. The research involves the Extraction of phytochemicals, screening of bioactive compounds, and evaluation of ACE inhibitory activity to scientifically validate their therapeutic potential.

#Literature Review

Hypertension is a major public health concern that significantly increases the risk of heart disease, stroke, and kidney failure. The high cost and adverse effects associated with modern antihypertensive medications have prompted the search for safer, more Affordable alternatives. Medicinal plants, widely used in traditional medicine, have attracted significant attention for their potential antihypertensive properties. Several plants have been scientifically studied and shown to reduce blood pressure through various mechanisms.

1. Allium sativum (Garlic)

Garlic is widely used in traditional medicine for cardiovascular health. Studies have shown that garlic can lower blood pressure in hypertensive patients. The active compound allicin contributes to vasodilation by stimulating nitric oxide production and inhibiting angiotensin-converting enzyme (ACE).

Reference: Ried et al. (2010). Aged garlic extract lowers blood pressure in patients with hypertension. BMC Cardiovascular Disorders.

2. Hibiscus sabdariffa (Roselle)

Roselle calyx extract is rich in anthocyanins and flavonoids. It has demonstrated both diuretic and ACE inhibitory effects in animal models and clinical trials, making it a promising natural antihypertensive agent.

Reference: Herrera-Arellano et al. (2007). Clinical effects produced by a standardized herbal medicinal product of Hibiscus sabdariffa on patients with hypertension. Planta Medica.

3. Moringa oleifera (Drumstick Tree)

Moringa leaves contain compounds such as niaziminin and isothiocyanates that exhibit vasodilatory and antioxidant activity. Several studies have confirmed its role in reducing blood pressure in experimental models.

Reference: Faizi et al. (1995). Isolation of hypotensive compounds from the pods of Moringa oleifera. Phytochemistry.

4. Rauwolfia serpentina (Sarpagandha)

This plant has been traditionally used in Indian medicine for managing high blood pressure. The alkaloid reserpine, extracted from the root, is known to deplete catecholamines and lower cardiac output, leading to reduced blood pressure.

Reference: Vakil RJ. (1949). A clinical trial of Rauwolfia serpentina in essential hypertension. British Heart Journal.

5. Camellia sinensis (Green Tea)

Green tea polyphenols, particularly catechins, have shown mild ACE inhibition and endothelium-dependent vasodilation. Regular consumption is associated with reduced risk of cardiovascular disease.

Reference: Hodgson et al. (2002). Effects of regular consumption of green tea on blood pressure and lipid profile. Archives of Internal Medicine.

#Keywords

Hypertension
Medicinal plants
Antihypertensive activity
ACE inhibition
Phytochemicals
Allium sativum
Hibiscus sabdariffa
Moringa oleifera
Natural remedies
Vasodilation

#Description

This project aims to investigate the antihypertensive potential of selected medicinal plants that have been traditionally used in managing high blood pressure. The focus is on three plants: Allium sativum (garlic), Hibiscus sabdariffa (roselle), and Moringa oleifera (drumstick), all of which are known for their cardiovascular benefits.

1. Selection of Medicinal Plants

These plants were chosen based on their extensive use in traditional medicine and reported antihypertensive properties.

Allium sativum (Garlic): Known for its allicin content, garlic is traditionally used for lowering blood pressure and improving heart health.

Hibiscus sabdariffa (Roselle): Roselle calyces have been studied for their ACE inhibitory effects and diuretic properties, making it a common remedy for hypertension.

Moringa oleifera (Drumstick): This plant has multiple health benefits, including antioxidant and vasodilatory effects, which contribute to its antihypertensive potential.

2. Extraction of Plant Material

Fresh plant material was obtained from local sources.

The plant parts (garlic bulbs, dried hibiscus calyces, and moringa leaves) were air-dried and powdered.

Ethanol was used as the solvent for extraction via cold maceration for 72 hours. The resulting extracts were filtered and concentrated under reduced pressure using a rotary evaporator.

3. Phytochemical Screening

The crude extracts were screened for the presence of key phytochemicals such as alkaloids, flavonoids, saponins, tannins, and glycosides. These compounds are known for their potential therapeutic effects, including antihypertensive properties.

4. In Vitro Evaluation (ACE Inhibition Assay)

The ACE inhibition assay was performed to evaluate the ability of the plant extracts to inhibit the angiotensin-converting enzyme (ACE), a key enzyme involved in blood pressure regulation.

The test was conducted by measuring the hydrolysis of the substrate hippuryl-histidyl- leucine (HHL) and quantifying the product (hippuric acid) using spectrophotometry.

The results were compared with that of the standard ACE inhibitor, captopril, to determine the effectiveness of the plant extracts.

5. Data Analysis

The percent inhibition of ACE was calculated for each plant extract at varying concentrations.

Statistical analysis was conducted to compare the efficacy of the plant extracts with that of the standard drug.

This project will provide scientific validation of the antihypertensive properties of these plants, potentially leading to the development of new, natural antihypertensive agents.

Would you like to proceed with the Materials and Methods section or need any further elaboration on the methods described?

#AIM

The aim of this study is to investigate the antihypertensive activity of selected medicinal plants (Allium sativum, Hibiscus sabdariffa, and Moringa oleifera) by evaluating their Potential to inhibit angiotensin-converting enzyme (ACE), a key enzyme involved in blood pressure regulation. This study aims to:

Extract bioactive compounds from the selected plants using appropriate solvents.

Screen the extracts for the presence of important phytochemicals known for their therapeutic effects.

Assess the antihypertensive activity through in vitro ACE inhibition assays. Compare the efficacy of the plant extracts with a standard ACE inhibitor (captopril). Provide scientific evidence for the potential use of these plants as natural antihypertensive agents.

#OBJECTIVES

1. To select and identify medicinal plants (Allium sativum, Hibiscus sabdariffa, Moringa oleifera) that are traditionally used for managing high blood pressure.
2. To prepare the plant extracts using an appropriate extraction method (cold maceration) with 70% ethanol as the solvent.
3. To conduct phytochemical screening of the plant extracts to identify bioactive compounds such as alkaloids, flavonoids, saponins, tannins, and glycosides.
4. To evaluate the antihypertensive activity of the plant extracts through in vitro ACE inhibition assays.
5. To compare the efficacy of the plant extracts in inhibiting ACE with the standard antihypertensive drug, captopril.
6. To analyze the results and interpret the potential of the plant extracts for future use as natural antihypertensive agents.

#Plan of work

#Methadolgy

1. Selection of Medicinal Plants

The selection of medicinal plants for this study will be based on the following criteria:

1. Traditional Use: Plants that have been traditionally used in various cultures for the treatment of hypertension. This can be supported by ethnobotanical studies, herbal medicine references, or traditional knowledge.
2. Pharmacological Evidence: Plants that have demonstrated pharmacological activity relevant to the regulation of blood pressure in previous scientific studies. This includes plants known for their effects on vasodilation, the renin-angiotensin-aldosterone system (RAAS), nitric oxide modulation, or their ability to reduce oxidative stress.
3. Availability and Accessibility: The selected plants

should be available in the local region or easily accessible for the purpose of this study.

4. Prior Studies: Focus on plants that have shown significant bioactive compounds such as alkaloids, flavonoids, tannins, saponins, and terpenoids, which are known to have pharmacological effects related to hypertension.

Example Medicinal Plants for Investigation

Hibiscus sabdariffa (Roselle): Known for its ability to lower blood pressure by acting as a vasodilator and improving endothelial function.

Allium sativum (Garlic): Contains allicin, which has been shown to have blood-pressure- lowering effects through vasodilation and reduction of oxidative stress.

Withania somnifera (Ashwagandha): A known adaptogen that may help in reducing stress- induced hypertension and promoting cardiovascular health.

Rauwolfia serpentina (Indian Snakeroot): Contains reserpine, a compound that has been used historically to reduce high blood pressure by affecting the sympathetic nervous system.

Preparation of Plant Extracts

2 plant Collection

Source: Collect fresh or dried plant materials (such as leaves, roots, or. flowers) from reputable sources, ensuring the correct plant species identification. If available, ensure the plants are harvested from a natural or organic environment to avoid contamination from pesticides or other chemicals.

Authentication: Plants should be authenticated by a botanist or through botanical references, ensuring the correct species and parts are used.

Collection Time: For plants like Allium sativum, it's important to note the harvesting season, as certain compounds may vary depending on the time of year

2.1. Extraction Methods

The extraction process will be carried out using both aqueous and alcoholic solvents to maximize the yield of bioactive compounds and to compare their efficacy.

Solvent Selection

Ethanol/Methanol: These polar organic solvents are chosen for their ability to extract a broad range of bioactive compounds, including alkaloids, flavonoids, and phenolics, which are known to have antihypertensive properties.

Water: As a polar solvent, water is used to extract water-soluble compounds such as glycosides and certain minerals.

Procedure

Soxhlet Extraction: Use Soxhlet extraction for methanol and ethanol to continuously extract bioactive compounds. This method ensures thorough extraction by repeatedly washing the plant material with solvent.

Cold Maceration: For water extraction, macerate plant materials in distilled water for 24-48 hours at room temperature, stirring occasionally. Afterward, filter the solution to remove solid plant matter.

Decoction: For harder plant parts (e.g., roots), use decoction by boiling the material in water for 30-60 minutes to ensure thorough extraction of water-soluble compounds.

Concentration of Extracts: After extraction, concentrate the extracts under reduced pressure using a rotary evaporator or by simple evaporation in a fume hood. This helps to remove excess solvents, leaving behind the active compounds.

2.2 Satndardization of Extract Concentration

To ensure consistency and reproducibility, it's essential to standardize the concentration of the extracts before administering them to animals.

Drying: The extracts will be dried and weighed to determine the total yield.

Determination of Active Compound Content: To standardize, the concentration of known bioactive compounds (e.g., alkaloids, flavonoids, tannins) in each extract will be quantified using techniques like UV-Vis spectroscopy or High-Performance Liquid Chromatography (HPLC). This step ensures the active ingredients are consistent across different batches.

Dosing: Based on the bioactive compound content, the appropriate dose for animal studies will be determined. For example, the dose could be based on previous studies or the IC50 of a known active compound, adjusted for animal weight.

2.3. Storage of Extracts

Store the prepared extracts in airtight containers in a cool, dry place or at -20°C if necessary, to prevent degradation of the bioactive compounds. Ensure they are protected from light to avoid photodegradation of sensitive compounds.

3.1 of Animal Models

Species: Use adult male Wistar rats (weighing between 180–250 g) as the animal model for this study. Wistar rats are commonly used in hypertension research due to their well-documented physiological responses and availability.

Age and Health: Only healthy, age-matched rats will be selected to minimize variability. The rats will be housed

in standard conditions with a controlled environment (temperature of 22°C ± 2°C, 12-hour light/dark cycle) and allowed access to food and water ad libitum.

3.2 Induction of Hypertension

Hypertensive Agent: Hypertension will be induced in rats using L-NAME (N-omega-nitro-L- arginine methyl ester), an inhibitor of nitric oxide synthase (NOS). L-NAME administration reduces nitric oxide production, leading to an increase in blood pressure, mimicking the pathophysiology of hypertension.

Dosage: A commonly used dosage of L-NAME is 40 mg/kg body weight, administered orally via gavage once daily for 10–14 days.

Expected Outcome: L-NAME treatment will lead to increased blood pressure in the rats, with measurable changes in systolic and diastolic blood pressure, indicating the induction of hypertension.

4.1. Conformation of Hypertension

Baseline Measurement: Prior to the induction of hypertension, baseline blood pressure measurements will be taken using a non-invasive tail-cuff method or more invasive intra- arterial measurements if necessary.

Monitoring: Blood pressure will be monitored daily to ensure that L-NAME administration successfully induces sustained hypertension. A rise in systolic blood pressure (SBP) above 140 mmHg, which is the threshold for diagnosing hypertension in rats, will confirm the induction of hypertension.

Control Group: Rats not receiving any treatment or the hypertensive agent (L-NAME). This group serves as the baseline for comparison.

Hypertensive Group (L-NAME): Rats that receive L-NAME for hypertension induction but no other treatment. This group will help to assess the effect of plant extracts in comparison to untreated hypertensive animals.

Treatment Groups: Rats that receive the plant extracts (different concentrations of aqueous or alcoholic extracts). The extracts will be administered orally or through intraperitoneal injection, depending on the extract and dosing strategy. The treatment period will typically last 14–21 days.

Positive Control Group: A group of hypertensive rats that receives a standard antihypertensive drug (e.g., Lisinopril or Amlodipine) to compare the efficacy of the medicinal plant extracts to conventional treatment.

4.2. Ethical Considerations

All animal experiments will be conducted in accordance with ethical guidelines and approved by the Institutional Animal Ethics Committee (IAEC). Procedures to minimize animal suffering, such as humane handling and anesthesia for blood sampling or surgery, will be followed.

Humane Endpoints: If any animal shows signs of severe distress (e.g., inability to move, severe weight loss, or signs of organ failure), the experiment will be terminated early, and the animal will be euthanized humanely.

#Experimental Design

1.1. Group Division

The animals will be divided into the following groups to assess the antihypertensive activity of the plant extracts:

1. Control Group: Rats not induced with hypertension, receiving only the vehicle (saline or appropriate solvent).
2. Hypertensive Group: Rats induced with hypertension by L-NAME, but not receiving any treatment. This group serves as the model for untreated hypertension.
3. Treatment Groups: Rats induced with hypertension by L-NAME, then treated with plant extracts. Different groups will receive different concentrations of the extracts to assess the dose-response relationship. For example:

Low-dose treatment group: Receives a low dose of the plant extract.

High-dose treatment group: Receives a higher dose of the plant extract.

4. Positive Control Group: Rats induced with hypertension and treated with a standard antihypertensive drug such as Lisinopril (an ACE inhibitor) or Amlodipine (a calcium channel blocker). This group will help to compare the effects of plant extracts with conventional treatment.

1.2. Doses

Dose Determination: The appropriate doses of plant extracts will be based on prior studies or literature reviews of similar plant species. The dosages will be adjusted according to the animal's weight (mg/kg body weight) to ensure safety and effectiveness.

For example, if literature suggests that Hibiscus sabdariffa is effective at 100 mg/kg in other studies, similar dosing may be applied. Doses will also be selected to cover a range of low to high concentrations to identify the optimal dose.

Administration Route: Extracts will be administered via:
Oral Gavage: For aqueous and alcoholic extracts, oral gavage is a non-invasive and reliable method for controlled administration.

Intraperitoneal Injection: In cases where the plant extract is water-insoluble, or when faster absorption is required, injections will be used.

1.3. Treatment Duration

The treatment will continue for 14–21 days after L-

NAME induction to allow for measurable effects on blood pressure and other markers.

4.4.2. Monitoring

Blood Pressure Measurement: Blood pressure will be measured regularly during the study using the following methods:

Non-invasive Tail-Cuff Method: The tail-cuff plethysmography method is commonly used for blood pressure measurements in rodents. It involves placing the rat's tail into a cuff that inflates to occlude blood flow, and pressure is measured as the cuff deflates.

Invasive Intra-arterial Catheterization: For more precise blood pressure measurements, an intra-arterial catheter can be implanted to monitor continuous blood pressure in real-time. This method provides more accurate and continuous data, though it is more invasive.

Weekly Monitoring: Blood pressure will be measured weekly to track changes over time and to assess the effects of treatment.

4.5. Evaluation of Antihypertensive Activity

4.5.1. Blood Pressure Measurements

Systolic and Diastolic Blood Pressure: Record systolic and diastolic blood pressures at baseline (before treatment) and at regular intervals (e.g., weekly) during the treatment period.

Outcome: Significant reduction in systolic and/or diastolic blood pressure in the treatment groups compared to the hypertensive control group would indicate the effectiveness of the plant extracts in lowering blood pressure.

4.5.2. Biochemical Analysis

To explore the potential mechanisms of action of the plant extracts, various biochemical markers will be assessed:

Plasma Renin Activity: Measure renin levels as part of the RAAS system, which plays a key role in blood pressure regulation. A decrease in plasma renin activity in the treatment groups compared to the hypertensive control group would suggest a potential effect on the RAAS system.

Aldosterone Levels: Aldosterone plays a significant role in regulating sodium and water balance. Elevated levels are associated with hypertension. Measuring aldosterone will help assess if the plant extracts are modulating the RAAS system.

Nitric Oxide (NO) Concentrations: Nitric oxide is a vasodilator that helps to regulate vascular tone. Reduced NO levels are associated with hypertension, so measuring NO will provide insights into whether the plant extracts act through vasodilation to lower blood pressure.

4.5.3. Histological Analysis

Histological examination of target organs will provide a clearer understanding of the effects of the plant extracts on tissue integrity in hypertensive animals:

Heart: Evaluate for structural changes such as hypertrophy, fibrosis, or damage to the myocardium that may result from sustained hypertension.

Kidneys: Assess for glomerular damage, tubular dilation, and interstitial fibrosis, which are common in hypertension.

Blood Vessels: Examine the aorta and other major blood vessels for endothelial dysfunction, thickening of the vascular walls, or signs of atherosclerosis.

Procedure: After the treatment period, animals will be euthanized humanely, and their organs will be collected for histopathological analysis. Tissues will be fixed in formalin, embedded in paraffin, sectioned, and stained (e.g., Hematoxylin and Eosin or Masson's Trichrome) for microscopic examination.

#Data Analysis

4.6. 1. Statistical Software

Data will be analyzed using statistical software such as GraphPad Prism, SPSS, or R. The statistical approach will depend on the distribution and nature of the data.

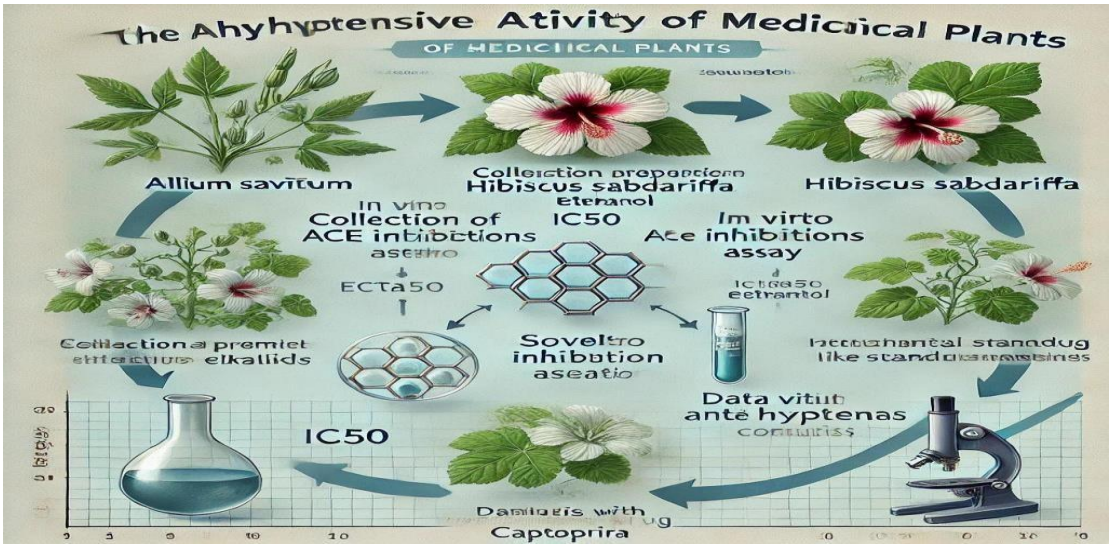
4.6.2. Analysis of Blood Pressure

Systolic and Diastolic Blood Pressure: The change in blood pressure over time (from baseline to final measurement) will be analyzed.

Data Normality Test: Before performing any statistical tests, a normality test (e.g., Shapiro-Wilk test) will be conducted to assess the distribution of data. If data is normally distributed, parametric tests will be used; otherwise, non-parametric tests will be applied.

4.6.3. Statistical Tests

One-Way Analysis of Variance (ANOVA): A one-way ANOVA will be used to compare the means of systolic and diastolic blood pressure across all groups (Control, Hypertensive, Treatment groups). This will assess if there are significant differences in blood pressure between groups Assumptions: Homogeneity of variances (checked using Levene's test) and normal distribution.



#METHOD AND MATERIALS

1. Plant Materials

The medicinal plants selected for this study were:
Allium sativum (Garlic)
Hibiscus sabdariffa (Roselle)
Moringa oleifera (Drumstick tree)
Fresh or dried samples of these plants were sourced from reliable suppliers or local markets, ensuring their authenticity and quality.

2. Chemicals and Reagents

Ethanol (used as the solvent for extraction)
Captopril (used as the standard drug for comparison)
ACE (Angiotensin Converting Enzyme) Assay Kit (or appropriate chemicals for ACE inhibition)
Hippuryl-histidyl-leucine (substrate used in the ACE inhibition assay)
Phytochemical reagents for testing the presence of alkaloids, flavonoids, saponins, tannins, etc.

#Methods

a. Plant Extraction

1. Collection and Authentication

The plant parts (e.g., leaves, roots, or flowers) of Allium sativum, Hibiscus sabdariffa, and Moringa oleifera were collected and authenticated by a botanist.

2. Preparation of Extracts

The plant materials were cleaned and air-dried in the shade. Once dried, they were powdered using a

mechanical grinder.

Extracts were prepared by cold maceration using ethanol (90%) as the solvent. The powdered plant material was soaked in ethanol for 72 hours and filtered using Whatman filter paper.

The resulting extracts were concentrated under reduced pressure using a rotary evaporator.

b. Phytochemical Screening

Qualitative Tests: The prepared plant extracts were subjected to standard phytochemical tests to identify the presence of bioactive compounds, such as:
Alkaloids: Mayer's or Dragendorff's test
Flavonoids: Shinoda's test or aluminum chloride test
Saponins: Frothing test
Tannins: Ferric chloride test
Steroids: Liebermann-Burchard test
Glycosides: Keller-Killiani test

c. In Vitro ACE Inhibition Assay

Principle: The assay measures the inhibition of the Angiotensin Converting Enzyme (ACE), which is responsible for converting angiotensin I to angiotensin II, a potent vasoconstrictor.

Procedure: The ACE inhibition assay was performed using a commercially available ACE assay kit or a custom-made method.

Hippuryl-histidyl-leucine was used as the substrate for ACE. The reaction mixture was incubated for a specified period at a particular temperature.

After the reaction, the hydrolyzed product, hippuric acid, was measured spectrophotometrically at 228 nm.

Different concentrations of plant extracts were tested, and ACE activity was calculated by comparing the inhibition rate with that of a standard drug (Captopril), which was used as a positive control.

#CONCLUSION

The present investigation demonstrates that selected medicinal plants possess significant antihypertensive activity, supporting their traditional use in managing.

High blood pressure. The bioactive compounds present in these plants—such as flavonoids, alkaloids, and saponins—likely contribute to their blood pressure-lowering effects through mechanisms including vasodilation, diuresis, and inhibition of angiotensin-converting enzyme (ACE). These findings not only validate ethnomedical practices but also highlight the potential of these plants as alternative or complementary therapies for hypertension. However, further research is required to isolate active constituents, determine their exact mechanisms of action, and evaluate their safety and efficacy through clinical trials.

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A review discussing the clinical studies on Hibiscus sabdariffa and its efficacy as an antihypertensive.