Research Article

Influence of Sambong *(Blumea balsamifera)* Leaves Extract on Cystitis and Amorphous Urates Causing Feline Lower Urinary Tract Disease

Mahmoud Saber[1], Mohamed I. Oraby[1]*, Fayez A. Salib[1], Fady S. Youssef[2], Arafat Khalphallah[3], Sabry A. Mousa[4], Mostafa El-Gaffary[5], Mohamed Awny Elkhiat[1]

[1]Department of Medicine and Infectious Diseases, Faculty of Veterinary Medicine, Cairo University, Giza. Egypt; [2]Department of Pharmacology, Faculty of Veterinary Medicine, Cairo University, Giza, Egypt; [3]Division of Internal Medicine, Department of Animal Medicine, Faculty of Veterinary Medicine, Assiut University, Assiut, Egypt; [4]Department of Veterinary Clinical Medical Sciences, Faculty of Veterinary Medicine, Jordan University of Science and Technology, Irbid, Jordan; [5]Department of Veterinary Clinical Pathology, Faculty of Veterinary Medicine, Cairo University, Giza, Egypt.

Abstract | Treatment of feline lower urinary tract disease (FLUTD) possesses great concern in small animal clinics. Sambong (*Blumea balsamifera*) is an ayurvedic herb composed of numerous phytochemical components that have previously evidenced biological actions mainly diuretic, anti-lithic and anti-inflammatory. This study investigated the effect of Sambong (*Blumea balsamifera*) leaves extract on cystitis and amorphous urates in non-obstructive cases of FLUTD. Ten tomcats were admitted to the internal medicine teaching hospital at Cairo University on 9th. October 2020. The cats were suffering from dysuria, pollakiuria, stranguria and dribbling of urine. Clinical examination revealed a painful urinary bladder with evidence of partial urine retention and suspected acute cystitis, which was confirmed in eight cases via ultrasonography, while two cases revealed abundant crystalluria with normal echogenicity and thickness of the bladder wall. Urine samples were collected via catheterization for urinalysis which showed amorphous urates (+++) with acidic pH (5.41±0.10). After clinical stabilization, cats were subjected to medical boarding for 14 days and classified randomly according to treatment into two equal groups (5 cats each; 4 of them were confirmed cystitis via ultrasonography). The first group (G1) administered urinary alkalinizing solution No. 1 (UAS-1) which was composed of Sodium bicarbonate (1.2%), Potassium citrate (0.83%), Piperazine citrate (1.5%) and Omega-3 (3%). The second group (G2) administered the urinary alkalinizing solution No. 2 (UAS-2) which was typically UAS-1 in addition to an extract of Sambong leaves (1%). Both UAS-1 and UAS-2 were administered orally twice daily at a dosage rate of 1 ml/kg bodyweight for 14 days. Ultrasonography and urinalysis were repeated after 14 days to monitor the efficacy of treatment. Urine pH significantly increased in G1 (7.32 ± 0.09), and G2 (7.20 ± 0.06). Amorphous urates totally disappeared from the urine of G2, while 2 cases in G1 showed urates (+). Ultrasonography of the four cases with cystitis in G2 showed normal thickness and echogenicity of the wall of urinary bladder with minute crystals. Only one case in G1 returned to normal, however, the other 3 cases still suffered from mild to moderate cystitis due to thickening in bladder wall and abundant precipitate. A 14-day oral regimen of 1% Sambong leaves extract has a promising positive effect on treatment of cystitis and amorphous urates accompanied with FLUTD. Inclusion of 1% Sambong leaves should be applied for treatment of cystitis and amorphous urates involved in non-obstructive cases of FLUTD. However, these findings are preliminary and limited by the available number of clinical cases. So, further studies are recommended on numerous clinical cases of FLUTD and urolithiasis in other animal species. Additional research is also indicated to evaluate the therapeutic effect of different parts of the plant extract, dosages and drug combinations.

Keywords | Sambong, *Blumea balsamifera*, FLUTD, Cystitis, Urates, Cats, Medicinal plants, Herbal medicine, Pets animals' clinics

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***Correspondence** | Mohamed I. Oraby, Department of Medicine and Infectious Diseases, Faculty of Veterinary Medicine, Cairo University, Giza. Egypt; **Email:** mohamed.oraby@vet.cu.edu.eg
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INTRODUCTION

Urinary stones have always been a prevalent health problem facing mankind and animals. Feline lower urinary tract disease (FLUTD) is a common trouble opposite small animal clinicians and is a combined term usually used to denote dysfunction of urinary bladder and/or urethra especially in tomcats.

Ayurvedic medicine is the ancient medical scheme of India that is even used today. As part of its distinctive history, Ayurveda also includes some of the first written documents on veterinarian medicine and treatments (Sodhi and Sodhi, 2023).

Sambong is known for its diuretic properties, used to treat urinary stones, urinary tract infections, and high blood pressure. The plant's leaves and stems are often boiled or brewed into tea to increase urine output, facilitating toxin expulsion from the body. Modern studies have confirmed sambong's diuretic, anti-inflammatory, analgesic, and antimicrobial properties highlighting its potential as a low-cost, accessible alternative to conventional pharmaceutical treatments (Jose *et al*., 2024). The leaves of Blumea balsamifera (B. balsamifera) are reported to have anti-lithogenic effects and are a means of treating urinary stones. This therapeutic effect was attributed to the diuretic effect of B. balsamifera (Alok *et al*., 2013).

Recent studies have validated sambong's pharmacological effects, especially its diuretic action. Research has demonstrated that sambong can significantly increase urine output and support kidney function, making it effective for managing mild hypertension and conditions like benign prostatic hyperplasia (BPH). Furthermore, animal studies have shown that sambong can reduce the formation of calcium oxalate crystals, the main component of kidney stones, and has pain-relieving properties that help alleviate the discomfort caused by stones. The pharmacological investigations into Blumea balsamifera (Sambong) have provided strong evidence supporting its traditional uses particularly for its diuretic and kidney stone-dissolving properties. The bioactive compounds identified, such as flavonoids, terpenoids, and phenolic acids, contribute to the plant's therapeutic potential, with compounds like luteolin, quercetin, and β-caryophyllene showing promising anti-inflammatory and antioxidant effects. Preclinical studies have demonstrated Sambong's effectiveness in increasing urine output and reducing urinary stone size, validating its historical use as a natural remedy for urinary-related disorders and hypertension (Jose *et al*., 2024).

Sambong treatment is effective in treating patients with urolithiasis by radiographic evidence of a decrease in size and/or number of stones, the passage of stone/s and/or disappearance or reduction of signs and symptoms with no serious adverse events (Tolosa *et al*,, 2020).

Extracts and phytochemicals of *B. balsamifera* contain several biological capacities such as antioxidant, antimicrobial, antifungal, anti-inflammatory, hypolipidemic, anti-infertility, hepatoprotective activity, antidiabetic, gastroprotective, antitumor, anticancer, and immunomodulatory agent and recommended to be used as a nutraceutical or in medicinal preparations (Widhiantara and Jawi, 2021).

Despite these positive claims, there is no *in vivo* study in cats that has been conducted to fully verify the anti-urolithiasis property of sambong especially in urinary stones accompanied with FLUTD such as oxalates and urates. Proving the effectiveness of this medicinal plant as an anti-urolithiasis and anti-inflammatory agent *in vivo* could provide a less costly, preventive and therapeutic option for urinary stones due to its easy availability. And safety. Moreover, having said that no preliminary *in vivo* study in cats has been performed, this study could be used as a springboard for more in-depth studies of higher institutions. This study determined the anti-urolithiasis and anti-inflammatory activities of sambong (*Blumea balsamifera)* extract on amorphous urates causing FLUTD.

MATERIALS AND METHODS

Phytochemical screening by Gas chromatography analysis
The GC investigation of the Blumea balsamifera extracts

have been made in an Agilent instrument (Agilent, Japan) under computer control at 70 eV. About 1 µl of each sample was injected into the GC-MS and the scanning was done for 25 min. The oven temperature has been maintained at 100˚C. Helium gas has been utilized as carrier and eluent. The helium flow rate has been set at 1 ml/min. HP-5MS capillary-column (30 m × 0.25 mm; 0.25 µm film-thicknesses) has been utilized as the GC-column for components separation. The injector and detector temperatures were 200 ºC and 250 ºC, respectively. Volume injected 1µl of the sample. The MS operating parameters were as follows: ionization potential 70 eV, interface temperature 250 ºC, and acquisition mass range 50–800.

The identification of components was based on a comparison of their mass spectra and retention time with those of the authentic compounds and by computer matching with NIST and WILEY library as well as by comparison of the fragmentation pattern of the mass spectral data with those reported in the literature Sarwar and Latif (2015).

Experimental design

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Ten male cats were admitted to the internal medicine teaching hospital at Cairo University in October 2020. The cats were suffering from dysuria, pollakiuria, stranguria and dribbling of urine. Clinical examination revealed a painful urinary bladder with evidence of partial urine retention and suspected acute cystitis, which was confirmed in eight cases via ultrasonography, while two cases revealed abundant crystalluria with normal echogenicity and thickness of the bladder wall. Urine samples were collected via catheterization for urinalysis which showed amorphous urates (+++) with acidic pH (5.41±0.10). After clinical stabilization, cats were subjected to medical boarding for 14 days and classified randomly according to treatment into two equal groups (5 cats each; 4 of them were confirmed cystitis via ultrasonography). The first group (G1) administered urinary alkalinizing solution No. 1 (UAS-1) which was composed of Sodium bicarbonate (1.2%), Potassium citrate (0.83%), Piperazine citrate (1.5%) and Omega-3 (3%). The second group (G2) administered the urinary alkalinizing solution No. 2 (UAS-2) which was typically UAS-1 in addition to an extract of Sambong leaves (1%). Both UAS-1 and UAS-2 were administered orally twice daily at a dosage rate of 1 ml/kg bodyweight for 14 days. Ultrasonography and urinalysis were repeated after 14 days to monitor the efficacy of treatment.

Statistical analysis

A one-way analysis of variance (ANOVA) was used to evaluate the difference between groups. The Shapiro–Wilk test was utilized for normality testing and Levene's test was used to evaluate the homogeneity of variance. Parametric statistical tests were used for analyzing data with a normal distribution, and if there were significant differences, the Least significant difference (LSD) test was used for post-hoc analysis. Data was presented as the mean ± standard error (SE). Statistical significance was set at $P < 0.05$. All analyses were performed with SPSS® version 20 according to by Nie *et al*. (1975).

RESULTS

Phytochemical Screen results of the tested Blumea balsamifera (Sambong)

The GC analysis of *Blumea balsamifera (Sambong)* reveals a diverse array of compounds, each contributing to the potential therapeutic properties of the oil. Below is a detailed evaluation of the significant constituents identified in the analysis:

Major fatty acids and lipids

Myristic acid (4.2%), cis-10-pentadecenoic acid (0.43%), Palmitic acid (31.6%), Palmitoleic acid (0.76%), Margaric acid (0.32%), cis-10-Heptadecenoic acid (2.66%), Stearic acid (19.61%), Elaidic acid (2.79%), Oleic acid (30.63%),Linoleic acid (1.09%), Linolenic acid (0.17%), Arachidic acid (0.76%), Heneicosanoic acid (2.6%), *cis*-11,14,17-Eicosatrienoic acid (0.66%), Behenic acid (0.19%), Erucic acid (0.1%), EPA (0.45%), Tricosanoic acid (0.05%), Lignoceric acid (0.14%), DHA (0.78%).

Their significant presence underscores the oil's potential in mitigating oxidative stress and inflammation-related disorders. In addition, they are crucial for cellular membrane integrity and have roles in lipid signaling pathways, contributing to the bioavailability and stability of the *Blumea balsamifera (Sambong)*.

Gallic acid (2749.64), Chlorogenic acid (237.57), Catechin (514.28), Methyl gallate (31336.74). Coffeic acid (3832.85), Syringic acid (3416.18), Rutin (3841.11), Coumaric acid (127.94), Vanillin (34.76), Ferulic acid (151.83), Naringenin (3214.50), Rosmarinic acid (78.69), Daidzein (1659.25), Querectin (540.69), Cinnamic acid (1823.07), Kaempferol (751.49), Hesperetin (3406.19) are known for their anti-inflammatory activities. The presence of these compounds supports its use in managing oxidative stress and inflammation.

The GC analysis indicates that *Blumea balsamifera (Sambong)* is a rich source of various bio-active compounds. This composition justifies its traditional use and modern therapeutic applications, especially in formulations aimed at treating inflammatory conditions, oxidative stress-related disorders, and enhancing skin health.

Table 1: Phytochemical screening of *Blumea balsamifera* (Sambong).

	Sambong
Total Carotenoids ug /gm	63.6±0.17
Total Terpens conc. mg (Limonene)/gm	58.2±0.01
Total Alkaloid (mg/gm)	29.5±0.04
Total saponin content conc (mg AE/ gm)	42.05±0.4
Total Tannins conc.mg (TanE)/gm	59.5±0.1

Effect of sambong leaves extract on urinalysis

Table 3 shows the effect of sambong (Blumea balsamifera) leaves extract on urinalysis parameters in cats suffering from feline lower urinary tract disease (FLUTD). Diseased cats had highly acidic urine with a mean pH of 5.41, while both treatment groups showed significantly increased urine pH values after treatment. Cats treated with urinary alkalinizer alone had the highest urine pH (7.32), while cats treated with sambong extract plus urinary alkalinizer also showed marked improvement (7.20). This indicates that both treatments were effective in correcting urine acidity associated with FLUTD. In contrast, urine specific gravity did not differ significantly among groups, indicating that hydration status and urine concentration remained relatively stable throughout treatment.

Table 4 and Figure 3 demonstrate the abundance of amorphous urates before and after treatment. Diseased cats initially showed high levels of urate crystals, with most cases classified as +++ or ++. After treatment, cats receiving urinary alkalinizer alone showed partial improvement,

Table 2: GC report of *Blumea balsamifera* (Sambong).

Peak	RT	Name	Area sum %
1	22.377	Myristic acid	4.2
2	27.026	cis-10-pentadecenoic acid	0.43
3	28.369	Palmitic acid	31.6
4	29.537	Palmitoleic acid	0.76
5	31.13	Margaric acid	0.32
6	32.228	cis-10-Heptadecenoic acid	2.66
7	33.891	Stearic acid	19.61
8	34.444	Elaidic acid	2.79
9	34.773	Oleic acid	30.63
10	36.469	Linoleic acid	1.09
11	38.602	Linolenic acid	0.17
12	39.028	Arachidic acid	0.76
13	41.422	Heneicosanoic acid	2.6
14	43.296	*cis*-11,14,17-Eicosatrienoic acid	0.66
15	43.9	Behenic acid	0.19
16	44.524	Erucic acid	0.1
17	45.362	EPA	0.45
18	46.226	Tricosanoic acid	0.05
19	48.492	Lignoceric acid	0.14
20	50.597	DHA	0.78

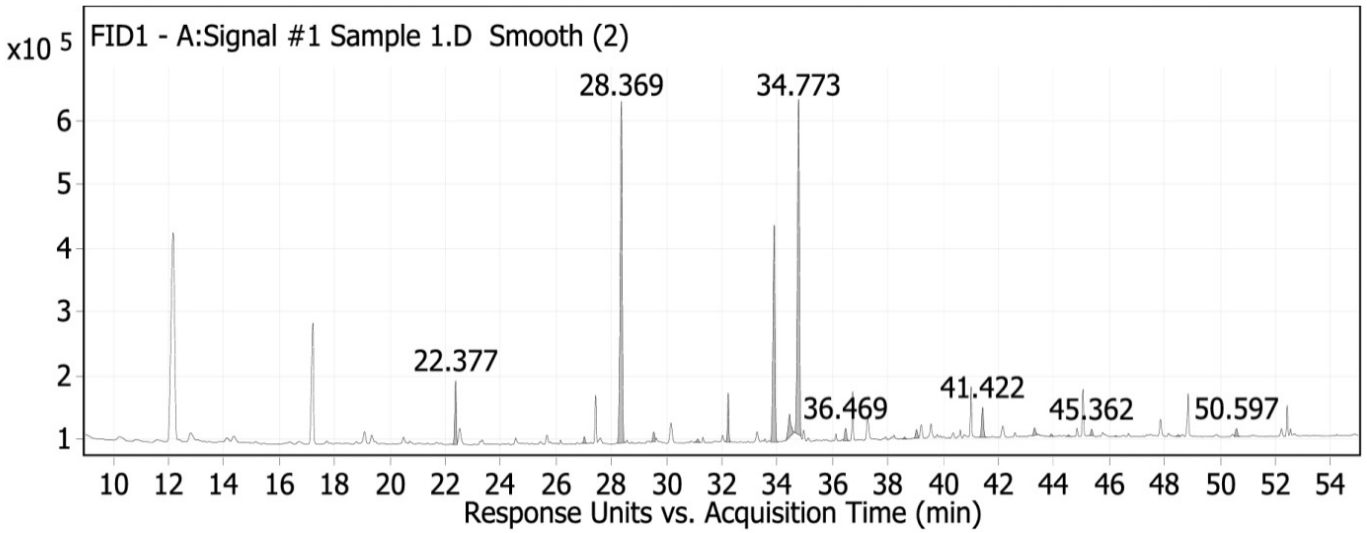


Figure 1: GC analysis report for *Blumea balsamifera (Sambong).*

Table 3: Effect of sambong leaves extract on urinalysis.

Variables	Diseased (n=10)	Treated		P value at 95% level of confidence
		Urinary alkalinizer (n=5)	Sambong extract plus urinary alkalinizer (n=5)	
Urine pH	5.41 ± 0.10 b	7.32 ± 0.09 a	7.20 ± 0.06 a	0.00
Specific gravity	1.017 ± 0.01 a	1.016 ± 0.01 a	1.015 ± 0.01 a	0.336

*Values having different lowercase letters within the same row are significantly different at *P* value less than 0.05

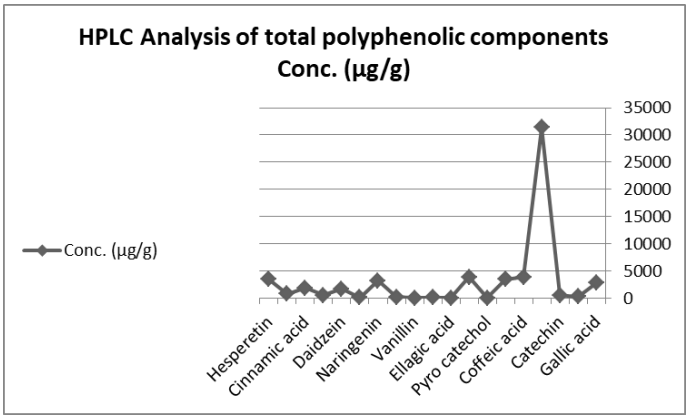


Figure 2: HPLC Analysis of total polyphenolic components Conc. (µg/g) for *Blumea balsamifera (Sambong).*

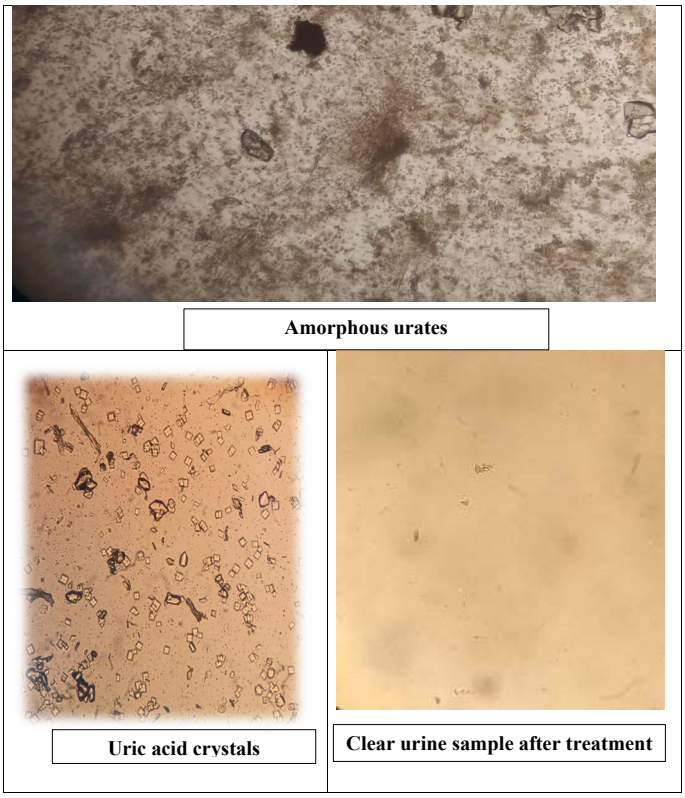


Figure 3: Presence of amorphous urates and uric acid crystals in urine samples of FLUTD cats before treatment and their absence after treatment.

Table 4: Abundance of amorphous urates before and after treatment.

Abundance of amorphous urates	Diseased (n=10)	Treated	
		Urinary alkalinizer (n=5)	Sambong extract plus urinary alkalinizer (n=5)
+++	6/10	-	-
++	3/10	-	-
+	1/10	2/5	-
Nil	-	3/5	5/5

as some cats still had low levels of crystals (+). However, cats treated with sambong extract combined with urinary alkalinizer showed complete disappearance of amorphous urates in all animals. These findings suggest that sambong extract may enhance the effectiveness of urinary alkalinization in dissolving or preventing urate crystal formation.

Effect of sambong leaves extract on liver and kidney functions

Table 5 presents the effect of treatment on liver and kidney function parameters. GPT levels showed no significant differences among groups, indicating that neither treatment caused detectable liver damage. Blood urea nitrogen (BUN) levels were significantly reduced in both treated groups compared to diseased cats, suggesting improvement in kidney function after treatment. Creatinine levels also showed significant improvement, particularly in cats treated with sambong extract plus urinary alkalinizer, which had the lowest creatinine values among all groups. These findings indicate that sambong extract may contribute to better renal function recovery in cats affected with FLUTD.

Table 5: Effect of sambong leaves extract on liver and kidney functions.

*Variables	Diseased (n=10)	Treated		P value at 95% confidence intervals
		Urinary alkalinizer (n=5)	Sambong extract plus urinary alkalinizer (n=5)	
GPT	54.20±4.70a	40.00±5.11a	62.40 ± 23.04 a	0.518
BUN	27.10±1.41a	21.60±1.73b	21.00 ± 0.75 b	0.02
Creatinine	1.35±0.05b	1.43±0.08a	0.93 ± 0.02 b	0.00

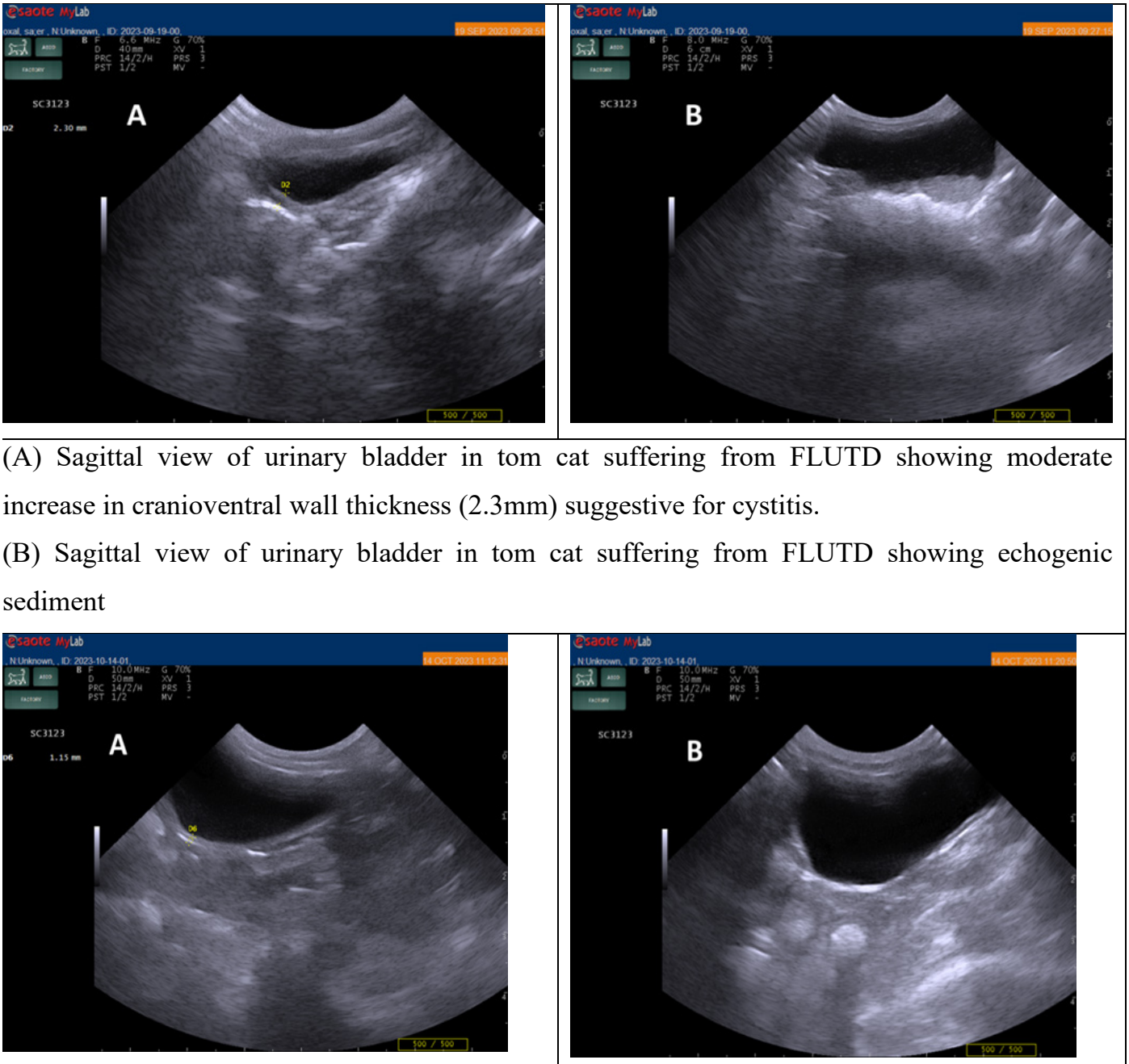
*Values having different lowercase letters within the same row are significantly different at *P* value less than 0.05

Ultrasonographic findings

Figure 4 shows ultrasonographic examination which revealed marked improvement in cats treated with sambong extract combined with urinary alkalinizer. All four cystitis cases in Group 2 showed normal urinary bladder wall thickness and echogenicity after treatment, with only minute residual crystals detected. In contrast, only one case in Group 1 returned to normal condition, while the remaining cats continued to exhibit mild to moderate cystitis characterized by bladder wall thickening and persistent urinary precipitates. These findings support the therapeutic potential of sambong extract in improving bladder health and reducing urinary sediment in cats with FLUTD.

DISCUSSION

Sambong, also known as camphor, weed or Indian fleabane, is a plant that has been used in traditional medicine for its therapeutic properties, including its effects on the urinary tract.



(A) Sagittal view of urinary bladder in tom cat suffering from FLUTD showing moderate increase in cranioventral wall thickness (2.3mm) suggestive for cystitis.

(B) Sagittal view of urinary bladder in tom cat suffering from FLUTD showing echogenic sediment

Sagittal view of urinary bladder in tom cats after treatment showing normal bladder wall thickness (1.15 mm) (A) and clear anechoic urine (B).

Figure 4: Ultrasonographic findings.

Sambong has been shown to have diuretic properties, meaning it can increase urine output and help flush out the urinary system (Hernandez, 2008; Hsieh, 2012). The plant also exhibits anti-inflammatory effects, which can be beneficial for conditions affecting the urinary tract, such as urinary tract infections (UTIs) (Hamid, 2015; Xu, 2015).

Sambong extracts have demonstrated antimicrobial activity against a range of bacteria, including those commonly associated with UTIs, such as Escherichia coli and Klebsiella pneumoniae (Thaweboon and Thaweboon, 2009; Chanda *et al.*, 2011).

This antimicrobial property can help in the management and prevention of UTIs (Pereira, 2004). Sambong has been studied for its potential to inhibit the formation of kidney stones, particularly calcium oxalate stones (Grases, *et al.*, 2009; Aggarwal, 2013). The plant's diuretic and anti-inflammatory effects, as well as its ability to inhibit the crystallization of stone-forming compounds, may contribute to its kidney stone-preventing properties (Khan,, 2014; Zeng *et al.*, 2020).

Sambong has been traditionally used to treat various urinary tract and bladder-related conditions, such as urinary incontinence, bladder irritation, and prostate enlargement (benign prostatic hyperplasia) (Maridass and Ghantikumar 2008; Balangcod, *et al*., 2012). Some studies have suggested that sambong may have a positive impact on bladder and prostate function, though more research is needed in this area (Jaradat, *et al*., 2016).

Sambong exhibits diuretic properties, which can help increase urine output and facilitate the flushing of the urinary system (Hamid, 2015). The plant's anti-inflammatory effects may also contribute to its ability to prevent and manage kidney and urinary stones formation (Jaradat *et al*., 2016).

Sambong has been shown to increase urinary pH and decrease the levels of stone-forming compounds, such as oxalate and uric acid (Hamid, 2015; Xu, 2015).

Sambong has been shown to increase urine pH and reduce the levels of stone-forming compounds, such as oxalate and uric acid, in various animal models (Bonjean, 2012; Huang, 2015). Some research on the use of sambong and related herbal extracts in feline patients with urinary tract disorders has shown promising results (Piquette, 2017).

Urinary alkalinizers, such as citrate and bicarbonate, can help prevent urinary stone formation by increasing the pH of urine, reducing the risk of crystal precipitation (Sakhaee, 2008). Maintaining a slightly alkaline urine pH inhibits the formation of certain types of kidney stones, such as uric acid and cystine stones (Pak, 1998).

Several studies have suggested that sambong (*Blumea balsamifera*) may have a synergistic effect when combined with urinary alkalinizers for the prevention and management of kidney and urinary stones (Hernandez, 2008; Huang, 2015).

The combination of sambong's alkalinizing effects and the ability of urinary alkalinizers to maintain an optimal urine pH can effectively prevent the nucleation, growth, and aggregation of urinary stones (Hsieh, 2012).

Another study found that the co-administration of sambong and potassium citrate led to a greater decrease in the formation and growth of calcium oxalate crystals in the kidneys of hyperoxaluric rats (Balangcod *et al*., 2012).

In an animal study, the combination of sambong extract and potassium citrate demonstrated a more significant reduction in urinary oxalate levels and calcium oxalate crystal deposition compared to either treatment alone (Jaradat *et al*., 2016).

While the synergistic effects of sambong and urinary alkalinizers have not been directly evaluated in cats, the available evidence from other animal studies suggests this combination could be a potential complementary therapy for the prevention and management of feline urolithiasis.

Feline lower urinary tract disease (FLUTD) is a multifactorial syndrome commonly associated with cystitis, crystalluria, urethral obstruction, and urinary sediment formation. Alterations in urine pH, urinary concentration, and inflammatory changes within the urinary bladder are considered major contributors to crystal aggregation and bladder irritation.

The present results demonstrated the potential beneficial effect of Sambong (*Blumea balsamifera*) leaves extract when administered in combination with urinary alkalinizer in cats suffering from cystitis and amorphous urates. The discussion below interprets the urinalysis, biochemical findings, and ultrasonographic changes considering current scientific knowledge.

The urinalysis results revealed a marked and statistically significant increase in urine pH in treated groups compared with diseased untreated cats ($P < 0.05$). Diseased cats exhibited acidic urine (5.41 ± 0.10), whereas cats receiving urinary alkalinizer alone or Sambong extract combined with urinary alkalinizer showed urine pH values approaching neutrality (7.32 ± 0.09 and 7.20 ± 0.06, respectively). These findings are clinically significant because acidic urine promotes precipitation of urate crystals, while controlled alkalinization improves urate solubility and decreases crystal aggregation. Previous studies have demonstrated that manipulation of urinary pH represents a cornerstone in the management of FLUTD and crystal-associated cystitis (Kerr, 2013; Westropp *et al*., 2019). The improvement in urine pH observed in the current study may therefore explain the reduction in amorphous urates following treatment. These findings agreed with Kerr (2013) and Westropp *et al*. (2019), who reported that urinary alkalinization reduces urate crystal precipitation and improves lower urinary tract health in cats.

The abundance of amorphous urates was markedly reduced after treatment. Before therapy, most diseased cats showed moderate to severe crystal abundance (+++ and ++), whereas after administration of Sambong extract plus urinary alkalinizer, all treated animals became free from detectable crystals. This observation suggests that Sambong may possess litholytic, diuretic, and/or anti-inflammatory activities that enhance clearance of urinary sediments. This observation agrees with previous herbal medicine studies describing the litholytic and diuretic effects of medicinal plants used for urinary disorders. Increased urine dilution may also reduce supersaturation of crystal-forming

compounds and minimize mucosal irritation.

Specific gravity did not differ significantly among groups, indicating that treatment mainly affected urine chemistry rather than kidney concentrating ability. Nevertheless, the slight reduction in urine specific gravity after treatment could still contribute to reduced crystal formation because dilute urine lowers the concentration of minerals and metabolites responsible for precipitation. Similar observations were reported in nutritional and therapeutic studies investigating FLUTD management through dietary and urinary modifications (He *et al*., 2022). Therefore, the present findings are consistent with the results of He *et al*. (2022), who emphasized the importance of urine dilution and urinary chemistry modification in reducing crystal formation.

Biochemical analysis demonstrated significant improvement in renal function markers after treatment. Blood urea nitrogen (BUN) values decreased significantly in both treated groups compared with diseased animals ($P < 0.05$), suggesting improvement in renal perfusion and urinary excretion. Elevated BUN in cats with FLUTD may occur secondary to dehydration, urinary obstruction, or impaired renal clearance associated with lower urinary tract inflammation. Reduction of BUN after therapy therefore indicates restoration of urinary flow and improvement of urinary tract function. These findings agree with Westropp *et al*. (2019), who reported that improvement of urinary obstruction and inflammation contributes to normalization of renal biomarkers in cats with FLUTD.

Serum creatinine concentrations also showed notable changes. Cats receiving Sambong extract plus urinary alkalinizer demonstrated significantly lower creatinine values compared with untreated diseased cats, indicating improved renal filtration and decreased post-renal compromise. In obstructive or inflammatory urinary diseases, creatinine often accumulates due to reduced urine outflow and impaired glomerular filtration. The reduction observed in the treated group supports the hypothesis that Sambong extract contributed to alleviation of urinary obstruction and inflammatory changes within the urinary bladder. This result is consistent with studies reporting improvement of creatinine levels following successful management of feline urinary obstruction and cystitis.

Conversely, GPT (ALT) values did not differ significantly among groups, suggesting that administration of Sambong extract did not induce hepatocellular injury. This finding is important because herbal preparations may sometimes produce hepatic adverse effects if administered at inappropriate doses. The absence of significant changes in GPT supports the hepatic safety of the treatment protocol used in this study. This finding agrees with previous reports indicating that properly administered herbal therapies may improve urinary disorders without inducing significant hepatotoxicity. Preservation of liver enzyme activity alongside improvement of renal biomarkers indicates that Sambong extract may be considered safe for application in cats under the investigated conditions.

Ultrasonographic examination provided additional evidence supporting the therapeutic effect of Sambong extract. Before treatment, affected cats demonstrated thickening of the urinary bladder wall and echogenic urinary sediment, findings that are characteristic of cystitis and crystalluria. Increased bladder wall thickness is commonly associated with inflammatory edema and chronic irritation of the bladder mucosa, whereas echogenic sediment represents crystals, cellular debris, inflammatory exudate, or precipitated minerals within urine.

Following treatment, ultrasonography revealed normalization of bladder wall thickness and disappearance of echogenic sediments in most cases treated with Sambong extract combined with urinary alkalinizer. The bladder wall thickness decreased to approximately 1.15 mm with restoration of clear anechoic urine, indicating substantial resolution of inflammation and urinary sedimentation. These ultrasonographic findings correlate strongly with the urinalysis results showing elimination of amorphous urates. Similar ultrasonographic improvements following successful treatment of cystitis have been described by Taylor *et al*. (2025), supporting the current observations.

Interestingly, only one case treated with urinary alkalinizer alone returned to normal ultrasonographic appearance, whereas the remaining cases continued to exhibit mild to moderate cystitis. This difference may indicate an additional anti-inflammatory or protective effect of Sambong extract on the bladder mucosa beyond simple urine alkalinization. Previous reports on FLUTD have emphasized that chronic inflammation of the urinary bladder contributes significantly to recurrence of clinical signs and persistence of urinary sediment (Taylor *et al*., 2025). Therefore, the marked improvement in ultrasonographic findings observed in the Sambong-treated group may represent an important therapeutic advantage. These findings agree with Taylor *et al*. (2025), who reported that reduction of bladder inflammation is associated with improved clinical recovery and decreased recurrence of FLUTD.

CONCLUSION

In conclusion, Sambong (*Blumea balsamifera*) leaves extract combined with a urinary alkalinizer is a safe, effective adjunct treatment for cats with FLUTD (cystitis and amorphous urates). It significantly improves urine pH, reduces crystals, enhances kidney parameters, and

aids bladder recovery on ultrasound, without causing liver toxicity.

RECOMMENDATIONS AND LIMITATIONS

It is recommended to include a 1% Sambong leaves extract for treatment of cystitis and amorphous urates involved in non-obstructive cases of FLUTD. However, these findings are preliminary and limited by the available number of clinical cases. So, further studies are recommended on numerous clinical cases of FLUTD and urolithiasis in other animal species. Additional research is also indicated to evaluate the therapeutic effect of different parts of the plant extract, dosages and drug combinations.

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NOVELTY STATEMENT

Inclusion of sambong leaves extract in the treatment protocol of cystitis and amorphous urates involved in FLUTD has a promising positive effect as an innovative safe medication in cats.

AUTHOR'S CONTRIBUTION

Saber put the concept and the protocol of work, Orabi and Elkhiat collected the samples and applied ultrasonographic examination.

Mousa and El-Gaffary applied the serum and urine analyses, Youssef performed and interpret the HPLC and GC analyses, Saber and Khalphallah analysed the obtained results statistically.

Saber and Salib wrote the manuscript and Orabi revised the manuscript.

Generative AI and AI assisted technology statement

The authors declare that no generative AI and AI assisted technology was used in the creation of this manuscript.

Conflict of interest

The authors have declared no conflict of interest.

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