

## EVALUATION OF DIURETIC ACTIVITY OF AQUEOUS EXTRACT OF *PRUNUS CERASUS* AND *CAESALPINIA SAPPAN* IN ALBINO RATS

SYED MOHAMMAD HUSSAINI<sup>1</sup>, SHABIL FATHAH FAROOK<sup>1</sup>, SURESH KUMAR SRINIVASAMURTHY<sup>2</sup>,  
MANJUNATHA GOUD<sup>3</sup>, VIJAYA PAUL SAMUEL<sup>4</sup>, NAVEEN KUMAR<sup>4\*</sup>

<sup>1</sup>MBBS Undergraduate Students, RAK College of Medical Sciences, Ras Al Khaimah, UAE. <sup>2</sup>Department of Pharmacology, RAK College of Medical Sciences, RAK Medical and Health Science University, Ras Al Khaimah, UAE. <sup>3</sup>Department of Biochemistry, RAK College of Medical Sciences, RAK Medical and Health Science University, Ras Al Khaimah, UAE. <sup>4</sup>Department of Anatomy, RAK College of Medical Sciences, RAK Medical and Health Science University, Ras Al Khaimah, UAE.

\*Corresponding author: Naveen Kumar; Email: naveentonse@gmail.com

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### ABSTRACT

**Objectives:** The aim of the study was to investigate the diuretic activity of aqueous extracts of *Prunus cerasus* and *Caesalpinia sappan* (CS) in albino rats.

**Methods:** A repeated-measures crossover study was conducted in seven albino rats over six treatment periods: Control (saline), furosemide (20 mg/kg), low- and high-dose *P. cerasus*, and low- and high-dose CS. Urine volume, pH, and electrolyte excretion (Na<sup>+</sup>, K<sup>+</sup>, Cl<sup>-</sup>) were measured over 24 h. Diuretic and saliuretic indices were calculated.

**Results:** Both the extracts have shown no significant diuretic actions. *P. cerasus* extracts did not enhance diuresis; however, the high dose increased potassium excretion (174.33±28.94 nmol/L, p<0.05). CS produced non-significant modest diuretic effects, with the low-dose group showing the highest urine volume among the extracts (11.41±2.37 mL).

**Conclusion:** CS and *P. cerasus* demonstrated no significant diuretic activity compared to furosemide but influenced electrolyte balance, indicating possible renal pharmacological actions. Further studies, particularly on *Prunus cerasoides*, are required to clarify their therapeutic relevance.

**Keywords:** *Caesalpinia sappan*, *Prunus cerasus*, *Prunus cerasoides*, Diuretic activity, Albino rats.

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### INTRODUCTION

The *Caesalpinia sappan* L., (CS), a member of the Leguminosae family, is the source of Brazilwood or *Sappan* wood, a classic component in Southeast Asian cuisine and drinks [1]. Thai traditional medicine uses red dye, derived from the heartwood of CS, and claimed for treatment of anemia, skin disorders, diarrhea, dysentery, and tuberculosis [2]. Phenolic components such as xanthone, coumarin, chalcones, flavones, homoisoflavonoids, and brazilin, a red dye used for histology staining, are obtained by the chemical makeup of *Sappan* wood [3]. In traditional Chinese medicine, it is used to treat increased blood circulation, menstruation disorders, and other conditions [4]. According to reports, brazilin has a variety of biological properties, including antibacterial properties, anti-inflammatory, anti-photoaging, hypoglycemic, vasorelaxant, anti-acne, antioxidant, and nuclease activity [3-9]. Bioactive compounds from natural sources, such as brazilin from CS heartwood, are being investigated by researchers for non-medicalized illnesses, therapeutic advantages, and coloring agents in a variety of sectors [10]. The Japanese Pharmacopoeia has added CS heartwood to their approved substances list [4].

Loop diuretics such as bumetanide and furosemide are the mainstay therapy for heart failure, and cardiomyopathy. The majority of medicinal plants have antioxidant qualities that make them useful in the treatment of conditions including cancer, Alzheimer's, and heart disease [11]. CS, a traditional medicinal plant, is often consumed as a tonic due to its diuretic action, a pharmacological property of great medical importance [2]. However, more studies are needed for scientifically testing these claims.

Cherry *Prunus cerasus* L. is a well-known plant used in fresh fruit, canned food, jam, and juice. It has medicinal properties and has uricosuric and anti-inflammatory effects. The chemical constituents of cherry fruits include carbohydrates, organic acids, phenolic compounds, and flavonoids. Anthocyanidin composition is also well-studied with cyanidin and mecocyanidin [12]. The skin of cherry fruits contains more vitamins than pulp, including ascorbic acid, B vitamins, and carotenoids. Studies proved that the cherry extract, when used under forced diuresis conditions, suppresses diuretic activity and reduces urine volume and daily diuresis by 30%. This indicates that prolonged use improves kidney filtration, inhibits water reabsorption, and stimulates fluid elimination, crucial for gout treatment [13].

CS and Cherry *P. cerasus* are known for their medicinal properties, such as potential diuretic effects. However, scientific validation of these effects is limited. This study is to assess the diuretic qualities of the aqueous extract of *Prunus* and CS in Albino rats, demonstrating its effectiveness as a natural diuretic, potentially providing a supplemental treatment to current therapies. In addition, we assessed the effect of the medication extract in water on the excretion of electrolytes in the urine.

### METHODS

This study was conducted using a repeated measures crossover design to evaluate the effects of different treatments on metabolic parameters in albino rats. The study protocol was reviewed and approved by the Institutional Research and Ethics Committee (RAKMHSU/REC/006 2021/22FM), and all experimental procedures were conducted in accordance with the guidelines for the care and use of laboratory animals. A total of seven normal albino rats were used,

each serving as its own control to minimize inter-animal variability. The study was conducted over 12 weeks with six treatment periods: Control, furosemide, low-dose *Prunus*, high-dose *Prunus*, low-dose CS, and high-dose CS. Each treatment period was followed by a 1-week washout phase to eliminate potential carryover effects before transitioning to the next treatment. The treatment responses were analysed independently for comparison with the control group.

During each treatment period, a single rat was placed in a metabolic cage to measure various physiological parameters, including body weight (g), food consumption (g), water intake (mL), and urinary output (mL). This process was repeated sequentially for all seven rats. The same procedure was followed across all treatment periods to ensure consistency in data collection. The metabolic cages were thoroughly cleaned every day to prevent cross-contamination.

Each rat was kept independently in the metabolic cage for 24 h. The rat was provided 100 g of food and 250 mL of water; post 24 h, all the parameters mentioned above were measured. The 1<sup>st</sup> treatment period – week measurements involved the control rats with the inclusion of 10 mL/kg of normal saline (IP). The 2<sup>nd</sup> treatment period involved furosemide (IP) (20 mg/kg), and the measurements were noted respectively. The 3<sup>rd</sup> and 4<sup>th</sup> treatment periods involved low-dose and high-dose *Prunus* extract in water. The 5<sup>th</sup> treatment period involved the inclusion of low-dose CS in the water (500 mg/L), and the 6<sup>th</sup> treatment period was continued with high-dose CS in water (2000 mg/L). The IP administration during treatments periods 1 and 2 was given to the rat before being placed in the metabolic cage. The extracts were administered ad libitum in drinking water during treatment periods 3, 4, 5, and 6. The doses were based on previous studies [1-4,12,13].

Immediately after IP administration, the animal was placed in a metabolic cage (one rat per cage), specially designed to separate urine and feces. The urine, collected in graduated vials, was measured at the end of 24 h and expressed as mL/100 g of body weight per 12 h. The urine samples were stored at -20 °C. The concentration of Na<sup>+</sup> and K<sup>+</sup> ions in the urine samples was estimated using a calibrated spectrophotometer and was expressed as Na<sup>+</sup> and K<sup>+</sup> in nmol/L and Cl<sup>-</sup> in mEq/L. A calibrated pH meter was used to measure the pH of the urine samples. The following formulas were used for the calculation of parameters and were compared among the different period groups. Urine volume was measured for each animal and used for calculating diuretic index and saliuretic index. However, electrolyte values were expressed as concentration rather than total excretion, which is as per the methodology of previously reported studies [14-18].

The diuretic index was calculated as the ratio of the mean urine volume of the test group to the mean urine volume of the control group. The saliuretic index was calculated as the ratio of the electrolyte concentration in the urine of the test group to that of the control group.

#### Preparation of CS

(a) Low-dose-125 mg of crushed CS is put on boil (100°C) in 250 mL of water in a stainless steel pot. After the water is boiled, it is cooled in room temperature for 10–15 min. Then the water is filtered using a strainer into a plastic bottle that is attached to the metabolic cage for the rats to drink. The water consumed, urine output, and the food eaten are measured 24 h later.

(b) High-dose-500 mg of crushed CS is put on boil (100°C) in 250 mL of water in a beaker. After the water is boiled, it is cooled in room temperature for 10–15 min. Then the water is filtered using a strainer into a plastic bottle that is attached to the metabolic cage for the rats to drink. The water consumed, urine output, and the food eaten are measured 24 h later.

#### Preparation of *P. cerasus*

(a) Low-dose-125 mg of crushed *P. cerasus* is put on boil (100°C) in 250 mL of water in a stainless steel pot. After the water was boiled, it was cooled at room temperature for 10–15 min. Then the water was filtered using a strainer into a plastic bottle that is attached to the metabolic cage for the rats to drink. The water intake, urine output, and the food eaten were measured 24 h later.

(b) High-dose-500 mg of crushed *P. cerasus* was put on a boil (100°C) in 250 mL of water in a stainless steel pot. After the water was boiled, it was cooled in room temperature for 10–15 min. Then the water was filtered using a strainer into a plastic bottle that was attached to the metabolic cage for the rats to drink. The water intake, urine output, and food eaten were measured 24 h later.

#### Statistical analysis

All data were expressed as mean±standard deviation (SD) (n=7). Statistical comparisons between the control and treatment data sets were performed using Student's t-test. A p<0.05 was considered statistically significant. Statistical analysis was carried out using through IBM Statistical Package for the Social Sciences version 29.

#### RESULTS

The study compared urine volume and electrolyte excretion among different groups, including a control group, a furosemide-treated group, and groups receiving different doses of *Prunus* and *Sappan* extracts, and results been shown in Table 1.

#### Urine output

Urine output was significantly higher in the Furosemide group (18.5±4.54 mL, p<0.05) compared to the control (10.41±3.49 mL). The *Prunus* and *Sappan* groups showed varying effects:

*Prunus* (low dose): 8.5±4.13 mL, *Prunus* (high dose): 9.16±1.32 mL, *Sappan* (low dose): 11.41±2.37 mL, and *Sappan* (high dose): 9.33±1.63 mL.

#### Electrolyte excretion

- Sodium (Na<sup>+</sup>): The Furosemide group exhibited significantly increased sodium excretion (194.24±20.59 nmol/L, p<0.05) compared to the control (159.56±37.66 nmol/L). *Prunus* (low dose) showed a significant reduction (75.5±13.81 nmol/L, p<0.05), while *Prunus* (high dose) showed a moderate decrease (108±7.7 nmol/L, p<0.05).
- Potassium (K<sup>+</sup>): Potassium excretion was significantly higher in the Furosemide group (134.78±17.91 nmol/L, p<0.05) compared to the control (110.76±14.8 nmol/L). The *Prunus* (high dose) group exhibited a notable increase (174.33±28.94 nmol/L, p<0.05).
- Chloride (Cl<sup>-</sup>): Furosemide significantly increased chloride excretion (30.28±10.44 mEq/L, p<0.05) compared to the control (10.88±2.30 mEq/L). Other groups did not show significant variations except *Sappan* (high dose) (16.84±5.15 mEq/L).

Table 1: The comparison of urine volume and electrolytes among the study groups

| Groups (n=7)              | Urine output (mL) | Na <sup>+</sup> nmol/L | K <sup>+</sup> nmol/L | Cl <sup>-</sup> mEq/L |
|---------------------------|-------------------|------------------------|-----------------------|-----------------------|
| Control                   | 10.41±3.49        | 159.56±37.66           | 110.76±14.8           | 10.88±2.30            |
| Furosemide group          | 18.5±4.54*        | 194.24±20.59*          | 134.78±17.91*         | 30.28±10.44*          |
| <i>Prunus</i> (low dose)  | 8.5±4.13          | 75.5±13.81*            | 107.96±40.63          | 9.96±4.36             |
| <i>Prunus</i> (High dose) | 9.16±1.32         | 108±7.7*               | 174.33±28.94*         | 10.83±2.51            |
| <i>Sappan</i> (low dose)  | 11.41±2.37        | 149.73±18.14           | 104.81±22.97          | 12.10±3.68            |
| <i>Sappan</i> (high dose) | 9.33±1.63         | 158.13±32.9            | 99.93±10.8            | 16.84±5.15            |

\*p<0.05; The values are expressed as mean±SD. The comparison was done with the control group by t-test. SD: Standard deviation

### Diuretic and saliuretic indices

Diuretic index: Furosemide demonstrated the highest diuretic activity (1.78), followed by *Sappan* (low dose) (1.09), while *Prunus* (low dose) showed the lowest (0.81). Saliuretic index: Sodium excretion was highest with Furosemide (1.21), whereas *Prunus* (low dose) showed the lowest sodium excretion index (0.47). The potassium excretion index was highest with *Prunus* (high dose) (1.57). Chloride excretion was significantly increased in the Furosemide group (2.7), whereas *Prunus* (low dose) had the lowest effect (0.91) (Table 2).

### DISCUSSION

The study evaluated the diuretic effects of *Prunus* and *Sappan* extracts compared to furosemide, a well-known diuretic, and a control group. The results indicate that the plant extracts exhibited varying degrees of diuretic and saliuretic effects.

The diuretic potential of natural extracts has been widely documented. Azaryan reported that aqueous extract of *C. avium* stem powder (200 and 400 mg/kg) exhibited therapeutic effects on calcium oxalate stones and reduced calcium oxalate deposits in rats with nephrolithiasis [7]. Similarly, another study found that individuals with nephrolithiasis consumed less cherry fruit compared to healthy controls [19], suggesting a possible association between cherry consumption and renal health. Clinical studies have also shown that *Prunus avium* stalk capsules increase urine output and act as a mild diuretic without adverse effects [20]. However, our study showed no diuretic activity, possibly due to the selected dose range in our study.

In our study, the urine output was significantly higher in the furosemide group ( $18.5 \pm 4.54$  mL,  $p < 0.05$ ) compared to the control ( $10.41 \pm 3.49$  mL). *Prunus* and *Sappan* groups displayed varying effects, with *Sappan* (low dose) showing the highest urine output among the extract-treated groups ( $11.41 \pm 2.37$  mL); however, this was not statistically significant. These findings indicate that while *Sappan* extracts may have some diuretic effect, their efficacy is lower than furosemide. This suggests that the diuretic activity of CS may not be as potent as other traditional herbal diuretics.

Electrolyte excretion analysis showed that furosemide significantly increased sodium ( $194.24 \pm 20.59$  nmol/L), potassium ( $134.78 \pm 17.91$  nmol/L), and chloride ( $30.28 \pm 10.44$  mEq/L) excretion compared to the control. Notably, *Prunus* (low dose) significantly reduced sodium excretion ( $75.5 \pm 13.81$  nmol/L,  $p < 0.05$ ), whereas *Prunus* (high dose) exhibited a moderate decrease. Interestingly, *Prunus* (high dose) increased potassium excretion ( $174.33 \pm 28.94$  nmol/L,  $p < 0.05$ ), suggesting a distinct ionic modulation compared to conventional diuretics. These results differ from Sayana *et al.*, who found that *Cissampelos pareira* root extract increased sodium, potassium, and chloride excretion to levels comparable to furosemide [21]. This discrepancy suggests that CS may have a different mechanism of action compared to more established herbal diuretics. Several herbal extracts, including *Hedyotis scandens*, *Ficus sur* Forssk, and *Verbascum nigrum* L., have demonstrated diuretic effects in animal studies [22-24]. In comparison, our study found that CS had a lower diuretic index than these established herbal diuretics, indicating that it may have a weaker overall effect on fluid balance.

**Table 2: Diuretic and saliuretic indices of different treatment groups**

| Group                     | Diuretic index | Saliuretic index (Na <sup>+</sup> ) | Saliuretic index (K <sup>+</sup> ) | Saliuretic index (Cl <sup>-</sup> ) |
|---------------------------|----------------|-------------------------------------|------------------------------------|-------------------------------------|
| Furosemide                | 1.78           | 1.21                                | 1.21                               | 2.7                                 |
| <i>Prunus</i> (low dose)  | 0.81           | 0.47                                | 0.97                               | 0.91                                |
| <i>Prunus</i> (high dose) | 0.87           | 0.67                                | 1.57                               | 0.99                                |
| <i>Sappan</i> (low dose)  | 1.09           | 0.93                                | 0.94                               | 1.11                                |
| <i>Sappan</i> (high dose) | 0.89           | 0.99                                | 0.9                                | 1.55                                |

Lenchyk *et al.* showed *P. cerasus* diuretic and potential for use in gout [13]. Similarly, the anti-oxidant, antimicrobial, and anti-inflammatory effects of *Prunus* are well documented [25-27]. These studies are not in congruence of our findings, which showed a lack of diuretic actions.

### Strengths and limitations

This study effectively utilized a minimal number of animals while adhering to ethical research principles. Rats served as a valuable model due to their metabolic similarities to humans, allowing for controlled evaluation of CS's diuretic effects. The study's design of sequential nature favored the reduction of inter-animal variability as well. The sequential design is in line with animal ethical principles of reducing the number of animals among 3Rs, which includes refinement and replacement [28-30]. However, findings may not be directly translatable to humans due to species differences and limited study duration. In addition, phytochemical variability in extraction methods may affect reproducibility, and a comprehensive evaluation of renal function was not included.

The study was conducted with a small sample size ( $n=7$ ) and was intended as an exploratory screening, which may limit the generalizability of the findings. Additionally, while the selected extract concentrations (500 mg/L and 2000 mg/L) and the 1-week washout period were based on previous traditional usage and standard crossover practices, these factors should be taken into account when interpreting the results. Furthermore, the normal saline, furosemide, and herbal extracts were administered as a single dose only on the day the rats were placed in the metabolic cages, which may limit the assessment of cumulative or long-term effects.

### Future directions and implications

Further studies are needed to establish the safety profile, potential adverse effects, and standardized dosing of *Prunus* and CS-based products. While their diuretic effects may be limited, the plants could offer other health benefits, such as antioxidant or anti-inflammatory properties, warranting further exploration. This study highlights the importance of scientific validation in herbal medicines, encouraging future research into alternative herbal combinations or bioactive compounds with stronger diuretic potential and promoting evidence-based integration into traditional and alternative therapies.

### CONCLUSION

Brazil wood (CS) has been recognized for its medicinal properties, including potential diuretic effects. The plant's flavonoid-rich composition suggests a role in modulating renal function. However, our findings do not fully support the hypothesis of increased urine output with CS treatment, contradicting previous assumptions. The observed effects on electrolyte excretion suggest potential pharmacological interactions requiring further investigation. Compared to previously studied herbal diuretics, CS exhibited a milder diuretic response, indicating it may not be as potent as other natural diuretics.

Similarly, *P. cerasus* demonstrated limited diuretic activity in our study. Although urine output was not significantly increased, the extracts showed distinct effects: The low dose significantly reduced sodium excretion, while the high dose markedly increased potassium excretion. These findings suggest that cherries may influence electrolyte balance without exerting a strong diuretic effect. Given that *Prunus cerasoides*, a related species widely used in traditional medicine, has been reported to possess antioxidant and anti-inflammatory properties, further research is warranted to evaluate whether different extraction methods, doses, or species variations could yield stronger renal or diuretic responses.

This study is among the first to comparatively evaluate the diuretic properties of CS. Future investigations should focus on identifying the active bioactive compounds, elucidating their mechanisms, and assessing the clinical significance of these plants, including *P. cerasoides*, as potential complementary therapies.

## AUTHORS' CONTRIBUTIONS

Data gathering and idea owner of this study: SMH, SFF, MG. Study design and data collection: VPS, MG, SMH. Approval of final draft: SKS, VPS, NK. Writing assistance and submitting manuscript: SKS, NK.

## CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest related to this study.

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## REFERENCES

- Toegel S, Wu SQ, Otero M, Goldring MB, Leelapornpisid P, Chiari C. *Caesalpinia sappan* extract inhibits IL1 $\beta$ -mediated overexpression of matrix metalloproteinases in human chondrocytes. *Genes Nutr*. 2012;7(2):307-18. doi: 10.1007/s12263-011-0244-8, PMID 21850498
- Sireeratawong S, Piyabhan P, Singhalak T, Wongkrajang Y, Temsiririrkkul R, Punsiriraj J. Toxicity evaluation of sappan wood extract in rats. *J Med Assoc Thai*. 2010;93 Suppl 7:S50-7. PMID 21294398
- Bae IK, Min HY, Han AR, Seo EK, Lee SK. Suppression of lipopolysaccharide-induced expression of inducible nitric oxide synthase by brazilin in RAW 264.7 macrophage cells. *Eur J Pharmacol*. 2005;513(3):237-42. doi: 10.1016/j.ejphar.2005.03.011, PMID 15862806
- Nirmal NP, Rajput MS, Prasad RG, Ahmad M. Brazilin from *Caesalpinia sappan* heartwood and its pharmacological activities: A review. *Asian Pac J Trop Med*. 2015;8(6):421-30. doi: 10.1016/j.apjtm.2015.05.014, PMID 26194825
- Yun J, Lee HM, Kim SK, Lee SY, Lee CS, Cho TS. Formation of Cu(II)-brazilin complex in the presence of DNA and its activities as chemical nuclease. *J Inorg Biochem*. 2006;100(9):1501-5. doi: 10.1016/j.jinorgbio.2006.04.013, PMID 16797715
- Washiyama M, Sasaki Y, Hosokawa T, Nagumo S. Anti-inflammatory constituents of Sappan lignum. *Biol Pharm Bull*. 2009;32(5):941-4. doi: 10.1248/bpb.32.941, PMID 19420769
- Azaryan E, Malekaneh M, Shemshadi Nejad M, Haghighi F. Therapeutic effects of aqueous extracts of *Cerasus avium* stem on ethylene glycol- induced kidney calculi in rats. *Urol J*. 2017;14(4):4024-9. PMID 28670670
- Yodsaou O, Cheenpracha S, Karalai C, Ponglimanont C, Tewtrakul S. Anti-allergic activity of principles from the roots and heartwood of *Caesalpinia sappan* on antigen-induced beta-hexosaminidase release. *Phytother res PTR*. *Phytother Res*. 2009;23(7):1028-31. doi: 10.1002/ptr.2670, PMID 19173220
- Sasaki Y, Hosokawa T, Nagai M, Nagumo S. *In vitro* study for inhibition of NO production about constituents of Sappan lignum. *Biol Pharm Bull*. 2007 Jan;30(1):193-6. doi: 10.1248/bpb.30.193, PMID 17202686
- Mekala K, Radha R. A review on Sappan wood-a therapeutic dye yielding tree. *Res J Pharmacogn Phytochem*. 2015;7:227.
- Karimi A, Majlesi M, Rafieian-Kopaei M. Herbal versus synthetic drugs; Beliefs and facts. *J Nephropharmacol*. 2015;4(1):27-30. PMID 28197471
- Wang H, Nair MG, Strasburg GM, Chang YC, Booren AM, Gray JI. Antioxidant and antiinflammatory activities of anthocyanins and their aglycon, cyanidin, from tart cherries. *J Nat Prod*. 1999;62(2):294-6. doi: 10.1021/np980501m, PMID 10075763
- Lenchyk LV, Ovezgeldiyev D, Shapoval OV, Baiurka SV, Ayaou A. Study of chemical composition and diuretic activity of cherry fruit extract. *Res J Pharm Technol*. 2018;11(7):3036-42. doi: 10.5958/0974-360X.2018.00559.0
- Vijay DT, Vishal BT, Ravindra SJ. Evaluation of *Leucas aspera* whole plant extracts for diuretic and laxative property. *Asian J Pharm Clin Res*. 2016;9:118-21.
- Shrivastava V, Tomar RS. Potent and efficacious diuretic activity with potassium sparing effect of *Terminalia belerica* fruit pulp aqueous extract in Wistar albino rats. *Asian J Pharm Clin Res*. 2016;9(6):241-3. doi: 10.22159/ajpcr.2016.v9i6.14287
- Kaushik ML, Goutam N, Ashawat MS. Anti-nephrolithiasis activity of ethanol extract of *Ipomoea carnea* Jacq. Against ethylene glycol-induced urolithiasis in rats. *Asian J Pharm Clin Res*. 2025;18:96-104.
- Vikasari SN, Sukandar EY, Sutjiatmo AB, Riyanti S. Diuretic effect of the ethanol extracts of *Phyllanthus acidus* L. (Skeels) leaves in Wistar rats. *Int J Pharm Pharm Sci*. 2015;7:120-3.
- Jayaweera G, Makuloluwa T, Perera K, Amararatne JK, Premakumara S, Ratnasooriya D. Oral diuretic activity of hot water extract of H-grade quills of *Cinnamomum Zeylanicum* Blume in rats. *Int J Pharm Pharm Sci*. 2018;10:114-8.
- Icer MA, Gezmen-Karadag M. The potential effects of dietary food and beverage intakes on the risk of kidney stone formation. *Rev Nutr*. 2019;32:e190029. doi: 10.1590/1678-9865201932e190029
- Hooman N, Mojab F, Nickavar B, Pouryousefi-Kermani P. Diuretic effect of powdered *Cerasus avium* (cherry) tails on healthy volunteers. *Pak J Pharm Sci*. 2009;22(4):381-3. PMID 19783515
- Sayana SB, Khanwelkar CC, Nimmagadda VR, Dasi JM, Chavan VR, Kutani A. Evaluation of diuretic activity of alcoholic extract of roots of *Cissampelos pareira* in albino rats. *J Clin Diagn Res*. 2014;8(5):HC01-4. doi: 10.7860/JCDR/2014/8192.4350, PMID 24995192
- Ayele M, Makonnen E, Ayele AG, Tolcha Y. Evaluation of the diuretic activity of the aqueous and 80% methanol extracts of ficus sur Forssk (Moraceae) leaves in saline-loaded rats. *J Exp Pharmacol*. 2020;12:619-27. doi: 10.2147/JEP.S283571, PMID 33364856
- Ngamlai EV, Pradhan RB, Lalbiaknii PC, Ralte V, Lalnunmawia F, Vanlalhluna PC. Diuretic activity evaluation and chemical composition analysis of *Hedyotis scandens* extract from Mizoram, India, in rat models. *J Ethnopharmacol*. 2024;319(1):117079. doi: 10.1016/j.jep.2023.117079, PMID 37659758
- Kalinina SA, Elkina OV, Kalinin DV, Syropyatov BY, Dolzhenko AV. Diuretic activity and toxicity of some *Verbascum nigrum* extracts and fractions. *Pharm Biol*. 2014;52(2):191-8. doi: 10.3109/13880209.2013.822001, PMID 24074166
- Popova A, Mihaylova D, Alexieva I, Doykina P. Ethnopharmacology and phytochemistry of some representatives of the genus *Prunus*. *J Cent Eur Agric*. 2022;23(3):665-78. doi: 10.5513/JCEA01/23.3.3629
- Malsawmtluangi C, Thanzami K, Lahlhnmawia H, Selvan V, Palanisamy S, Kandasamy R. Physicochemical characteristics and antioxidant activity of *Prunus cerasoides* D. Don gum exudates. *Int J Biol Macromol*. 2014;69:192-9. doi: 10.1016/j.ijbiomac.2014.05.050, PMID 24875319
- Agrawal S, Kumar A, Singh AK, Singh H, Kumar P. Antioxidant and antibacterial evaluation of leaf extracts of *Prunus cerasoides* Buch. Ham. ExD. Don; An *in vitro* and *in silico* study. *Pharmacol Res Nat Prod*. 2024;3:100037.
- Festing MF, Altman DG. Guidelines for the design and statistical analysis of experiments using laboratory animals. *ILAR J*. 2002;43(4):244-58. doi: 10.1093/ilar.43.4.244, PMID 12391400
- Lipnick RL, Cotruvo JA, Hill RN, Bruce RD, Stitzel KA, Walker AP. Comparison of the up-and-down, conventional LD50, and fixed-dose acute toxicity procedures. *Food Chem Toxicol*. 1995 Mar;33(3):223-31. doi: 10.1016/0278-6915(94)00136-C, PMID 7896233
- Blotwijk S, Hernot S, Barbé K. Group sequential designs for *in vivo* studies: Minimizing animal numbers and handling uncertainty in power analysis. *Res Vet Sci*. 2022;145:248-54. doi: 10.1016/j.rvsc.2022.03.003, PMID 35299085