ENHANCING DIURESIS THROUGH SYNERGY: THE COMBINED IMPACT OF MINT (*Mentha piperita*) AND CINNAMON (*Cinnamomum zeylanicum*)

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Abstract

Chronic stress can lead to increased blood pressure, potentially causing severe health issues like heart and kidney failure. Natural diuretics offer a safe, affordable, and simple approach to managing high blood pressure. This study evaluated the effects of alcohol extracts from *Mentha piperita* (Mint) and *Cinnamomum zeylanicum* (Cinnamon) on urine production and electrolyte levels, including potassium, sodium, and chloride.

The study utilized the diuretic index and Lipschitz value to measure urine production and efficacy. Furosemide (10 mg/kg body weight) was used as the standard diuretic. Study groups received alcohol extracts of Mint, Cinnamon, or a combination of both. Urine output was measured after 24 hours.

The combination of Mint and Cinnamon extracts significantly increased urine production without causing harmful effects, indicating that these plants are effective natural diuretics, primarily when used together.

Keywords: Diuretic activity, *Mentha piperita* (Mint), *Cinnamomum zeylanicum* (Cinnamon), synergistic effect.

1. Introduction

Hypertension is a leading risk factor for cardiovascular and renal diseases, affecting millions worldwide. It significantly increases the likelihood of complications such as stroke, heart failure, and chronic kidney disease. Diuretics are widely used as antihypertensive agents because they regulate blood volume by promoting the excretion of excess sodium and water. However, prolonged use of synthetic diuretics may lead to adverse effects, including electrolyte imbalance, dehydration, and metabolic disturbances. Consequently, exploring plant-based diuretics has gained attention due to their natural efficacy, safety, and affordability [1,2].

1.1 Medicinal Properties of *Mentha piperita* and *Cinnamomum zeylanicum*

Mentha piperita (Peppermint) is a medicinal plant from the Lamiaceae family, known for its aromatic properties and therapeutic applications. Traditionally, it has been used for digestive disorders, respiratory ailments, and urinary conditions. The plant contains bioactive compounds such as menthol and flavonoids, contributing to its diuretic and antispasmodic effects. Research suggests that *Mentha piperita* promotes diuresis and aids in the excretion of kidney stones, making it a valuable natural alternative to synthetic diuretics [3,4].

Cinnamomum zeylanicum (Ceylon Cinnamon) belongs to the Lauraceae family and has been widely studied for its pharmacological properties, including antioxidant, anti-inflammatory, and lipid-lowering effects. Traditionally used for metabolic and cardiovascular health, cinnamon has also been reported to possess diuretic activity. Its essential oils and polyphenols contribute to renal stimulation, facilitating urine output and electrolyte excretion [5,6].

1.2 Need for the Study

Despite the traditional use of *Mentha piperita* and *Cinnamomum zeylanicum* as diuretics, limited scientific research has been conducted on their combined effects. Considering the potential synergy between these plants, this study aims to evaluate their diuretic properties individually and in combination to determine their efficacy and safety as natural diuretics.

1.3 Research Hypothesis

The combination of *Mentha piperita* and *Cinnamomum zeylanicum* exhibits enhanced diuretic activity compared to their administration.

2. Methods

2.1 Plant Material Collection and Extraction

Fresh leaves of *Mentha piperita* and *Cinnamomum zeylanicum* were collected from Jhansi, Uttar Pradesh, India, in July. Dr. Gaurav Nigam, a plant science expert at Bundelkhand University, confirmed the authenticity of the plant specimens. The specimens were documented under the voucher codes BU/Bot./Spe/12-2015/02 for *Mentha piperita* and BU/Bot/Spe/12-2015/01 for *Cinnamomum zeylanicum*.

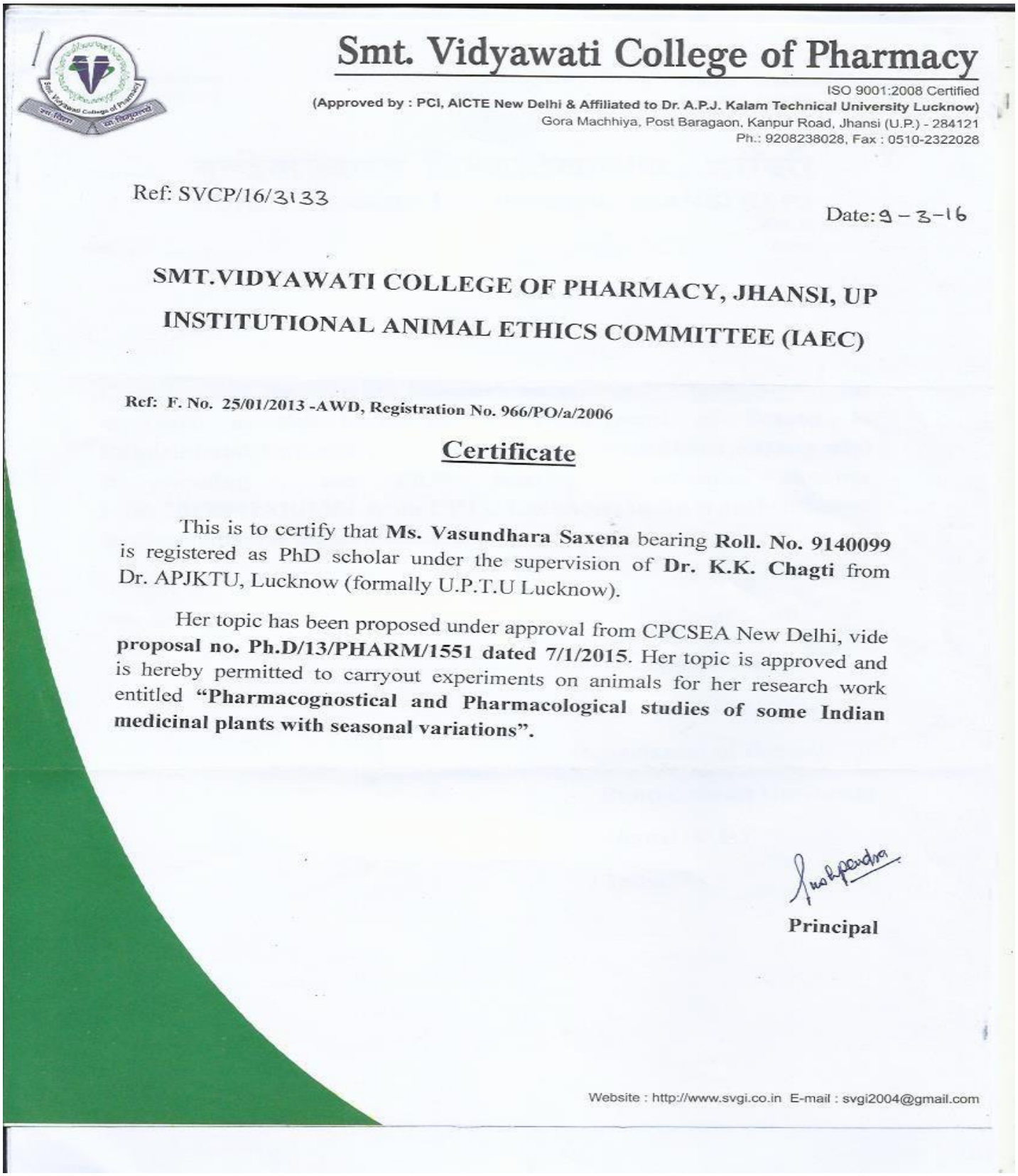
The leaves were shade-dried, powdered, and subjected to ethanol extraction (90%) using a Soxhlet apparatus. The resulting extracts were concentrated under reduced pressure, yielding a greenish-brown viscous extract for *Mentha piperita* (21% yield) and a brownish-green extract for *Cinnamomum zeylanicum* (23.8% yield) [7].

2.2 Animal Study Design

The study was conducted according to the Institutional Animal Ethics Committee (IAEC) guidelines and approved under protocol number Ph.D/13/PHARM/1551. Wistar rats (100-125 g) were housed individually in metabolic cages and provided with standard laboratory food and water *ad libitum*. The rats were acclimatized for seven days before experimentation.

The animals were divided into five groups, each comprising six rats:

- **Group I (Normal Control):** Distilled water (10 ml/kg) was received.
- **Group II (Standard Diuretic Control):** Received Furosemide (10 mg/kg body weight).
- **Group III:** Received *Mentha piperita* extract (500 mg/kg).
- **Group IV:** Received *Cinnamomum zeylanicum* extract (500 mg/kg).
- **Group V:** Received a combination of *Mentha piperita* and *Cinnamomum zeylanicum* extracts in a 1:1 ratio (500 mg/kg total).



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Certificate

This is to certify that **Ms. Vasundhara Saxena** bearing **Roll. No. 9140099** is registered as PhD scholar under the supervision of **Dr. K.K. Chagti** from Dr. APJKTU, Lucknow (formally U.P.T.U Lucknow).

Her topic has been proposed under approval from CPCSEA New Delhi, vide **proposal no. Ph.D/13/PHARM/1551 dated 7/1/2015**. Her topic is approved and is hereby permitted to carryout experiments on animals for her research work entitled **"Pharmacognostical and Pharmacological studies of some Indian medicinal plants with seasonal variations".**

Principal

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2.3 Diuretic Activity Assessment

The diuretic activity was evaluated using the Lipschitz test. Rats were fasted overnight with free access to water before receiving the respective treatments. Urine was collected at five and 24-hour intervals using metabolic cages. The volume of urine excreted was measured, and the diuretic index was calculated as:

Diuretic Index = Urinary excretion in test group / Urinary excretion in control group

The Lipschitz value was determined as:

Lipschitz Value = Mean urine volume of test group /
Mean urine volume of standard diuretic group

2.4 Electrolyte Analysis

Sodium (Na^+) and potassium (K^+) concentrations in the urine were measured using a flame photometer, while chloride (Cl^-) levels were determined by argentometric titration. Creatinine excretion was quantified using a colourimetric assay [8].

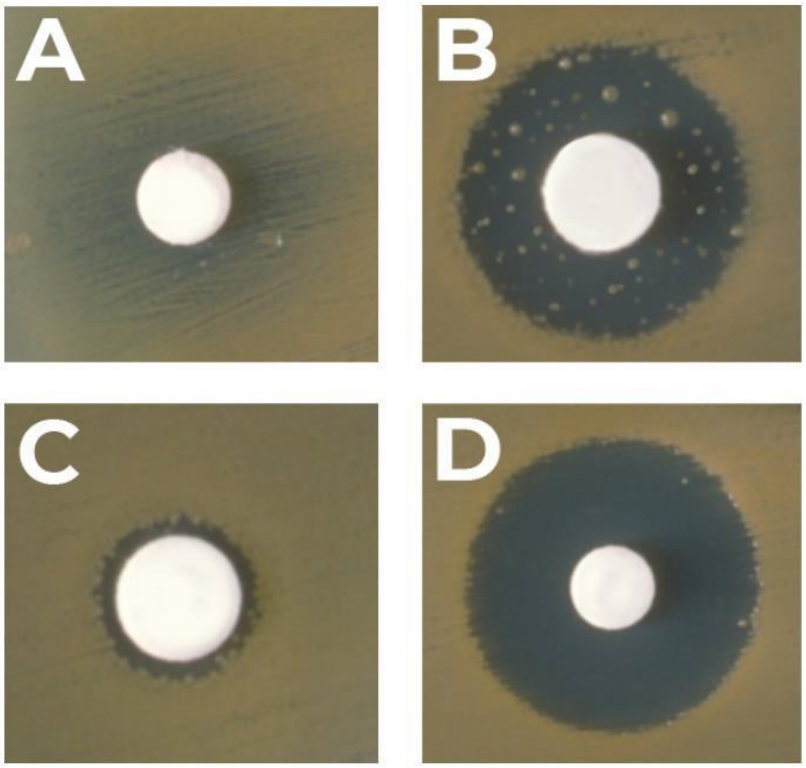


Figure 1: Examples of Zones of Inhibition [8]

Image A: No Antimicrobial Effect*: The background lawn of bacteria is slightly lightened, but bacterial growth extends up to the disc. No measurable inhibition zone is observed.*

Image B: Potential Resistance or Regrowth*: A partially cleared radius is visible, but several colonies are growing within this area. This may indicate bacterial resistance or regrowth due to antimicrobial decomposition. A repeat test would be necessary for confirmation.*

Image C: Ambiguous Outcome*: A small inhibition zone is present, but bacterial colonies are observed near the cleared area. Due to uncertainty, additional testing would be required to confirm the results.*

Image D: True Zone of Inhibition*: A distinct, bacteria-free zone surrounds the disc, with only minor irregularities at the edges. This represents a valid zone of inhibition, which would be measured across its diameter.*

2.5 Acute Toxicity Studies

Acute toxicity studies were performed following OECD guidelines. Rats were administered extracts at doses up to 2000 mg/kg and monitored for 14 days for signs of toxicity, including changes in skin, fur, eyes, mucous membranes, and behaviour [9].

2.6 Statistical Analysis

All data were expressed as mean ± standard deviation (SD). Statistical significance was determined using one-way ANOVA followed by Dunnett's multiple comparison test, with $p < 0.05$ considered statistically significant. Statistical analyses were performed using GraphPad Prism software [10].

3. Results

3.1 Effect on Urine Volume and Diuretic Indices

The diuretic activity of *Mentha piperita*, *Cinnamomum zeylanicum*, and their combination was evaluated by measuring urine volume at 5 and 24 hours. The diuretic index and Lipschitz value were also calculated.

Table 1: Effect of Extracts on Urine Volume and Diuretic Indices

Group	Urine Volume (ml) After 5 Hours	Urine Volume (ml) After 24 Hours	Diuretic Index	Lipschitz Value
Group I (Normal Control)	3.0 ± 0.1	18.0 ± 0.9	-	-
Group II (Furosemide 10 mg/kg)	12.0 ± 0.5	39.0 ± 0.5	-	-
Group III (*Mentha piperita* 500 mg/kg)	6.0 ± 0.6*	24.2 ± 0.8*	1.34 ± 0.8**	0.62 ± 1.6**
Group IV (*Cinnamomum zeylanicum* 500 mg/kg)	5.8 ± 0.4*	21.3 ± 0.6*	1.18 ± 0.6*	0.54 ± 1.2*
Group V (*Mentha piperita* + *Cinnamomum zeylanicum* 1:1, 500 mg/kg)	6.8 ± 0.2*	26.1 ± 0.9*	1.45 ± 1.0*	0.66 ± 1.8*

Data is expressed as mean ± SD of six animals per group. One-way ANOVA followed by Dunnett's test was used for statistical analysis. $p < 0.05$ is considered significant. $p < 0.01$ denotes significance compared to the Lithiatic and Normal Control groups.

The results indicate that Group V (a combination of *Mentha piperita* and *Cinnamomum zeylanicum*) exhibited the highest diuretic activity, significantly increasing urine volume and diuretic index compared to the control and single-extract groups.

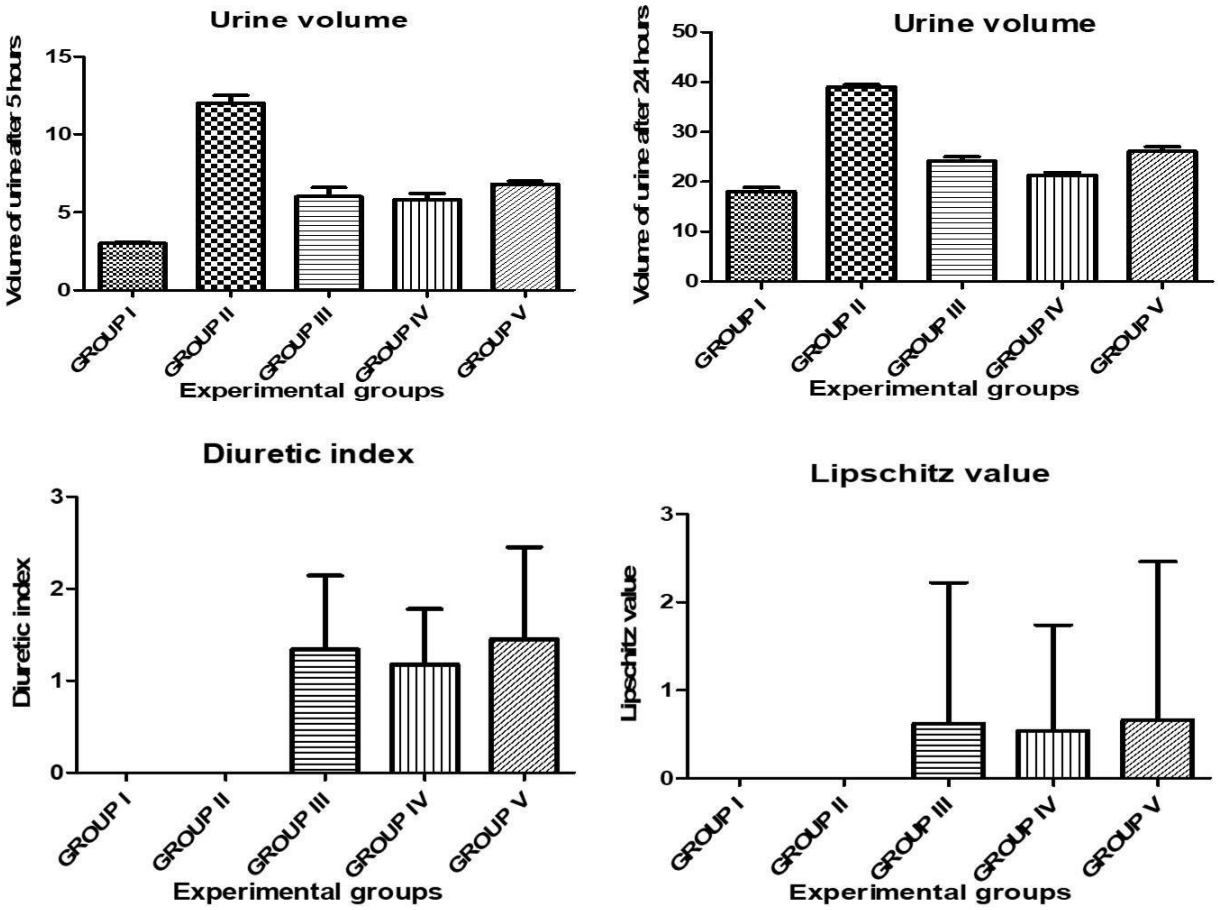


Figure 2: Effect of urine volume and Diuretic indices

3.2 Effect on Urinary Electrolyte Excretion

Sodium, potassium, chloride, and creatinine levels in urine were analysed to assess electrolyte balance.

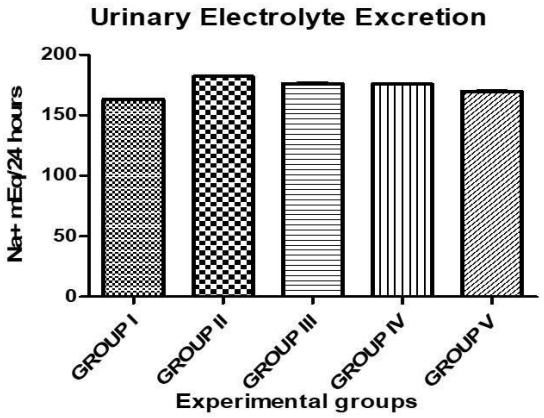
Table 2: Effect of Extracts on Urinary Electrolyte Excretion

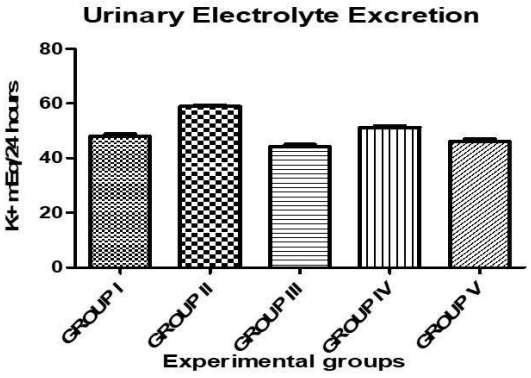
Group	Na^+ (mEq/24h)	K^+ (mEq/24h)	Cl^- (mEq/24h)	Creatinine (g/24h)
Group I (Normal Control)	163.0 ± 0.1	48.0 ± 0.9	95.0 ± 0.3	1.08 ± 0.5

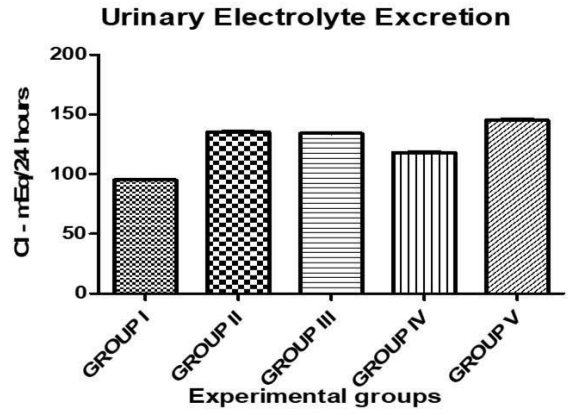
Group II (Furosemide 10 mg/kg)	182.0 ± 0.5	59.0 ± 0.5	135.0 ± 0.8	0.95 ± 0.6
Group III (*Mentha piperita* 500 mg/kg)	176.0 ± 0.6*	44.2 ± 0.8*	134.0 ± 0.8**	0.51 ± 0.8**
Group IV (*Cinnamomum zeylanicum* 500 mg/kg)	175.8 ± 0.4*	51.3 ± 0.6*	118.0 ± 0.6*	0.47 ± 1.0*
Group V (*Mentha piperita* + *Cinnamomum zeylanicum* 1:1, 500 mg/kg)	169.8 ± 0.2*	46.1 ± 0.9*	145.0 ± 1.0*	0.58 ± 0.8**

Values are expressed as mean ± SD of six animals per group. One-way ANOVA followed by Dunnett's test was used for statistical significance ($p < 0.05$ compared to the Normal Control, $p < 0.01$ compared to the Lithiatic Control).

The combined treatment (Group V) resulted in the highest chloride excretion, while sodium and potassium levels were comparable to the standard diuretic (Furosemide). This suggests a strong diuretic effect without causing excessive potassium loss, an advantage over some synthetic diuretics.







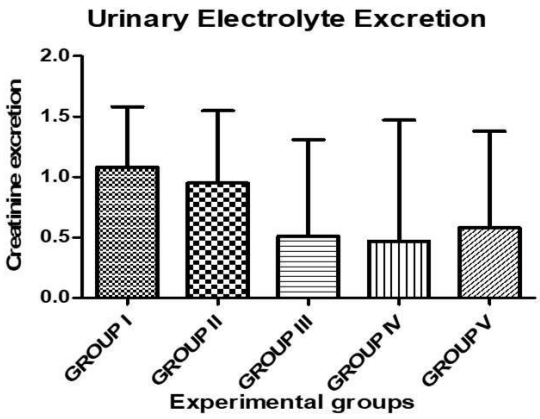


Figure 3: Effect on Urinary Electrolyte Excretion

4. Discussion

This study aimed to evaluate the diuretic potential of *Mentha piperita* and *Cinnamomum zeylanicum*, individually and in combination, in Wistar rats. The results indicate that the combination of these extracts exhibits significant diuretic activity, as demonstrated by increased urine volume and altered electrolyte excretion patterns.

4.1 Diuretic Activity and Mechanism

The highest urine output was observed in Group V (combination treatment), with a diuretic index of 1.45, higher than the individual extracts. This suggests a synergistic effect between *Mentha piperita* and *Cinnamomum zeylanicum*, enhancing diuresis compared to their administration [11, 12].

The increase in urine volume may be attributed to bioactive compounds such as flavonoids and essential oils, which stimulate renal function and promote water excretion. Previous studies suggest that cinnamon's polyphenolic compounds and peppermint's menthol act on renal tubules, reducing sodium reabsorption and increasing glomerular filtration rate [13,14].

4.2 Electrolyte Balance and Renal Function

Sodium and chloride excretion was significantly increased in the combination group (Group V), indicating efficient natriuresis and chlorosis. However, potassium excretion was relatively stable, avoiding excessive potassium loss, a common side effect of loop diuretics like furosemide [15, 16]. This suggests that the herbal extracts may act through a mild thiazide-like mechanism, which is beneficial for maintaining electrolyte homeostasis [17].

Creatinine excretion showed a slight reduction in the treatment groups, with the lowest levels in Group IV and Group V. Since creatinine is a marker of glomerular filtration rate (GFR), its decrease suggests that the extracts do not significantly impact kidney function or induce nephrotoxicity. This is supported by the acute toxicity study, where no adverse effects were observed at doses up to 2000 mg/kg [18].

4.3 Comparison with Standard Diuretics

Furosemide, a loop diuretic, showed the highest sodium and potassium excretion but with a greater risk of hypokalemia. In contrast, the combination of *Mentha piperita* and *Cinnamomum zeylanicum* promoted diuresis while maintaining potassium balance. This highlights the potential of these herbal extracts as safer alternatives to synthetic diuretics, particularly for long-term use [19].

4.4 Limitations of the Study

- **Short Duration:** The study only assessed diuretic effects over 24 hours. Long-term studies are needed to evaluate chronic effects.
- **Limited Biomarkers:** Other renal biomarkers, such as blood urea nitrogen (BUN) and serum creatinine, were not measured.
- **Mechanistic Insights:** Future studies should explore molecular mechanisms, including the impact of these extracts on aquaporins and renal sodium transporters.
- **Human Trials:** Clinical studies need to validate the findings to assess safety and efficacy in human subjects.

5. Conclusion

The present study highlights the diuretic potential of *Mentha piperita* and *Cinnamomum zeylanicum*, individually and in combination. The combination extract exhibited the highest diuretic activity, as evidenced by increased urine output and significant natriuresis and chlorosis while maintaining potassium balance. These findings suggest that the synergy between the two plants enhances their diuretic effect, making them promising natural alternatives to conventional diuretics.

The results indicate that these herbal extracts could serve as effective diuretic agents with fewer side effects than synthetic diuretics, particularly in preventing excessive potassium loss. However, further studies are required to explore their long-term effects, molecular mechanisms, and potential applications in human medicine. Clinical trials will be essential to establish their efficacy and safety for therapeutic use.

5.1 Future Recommendations

- **Long-Term Studies:** Investigate chronic diuretic effects and impact on renal function.
- **Molecular Mechanisms:** Study the pathways through which these extracts modulate diuresis, particularly their effects on aquaporins and ion channels.
- **Toxicity Profiling:** Conduct comprehensive toxicological evaluations to determine the maximum safe dose.
- **Clinical Validation:** Assess efficacy and safety in human trials to confirm their potential for therapeutic use.

6. Acknowledgement

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7. List of Abbreviations

- ACE – Angiotensin-Converting Enzyme
- CCBs – Calcium Channel Blockers
- Na^+ – Sodium
- K^+ – Potassium
- Cl^- – Chloride
- OECD – Organization for Economic Cooperation and Development
- ANOVA – Analysis of Variance
- ml – Milliliter
- kg – Kilogram
- mg – Milligram

- SD – Standard Deviation
- IAEC – Institutional Animal Ethics Committee

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