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Research Article

Evaluation of the Diuretic and Electrolyte Excretion Effects of *Syzygium Cumini* Fruit Pulp Extract in Experimental Rats

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Background: Syzygium cumini fruit pulp is traditionally used for managing fluid retention; however, its diuretic potential and underlying mechanisms remain inadequately explored. Objective: The current investigation sought to assess the methanolic extract of Syzygium cumini fruit pulp (MESCFP) in Wistar rats for its diuretic, natriuretic, and mechanistic effects. Methods: MESCFP was prepared by cold percolation and subjected to preliminary phytochemical screening. Wistar rats were divided into groups and given furosemide (10 mg/kg) and MESCFP (150 and 300 mg/kg, p.o.), Urea (1 g/kg), or vehicle. To assess prostaglandin involvement, Lornoxicam (3 mg/kg) was administered alone and in combination with MESCFP or furosemide. Urine was collected at 5 h, 24 h, and 15 h (mechanistic study) to evaluate volume, electrolyte excretion (Na^+, K^+, Cl^-), diuretic indices, and carbonic anhydrase activity. Results: Urine production was significantly and dose-dependently increased by MESCFP, with the 300 mg/kg dose showing effects comparable to furosemide, particularly at 24 h. The extract significantly enhanced sodium and chloride excretion while producing relatively lower potassium loss, indicating a potassium-sparing effect. Saluretic and natriuretic indices were markedly increased, and carbonic anhydrase inhibition ratios suggested mild enzyme inhibition. Co-administration with lornoxicam attenuated the diuretic and natriuretic effects of MESCFP, indicating partial dependence on prostaglandin-mediated pathways. Conclusion: MESCFP exhibits significant diuretic, natriuretic, and saluretic activities with a favorable potassium-sparing profile. Its mechanism appears to involve prostaglandin-mediated pathways along with mild carbonic anhydrase inhibition. These findings support the potential of Syzygium cumini fruit pulp as a natural diuretic and warrant further studies for isolation of active constituents and clinical evaluation.

Keywords: Syzygium cumini, diuretic activity, natriuresis, saluresis, prostaglandins, carbonic anhydrase.

INTRODUCTION

Diuretics are drugs that increase the amount of urine produced by improving the excretion of water and electrolytes, mainly by preventing the renal tubules from reabsorbing sodium. They are frequently used in the treatment of diseases such as hypertension, congestive heart failure, renal problems, and edema and are necessary for preserving fluid and electrolyte balance (1,2). Looking for safer and more effective alternatives is necessary because, even though their therapeutic significance, currently available diuretics are commonly linked to side effects such as electrolyte imbalance, metabolic disorders, and renal problems (2). Throughout many decades, medicinal plants have been an important source of therapeutic agents, providing a variety of bioactive compounds with possible pharmacological benefits (3). Among these, Syzygium cumini, also referred to as jamun, is a historically significant medicinal plant that is

utilized in many medical systems to treat gastrointestinal disorders, diabetes, and inflammation (4,5). The fruit pulp is particularly rich in phytoconstituents such as flavonoids, phenolics, and tannins, which are known to exhibit diverse biological activities (6,7). Although *Syzygium cumini* has been extensively studied for its antidiabetic and antioxidant properties, limited scientific evidence is available regarding its potential diuretic activity. Considering the presence of bioactive phytochemicals that may influence renal function and electrolyte balance, it is hypothesized that the fruit pulp extract may exhibit significant diuretic effects (8,9). Therefore, in order to assess the diuretic activity of methanolic extract of Syzygium cumini fruit pulp (MESCFP) in experimental models and investigate its potential mechanism of action by measuring urine output, electrolyte excretion (Na^+, K^+, Cl^-), and associated diuretic indices, the current study was conducted.

MATERIALS & METHODS

Collection of plant material

Syzygium cumini fresh fruits were collected at Kalaburagi, Karnataka, India (15.32°N, 75.83°E). Dr. Pratibha G. Sangapurkar, a professor and chairman of the Department of P.G. Studies and Research in Botany at Gulbarga University in Kalaburagi, verified and taxonomically identified the plant material. For future reference, a voucher specimen (HGUK 217) was placed in the scientific herbarium.

Preparation of Fruit Pulp

The collected fruits were thoroughly washed with distilled water to remove adhering impurities. The pulp was carefully separated from the seeds, rewashed, and air-dried at room temperature. The dried pulp was then coarsely powdered and stored in an airtight container until further use.

Preparation of plant extract

The powdered material was initially defatted using hexane to remove lipophilic constituents. After filtration, the hexane fraction was discarded, and the defatted residue was subjected to extraction. Cold percolation was used for extraction with methanol as a solvent. To produce an effective extraction, the defatted powder was soaked in methanol at a 1:5 (w/v) ratio for 72 hours while shaking periodically. The mixture was then filtered through Whatman's filter paper, and the filtrate was concentrated under reduced pressure with a rotary evaporator to get the methanolic extract of Syzygium cumini fruit pulp (MESCFP) (10).

Phytochemistry Analysis

A preliminary qualitative phytochemical screening of the methanolic extract of Syzygium cumini fruit pulp (MESCFP) was performed using established methods to detect essential phytoconstituents such as alkaloids, flavonoids, tannins, saponins, glycosides, and anthraquinones (11).

Animals & Ethics

Wistar albino rats weighing between 150 and 200 grams were maintained under standard laboratory conditions with unlimited access to food and water. All experimental protocols followed CPCSEA guidelines and were approved by the Institutional Animal Ethics Committee (HKES/MTRIPS/IAEC/164/2024-25) (12).

Acute Oral Toxicity

Acute oral toxicity of the methanolic extract of *Syzygium cumini* was assessed according to OECD guideline 425 (13). Animals were observed for mortality and clinical signs of toxicity for 14 days following oral administration of the extract.

Diuretic Activity

Experimental Animals and Housing

Wistar albino rats were divided into groups of six each (n = 6). To get comfortable, the animals were housed individually in metabolic cages for 24 hours before the experiment. The cages had wire mesh bottoms and funnel systems for collecting quantitative pee, as well as stainless-steel sieves for separating feces. Animals were fasted for 18 hours before the experiment and given free access to water. Before administering the test and usual medicines, the urine bladder was gently emptied by exerting light pressure to the pelvic region. All animals were given normal

saline orally to ensure a consistent water and electrolyte load.

Experimental design

The animals were separated into five groups:

- Group I (Control) administered 0.1% sodium carboxymethylcellulose (Na-CMC), p.o.
- Group II (Urea) administered urea (1 g/kg, p.o).
- Group III (Standard) administered furosemide (10 mg/kg p.o.).
- Group IV (MESCFP Low Dose) received 150 mg/kg of methanolic extract of Syzygium cumini fruit pulp (p.o.).
- Group V (MESCFP High Dose) administered MESCFP (300 mg/kg, p.o).

Urine samples were collected at 5 and 24 hours after medication administration. Urine volume was evaluated to assess sodium (Na^+), potassium (K^+), and chloride (Cl^-) contents. Sodium and potassium levels were determined using a flame photometer. Lipschitz et al. (14) suggested a method for determining diuretic activity.

Evaluation of Diuretic Activity

The following parameters have been calculated:

- Urinary excretion (%) = (Total urine output / Total liquid provided) x 100 (15)
- Diuretic action is calculated as test group urine excretion divided by control group urine excretion (15).
- Diuretic activity is calculated by dividing the diuretic action of the test medication by that of urea or furosemide. (15)

Natriuretic activity was determined as the ratio of Na^+ and K^+.Saluretic activity was calculated as the sum of Na^+ and Cl^- excretions. The inhibition of carbonic anhydrase was measured using the ratio $Cl^-/(Na^+ + K^+)$ (16).All treatment groups were given their diuretic and electrolyte excretion indices measured.

Diuretic Activity with Prostaglandin Involvement

Animals were divided into six groups (n = 6). Prior to treatment, all animals received normal saline (0.9% NaCl, 25 mL/kg, p.o.).

Experimental Design

- Group I (Control) received 0.1% Na-CMC, p.o.
- Group II (Lornoxicam): Lornoxicam (3 mg/kg, PO)
- Group III (MESCFP): 300 mg/kg, p.o.
- Group IV (MESCFP + Lornoxicam): MESCFP (300 mg/kg) + lornoxicam (3 mg/kg) given orally.
- Group V (Standard) administered furosemide (10 mg/kg, p.o.).
- Group VI (Furosemide + Lornoxicam): Furosemide (10 mg/kg) and lornoxicam (3 mg/kg), p.o.

The urine was collected for 15 hours, and the total Urine volume was recorded. Urinary electrolyte concentrations (Na^+, K^+, and Cl^-) were determined and interpreted as mmol/L (17).

Statistical analysis

All experimental data were presented as mean ± SEM. One-way ANOVA was employed for statistical analysis, followed by Dunnett's multiple comparison test. A p-value of <0.05 was considered to be statistically significant (18).

RESULTS

Percentage Yield

The methanolic extract of Syzygium cumini fruit pulp (MESCFP) has resulted in a percentage yield of 10.40% w/w.

Preliminary phytochemical investigations

Preliminary qualitative phytochemical examination of Syzygium cumini fruit pulp (MESCFP) revealed the presence of alkaloids, flavonoids, saponins, tannins, glycosides, and anthraquinones (Table 1).

Table 1: Chemical constituents present in methanolic extract of Syzygium cumini fruits pulp

Test	MESCFP
Alkaloids	+
Flavonoids	+
Saponins	+
Tannins	+
Glycosides	+
Anthraquinones	+

Diuretic Activity

Effect on Urine Volume, Urinary Excretion, Diuretic Action, and Diuretic Activity

Effects on urine volume, excretion, diuretic effect, and activity.

Table 2 shows how the methanolic extract of Syzygium cumini fruit pulp (MESCFP) affects urine volume, urinary excretion, diuretic action, and diuretic activity.

Table 2: Effect of MESCFP on Urine Volume, Urinary Excretion, Diuretic Action and Diuretic Activity

Treatment	Dose (mg/kg)	Urine Volume (mL) 5 h	Urine Volume (mL) 24 h	Urinary Excretion (%) 5 h	Urinary Excretion (%) 24 h	Diuretic Action 5 h	Diuretic Action 24 h	Diuretic Activity 5 h	Diuretic Activity 24 h
Control	0.1% Na-CMC	0.621 ± 0.007	1.073 ± 0.013	21.30	36.80	–	–	–	–
Urea	1g/kg	1.143 ± 0.009****	1.983 ± 0.140****	34.23	97.56	1.38	0.96	–	–
Furosemide	10mg/kg	2.298 ± 0.010****	3.672 ± 0.012****	57.76	101.80	3.69	3.41	2.00	3.55
MESCFP I	150mg/kg	0.900 ± 0.089**	1.567 ± 0.114**	31.30	84.57	1.75	2.72	0.94	2.82
MESCFP II	300mg/kg	1.893 ± 0.061***	3.513 ± 0.026***	49.05	91.40	3.04	3.27	1.65	3.39

MESCFP induced a dose-dependent increase in urine output in normal rats. MESCFP at 150 mg/kg significantly increased urine volume (0.900 ± 0.089 mL at 5 h and 1.567 ± 0.114 mL at 24 h) compared to the control group (0.621 ± 0.007 mL and 1.073 ± 0.013 mL, respectively, $p < 0.01$). The respective urine excretion rates were 31.30% and 84.57% at 5 and 24 hours, respectively. The diuretic action was 1.75 and 2.72, while the diuretic activity was 0.94 and 2.82 at 5 and 24 hours, respectively. At a higher dose (300 mg/kg), MESCFP significantly increased urine production (1.893 ± 0.061 mL at 5 h and 3.513 ± 0.026 mL at 24 h) compared to the control ($p < 0.001$). Urinary excretion rates were 49.05% and 91.40%, respectively. The diuretic action was 3.04 (5 h) and 3.27 (24 h), with diuretic activity of 1.65 and 3.39, respectively. The standard drug, Furosemide (10 mg/kg), produced the highest urine volume (2.298 ± 0.010 mL at 5 h and 3.672 ± 0.012 mL at 24 h), which was extremely significant ($p < 0.0001$) compared to control. The urinary excretion values were 57.76% and 101.8%, confirming its potent diuretic effect. Urine output was also significantly higher in urea-treated animals (1.143 ± 0.009 mL at 5 hours and

1.983 ± 0.140 mL at 24 hours) than in the control group ($p < 0.0001$). Overall, MESCFP revealed strong and dosage-dependent diuretic efficacy; at 24 hours, the effects of the higher dose (300 mg/kg) were similar to those of furosemide.

Effect on Urinary Electrolyte Excretion

Table 3 indicates that the methanolic extract of Syzygium cumini fruit pulp (MESCFP) affects the excretion of electrolytes in the urine.

Table 3: Electrolyte's excretion(mmol/L), of methanolic extract of Syzygium cumini fruit pulp in normal rats at 5 and 24th hour by oral administration.

Treatment	Dose(mg/kg)	Electrolyte excretion (mmol/L)					
		Na^+		K+		Cl^-	
		5thhr	**24thhr**	**5thhr**	**24thhr**	**5thhr**	**24thhr**
Control	0.1% Na CMC	124.5±1.147	101.2±0.477	*51.83*±0.980	*71.67*±0.614	*91.17*±0.980	*88.17*±1.515
Urea	1g/kg	150.0±6.234*	109.8±1.249****	*79.00*±0.856****	*202.7*±0.714****	*134.3*±0.954****	*121.7*±2.334****
Furosemide	10mg/kg	218.3±8.800****	142.0±2.206****	*59.50*±2.604**	*102.8*±0.945****	*120.8*±1.222****	*119.5*±0.223****
MESCFP I	150mg/kg	171.0±8.903***	123±1.265***	*54.00*±1.862**	*86.50*±0.839***	*97.17*±0.909**	*96.17*±0.654***
MESCFP II	300mg/kg	*194.4*±4.129****	131.5±1.025****	*55.50*±1.204***	*95.67*±0.892****	*100.8*±1.376***	*112*±1.406****

Urinary sodium (Na^+), potassium (K^+), and chloride (Cl^-) excretion levels were relatively low in the control group at both 5 and 24 hours.

Urea (1 g/kg) resulted in a significant improvement in electrolyte excretion. A marked elevation in K^+ excretion was observed (79.00 ± 0.856 mmol/L at 5 h and 202.7 ± 0.714 mmol/L at 24 h), which was highly significant ($p < 0.0001$). Similarly, Cl^- excretion (134.3 ± 0.954 and 121.7 ± 2.334 mmol/L) and Na^+ excretion (109.8 ± 1.249 mmol/L at 24 h) were significantly increased ($p < 0.0001$), indicating its osmotic diuretic effect. The standard drug, Furosemide (10 mg/kg), significantly increased Na^+ excretion (218.3 ± 8.800 and 142.0 ± 2.206 mmol/L at 5 h and 24 h, respectively; $p < 0.0001$). It also produced a moderate but significant increase in K^+ excretion (59.50 ± 2.604 mmol/L, $p < 0.01$ at 5 h; 102.8 ± 0.945 mmol/L, $p < 0.0001$ at 24 h) and Cl^- excretion ($p < 0.0001$), consistent with its loop diuretic action. MESCFP at 150 mg/kg (MESCFP I) showed a significant increase in Na^+ excretion (171.0 ± 8.903 and 123 ± 1.265 mmol/L; $p < 0.001$) and Cl^- excretion (97.17 ± 0.909 mmol/L, $p < 0.01$ at 5 h; 96.17 ± 0.654 mmol/L, $p < 0.001$ at 24 h). A moderate increase in K^+ excretion was also observed (54.00 ± 1.862 mmol/L, $p < 0.01$ at 5 h; 86.50 ± 0.839 mmol/L, $p < 0.001$ at 24 h). At the higher dose (300 mg/kg), MESCFP (MESCFP II) produced a more pronounced increase in Na^+ excretion (194.4 ± 4.129 and 131.5 ± 1.025 mmol/L; $p < 0.0001$) and Cl^- excretion (100.8 ± 1.376 mmol/L, $p < 0.001$ at 5 h; 112 ± 1.406 mmol/L, $p < 0.0001$ at 24 h). K^+ excretion was also significantly increased (55.50 ± 1.204 mmol/L, $p < 0.001$ at 5 h; 95.67 ± 0.892 mmol/L, $p < 0.0001$ at 24 h). Overall, MESCFP significantly enhanced urinary electrolyte excretion in a dose-dependent manner, particularly for Na^+ and Cl^- ions. The higher dose (300 mg/kg) exhibited effects comparable to Furosemide, indicating prominent natriuretic and chloruretic activity.

Electrolyte Excretion Index and Diuretic Index

Table 4 indicates the electrolyte excretion indices (Na^+, K^+, and Cl^-) and diuretic index of the methanolic extract of Syzygium cumini fruit pulp (MESCFP) at 5 and 24 hours.

Table 4: Effect of methanolic extract of *Syzygium cumini fruit pulp* on diuretic index and Electrolytic excretion index at 5 and 24th hour of urine collection

Treatment	Dose (mg/ kg)	diuretic index		Electrolytic excretion index					
				Na^+		K+		Cl^-	
		5thhr	24thhr	5thhr	24thhr	5thhr	24thhr	5thhr	24thhr
Control	0.1% Na CMC	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Urea	1g/kg	1.84	1.84	1.20	1.08	1.52	2.82	1.47	1.38
Furosemide	10mg/kg	3.70	3.42	1.75	1.40	1.14	1.43	1.32	1.35
MESCFP I	150mg/kg	1.44	1.46	1.73	1.21	1.04	1.20	1.06	1.09
MESCFP II	300mg/kg	3.04	3.27	1.56	1.29	1.07	1.33	1.10	1.27

At 5 h, Furosemide (10 mg/kg) exhibited the highest diuretic index (3.70), followed by MESCFP II (300 mg/kg; 3.04), urea (1.84), and MESCFP I (150 mg/kg; 1.44). A similar trend was observed at 24 h, where MESCFP II (3.27) maintained a diuretic response comparable to furosemide (3.42), indicating sustained activity.

The sodium excretion index was elevated in MESCFP-treated groups, with MESCFP I (1.73) and MESCFP II (1.56) at 5 h exceeding that of urea (1.20), suggesting a significant natriuretic effect. At 24 h, MESCFP II (1.29) and MESCFP I (1.21) continued to enhance sodium excretion, although to a lesser extent than furosemide (1.40).

Potassium excretion was highest in the urea-treated group (2.82 at 24 h), followed by furosemide (1.43), indicating pronounced kaliuresis. In contrast, MESCFP I (1.20) and MESCFP II (1.33) showed comparatively lower potassium excretion, suggesting a potassium-sparing effect.

Chloride excretion index was greatest with urea at both 5 h (1.47) and 24 h (1.38). MESCFP-treated groups demonstrated moderate increases (1.06–1.27), indicating balanced chloride excretion relative to standard treatments. Overall, MESCFP, particularly at 300 mg/kg, exhibited significant diuretic and natriuretic activity with relatively lower potassium loss, supporting its potential as a potassium-sparing diuretic.

Saluretic, Natriuretic, and Carbonic Anhydrase Activity

The combined electrolyte excretion indices of the methanolic extract of *Syzygium cumini* fruit pulp (MESCFP) are presented in (Table 5).

Table 5: Saluretic, Natriuretic, and CAI activity of methanolic extract of Syzygium cumini fruits pulp in normal rats at 5 and 24th hr by oral administration

Treatment	Dose(mg /kg)	Electrolyte excretion (mmol/L)					
		$Na^+ + Cl^-$ (Saluretic)		Na^+ / K^+(Natriuretic)		$Cl^-/(Na^+ + K^+)$ Carbonic Anhydrase Activity	
		5thhr	24thhr	5thhr	24thhr	5thhr	24thhr
Control	0.1%NaMC	*226.4*±1.030	*184.0*±2.295	*3.040*±0.012	*1.383*±0.007	*0.567*±0.003	*0.470*±0.002
Urea	1g/kg	*254.4*±2.713****	*223.7*±2.985****	*2.682*±0.020****	*1.072*±0.007****	*0.549*±0.003***	*0.495*±0.001****
Furosemide	10mg/kg	*317.6*±2.926****	*257.7*±1.892****	*2.477*±0.015****	*1.275*±0.005****	*0.506*±0.001****	*0.490*±0.001****
MESCFP I	150 mg/kg	*236.4*±1.166*	*196.8*±2.197**	*2.950*±0.021**	*1.345*±0.006**	*0.551*±0.002**	*0.479*±0.000***

MESCFP II	300 mg/kg	*307.4*±2.786 **	*239.8*±2.750 ***	*2.568*±0.014****	*1.288*±0.007 ***	*0.501*±0.002 ***	*0.483*±0.002 ****

At 5 h, Furosemide (10 mg/kg) produced the highest saluretic effect ($Na^+ + Cl^-$: 317.6 mmol/L), followed closely by MESCFP II (300 mg/kg; 307.4 mmol/L), indicating a pronounced saluretic response. MESCFP I and urea exhibited comparatively lower values (236.4 and 254.4 mmol/L, respectively). At 24 h, MESCFP II (239.8 mmol/L) maintained substantial saluretic activity, comparable to furosemide (257.7 mmol/L), suggesting a sustained effect.

The natriuretic index (Na^+/K^+ ratio) at 5 h was highest in the control group (3.04), followed by MESCFP I (2.95), whereas urea and furosemide showed lower ratios (2.68 and 2.47, respectively), indicative of increased potassium loss with standard treatments. At 24 h, MESCFP I (1.345) and MESCFP II (1.288) maintained relatively higher Na^+/K^+ ratios compared to urea (1.072), supporting a potassium-sparing effect.

The carbonic anhydrase inhibition index ($Cl^-/(Na^+ + K^+)$) was lowest in furosemide (0.506 at 5 h; 0.490 at 24 h) and MESCFP II (0.501 at 5 h; 0.483 at 24 h) compared to control (0.567 at 5 h; 0.470 at 24 h). This reduction suggests that MESCFP, particularly at higher dose, may exert mild carbonic anhydrase inhibitory activity, contributing to its diuretic effect. Overall, MESCFP demonstrated significant saluretic and natriuretic activity with relatively lower potassium loss and evidence of mild carbonic anhydrase inhibition, indicating a balanced and potentially safer diuretic profile.

Assessment of Diuretic Activity with Prostaglandin Involvement

Table 6 shows how the methanolic extract of Syzygium cumini fruit pulp (MESCFP) affects urine volume and electrolyte excretion both with and without Lornoxicam.

Table 6. Single-dose administration, with collection of urine for 15th hr after oral treatment with MESCFP, and study of involvement of prostaglandins in diuretic activity.

Treatment (dose)	Urinary volume (mL)	Na^+ (mmol/L)	K^+ (mmol/L)	Cl^- (mmol/L)
Control (0.9% NaCl, 25 mL/kg)	1.248 ± 0.105	147.5 ± 1.839	85.67 ± 1.978	70.33 ± 2.974
Lornoxicam (3 mg/kg)	1.055 ± 0.019*	124.0 ± 1.807**	53.17 ± 3.554**	46.33 ± 3.518*
MESCFP (300 mg/kg)	2.472 ± 0.102**	162.8 ± 2.960***	113.8 ± 4.159**	96.67 ± 5.149**
MESCFP + Lornoxicam	1.517 ± 0.124*	130 ± 6.506**	108.7 ± 3.095*	38.17 ± 2.442*
Furosemide (10 mg/kg)	3.633 ± 0.090****	170.2 ± 2.272****	118.2 ± 5.833***	110.3 ± 6.746****
Furosemide + Lornoxicam	3.167 ± 0.033***	154.5 ± 1.025***	39.17 ± 6.882**	90.83 ± 2.358***

Urinary Volume

The control group produced a mean urinary volume of 1.248 ± 0.105 mL. Lornoxicam alone significantly reduced urine output (1.055 ± 0.019 mL, $p < 0.05$), indicating an antidiuretic effect. MESCFP (300 mg/kg) significantly increased urine volume (2.472 ± 0.102 mL, $p < 0.01$), demonstrating pronounced diuretic activity. However, co-administration with lornoxicam reduced urine output (1.517 ± 0.124 mL), indicating partial antagonism. Furosemide (10 mg/kg) produced the highest diuresis (3.633 ± 0.090 mL, $p < 0.0001$), which was slightly reduced in combination with lornoxicam (3.167 ± 0.033 mL).

Sodium Excretion (Na^+)

Control animals excreted 147.5 ± 1.839 mmol/L of sodium. Lornoxicam significantly decreased sodium excretion (124.0 ± 1.807 mmol/L, $p < 0.01$). MESCFP significantly increased sodium excretion (162.8 ± 2.960 mmol/L, $p < 0.001$), whereas co-administration with lornoxicam reduced this effect (130 ± 6.506 mmol/L). Furosemide produced marked natriuresis (170.2 ± 2.272 mmol/L, $p < 0.0001$), which was moderately attenuated in the presence of lornoxicam (154.5 ± 1.025 mmol/L).

Potassium Excretion (K^+)

Control animals showed potassium excretion of 85.67 ± 1.978 mmol/L. Lornoxicam significantly reduced potassium levels (53.17 ± 3.554 mmol/L, $p < 0.01$). MESCFP increased potassium excretion (113.8 ± 4.159 mmol/L, $p < 0.01$), and this effect was largely maintained in combination with lornoxicam (108.7 ± 3.095 mmol/L). Furosemide induced the highest potassium excretion (118.2 ± 5.833 mmol/L, $p < 0.001$), whereas co-administration with lornoxicam markedly reduced potassium levels (39.17 ± 6.882 mmol/L).

Chloride Excretion (Cl^-)

Control animals excreted 70.33 ± 2.974 mmol/L of chloride. Lornoxicam significantly reduced chloride excretion (46.33 ± 3.518 mmol/L, $p < 0.05$). MESCFP significantly increased chloride levels (96.67 ± 5.149 mmol/L, $p < 0.01$), while co-administration with lornoxicam resulted in a marked reduction (38.17 ± 2.442 mmol/L). Furosemide produced the highest chloride excretion (110.3 ± 6.746 mmol/L, $p < 0.0001$), which was slightly reduced when combined with lornoxicam (90.83 ± 2.358 mmol/L).

DISCUSSION

The present study shows, Increased urine output and improved electrolyte excretion in experimental rats showed that the methanolic extract of Syzygium cumini fruit pulp (MESCFP) has strong diuretic action (1). The effects were dosage-dependent, with the higher dose (300 mg/kg) exhibiting activity similar to that of the common diuretic furosemide, especially after 24 hours (2). The diuretic effect of MESCFP was associated with a marked increase in urinary sodium and chloride excretion, indicating prominent natriuretic and chloruretic activity. Since sodium excretion is a primary determinant of diuresis, the increased Na^+ output suggests that the extract may inhibit tubular reabsorption of electrolytes, thereby promoting water excretion (8). The relatively lower potassium excretion compared to urea and furosemide indicates a potassium-sparing tendency, which is considered advantageous in minimizing electrolyte imbalance (17). The diuretic index and electrolyte excretion indices further support the efficacy of MESCFP, with values approaching those of the standard drug at higher dose levels. The elevated saluretic index ($Na^+ + Cl^-$) confirms enhanced electrolyte elimination, while the favorable Na^+/K^+ ratio indicates balanced natriuresis with reduced kaliuresis (15). These findings suggest that MESCFP may produce a safer diuretic profile compared to conventional diuretics that often cause excessive potassium loss (17). The carbonic anhydrase inhibition index ($Cl^-/(Na^+ + K^+)$) suggests that MESCFP may exert mild inhibitory effects on carbonic anhydrase activity. Such inhibition can reduce bicarbonate reabsorption in renal tubules, contributing to increased urinary output (20). However, the effect was less pronounced than that of standard diuretics, suggesting that inhibition of carbonic anhydrase might only be a part of the mechanism of action. To further elucidate the mechanism, the involvement of prostaglandins was investigated using Lornoxicam, a cyclooxygenase inhibitor. Lornoxicam alone significantly reduced urine output and electrolyte excretion, indicating the role of endogenous prostaglandins in maintaining renal blood flow and diuresis (21). Co-administration of lornoxicam with MESCFP resulted in a marked attenuation of diuretic and natriuretic effects, suggesting that the activity of MESCFP is at least partly mediated through prostaglandin-dependent pathways (22). A similar but less pronounced reduction was observed with furosemide, supporting the involvement of prostaglandins in diuretic mechanisms (23). The presence of bioactive phytoconstituents such as flavonoids, tannins, saponins, and glycosides in MESCFP may contribute to its pharmacological activity. Flavonoids, in particular, are known to influence renal function, enhance renal blood flow, and modulate electrolyte transport, which may account for the observed diuretic effects (24). Overall, the findings of the

present study indicate that MESCFP exerts significant diuretic, natriuretic, and saluretic effects through a combination of mechanisms, including modulation of electrolyte reabsorption, partial carbonic anhydrase inhibition, and prostaglandin-mediated pathways. The relatively lower potassium loss further highlights its potential as a safer alternative to conventional diuretics (25).

CONCLUSION

The current study shows that in experimental rats, the methanolic extract of Syzygium cumini fruit pulp (MESCFP) has significant and dose-dependent diuretic effect, as shown by increased urine production and improved excretion of sodium, potassium, and chloride ions. Particularly after 24 hours, the greater dose (300 mg/kg) had effects similar to those of the common diuretic furosemide. MESCFP showed prominent natriuretic and saluretic activity with relatively lower potassium loss, indicating a favorable potassium-sparing profile. The observed diuretic effect appears to involve multiple mechanisms, including modulation of renal electrolyte handling, mild carbonic anhydrase inhibition, and partial dependence on prostaglandin-mediated pathways, as evidenced by attenuation of activity in the presence of Lornoxicam. With all aspects taken into consideration, these results suggest Syzygium cumini fruit pulp extract as a promising natural diuretic with a balanced safety and effectiveness profile. To determine its long-term safety and therapeutic application, as well as to identify and describe the active ingredients, more research is necessary.

REFERENCES

1. Rang HP, Dale MM, Ritter JM, Flower RJ, Henderson G. Rang and Dale's Pharmacology. 9th ed. London: Elsevier; 2020.
2. Brunton LL, Hilal-Dandan R, Knollmann BC. Goodman and Gilman's The Pharmacological Basis of Therapeutics. 13th ed. New York: McGraw-Hill Education; 2018.
3. World Health Organization. WHO guidelines on good herbal medicines. Geneva: World Health Organization; 2013.
4. Kirtikar KR, Basu BD. Indian Medicinal Plants. 2nd ed. Dehradun: International Book Distributors; 2005.
5. Nadkarni KM. Indian Materia Medica. 3rd ed. Mumbai: Popular Prakashan; 2007.
6. Ayyanar M, Subash-Babu P. Syzygium cumini (L.) Skeels: A review of its phytochemical constituents and traditional uses. Asian Pac J Trop Biomed. 2012;2(3):240–6.
7. Baliga MS, Bhat HP, Baliga BRV, Wilson R, Palatty PL. Phytochemistry, traditional uses and pharmacology of Syzygium cumini: A review. Food Res Int. 2011;44(7):1776–89.
8. Cowley AW Jr. Role of the kidney in long-term control of arterial blood pressure and in hypertension. Am J Med Sci. 1997;313(3):150–6.
9. Ghelani H, Chapala M, Jadav P. Diuretic and natriuretic activity of plant extracts: A review. J Adv Pharm Technol Res. 2011;2(1):2–7.
10. Harborne JB. Phytochemical Methods. 3rd ed. London: Chapman & Hall; 1998.
11. Khandelwal KR. Practical Pharmacognosy. 23rd ed. Pune: Nirali Prakashan; 2005.
12. CPCSEA. Guidelines for care and use of laboratory animals. New Delhi: Government of India; 2018.
13. OECD. Guideline 425: Acute Oral Toxicity – Up-and-Down Procedure. Paris: OECD; 2008.
14. Lipschitz WL, Hadidian Z, Kerpcsar A. Bioassay of diuretics. J Pharmacol Exp Ther. 1943; 79:97–110.
15. Kau ST, Keddie JR, Andrews D. A method for screening diuretic agents. J Pharmacol Methods. 1984; 11:67–75.
16. Vogel HG. Drug Discovery and Evaluation: Pharmacological Assays. 2nd ed. Berlin: Springer; 2002.
17. Rang HP, Dale MM, Ritter JM, Flower RJ. Rang & Dale's Pharmacology. 8th ed. Elsevier; 2016.
18. Snedecor GW, Cochran WG. Statistical Methods. 8th ed. Iowa State Press; 1989.
19. Nasrallah R, Hebert RL. Prostacyclin signaling in the kidney. Am J Physiol Renal Physiol. 2005;289: F235–46.
20. Harris RC, Breyer MD. Physiological regulation of cyclooxygenase-2 in the kidney. Am J Physiol Renal Physiol. 2001;281: F1–11.
21. Vane JR, Botting RM. Mechanism of action of NSAIDs. Am J Med. 1998;104(3A):2S–8S.

22. Middleton E, Kandaswami C, Theoharides TC. Effects of flavonoids on immune and inflammatory responses. Pharmacol Rev. 2000;52(4):673–751.
23. Ellison DH. Diuretic therapy and resistance in congestive heart failure. N Engl J Med. 2017; 377:1964–75.
24. Brenner BM, Rector FC. The Kidney. 8th ed. Philadelphia: Elsevier; 2007.
25. Guyton AC, Hall JE. Textbook of Medical Physiology. 13th ed. Philadelphia: Elsevier; 2016.

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