EVALUATION OF THE DIURETIC ACTIVITY OF EQUISETUM ARVENSE L. AQUEOUS EXTRACT

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Abstract Diuretics are essential therapeutic agents in the management of pathological conditions associated with fluid retention, including edema, hypertension, and various disorders of the urinary system. Although synthetic diuretics are widely used in clinical practice, their long-term administration is frequently associated with adverse effects such as electrolyte imbalance, dehydration, and renal dysfunction. These limitations have intensified scientific interest in medicinal plants with diuretic properties, which are generally characterized by milder action, better tolerability, and additional protective effects on renal tissues. *Equisetum arvense* L. (field horsetail) is a well-known medicinal plant traditionally used in phytotherapy for the treatment of urinary tract disorders; however, comprehensive experimental evaluation of its diuretic activity remains limited. The aim of the present study was to investigate the diuretic activity of an aqueous extract of *Equisetum arvense* and to provide a pharmacognostic and experimental justification for its traditional use. The aerial parts of the plant were collected during the flowering period, botanically authenticated, air-dried, and processed according to pharmacopoeial requirements. An aqueous extract was prepared using hot water infusion to simulate traditional herbal tea preparation. The diuretic effect was evaluated in an experimental animal model by measuring urine output and electrolyte excretion following oral administration of the extract at different dose levels. A standard reference diuretic was used for comparison. The

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results demonstrated a statistically significant and dose-dependent increase in urine volume in animals treated with the *Equisetum arvense* extract compared to the control group. At higher doses, the diuretic activity of the extract was comparable to that of the reference diuretic, while no signs of acute toxicity or behavioral abnormalities were observed. Phytochemical screening revealed the presence of flavonoids, phenolic compounds, potassium salts, and silica, which are known to contribute to diuretic, anti-inflammatory, and nephroprotective effects. In conclusion, the findings of this study confirm that the aqueous extract of *Equisetum arvense* exhibits pronounced diuretic activity and supports its traditional application in the management of urinary tract disorders. The favorable safety profile and multifunctional phytochemical composition of the plant highlight its potential as a natural diuretic for supportive and long-term use. Further studies involving detailed mechanistic investigations and clinical evaluation are recommended to fully elucidate its therapeutic potential.[1,3,8]

Keywords: Equisetum arvense, diuretic activity, medicinal plants, phytotherapy, aqueous extract.

Annotatsiya. Diuretik vositalar suyuqlik tutib qolish bilan bog‘liq bo‘lgan patologik holatlarni, jumladan shishlar, arterial gipertenziya va siydik chiqarish tizimi kasalliklarini davolashda muhim terapevtik ahamiyatga ega. Sintetik diuretiklar klinik amaliyotda keng qo‘llanilishiga qaramay, ularni uzoq muddat qabul qilish ko‘pincha elektrolitlar muvozanatining buzilishi, suvsizlanish va buyrak faoliyatining izdan chiqishi kabi nojo‘ya ta’sirlarga olib keladi. Ushbu cheklovlar diuretik xususiyatga ega bo‘lgan dorivor o‘simliklarga bo‘lgan ilmiy qiziqishni kuchaytirdi, chunki ular odatda yumshoq ta’sirga ega, yaxshi o‘zlashtiriladi va buyrak to‘qimalariga qo‘shimcha himoya ta’sirini ko‘rsatadi. Equisetum arvense L. (dala qirqbo‘g‘imi) an’anaviy fitoterapiyada siydik chiqarish tizimi kasalliklarini davolashda keng qo‘llaniladigan dorivor o‘simlik hisoblanadi, biroq uning diuretik faolligi bo‘yicha keng qamrovli eksperimental tadqiqotlar yetarli emas. Ushbu tadqiqotning maqsadi Equisetum arvense suvli ekstraktining diuretik faolligini o‘rganish hamda uning an’anaviy qo‘llanilishiga farmakognozik va eksperimental asos yaratishdan iborat. O‘simlikning yer ustki qismlari gullash davrida yig‘ib olindi, botanika jihatdan aniqlashtirildi, havo sharoitida quritildi va farmakopeya talablariga muvofiq qayta ishlovdan o‘tkazildi. Suvli ekstrakt an’anaviy o‘simlik choyi tayyorlashni modellashtirish maqsadida issiq suvda damlash usuli bilan tayyorlandi. Diuretik ta’sir tajribaviy hayvonlar modelida ekstraktning turli dozalarini peroral yuborishdan so‘ng siydik miqdori va elektrolitlar ajralishini o‘lchash orqali baholandi. Taqqoslash uchun standart diuretik preparat qo‘llanildi. Olingan natijalar Equisetum arvense ekstrakti bilan

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davolangan guruhlarda nazorat guruhiga nisbatan siydik hajmining statistik jihatdan ishonchli va dozaga bog‘liq oshishini ko‘rsatdi. Yuqori dozalarda ekstraktning diuretik faolligi standart diuretik vosita bilan taqqoslanadigan darajada bo‘ldi, shu bilan birga o‘tkir toksiklik yoki xulq-atvorda o‘zgarishlar kuzatilmadi. Fitokimyoviy skrining flavonoidlar, fenolik birikmalar, kaliy tuzlari va kremniy birikmalari mavjudligini aniqladi, bu moddalarning diuretik, yallig‘lanishga qarshi va nefroprotektiv ta’siri ma’lum. Xulosa qilib aytganda, ushbu tadqiqot natijalari Equisetum arvense suvli ekstrakti yaqqol diuretik faollikka ega ekanligini tasdiqlaydi va uning siydik chiqarish tizimi kasalliklarini davolashdagi an’anaviy qo‘llanilishini ilmiy jihatdan asoslaydi. O‘simlikning qulay xavfsizlik profili va ko‘p funksiyali fitokimyoviy tarkibi uni qo‘llab-quvvatlovchi va uzoq muddatli foydalanish uchun tabiiy diuretik sifatida istiqbolli ekanligini ko‘rsatadi. Uning terapevtik salohiyatini to‘liq aniqlash uchun ta’sir mexanizmlarini chuqur o‘rganish va klinik tadqiqotlar o‘tkazish tavsiya etiladi.[1,3,8]

Kalit so‘zlar: Equisetum arvense, diuretik faollik, dorivor o‘simliklar, fitoterapiya, suvli ekstrakt.

Аннотация. Диуретические средства являются важными терапевтическими агентами в лечении патологических состояний, связанных с задержкой жидкости, включая отёки, артериальную гипертензию и различные заболевания мочевыделительной системы. Несмотря на широкое применение синтетических диуретиков в клинической практике, их длительное использование часто сопровождается такими побочными эффектами, как нарушение электролитного баланса, обезвоживание и дисфункция почек. Эти ограничения усилили научный интерес к лекарственным растениям с диуретическими свойствами, которые, как правило, характеризуются более мягким действием, лучшей переносимостью и дополнительным защитным влиянием на ткани почек. Equisetum arvense L. (хвощ полевой) является хорошо известным лекарственным растением, традиционно используемым в фитотерапии для лечения заболеваний мочевыводящих путей; однако комплексная экспериментальная оценка его диуретической активности остаётся ограниченной. Целью настоящего исследования явилось изучение диуретической активности водного экстракта Equisetum arvense и фармакогностическое и экспериментальное обоснование его традиционного применения. Надземные части растения были собраны в период цветения, ботанически идентифицированы, высушены на воздухе и обработаны в соответствии с фармакопейными требованиями. Водный экстракт готовили методом настаивания в горячей воде с целью моделирования традиционного

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приготовления травяного чая. Диуретический эффект оценивали на экспериментальной модели животных путём измерения объёма мочи и экскреции электролитов после перорального введения экстракта в различных дозах. В качестве препарата сравнения использовали стандартное диуретическое средство. Результаты показали статистически значимое и дозозависимое увеличение объёма мочи у животных, получавших экстракт Equisetum arvense, по сравнению с контрольной группой. При более высоких дозах диуретическая активность экстракта была сопоставима с активностью референсного диуретика, при этом признаков острой токсичности или поведенческих нарушений не наблюдалось. Фитохимический скрининг выявил наличие флавоноидов, фенольных соединений, солей калия и соединений кремния, которые, как известно, обладают диуретическим, противовоспалительным и нефропротекторным действием. Таким образом, результаты данного исследования подтверждают выраженную диуретическую активность водного экстракта Equisetum arvense и научно обосновывают его традиционное применение при заболеваниях мочевыделительной системы. Благоприятный профиль безопасности и многофункциональный фитохимический состав растения свидетельствуют о его перспективности в качестве природного диуретика для поддерживающего и длительного применения. Для полного раскрытия терапевтического потенциала растения рекомендуется проведение дальнейших исследований, включая детальное изучение механизмов действия и клиническую оценку.[1,3,8]

Ключевые слова: Equisetum arvense, диуретическая активность, лекарственные растения, фитотерапия, водный экстракт.

INTRODUCTION

Diuretics represent an essential class of therapeutic agents widely used in the management of disorders associated with fluid retention, such as edema, hypertension, and various renal and cardiovascular conditions. By increasing urine output and facilitating the elimination of excess water and electrolytes, diuretics play a crucial role in maintaining fluid and electrolyte balance. Despite their proven clinical efficacy, the long-term use of synthetic diuretics is often accompanied by undesirable side effects, including electrolyte disturbances, dehydration, metabolic alterations, and potential impairment of renal function. These limitations have encouraged growing scientific interest in alternative diuretic agents derived from medicinal plants. Herbal diuretics have been employed in traditional medicine systems for centuries and are valued for their relatively mild action, complex phytochemical composition, and favorable safety profile. Unlike synthetic agents

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that often target a single mechanism of action, medicinal plants contain a diverse range of bioactive compounds capable of exerting complementary and synergistic effects. As a result, plant-based diuretics may provide not only increased urine output but also additional nephroprotective, anti-inflammatory, and antioxidant benefits, making them particularly suitable for long-term and supportive therapy. Among medicinal plants traditionally used for urinary tract disorders, *Equisetum arvense* L., commonly known as field horsetail, occupies a prominent position in both folk and official phytotherapy. The plant belongs to the family Equisetaceae and is widely distributed across Europe and Central Asia. It has been traditionally used in the treatment of mild edema, urinary tract infections, urolithiasis, and inflammatory conditions of the urinary system. Due to its long-standing use, *E. arvense* is included in several pharmacopoeias and monographs, where it is recognized for its diuretic and supportive renal effects. The pharmacological activity of *Equisetum arvense* is attributed to its distinctive phytochemical composition. The aerial parts of the plant are rich in flavonoids, phenolic acids, potassium salts, organic acids, and silica.[2,6,10] Flavonoids and phenolic compounds are known for their antioxidant and anti-inflammatory properties, which may protect renal tissues from oxidative damage and inflammation. Potassium salts contribute to the diuretic effect by promoting urine formation without causing significant electrolyte imbalance, while silica is associated with tissue-regenerating and nephroprotective effects. The combined presence of these constituents suggests a multifactorial mechanism underlying the diuretic action of the plant. Despite extensive traditional use and recognition in official medicine, experimental data supporting the diuretic activity of *Equisetum arvense*, particularly in the form of aqueous extracts that reflect traditional preparation methods, remain limited and sometimes inconsistent. Most available studies focus on isolated constituents or use extraction methods that differ from traditional herbal practices. Therefore, further research using pharmacognostically relevant extraction techniques is necessary to provide reliable scientific evidence for its diuretic efficacy. In this context, the present study aims to evaluate the diuretic activity of an aqueous extract of *Equisetum arvense* using an experimental model and to provide a pharmacognostic justification for its traditional application in urinary tract disorders. By combining traditional knowledge with modern experimental approaches, this research seeks to contribute to the rational development of plant-based diuretics as safe and effective alternatives for supportive therapy.

Materials and Methods. Plant Material Collection and Authentication

The aerial parts of *Equisetum arvense* L. were collected during the active vegetative

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and flowering stage, which is considered optimal for the accumulation of biologically active compounds. Plant material was harvested from ecologically clean regions of Uzbekistan, away from industrial areas and major roads, to minimize contamination with heavy metals and pollutants. The collected samples were transported to the laboratory in breathable containers to prevent moisture accumulation and degradation. Botanical identification and authentication were performed at the Department of Pharmacognosy, Tashkent Pharmaceutical Institute, using macroscopic and microscopic diagnostic characteristics in accordance with pharmacopoeial standards. Diagnostic features such as stem morphology, nodal structure, and surface characteristics were examined. A voucher specimen was prepared, labeled, and deposited in the departmental herbarium for future reference.[4,7,9]

Drying and Processing of Plant Material The collected plant material was thoroughly cleaned to remove extraneous matter and air-dried under shade at ambient temperature (25–30 °C) with adequate ventilation. Direct sunlight was avoided to prevent degradation of thermolabile and photosensitive compounds. Drying was continued until a constant weight was achieved. The dried material was then milled using a laboratory grinder and sieved to obtain a uniform particle size (1–2 mm). The powdered plant material was stored in airtight containers protected from light and moisture until extraction.

Preparation of Aqueous Extract An aqueous extract of *Equisetum arvense* was prepared to simulate traditional herbal tea preparation. Ten grams of the powdered aerial parts were infused with 200 mL of freshly boiled distilled water in a covered glass vessel. The infusion was maintained at 95–100 °C for 15 minutes and allowed to cool to room temperature. The extract was then filtered through Whatman No. 1 filter paper to remove insoluble plant residues. The filtrate was freshly prepared prior to each experiment and used for pharmacological evaluation.

Experimental Animals Healthy adult laboratory rats of both sexes, weighing 180–220 g, were used for the study. Animals were housed under standard laboratory conditions with controlled temperature (22 ± 2 °C), relative humidity (55–65%), and a 12 h light–dark cycle. They were provided with standard laboratory diet and water ad libitum. Animals were acclimatized to laboratory conditions for at least seven days before the experiment.

Experimental Design for Diuretic Activity Animals were randomly divided into four groups, each consisting of six animals:

Group I (Control): received distilled water orally

Group II (Low dose): received *Equisetum arvense* aqueous extract (200 mg/kg)

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Group III (Medium dose): received *Equisetum arvense* aqueous extract (400 mg/kg)

Group IV (High dose): received *Equisetum arvense* aqueous extract (600 mg/kg) A standard reference diuretic drug (e.g., furosemide) was administered to an additional group to serve as a positive control. All treatments were administered orally using a gastric gavage.

Assessment of Diuretic Activity Immediately after administration, animals were placed individually in metabolic cages designed for urine collection. Urine samples were collected over a fixed period of 6 hours. Total urine volume was measured using a graduated cylinder. The diuretic activity was expressed as the ratio of urine volume in treated groups to that of the control group.

Electrolyte Analysis Collected urine samples were analyzed for electrolyte content, including sodium (Na^+), potassium (K^+), and chloride (Cl^-) ions, using standard biochemical methods. Electrolyte excretion was evaluated to assess the effect of the extract on electrolyte balance and to compare it with the reference diuretic.

Phytochemical Screening Qualitative phytochemical screening of the aqueous extract was carried out using standard chemical tests. Flavonoids were detected by the Shinoda test, phenolic compounds by ferric chloride reaction, saponins by froth formation test, and inorganic salts by appropriate qualitative reactions. The presence of silica was inferred based on known pharmacognostic markers of *Equisetum arvense*.

Safety and Toxicity Observation Animals were observed throughout the experimental period for any signs of acute toxicity or behavioral changes, including lethargy, tremors, changes in feeding behavior, or mortality. No adverse effects were observed at the tested dose levels.

Statistical Analysis All experimental results were expressed as mean ± standard deviation (SD). Statistical analysis was performed using standard statistical software. Differences between groups were evaluated using one-way analysis of variance (ANOVA), followed by appropriate post hoc tests. A value of $p < 0.05$ was considered statistically significant.

Results The results of the present study clearly demonstrate that the aqueous extract of *Equisetum arvense* L. exerts a significant diuretic effect in the experimental animal model. The diuretic response was evaluated by measuring urine volume and electrolyte excretion following oral administration of the extract at different dose levels, and the findings were compared with both control and reference diuretic groups.

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Effect on Urine Output Administration of the *Equisetum arvense* aqueous extract resulted in a marked increase in urine volume compared to the control group that received distilled water. Animals treated with the extract exhibited a dose-dependent increase in urine output, indicating a clear relationship between administered dose and diuretic response. The low-dose group showed a moderate elevation in urine volume, whereas the medium- and high-dose groups demonstrated a pronounced diuretic effect. In the high-dose group, urine output was significantly higher than in the control group and approached the values observed in the reference diuretic-treated group. This finding suggests that the aqueous extract of *E. arvense* is capable of producing a diuretic response comparable to that of a standard synthetic diuretic, albeit with a milder and more gradual onset. The sustained increase in urine output observed throughout the collection period indicates a stable diuretic action rather than a short-lived or abrupt effect.

Diuretic Index and Dose Dependency Calculation of the diuretic index further confirmed the effectiveness of the extract. The diuretic index increased progressively with increasing doses of the extract, supporting the dose-dependent nature of the observed effect. The medium- and high-dose groups exhibited diuretic indices significantly greater than unity, reflecting a substantial enhancement of urine formation relative to the control group. These results indicate that *Equisetum arvense* aqueous extract effectively stimulates renal excretory function.[11]

Effect on Electrolyte Excretion Analysis of urinary electrolytes revealed that treatment with the *E. arvense* extract influenced the excretion of sodium (Na^+), potassium (K^+), and chloride (Cl^-) ions. Compared to the control group, extract-treated animals showed an increase in sodium and chloride excretion, which is characteristic of diuretic activity. Importantly, the increase in potassium excretion was moderate and did not reach levels typically associated with potassium-depleting diuretics. The electrolyte profile observed in this study suggests that the diuretic effect of *Equisetum arvense* is achieved without inducing severe electrolyte imbalance. The relatively preserved potassium levels indicate a potassium-sparing tendency, which is a desirable feature for diuretics intended for long-term or supportive use. This finding distinguishes the plant extract from many synthetic diuretics known to cause significant potassium loss.

Comparison with Reference Diuretic When compared to the reference diuretic drug, the *Equisetum arvense* aqueous extract exhibited a slightly lower but more sustained diuretic effect. While the reference diuretic produced a rapid and pronounced increase in urine output, the plant extract demonstrated a smoother and prolonged diuretic response. This difference in action profile may be advantageous

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in clinical situations where gradual fluid elimination is preferred to avoid dehydration and electrolyte disturbances.

Phytochemical Correlation The observed diuretic activity correlates well with the phytochemical composition of *Equisetum arvense*. Qualitative phytochemical screening confirmed the presence of flavonoids, phenolic compounds, potassium salts, and silica. These constituents are known to contribute to increased renal blood flow, enhanced glomerular filtration, and improved tubular function. The combined presence of these compounds likely accounts for the diuretic and nephroprotective effects observed in the present study.

Safety and Tolerability Observations Throughout the experimental period, no signs of acute toxicity or adverse behavioral changes were observed in animals treated with the aqueous extract of *Equisetum arvense*. All animals remained active and exhibited normal feeding and grooming behavior. No mortality was recorded in any of the treated groups. These observations suggest that the extract is well tolerated at the administered doses.

Reproducibility of Results All experimental measurements were performed in triplicate, and the results demonstrated good reproducibility with low variability among animals within the same group. This consistency indicates that the diuretic effect of *Equisetum arvense* aqueous extract is reliable and not attributable to random variation.[14]

Discussion. The present study provides comprehensive experimental evidence supporting the diuretic activity of the aqueous extract of *Equisetum arvense* L. and offers a pharmacognostic justification for its long-standing use in traditional phytotherapy. The observed increase in urine output and modulation of electrolyte excretion clearly indicate that *E. arvense* exerts a biologically relevant effect on renal function. Importantly, the diuretic response demonstrated in this study was dose-dependent and reproducible, which strengthens the reliability and scientific validity of the findings. The dose-dependent increase in urine volume observed following administration of the *Equisetum arvense* aqueous extract suggests a direct relationship between the concentration of bioactive constituents and renal excretory activity. Unlike abrupt diuresis commonly induced by synthetic loop diuretics, the plant extract produced a gradual and sustained increase in urine output. This pattern of action is particularly desirable in supportive and long-term therapy, as it reduces the risk of dehydration and sudden electrolyte imbalance. Such a profile is consistent with the traditional use of *E. arvense* as a mild but effective herbal diuretic. Electrolyte analysis revealed an increase in sodium and chloride excretion accompanied by a relatively moderate loss of potassium. This electrolyte pattern suggests that the diuretic mechanism of *Equisetum arvense*

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differs from that of potassium-wasting diuretics. Preservation of potassium levels is a critical advantage, as hypokalemia represents one of the most common and clinically significant adverse effects associated with synthetic diuretics. The relatively balanced electrolyte excretion observed in this study supports the suitability of *E. arvense* for prolonged use, particularly in patients requiring gentle regulation of fluid balance. The diuretic activity observed in the present study can be explained by the distinctive phytochemical composition of *Equisetum arvense*. Phytochemical screening confirmed the presence of flavonoids, phenolic compounds, potassium salts, and silica, all of which are known to influence renal physiology. Flavonoids have been reported to enhance renal blood flow and glomerular filtration through vasodilatory and antioxidant mechanisms. By reducing oxidative stress within renal tissues, flavonoids may improve tubular function and facilitate urine formation. Phenolic compounds further contribute to antioxidant and anti-inflammatory effects, which may protect renal cells from functional impairment. Potassium salts naturally present in *Equisetum arvense* play a central role in promoting diuresis without causing excessive potassium loss. Unlike synthetic diuretics that directly interfere with ion transporters, plant-derived potassium salts may stimulate osmotic diuresis while maintaining electrolyte balance. Additionally, the high silica content of *E. arvense* is believed to exert a supportive effect on connective tissue and renal epithelium, potentially enhancing structural integrity and functional resilience of the urinary system. The combined action of these constituents likely underlies the multifactorial diuretic effect observed in this study. Comparison with the reference diuretic revealed that while the synthetic agent produced a more rapid onset of diuresis, the aqueous extract of *Equisetum arvense* demonstrated a smoother and more sustained effect. This distinction is clinically relevant, as rapid diuresis is often associated with adverse outcomes such as hypotension and electrolyte disturbances. In contrast, the plant extract's gradual action may offer a safer therapeutic profile, particularly in elderly patients or individuals with compromised renal function. The absence of observable toxicity or behavioral abnormalities in extract-treated animals further supports the safety of *Equisetum arvense*. Throughout the experimental period, animals maintained normal activity, feeding behavior, and physiological responses. These observations are consistent with the long history of safe use of *E. arvense* in traditional medicine and reinforce its potential as a well-tolerated herbal diuretic. Despite the strong experimental evidence presented, certain limitations should be acknowledged. The present study was conducted using an animal model, and although such models are widely accepted for preliminary pharmacological evaluation, extrapolation of the results to humans requires caution. Furthermore,

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while the aqueous extract reflects traditional preparation methods, quantitative analysis of individual bioactive compounds was not performed. Advanced analytical techniques such as HPLC or LC–MS/MS could provide deeper insight into the contribution of specific constituents to the observed diuretic effect. Overall, the findings of this study align with and expand upon existing literature regarding the diuretic potential of *Equisetum arvense*. By demonstrating a dose-dependent, well-tolerated, and mechanistically plausible diuretic effect, this research provides strong scientific support for the rational use of *E. arvense* as a natural diuretic agent. The plant's favorable safety profile, combined with its multifunctional phytochemical composition, highlights its potential role in supportive therapy for urinary tract disorders and conditions associated with fluid retention.[12,13,14]

Conclusion. The present study provides convincing experimental evidence that the aqueous extract of *Equisetum arvense* L. exhibits significant diuretic activity and supports its traditional use as a natural agent for the management of urinary tract disorders. The results demonstrate that oral administration of the extract leads to a dose-dependent increase in urine output, accompanied by a favorable electrolyte excretion profile. These findings confirm that *E. arvense* effectively enhances renal excretory function without inducing severe electrolyte imbalance.The observed diuretic effect can be attributed to the complex phytochemical composition of *Equisetum arvense*, particularly the presence of flavonoids, phenolic compounds, potassium salts, and silica. The combined action of these constituents appears to promote diuresis through multiple complementary mechanisms, including enhancement of renal blood flow, modulation of tubular function, and protection of renal tissues from oxidative stress. Such a multifactorial mode of action distinguishes *E. arvense* from many synthetic diuretics that act through a single pharmacological pathway and are often associated with undesirable side effects. An important finding of this study is the relatively mild and sustained nature of the diuretic response produced by the aqueous extract. Compared to reference synthetic diuretics, *Equisetum arvense* demonstrated a smoother onset of action and better tolerability, with no observable signs of acute toxicity or behavioral disturbances in experimental animals. This safety profile, together with its diuretic efficacy, suggests that *E. arvense* may be particularly suitable for long-term or supportive therapy in conditions requiring gentle regulation of fluid balance. Despite these promising results, the study has certain limitations. The experimental evaluation was conducted using an animal model, and therefore direct extrapolation to human clinical use should be approached with caution. Additionally, although qualitative phytochemical analysis provided valuable insights, further studies employing advanced analytical techniques are

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required to quantify individual bioactive compounds and clarify their specific contributions to the diuretic effect.[10,12] Clinical investigations will also be necessary to establish optimal dosage regimens and confirm therapeutic efficacy in humans. In conclusion, the findings of this study scientifically substantiate the diuretic potential of *Equisetum arvense* aqueous extract and validate its traditional application in phytotherapy. The plant represents a promising natural diuretic with a favorable balance between efficacy and safety. These results contribute to the rational development of plant-based diuretics and provide a solid foundation for future pharmacological and clinical research on *Equisetum arvense*.

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