



Comparative evaluation of Thai folk herbal recipes and potassium citrate in rats with calcium oxalate urolithiasis

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ABSTRACT

Urolithiasis is a common urological disease in Thailand, and traditional herbal recipes remain widely used in community practice. This study evaluated the efficacy and safety of three recipes—Hibiscus, Orthosiphon, and Coix—compared with potassium citrate (K-Citrate) in a rat model of calcium oxalate urolithiasis. Forty-eight male Wistar rats were randomized into six groups (control, urolithiasis, K-Citrate, Hibiscus, Orthosiphon, Coix). Urolithiasis was induced by intraperitoneal ethylene glycol and vitamin D for 5 days, followed by 2 weeks of treatment. The Coix recipe markedly reduced renal calcium oxalate deposition (grade 0; $p < 0.001$), with efficacy similar to K-Citrate, though urinary crystal counts at week 2 were not lower than in untreated rats, likely reflecting reduced tubular crystal burden rather than obstruction. Hibiscus treatment provided moderate protection (grade 1; $p < 0.001$) but showed higher urinary crystal counts at week 2, possibly due to enhanced clearance. Orthosiphon failed to reduce stone severity (grade 5; $p = 0.087$), despite transient diuretic effects. All herbal treatments maintained normal ALT, AST, and creatinine levels, indicating a favorable safety profile. These findings suggest that Coix and Hibiscus recipes have potential as safe, culturally rooted, and environmentally sustainable options for urolithiasis management, though further studies are required to standardize dosing, identify active compounds, and assess urinary biochemical effects before clinical application.

1. INTRODUCTION

Urolithiasis, commonly referred to as kidney stones or nephrolithiasis, represents a significant urological health concern among the Thai population, with particularly high prevalence observed in the northeastern and northern regions of the country [1]. The primary risk factors for urolithiasis in

Thailand include hypocitraturia, hypercalciuria, hyperoxaluria, and urinary supersaturation [1,2]. Globally, the burden of urolithiasis remains substantial. A recent analysis from the Global Burden of Disease Study 2021 estimated that over 50 million individuals were affected by urolithiasis worldwide, with a steadily increasing number of cases compared to previous decades, despite a modest decline in age-standardized incidence rates [3]. In Asia, the prevalence ranges from 1% to 19.1% depending on geographic and socioeconomic factors, and Thailand remains among the countries with relatively high reported rates [2]. These epidemiological trends underscore the need for effective preventive and therapeutic strategies

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that are both accessible and evidence-based. Current standard treatments involve surgical procedures and pharmacological interventions, with potassium magnesium citrate serving as the first-line medication for both stone management and recurrence prevention. However, its clinical utility is often constrained by frequent gastrointestinal side effects [4], indicating the need for alternative therapeutic approaches to improve patient outcomes.

Traditional herbal medicine remains deeply embedded within Thailand's cultural and healthcare landscape. The nation's rich folk medicine tradition incorporates plant-based therapies for disease prevention, diagnosis, and treatment [5]. Nowhere is this more evident than in Phayao province, where rural communities have preserved generations-old herbal formulations for managing various ailments, including urolithiasis. Our investigation focuses on three anti-lithogenic formulations documented by the Rak-Phan-Thai Herbal Club (Baan-Thum subdistrict, Dok-Kham-Tai district, Phayao province): the Hibiscus, Orthosiphon, and Coix recipes.

The Hibiscus recipe combines roselle flowers (*Hibiscus sabdariffa* L.), pandan leaves (*Pandanus amaryllifolius* Roxb.), and pineapple leaves (*Ananas comosus*)—each demonstrating promising pharmacological activities. Roselle exhibits calcium crystal inhibition [6, 7], nephroprotective effects [8], and anticancer properties [9, 10]. Pandan leaf extracts demonstrate calcium dissolution capacity [11], uric acid reduction [12], and xanthine oxidase inhibition [13], while pineapple leaves show diverse bioactivities including anti-inflammatory and metabolic effects [14–18].

The Orthosiphon recipe integrates four medicinal components: Java tea leaves (*Orthosiphon stamineus*), Mok cruea vine (*Aganosma marginata*), pineapple leaves, and royal poinciana stem (*Delonix regia*). The Java tea leaves have been reported the anti-urolithiasis *in vitro* [19] and have also been used in diabetes treatment and its complications [20, 21]. *Mok cruea* vine is an ingredient in traditional cough remedies in Malaysia [22]. The royal poinciana stem has shown antibacterial, antifungal, and antioxidant properties [23].

The Coix recipe incorporates the roots of three medicinal plants: Job's tears (*Coix lacryma-jobi*), star fruit tree root (*Averrhoa carambola* L.), and Som poi tree root (*Acacia concinna*). Each component contributes distinct therapeutic properties: Job's tears root is renowned for its efficacy in treating urinary tract disorders [24], meningitis [25] and fever [26]. The star fruit tree exhibits antidiabetic effect *in vivo* [27], though its fruit is associated with nephrotoxicity [28]. The Som poi tree root demonstrates antioxidant and tyrosinase-inhibitory activity [29], alongside documented antibacterial and anthelmintic actions [30, 31].

Despite their widespread traditional use, these formulations lack rigorous scientific validation regarding their efficacy and safety profiles. This study, therefore, systematically evaluates the anti-lithogenic potential of these three traditional recipes using an established animal model, aiming to bridge the gap between traditional knowledge and evidence-based medicine in urolithiasis management.

2. MATERIALS AND METHODS

2.1. Folk medicine recipe preparation

Herbal samples used in the folk medicine recipes for urolithiasis treatment were sourced from the Rak-Phan-Thai Herbal Club in Baan-Thum subdistrict, Dok-Kham-Tai district, Phayao province, Thailand.

Each folk medicine recipe (treatment unit; one herbal bag) was prepared by boiling in 2 L of water for 5 minutes, following the traditional method of use. The decoctions were freeze-dried and stored at 4 °C until further use. To determine extraction yields, each recipe was prepared independently in triplicate, and the crude extract weight was recorded. The average yield (mean of three independent preparations) is reported in Supplementary Table S1.

2.2. Ethical consideration

The study protocol was approved by the Laboratory Animal Research Center, School of Medical Sciences, University of Phayao (LARCUP) (Approval No.: 610104032). All experiments were conducted in accordance with the IACUC and ARRIVE guidelines and relevant regulations.

2.3. Experimental animals and experimental design

Forty-eight male Wistar rats, weighing approximately 200 g and aged 8 weeks, were purchased from Nomura International Siam (Thailand). The rats were maintained under pathogen-free conditions with a 12-hour light/dark cycle, at a temperature of 25°C ± 2°C, and a relative humidity of 50%–70%. They were provided with a standard diet and had *ad libitum* access to food and water.

The study employed a completely randomized design (CRD). The rats were randomly divided into six groups: Control (received water as vehicle), Urolithiasis (received water as vehicle), urolithiasis treated with potassium (K)-Citrate (2.5 mEq/day, a standard treatment as a positive control), and urolithiasis treated with the Hibiscus, Orthosiphon, or Coix folk medicine recipes.

Urolithiasis was induced in the rats by intraperitoneal injection of ethylene glycol (500 mg/kg BW) and vitamin D (0.1 µg) for five consecutive days [32]. This intraperitoneal protocol was selected because it induces calcium oxalate urolithiasis reliably within 5 days, whereas oral EG-in-water models generally require 8 weeks to establish lithogenesis [33]. At the end of the induction phase (day 5), the rats were placed individually in metabolic cages overnight (12 h) for urine collection to confirm stone induction. Treatment with K-Citrate or the folk medicine recipes was initiated immediately thereafter (day 6).

Sample size determination: The number of animals per group ($n = 8$) was determined a priori using G*Power 3.1 software. With $\alpha = 0.05$, power $(1-\beta) = 0.95$, and effect size estimated from preliminary data, the minimum required sample size was calculated as 8 rats per group.

2.4. Measurement of physiological parameters

The well-being of rats with urolithiasis under various treatments was evaluated by analyzing growth rate using

percent change of body weight, water consumption, and urine output. The pre-induction stone values were transformed to 100 percent, and then, this value was used as the baseline to calculate the data for the rest of the time series in each group. The baseline values were also used to standardize the results of other groups. Body weight was recorded daily. The rats were housed individually in metabolic cages to measure water consumption and urine excretion at pre-induction, post-stone induction, and 1 and 2 weeks post-treatment. At the end of the experiment, all animals were sacrificed via carbon dioxide overdose. Blood was collected from the heart for the measurement of liver and kidney function.

2.5. Urine crystal excretion

To evaluate urinary crystal excretion, spot urine collected on pre-induced, stone-induced, and 1 and 2 weeks after treatment were spun, and the sediment was revealed by a low magnified light microscope. Calcium oxalate crystal was qualified per low-power field (LPF) by an average of 20 areas for each sample.

2.6. Renal histopathological study

The left kidney of each rat was sagittally bisected and fixed in 10% buffered formalin for 1 week. The kidneys were embedded in paraplast, sectioned at 4 μm thickness using a microtome, and stained with hematoxylin and eosin (H&E). Calcium oxalate crystals were examined under a light microscope. For each kidney, twenty random low-power fields (LPF) were evaluated, and the number of nephrons containing CaOx crystals in tubular lumens was recorded. Urolithiasis severity was graded on a semi-quantitative scale modified from previously reported methods [34], as follows: Grade 0 = none; Grade 1 = <10 crystals/LPF; Grade 2 = 10–20 crystals/LPF; Grade 3 = 21–50 crystals/LPF; Grade 4 = 51–100 crystals/LPF; Grade 5 = >100 crystals/LPF. Randomization of field selection was performed using a computer-generated random number list, and histological evaluation and scoring were conducted by an investigator blinded to the treatment groups.

2.7. The safety of folk medicine recipes for urolithiasis on liver and kidney function

To evaluate the safety of the folk medicine recipes, liver and kidney functions were assessed by measuring serum alanine aminotransferase (ALT), aspartate aminotransferase (AST), and creatinine (Cr). Blood samples were centrifuged at 3000 rpm for 5 minutes, and serum levels were analyzed using a fully automated Roche Cobas® C 502 Chemistry Analyzer.

2.8. Statistical analysis

Continuous variables (body weight, water intake, urine output, and serum biochemical parameters) were first tested for normality using the Shapiro–Wilk test. Normally distributed variables were expressed as mean \pm standard error of the mean (SEM) and analyzed using one-way ANOVA followed by Bonferroni's post hoc test. Non-normally distributed variables (urinary crystal counts and histopathology grades) were expressed as median and interquartile range and analyzed using

the Kruskal–Wallis test followed by Dunn's post hoc test. Data analyses were performed using GraphPad Prism 5.0 (Dotmatics, MA, USA). Statistical significance was defined as $p < 0.05$.

3. RESULTS

3.1. Effects of folk medicine recipes on the well-being of urolithiasis rats

3.1.1. Body weight changes

Body weight changes (% of baseline) were monitored across all groups (Fig. 1a). During the induction phase, urolithiasis-induced rats failed to gain weight and showed significantly impaired growth compared with the Control group ($p < 0.05$). Following treatment, all urolithiasis groups exhibited gradual recovery, and by the end of the study, their body weights were comparable to those of the Control rats, indicating compensatory growth.

3.1.2. Water intake

Water intake (% of baseline) was recorded throughout the experiment (Fig. 1b). During induction, water consumption in urolithiasis-induced rats was not different from the Control group ($p > 0.05$). After 1 week of treatment, the K-Citrate group consumed significantly more water than both the Control ($p < 0.001$) and untreated urolithiasis groups ($p < 0.01$). Rats treated with folk medicine recipes also showed increased water intake compared with the Control (Hibiscus, $p < 0.001$; Orthosiphon, $p < 0.05$; Coix, $p < 0.01$), though their intake did not differ significantly from the untreated urolithiasis group ($p > 0.05$). By week 2, elevated intake persisted in most groups ($p < 0.05$ vs Control), except for Orthosiphon-treated rats, which returned to Control levels. Notably, the K-Citrate group showed the highest intake at week 1, but this difference was no longer significant at week 2 ($p > 0.05$).

3.1.3. Urine output

Urine excretion (% of baseline) was measured as an indicator of renal function (Fig. 1c). During induction and week 1, all urolithiasis groups excreted more urine than the Control group ($p < 0.01$), with the K-Citrate and Hibiscus groups showing the greatest increases ($p < 0.001$). By week 2, urine output in the untreated urolithiasis and Orthosiphon groups had normalized to Control levels, whereas it remained significantly elevated in the K-Citrate ($p < 0.05$), Hibiscus ($p < 0.01$), and Coix ($p < 0.001$) groups.

3.2. Effects of folk medicine recipes on urine crystal excretion

During the stone induction phase, urolithiasis-induced rats exhibited substantial calcium oxalate crystal formation, with median counts ranging from 8.5 (Hibiscus group) to 13 (Coix group) crystals per low-power field (LPF), significantly higher than the control group's 0 crystals ($p < 0.001$). Following 1 week of treatment, all groups showed reduced crystal counts, with medians declining to 1–5 crystals/LPF. While the K-Citrate group displayed the highest residual crystals (5 crystals, $p = 0.065$ vs urolithiasis control), other treatments maintained comparable levels to the disease control (1–3.5

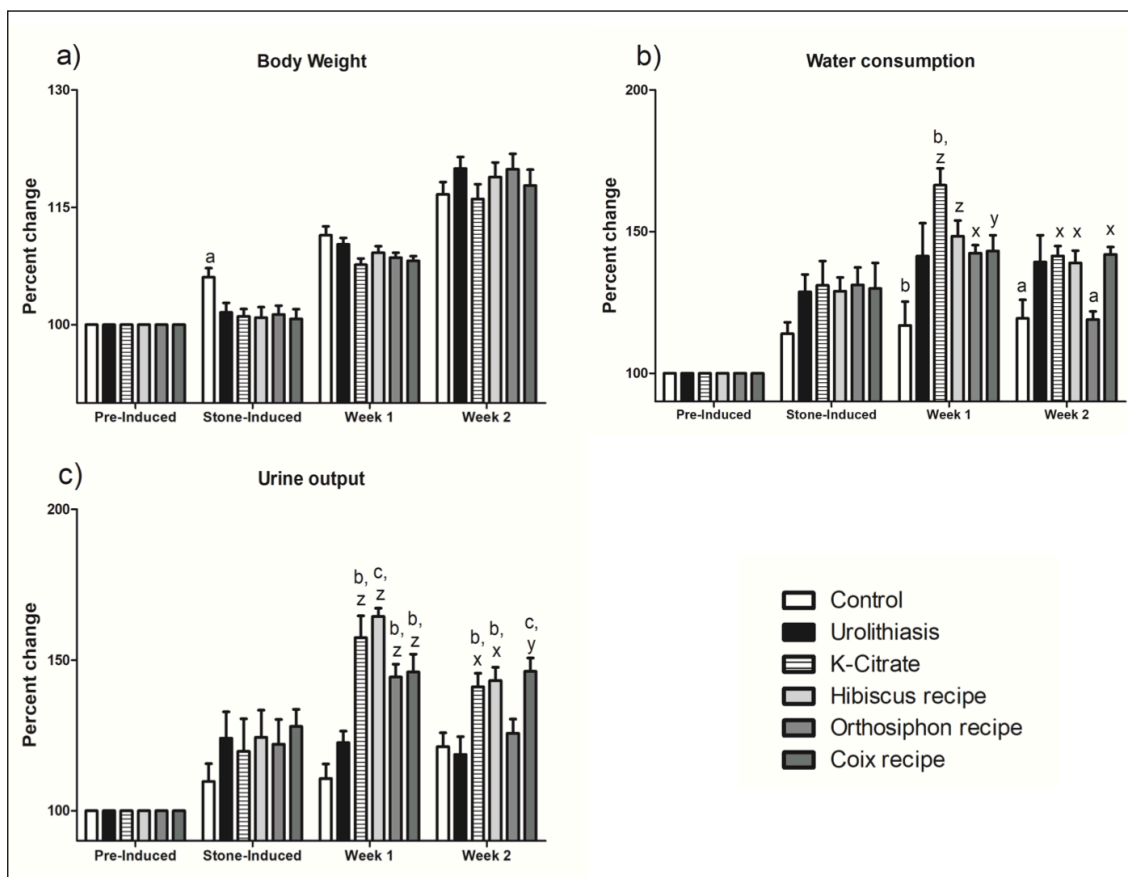


Figure 1. Effects of folk medicine recipes on (a) percent change of body weight, (b) percent change of water consumption, and (c) percent change of urine output in urolithiasis-induced rats. Data are presented as mean ± standard error of the mean (SEM), *n* = 8 per group. a, b, c: *p* < 0.05, *p* < 0.01, and *p* < 0.001 vs. the urolithiasis group at the same time point. x, y, z: *p* < 0.05, *p* < 0.01, and *p* < 0.001 vs. the control group at the same time point.

Table 1. Number of urinary calcium oxalate crystals per low-power field (LPF) at different stages of the experiment.

	Pre-induced		Stone-induced		Week 1		Week 2	
	Stone number	<i>P</i> value	Stone number	<i>P</i> value	Stone number	<i>P</i> value	Stone number	<i>P</i> value
Control	0 (0–0)	1.000	0 (0–0)	<0.001	0 (0–0)	0.054	0 (0–0)	<0.05
Urolithiasis	0 (0–0)		10 (8–20)		1 (0–3)		2 (0–3)	
K-Citrate	0 (0–3)	0.315	10 (10–10)	0.860	5 (2–5)	0.065	5 (1–5)	<0.05
Hibiscus recipe	0 (0–1)	0.533	8.5 (5.2–10)	0.264	3.5 (1–5)	0.343	3 (2–5)	<0.05
Orthosiphon recipe	0 (0–2.5)	0.390	10 (3.5–15.5)	0.467	3 (2–4.5)	0.190	3 (1.2–5)	0.153
Coix recipe	0.5 (0–2)	0.298	13 (5–20)	0.692	3 (2–5)	0.252	3 (0–5)	0.678

Data are presented as median (interquartile range), *n* = 8 per group. Comparisons were made between the urolithiasis and treatment groups using the Kruskal–Wallis test followed by Dunn’s post hoc test. Exact *p*-values are shown instead of significance symbols.

crystals). By week 2, distinct treatment effects emerged: both K-Citrate and Hibiscus groups showed significantly elevated crystal counts (3 crystals each) compared to the control (*p* = 0.033 and *p* = 0.041, respectively), while Orthosiphon and Coix treatments maintained counts statistically indistinguishable from the urolithiasis control (3 crystals each, *p* = 0.153–0.678). Notably, the Coix recipe demonstrated efficacy comparable to that of Orthosiphon throughout the treatment period, with both maintaining stable crystal counts that did not differ significantly

from the disease control group at either week 1 (*p* = 0.190–0.252) or week 2 (*p* = 0.153–0.678). These findings suggest differential effects of the tested interventions on calcium oxalate crystal clearance, with Orthosiphon and Coix showing the most favorable profiles.

3.3. Effects of folk medicine recipes on renal pathology

The renal oxalate crystals were observed under the light microscope as shown in Fig. 2. The control group, which

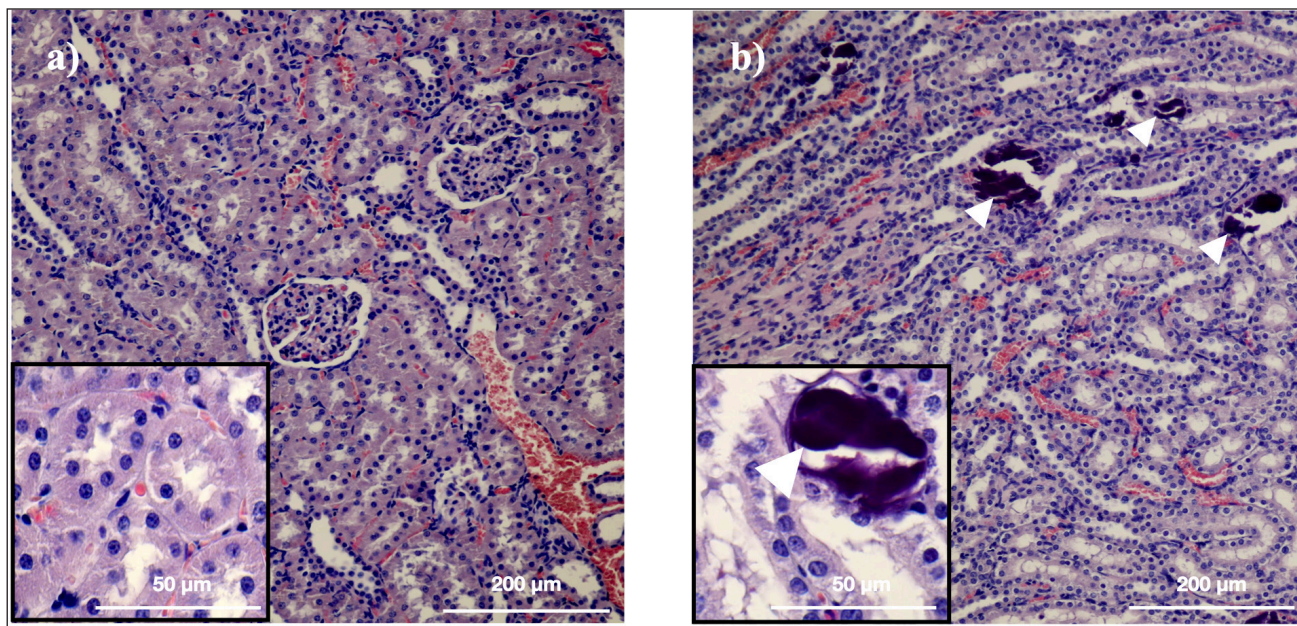


Figure 2. Representative renal histopathology of (a) Control and (b) Urolithiasis groups. Kidney sections were stained with hematoxylin and eosin (H&E). White arrowheads indicate calcium oxalate crystals deposited in renal tubules. Images were captured at 10× magnification; insets show higher magnification at 40×. Scale bars = 200 µm (main panels) and 50 µm (insets).

was not subjected to any lithogenic agents, showed no stone formation, maintaining a grade of 0 (Fig. 2a). In contrast, the urolithiasis group exhibited severe stone formation, with a consistent grade of 5 (Fig. 2b), confirming the calcium oxalate stone formation in kidneys.

The severity of renal calcium oxalate crystal deposition was graded on a scale of 0–5, with higher grades indicating more severe stone formation (Table 2). Treatment outcomes revealed significant differences among the intervention groups. The positive control group (K-Citrate) demonstrated marked anti-lithogenic efficacy, completely preventing crystal accumulation (grade 0; $p < 0.001$ vs urolithiasis control). Similarly, the Coix recipe showed pronounced protective effects, with no detectable crystal formation in most animals (grade 0; $p < 0.001$). The

Hibiscus recipe exhibited moderate but statistically significant activity (grade 1; $p < 0.001$), representing a substantial improvement over untreated urolithiasis animals while being less potent than either K-Citrate or Coix treatments.

In contrast, the Orthosiphon recipe failed to demonstrate significant therapeutic benefit, with crystal deposition grades (5; $p = 0.087$) indistinguishable from untreated urolithiasis controls (grade 5).

3.4. The safety of folk medicine recipes on urolithiasis on liver and kidney function

The levels of ALT, AST, and creatinine at the end of the study did not differ significantly among the groups, including those treated with K-Citrate or the folk medicine recipes, compared with either the Control or the untreated urolithiasis group ($p > 0.05$) (Table 3).

Table 2. Histopathological grading of calcium oxalate crystal deposition in renal tissue.

Group	Grade	P value
Control	0 (0–0)	<0.001
Urolithiasis	5 (5–5)	
K-Citrate	0 (0–2.7)	<0.001
Hibiscus recipe	1 (0–2)	<0.001
Orthosiphon recipe	5 (0–5)	0.087
Coix recipe	0 (0–3.2)	<0.001

Data are presented as median (interquartile range), $n = 8$ per group. Grading was based on the number of tubules containing calcium oxalate crystals per low-power field (LPF), as described in the Methods. Comparisons between the urolithiasis and treatment groups were performed using the Kruskal–Wallis test followed by Dunn’s post hoc test.

Table 3. Serum biochemical markers of liver and kidney function at the end of the study.

	ALT (U/L)	AST (U/L)	Cr (mg/dl)
Control	19.27 ± 2.99	50.33 ± 3.37	0.31 ± 0.09
Urolithiasis	22.17 ± 3.41	58.60 ± 4.54	0.32 ± 0.07
K-Citrate	21.80 ± 2.89	56.43 ± 2.13	0.30 ± 0.06
Hibiscus recipe	20.58 ± 3.09	61.25 ± 2.59	0.34 ± 0.06
Orthosiphon recipe	20.77 ± 3.04	53.25 ± 2.77	0.29 ± 0.05
Coix recipe	21.42 ± 2.29	59.73 ± 4.97	0.32 ± 0.07

ALT, alanine aminotransferase; AST, aspartate aminotransferase; Cr, creatinine; SEM, standard error of the mean. Data are expressed as mean ± SEM, $n = 8$ per group. One-way ANOVA was used for comparisons. No statistically significant differences were observed among groups ($p > 0.05$).

4. DISCUSSION

This study investigated the efficacy and safety of three traditional Thai herbal recipes—Hibiscus, Orthosiphon, and Coix—compared with potassium citrate (K-Citrate) in a rat model of calcium oxalate urolithiasis. The results integrate multiple endpoints, including body weight, water intake, urine output (Fig. 1), urinary crystal excretion (Table 1), renal histopathology (Table 2), and serum biochemical markers of liver and kidney function (Table 3). Together, the findings suggest differential protective effects of these herbal formulations, with Coix and Hibiscus showing encouraging outcomes, while Orthosiphon was less effective.

The Coix recipe showed the strongest evidence of benefit. Rats treated with Coix maintained stable body weight recovery and elevated urine output compared with controls, supporting its diuretic effect (Fig. 1a, 1c). Histopathology confirmed minimal renal crystal deposition (grade 0; Table 2), consistent with previous reports that *Coix lacryma-jobi* root can reduce calcium oxalate crystallization through antioxidant and diuretic mechanisms [24, 35, 36]. Interestingly, urinary crystal counts in Week 2 (Table 1) did not differ from untreated urolithiasis rats. We interpret this discrepancy as reflecting distinct underlying mechanisms: in untreated urolithiasis, obstruction by heavy tubular crystal load (Table 2, grade 5) may limit crystal excretion into urine, whereas in Coix-treated rats, fewer intratubular crystals (grade 0) naturally result in lower urinary shedding. This interpretation suggests that low urinary crystal counts can arise either from severe obstruction or effective prevention, emphasizing the importance of integrating histological data when evaluating anti-lithogenic interventions.

The Hibiscus recipe demonstrated moderate protective effects. Body weight and urine output gradually improved, although water intake remained only modestly elevated compared to controls (Fig. 1a–c). Histology revealed partial protection (grade 1; Table 2), which aligns with the known anti-crystallization activity of roselle (*Hibiscus sabdariffa*) [6–8] and complementary actions of pandan [11] and pineapple leaves [14, 18]. However, urinary crystal counts were unexpectedly higher than untreated urolithiasis at week 2 (Table 1). One possible explanation is that Hibiscus reduced tubular retention of calcium oxalate, thereby facilitating greater excretion into urine. In this interpretation, higher urinary crystal counts may reflect enhanced clearance rather than greater stone burden, although further studies measuring urinary supersaturation indices (e.g., calcium, oxalate, citrate, pH) would be required to confirm this mechanism. Safety evaluation showed no major toxicity, though AST levels were slightly elevated relative to controls (Table 3), warranting caution in populations with hepatic susceptibility.

In contrast, the Orthosiphon recipe failed to show significant anti-lithogenic activity. Although transient increases in water intake and urine output were observed in week 1 (Fig. 1b–c), these effects were not sustained in week 2. Histological grades remained similar to untreated urolithiasis (grade 5; Table 2), and urinary crystal counts showed no significant differences (Table 1). This lack of efficacy contrasts with prior studies reporting diuretic and litholytic effects of *Orthosiphon stamineus* [19, 20]. Possible explanations include insufficient

dose, interactions among recipe components, or extraction method differences, since alcohol-based extracts may yield different phytochemical profiles than aqueous decoctions. Importantly, liver and kidney function remained unaffected, suggesting that although ineffective in this model, the recipe appears safe for further optimization.

When compared with the positive control, K-Citrate, both Coix and Hibiscus recipes demonstrated partial but noteworthy benefits. K-Citrate prevented stone formation almost completely (Table 2) and induced marked diuresis in week 1 (Fig. 1c), consistent with its known mechanism of urinary alkalization and citrate supplementation [37, 38]. While Coix achieved a comparable histological outcome, it lacked the clear biochemical modulation associated with K-Citrate, underscoring the need for mechanistic studies before establishing therapeutic equivalence. Hibiscus, on the other hand, appeared to facilitate crystal excretion without full suppression of deposition, suggesting complementary rather than equivalent efficacy.

In terms of safety, none of the herbal recipes produced significant changes in serum ALT, AST, or creatinine (Table 3). This finding supports their potential for safe use, particularly for Coix, which showed values nearly identical to controls. Collectively, the results suggest that traditional recipes, especially Coix and Hibiscus, may support urolithiasis management through distinct mechanisms, although standardized preparations, urinary biochemical monitoring, and mechanistic validation remain essential.

5. LIMITATIONS

Several limitations should be considered when interpreting the present findings. First, the dosing of the herbal recipes was based on traditional community use, scaled pragmatically for animal experiments, rather than standardized pharmacological titration. Further work is needed to identify active constituents and define optimal dosing. Second, the lithogenesis model employed intraperitoneal ethylene glycol with vitamin D, which provided rapid and consistent induction within 5 days but differs from the more widely used oral EG-in-water models that require longer induction periods. Therefore, the applicability of this model to human stone disease should be interpreted with caution. Third, urinary biochemical parameters such as pH, calcium, oxalate, and citrate were not measured, which prevents direct conclusions on how the recipes modulate lithogenic risk factors. Fourth, while the Coix recipe showed reductions in histopathology scores similar to K-Citrate, the absence of biochemical data means equivalence cannot yet be assumed. Finally, our study focused on validating recipes traditionally used in the community. While we demonstrated anti-urolithic efficacy and short-term safety in a rat model, these results should be interpreted as preclinical support rather than direct evidence for clinical application. Further research with standardized extracts, mechanistic assays, and diverse experimental conditions will help clarify their potential and ensure reproducibility.

6. CONCLUSION

This study provides experimental evidence supporting the safety and efficacy of Thai folk herbal recipes for urolithiasis. Among the three formulations tested, the coix recipe showed the

strongest anti-lithogenic activity, with outcomes comparable to k-citrate, while the hibiscus recipe demonstrated moderate benefits. the orthosiphon recipe, despite its traditional use, did not significantly reduce stone severity but remained safe. importantly, none of the recipes induced hepatorenal toxicity, as reflected by stable ALT, AST, and creatinine levels.

These findings suggest that certain community-used recipes, particularly coix and hibiscus, may have therapeutic potential as adjunctive or alternative remedies for urolithiasis. however, further studies are required to standardize dosing, identify active compounds, and evaluate urinary biochemical effects before clinical application.

7. ACKNOWLEDGMENT

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8. AUTHOR CONTRIBUTION

All authors made substantial contributions to conception and design, acquisition of data, or analysis and interpretation of data; took part in drafting the article or revising it critically for important intellectual content; agreed to submit to the current journal; gave final approval of the version to be published; and agree to be accountable for all aspects of the work. All the authors are eligible to be an author as per the International Committee of Medical Journal Editors (ICMJE) requirements/guidelines.

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10. DATA AVAILABILITY

All the data is available with the authors and shall be provided upon request.

11. CONFLICTS OF INTEREST

The authors report no financial or any other conflicts of interest in this work.

12. DECLARATION OF GENERATIVE AI IN SCIENTIFIC WRITING

During the preparation of this manuscript, the authors used DeepSeek AI solely for language editing and grammar correction. The authors reviewed and edited the output as necessary and take full responsibility for the content of this publication.

13. ETHICAL APPROVALS

Ethical approval details are given in the 'Materials and Methods' section.

14. PUBLISHER'S NOTE

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15. SUPPLEMENTARY MATERIAL

The supplementary material can be accessed at the link here: [https://japsonline.com/admin/php/uploadss/4756_pdf.pdf].

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