POTENTIALS OF THE CAT'S WHISKER PLANTS (*Orthosiphon aristatus*) FOR KIDNEY HEALTH

(POTENSI TANAMAN KUMIS KUCING (Orthosiphon aristatus) UNTUK KESEHATAN GINJAL)

Yudith Yunia Kusmala[1]*, Nasywa Fathiyya A[2], Naura Khanza M. Z.[2], Alia Fatimah M[2], Soraya Riyanti[3]

[1]Department of Internal Medicine, Faculty of Medicine, Universitas Jenderal Achmad Yani, Cimahi, Indonesia

[2]Faculty of Dentistry, Universitas Jenderal Achmad Yani, Cimahi, Indonesia

[3]Faculty of Pharmacy, Universitas Jenderal Achmad Yani, Cimahi, Indonesia

*Corresponding author

yudith.yunia@lecture.unjani.ac.id

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ABSTRACT

The cat's whisker plant (*Orthosiphon aristatus*) could be helpful as an antioxidant, anti-inflammatory, antihypertensive, antidiabetic, and anti-microbial activity and has a diuretic effect. The cat's whiskers' leaves are medicinal plants containing flavonoid compounds. Cat whiskers plant can also treat various empirical and clinical diseases, including kidney stones. Kidney stones are a clinical disorder due to the blockage of the components of crystal stones that inhibit the work of the kidneys and can cause abnormalities in the urinary tract. Some constituent compounds that are usually found in kidney stones are calcium oxalate, calcium phosphate (brusit), uric acid, cystine, struvite (MgNH4PO4), and wedelit Efforts to treat kidney stones by utilizing a variety of herbs as medicine, in this context by using a cat whiskers plant called Alternative

Medicine, and this is because herbal plants have minimal side effects in long-term use when used with the proper indications and proportions, the price is also more affordable and easier to obtain. The purpose of this paper is to discuss and provide information on the morphology, secondary metabolite content, and pharmacological activity of cat whiskers plants so that they can be used to support kidney health. This literature review is a type of research that collects, manages, uses, and reviews research data from scientific journals, previous research manuscripts, and textbooks relevant to the theme. The results of a literature search indicated that the cat's whisker plant could benefit kidney health because the extract has diuretic activity and could modulate the excretion of sodium and potassium ions in the urine. Flavonoids, saponins, and phenolic compounds played a role in diuresis activity. The cat whiskers plant was efficacious in treating kidney stone disease because it destroys kidney stones, reduces urine (diuretic), and is anti-inflammatory.

Keywords: kidney health; kidney stones; *Orthosiphon aristatus*

ABSTRAK

Tanaman Kumis Kucing (Orthosiphon aristatus) dapat bermanfaat sebagai aktivitas antioksidan, antiinflamasi, antihipertensi, antidia betes, dan anti mikroba serta memiliki efek diuretik. Daun kumis kucing merupakan tanaman obat yang mengandung senyawa flavonoid. Tanaman Kumis Kucing juga dapat digunakan untuk mengobati berbagai jenis penyakit baik secara empiris maupun klinis, diantaranya batu ginjal. Batu ginjal merupakan gangguan klinis akibat tersumbatnya komponen batu kristal sehingga menghambat kerja ginjal & dapat menyebabkan kelainan saluran kemih. Beberapa senyawa penyusun yang biasanya dijumpai dalam batu ginjal adalah kalsium oksalat, kalsium fosfat (brusit), asam urat, sistin, struvit (MgNH4PO4) dan wedelit (Bakta, 1995). Upaya pengobatan batu ginjal dengan memanfaatkan berbagai tumbuhan herbal sebagai obat, dalam konteks

ini dengan menggunakan tanaman Kumis Kucing disebut dengan pengobatan alternatif, hal ini dikarenakan tanaman herbal memiliki efek samping yang minim dalam penggunaan jangka panjang apabila digunakan dengan indikasi dan proporsi yang tepat, harganya juga lebih terjangkau dan mudah untuk didapat. Tujuan penulisan ini membahas dan memberikan informasi mengenai morfologi, kandungan metabolit sekunder, dan aktivitas farmakologi tanaman kumis kucing sehingga dapat digunakan sebagai penunjang kesehatan ginjal. Penelitian ini merupakan penelitian studi kepustakaan atau literature review yaitu jenis penelitian yang mengumpulkan, mengelola, menggunakan dan mengkaji data penelitian bersumber dari jurnal penelitian ilmiah, naskah penelitian terdahulu dan textbook yang memiliki relevansi dengan tema. Hasil penelusuran literatur menunjukkan bahwa tanaman kumis kucing dapat bermanfaat bagi kesehatan ginjal, dikarenakan ekstraknya memiliki aktivitas diuretik dan mampu memodulasi ekskresi ion natrium dan kalium dalam urin. Adanya senyawa flavonoid, saponin dan fenolik yang berperan terhadap aktivitas diuresis, sehingga tanaman kumis kucing ini berkhasiat mengobati penyakit batu ginjal karena memiliki efek penghancur batu ginjal, peluruh air seni (diuretik) dan anti radang (antiinflamasi).

***Kata kunci**: batu ginjal; kesehatan ginjal; Orthosiphon aristatus*

INTRODUCTION

Indonesia is an agricultural country with a variety of abundant biological wealth with the potential of plants that are hereditary and used as traditional medicine. Indonesia is the 2nd largest biodiversity mega center in the world, with around 30.000 plant species and 7.000 estimated to have medicinal properties, and 2.500 medicinal plants.[1]

Family medicinal plants/tanaman obat keluarga (TOGA) are home-grown plants that are productive as medicines. Medicine is a material or guide materials intended to establish the diagnosis, prevent, reduce, eliminate, cure disease or symptoms of disease, injury, or bodily and spiritual abnormalities in

humans or animals and to improve the body or parts of the human body.[1]

One of the most used herbs for treating cat's whiskers (*Orthosiphon aristatus)*. Cat Whiskers *Orthosiphon aristatus)* it has long been used in traditional medicine in East India, Indochina, Southeast Asia, and the tropical regions of Australia, where it is commonly found. The plant is known as the cat's whiskers (*cat's whiskers*). Traditionally, cat whiskers (*Orthosiphon aristatus)* are helpful as an antioxidant, anti-inflammatory, antihypertensive, antidiabetic, and anti-microbial activity and have a diuretic effect. Cat whisker leaves are medicinal plants that contain flavonoid compounds (Gunawan et al., 1996). Cat whiskers can treat various diseases empirically and clinically, including kidney stones.[2]

The kidneys are one of the vital organs in the body; they play an essential role in regulating fluid and electrolyte needs, such as regulating water, regulating salt concentration in the blood, and regulating waste or excess salt excretion, which includes regulatory functions, excretory functions, and secreting renin. Because of its important role, it will be fatal if the kidneys are damaged so that there is a decrease in part or even loss its function. Various factors, such as infections, tumors, or other factors, such as congenital, metabolic, or degenerative diseases, lifestyle, race/ethnicity, geographical conditions, etc., can cause it. This decrease in function causes the kidneys to no longer be able to filter the body's electrolyte disposal and maintain the balance of fluids and body chemicals that can even cause death. Diseases that can attack the kidneys include *Acute Kidney Injury (AKI)*, *Chronic Kidney Disease* (CKD), Glomerulonephritis, Kidney stones or nephrolithiasis, and Nephrotic Syndrome.[3]

Chronic Kidney Disease (CKD) or chronic kidney disease (CKD) occurs due to kidney or glomerular Filtrate Rate damage <60 ml/minute/1.73 for three months or more and is said to have reached the final stage if the GFR comes <15 ml/minute/1.73 with or without dialysis. According to the World Health Organization (WHO), chronic kidney disease contributes to the world's disease burden, with a death rate of 850,000 people per year. It occupies the second highest health cost burden in Indonesia after heart disease. The primary health research report (Riskesdas) year 2013 showed that the prevalence of CKD in Indonesia is about 0.2%, increasing with age. It was risen sharply in the age group of 35-44 years (0.3%), followed by age 45-54 years (0.4%), and age 55-74 years

(0.5%), the highest in the age group 75 years (0.6%). In addition, it is known that the prevalence in the male sex (0.3%) is higher than in females (0.2%). CKD can cause kidney failure, cardiovascular complications, and death. [3,4]

In addition, a kidney disease that commonly occurs in the community is kidney stones (nephrolithiasis) which is a clinical disorder due to blockage of crystal stone components that inhibit the work of the kidneys in the calyx or renal pelvis caused by balance disorders in the solubility and deposition of salts in the urine and kidney due to blockage of the urinary tract. Kidney stones can cause urinary tract abnormalities. Some of the constituent compounds that are usually found in kidney stones are calcium oxalate, calcium phosphate (brusit), uric acid, Sistine, struvite (MgNH4PO4) dan wedelit). Based on the results of research by several medical experts, of the 96 kidney stones found to contain high calcium oxalate, which is about 70-76%, then about 5-20% contains uric acid, struvite ($MgNH_4PO_4$), about 10-17% and cystine stones of 1-3% (Sukahatya and Muhamad Ali, 1975). According to the results of reports in several Indonesian hospitals, about 75-85% of kidney stones are calcium oxalate stones, a combination of calcium and oxalate arising from the content of these substances being too much in the urine. [5,6]

The consumption of substrates/diets that have a high calcium and oxalate content can also affect the increased levels of calcium oxalate in the urine. Hot climates with high exposure to ultraviolet light will tend to cause individuals to dehydrate and increase the production of vitamin D3 (which can trigger increased excretion of calcium oxalate), so the incidence of urinary stone formation will be able to increase. [5,7]

With the development of the medical world, various actions/efforts of conventional kidney treatment can be made, such as, for example, the management of kidney stones, including urethroscopy and lithotripsy with laser or electrohydraulic, cystolithotomy, etc., pharmacologically carried out with the administration of diuretics, analgesics, antibiotics, citric acid, allopurinol and increased fluid intake which can substantially reduce the prevalence of recurrence of kidney stones, nonsteroidal anti-inflammatory administration is also given to overcome acute pain in kidney stone patients. However, conventional medicine treatment often causes side effects, risks, or even a significant burden of treatment costs when used in the long term. [6]

So, because of the above

considerations, we can use alternative medicine, that is, by utilizing various herbs as medicine; herbal plants have minimal or even no side effects when used with the correct indications and proportions, and the price is also more affordable and easier to obtain. Based on WHO data in 2007, about 80% of the world's population uses traditional medicine derived from plant extracts to treat their health. Herbal plants are claimed to be an alternative in treating kidney stone disease with various mechanisms such as an antioxidant, diuretic, and increased excretion of citrate urine. One of the herbs that can be used in overcoming kidney stones is the cat's whiskers *(Orthosiphon aristatus). A*lmost all parts of the plant can be used, especially the leaves. [1]

METHOD

The design of this research was literature review research. Literature review research design is a method used to collect data related to the formulation of the problem in research papers obtained from various literature sources such as scientific research journals, previous research manuscripts, and related textbooks and can answer the number of samples of scientific research journals used in research.

A literature search was performed combining "*Orthhosiphon aristatus"* and "Kidney health" after previously identifying the chosen descriptors in articles published on the topic and in the Medical Subject Headings (MeSH). The PubMed, MEDLINE, BBO, LILACS and Sci, ELO, and Google Scholar databases were accessed from January 2018 to November 2022.

Inclusion and exclusion criteria English-language publications with the title and abstract related to the topic were included. Incomplete articles, duplicated ones, studies on animals, and those that, when read, did not fit the proposed theme were excluded from the research.

RESULT

The search resulted in 69 published papers, with 20 potentially eligible identified after applying the inclusion and exclusion criteria. After reading these papers in total, 20 pieces of literature remained**.**

DISCUSSION

Morphology Of Cat Whiskers Plants

Orthosphon aristatus is the Latin name of the cat's whisker plant. In various regions, this cat whiskers plant is known by several local names, namely *kutum, mamam, Spider Flower, manguk jung, remujung, cat whiskers, songot koceng*. The classification of cat whisker plants is as

follows (Moh, 1980; USDA, 2015).

Division : Magnoliophyta
Class : Magnoliopsida
Order : Labiatae/ Lamiaceae
Genus : *Orthosiphon*
Species :*Orthosiphon aristatus* Benth.

Figure 1. *Orthosphon aristatus.*

The cat's whisker plant has a height of 0.3-1.5 m and has a 4-corner stem. The leaves are simple and have a width of 2-4 cm and a length of 4-7 cm. The flowers are white, blue, or purple. When the flower opens, the stamens and pistil extend far beyond the petals, which look like "cat's whiskers." Cat whiskers plants are found in tropical countries such as Asia and Australia. Cat whisker plant cultivation can be done in the plains with an altitude of 500-1200 MASL with rainfall of more than 3000 mm/year. Fertile and loose soil conditions with a pH of 5-7. Seven contains a lot of humus, has good air, and is exposed to the flow of direct sunlight, which is a suitable habitat for the cultivation of this plant. [2]

Content of Secondary Metabolites

The cat's whisker plant contains polymethoxylated flavonoid compounds, phenylpropanoids (down caffeic acid), and terpenoids (mainly diterpenes and triterpenes). The most prominent flavonoids isolated from cat whisker leaf extract are sinensetin, eupatorium, 3'-hydroxy-5,6,7,4'-tetra methoxy flavones, 20-23 tetramethylcutellarein, 20 salvegenin, ladanein, vomifoliol, 7,3 ', 4'-tri-o-methyl luteolin, and scutellarein tetramethylether. Ameer et al. 2012) Sinensitin is a flavonoid class compound that is the essential phytochemical compound and becomes the pen of the cat whisker plant.[8]

Pharmacological Activity

Cat's whisker leaves in Indonesia have been widely used for diuretics, preventing, and treating rheumatism, diabetes mellitus, hypertension, tonsillitis, epilepsy, menstrual disorders, gonorrhea, syphilis, kidney stones, gallstones, acute and chronic nephritis, gouty arthritis, and antipyretics (Adnyana et al. 2013). Cat's whiskers plant is a herbal medicine widely used empirically (hereditary) and believed to have a diuretic effect. Some countries trust and use this plant to treat diseases such as hypertension, atherosclerosis, kidney inflammation, fever, influenza, hepatitis, diabetes, and others.[8]

There are various benefits of

mustache plants, namely: benefits as an antioxidant because it has high antioxidant activity and hepatoprotective activity because they can reduce bilirubin levels in mice affected by jaundice. Cat's whisker leaf extract also functions as a diuretic drug that benefits treating kidney stones and flushing the kidneys and urinary tract. The cat's whisker plant is helpful as an anti-inflammatory that can be used to treat arthritis and rheumatism. In addition, the benefits leave cat whiskers also have strong hemolytic properties that can lower high blood pressure and reduce cholesterol. The cat's whisker plant exhibits antioxidant, antitumor, diuretic, antidiabetic, antihypertensive, anti-inflammatory, antibacterial, and hepatoprotective activity.[9]

Kidney Anatomy

The two kidneys are located in the upper abdominal cavity on either side of the vertebral column, behind the peritoneum (retroperitoneal). The kidneys' upper portions rest on the diaphragm's lower surface and are enclosed and protected by the lower rib cage.[10]

The kidney has a connective layer consisting of a renal capsule, an adipose body, and renal fascia to protect the structure. In addition, these layers also function to fix the kidney. Kidneys have an approximate weight of 150 grams, roughly the size of a fist. An indentation called the hilum on the medial side of the kidney houses the renal veins, arteries, ureters, nerves, and lymphatic vessels.[10]

The frontal section of the kidney looks at two main parts of making the kidney: the cortex area on the outside and the medulla on the inside. The medulla of the kidney is composed of 8-10 cone-shaped masses of tissue called renal pyramids. The base of each end in the papillary structures protrudes in the renal pelvis. The cortex consists of 1 to 4 million nephrons. The nephron is the smallest unit of the kidney, consisting of a collection of capillaries called the glomerulus and long tubules where filtered fluid is converted into urine on its way to the pelvis (proximal convoluted tubule, the loop of Henle, distal convoluted tubule, and collecting tubule). Bowman's capsule covers the glomerulus, the beginning of the tubular component.[10]

Cardiac output supplies about 22% or 1.100 ml/minute of blood to both kidneys under normal circumstances. The renal arteries will carry blood through the hilum, which will then branch progressively to form interlobar arteries, arcuate arteries, interlobular arteries, and afferent arterioles through the glomerular capillaries, where most of the fluid and solutes are filtered for

the process of forming urine. The distal ends of the capillaries in each glomerulus join to form the efferent arterioles, which lead to a second capillary network, the peritubular capillaries, which surround the renal tubules. The renal cortex is the central part of the kidney, which gets a higher proportion of blood flow (90%) than the medulla and papillae.[10]

Kidney Physiology

The kidney has a function to maintain the stability of the internal fluid environment that the body needs in carrying out activities. The functions of the kidneys include removing metabolic wastes, regulating fluid and electrolyte balance, maintaining the osmolarity of body fluids and electrolytes, adjusting arterial pressure in the long term by excreting Na+ and water and in the short term by secreting the hormone renin and regulating acid and base balance.[10–12]

The functional unit, the nephron, is the smallest unit in the kidney that can carry out all the kidney functions, one of which is by producing urine. Nephrons carry out the kidney's vital functions by filtering blood plasma in the glomerulus and reabsorbing an appropriate number of solutes and water along the kidney tubules. The body will excrete excess solutes and water through the urine with the urine collection system.[10,11]

There are three basic processes involved in the formation of urine. As blood flows through the glomerulus, protein-free plasma is filtered through the glomerular capillaries into Bowman's capsule. Under normal circumstances, 20% of plasma will be filtered. This process is known as glomerular filtration, the first step in urine formation. The composition of glomerular fi ltrate is determined by the structure, arrangement and electrical charge of the collagen protein molecules that form the fi ltration barrier. So glomerular filtration is both size-selective and charge-selective; molecules that are too large or too highly charged cannot get through. [10,13]

Furthermore, there will be a process of reabsorption in the tubules. A substantial amount of albumin does get through the barrier, between 3.3 and 5.7 g per day. A proportion passes from the sub-podocyte space through the podocytes by transcytosis. Passage of albumin through the barrier is increased by angiotensin II. Almost all the fi ltered albumin is reabsorbed by active uptake into the proximal tubular cells as the filtrate flows through the tubules, materials that are beneficial to the body are returned to the peritubular capillary plasma. The final process is tubular secretion, which is the selective transfer of peritubular capillary materials into the tubular lumen. The results of the three processes will flow into the renal pelvis to be excreted as urine. Toxic

substances in the body can increase free radicals that cause cell damage, including cells in the kidneys, especially in the glomerulus and tubules.[10,11,13]

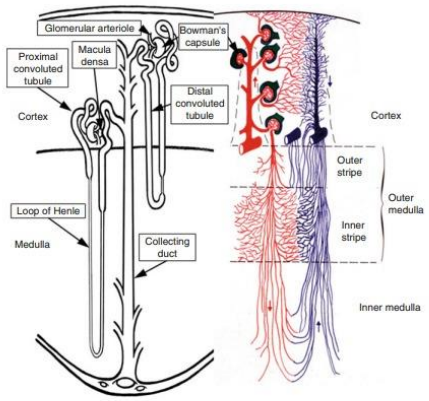


Fig. 1.3 Nephons and their blood supply. *Left*: a short looped- and a long looped-nephron. *Right*: the different vascular territories and their location in the four renal zones. For clarity, the cortex has been widened and the inner medulla compressed

Figure 2. *Nephons and their blood supply.*

Pathophysiology of the Kidneys

Kidney disease is a loss of kidney function that has decreased by up to 10%. The most severe stage, kidney disease, leads to kidney failure or even *End-Stage Renal Disease* (ESRD). This decrease in function makes the kidneys no longer able to filter the body's electrolyte disposal and maintain the balance of fluids and body chemicals. Kidney disorders or diseases that can arise are as follows:

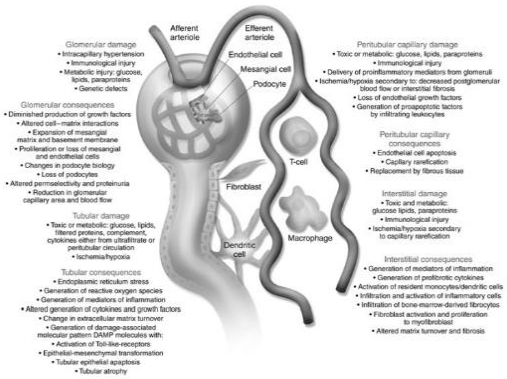
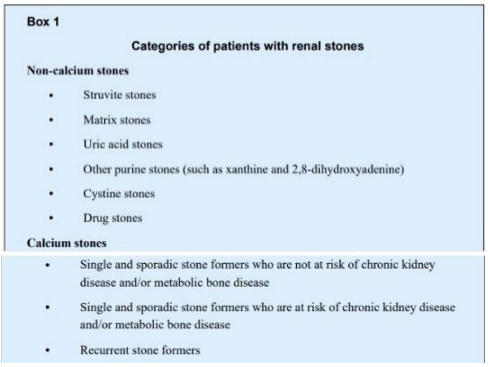


Figure 3. *Overall scheme of factors and pathways contributing to the progression of renall disease.*

1. Kidney stones or nephrolithiasis

Kidney stones or nephrolithiasis is a condition of kidney stones (calculi) because the formation resembles stones derived from minerals and salts in the kidneys. A disturbance in the balance between solubility and deposition of salts in the urinary tract and kidneys causes nephrolithiasis or kidney stones. Kidney stones are formed when urine becomes saturated with insoluble compounds containing calcium oxalate and phosphate due to dehydration or lack of fluid. Kidney stones or nephrolithiasis are formed when minerals in the kidneys cannot be excreted so that they eventually become grains that resemble crystals. Kidney stones can occur along the urinary tract, from the kidneys, ureters (the urinary tract carrying urine from the kidneys to the bladder), bladder, and urethra (the urinary tract that carries urine outside the body). The impact or consequences of kidney stones, if left too long and not treated immediately, it is not likely to progress to more severe conditions, namely *Chronic Kidney Disease* (CKD).[7,14]



Box 1

Categories of patients with renal stones

Non-calcium stones

- Struvite stones
- Matrix stones
- Uric acid stones
- Other purine stones (such as xanthine and 2,8-dihydroxyadenine)
- Cystine stones
- Drug stones

Calcium stones

- Single and sporadic stone formers who are not at risk of chronic kidney disease and/or metabolic bone disease
- Single and sporadic stone formers who are at risk of chronic kidney disease and/or metabolic bone disease
- Recurrent stone formers

Figure 4. *Categories of Patients with Renal Stones.*

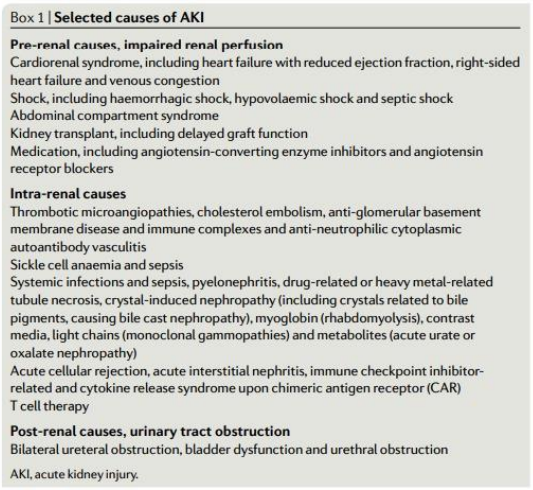
We suggest that stone disease should not be evaluated only in reference to stone composition and clinical activity, but the risk of complications should also be appraised in the diagnostic process and patient categorization.

Stone formation can be a recurring disease that may have severe consequences, such as CKD, MBD and ESRD. Thus, the aim of preventive strategies should also focus on CKD, MBD and ESRD. Examples that such an approach is possible, at least with respect to MBD, have been reported. Comprehensive metabolic evaluation is followed by a range of preventive measures, including specific pharmacological interventions in addition to advice for a change in lifestyle and nutritional habits.[15]

2. *Acute Kidney Injury*

Acute Kidney Injury (AKI) or acute renal failure is a condition in which the kidneys experience a sudden loss of function within a few days or weeks, with or without oliguria, resulting in a decrease in the ability of the kidneys to maintain body homeostasis.[7,14]

Generally, acute kidney failure occurs due to the decline and destruction of nephrons, resulting in the disappearance of progressive kidney function. Total glomerular filtration rate (GFR) and clearance decreased while there was an increase in blood urea nitrogen and creatine. Then the remaining nephrons become hypertrophied due to their function to filter into more. This results in the kidneys, where the kidneys lose the ability to thicken urine. Urine is excreted in large amounts so that the patient experiences fluid loss. Tubules will eventually lose the ability to receive electrolytes, and discarded urine contains a lot of sodium resulting in polyuria.[7,14]



Box 1 | **Selected causes of AKI**

Pre-renal causes, impaired renal perfusion

Cardiorenal syndrome, including heart failure with reduced ejection fraction, right-sided heart failure and venous congestion
Shock, including haemorrhagic shock, hypovolaemic shock and septic shock
Abdominal compartment syndrome
Kidney transplant, including delayed graft function
Medication, including angiotensin-converting enzyme inhibitors and angiotensin receptor blockers

Intra-renal causes

Thrombotic microangiopathies, cholesterol embolism, anti-glomerular basement membrane disease and immune complexes and anti-neutrophilic cytoplasmic autoantibody vasculitis
Sickle cell anaemia and sepsis
Systemic infections and sepsis, pyelonephritis, drug-related or heavy metal-related tubule necrosis, crystal-induced nephropathy (including crystals related to bile pigments, causing bile cast nephropathy), myoglobin (rhabdomyolysis), contrast media, light chains (monoclonal gammopathies) and metabolites (acute urate or oxalate nephropathy)
Acute cellular rejection, acute interstitial nephritis, immune checkpoint inhibitor-related and cytokine release syndrome upon chimeric antigen receptor (CAR) T cell therapy

Post-renal causes, urinary tract obstruction

Bilateral ureteral obstruction, bladder dysfunction and urethral obstruction

AKI, acute kidney injury.

Figure 5. *Causes of AKI.*

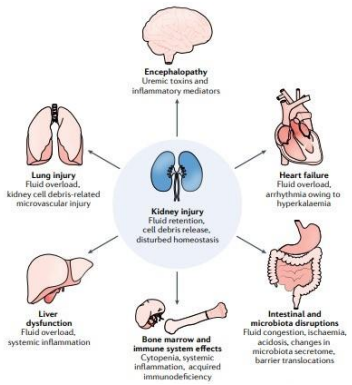


Figure 6. *Systematic consequences of AKI.*

Systemic consequences of AKI. The kidneys maintain homeostasis; hence, acute kidney injury (AKI) affects almost all systems of the body, albeit in different ways. Fluid retention affects especially the lungs and the heart, frequently with clinical signs of respiratory or circulatory failure. Fluid retention also compromises the gastrointestinal system, for example the liver or the intestine, promoting intestinal barrier dysfunction and translocation of bacteria and bacterial toxins. Impaired uraemic toxin excretion affects the function of the brain, the heart, the bone marrow and the immune system, leading to neurocognitive defects, anaemia and acquired immunodeficiency accompanied by persistent systemic inflammation. Kidney cell necrosis releases debris into the venous circulation, which accumulates in the lungs and causes direct microvascular injury, thrombosis and, sometimes, acute respiratory distress syndrome. [16]

3. Chronic Kidney Disease (CKD)

Pathogenesis of chronic renal failure involves the decline and destruction of nephrons followed by progressive loss of kidney function. The Total glomerular filtration rate (LFG) decreases and, clearance decreases, BUN and creatinine increase. The remaining nephrons are hypertrophied due to attempts to filter a more significant amount of fluid. As a result, the kidneys lose the ability to concentrate urine. In stages to continue excretion, a large amount of urine is excreted, which leads to a lack of fluid. Tubules gradually lose the ability to absorb electrolytes. Typically, the discarded urine contains a lot of sodium, so polyuria occurs.[7,14]

At an average decrease in function of 50%, signs and symptoms of moderate azotemia, polyuria, nocturia, hypertension, and occasional anemia usually appear. In addition, the balance of fluids and electrolytes is disturbed during kidney function failure. In essence, the signs and symptoms of chronic kidney failure are almost the same as acute kidney failure, but the onset of time alone is the difference. The course of chronic renal failure has a systemic impact on all body systems and often leads to complications.[7,14,17]

Table 1. Definition and classification of chronic kidney disease.

Stage	Description	Classification by severity		Classification by treatment
		GFR ml/min/1.73m^2	Related terms	
1.	Kidney damage with normal or ↑ GFR	≥ 90	albuminuria, proteinuria, hematuria	T if kidney transplant, recipient
2.	Kidney damage with mild ↓ GFR	60 – 89	albuminuria, proteinuria, hematuria	
3.	Moderate ↓ GFR	30 – 59	chronic renal insufficiency, early renal insufficiency	
4.	Severe ↓ GFR	15 – 29	chronic renal insufficiency, late renal insufficiency, pre-ESRD	
5.	Kidney failure	< 15 (or dialysis)	renal failure, ureamia, end-stage, renal disease	D if dialysis (hemodialysis, peritoneal dialysis)

Cat Whiskers For Kidney Health

Cat whiskers contain potassium salts, especially in the leaves, and orthosiphon, which serves to help dissolve phosphate, oxalate, and uric acid in the human kidneys to prevent and overcome the deposition of stones in the kidneys. *Orthosiphon aristatus* is commonly used in kidney stone disease because it is thought to have diuretic, anti-inflammatory, and anti-spasmodic effects. Previous studies proved that the antihypertensive effect *of Orthosiphon aristatus was caused by* some content of *Orthosiphon aristatus*, which can inhibit contractions in the smooth muscles of the aorta. Leaves *Orthosiphon aristatus* has been studied in experimental animals and has been shown to have a diuretic effect. Methanol-water leaf extract administration *Orthosiphon aristatus* at a dose of 2 g/kg can increase the excretion of sodium and potassium in the first 8 hours of administration. Meanwhile, leaf metallonic extract *Orthosiphon aristatus* with doses of 100 and 200 mg/kg BW was shown to have nephroprotective effects by lowering creatinine, urea, and urine protein levels and inhibiting the occurrence of free radicals. Essential oils of *Orthosiphon aristatus* has anti-microbial activity against bacteria *Vibriaparahaemolyticus* and *Strep tococcus mutans*, so they can be used to treat urinary tract infections.[9,18]

According to the study's results, the extract of the cat's whiskers plant contains flavonoids, saponins, and phenolics. The diuretic mechanism of this secondary metabolite is that flavonoids could increase glomerular filtration rate resulting in increased urine volume (Jouad et al. 2011 and Madyastuti et al. 2015), stimulate regional blood flow or initial vasodilation (Stanic and Samarzija, 1993) and inhibit water and ion reabsorption in the tubular region (Pantoja et al. 1991). [19]

This study was conducted in several stages, from extraction to testing the content of total flavonoids and the antioxidant activity of cat's whisker leaf extract. Extraction of cat whiskers leaves with 96% ethanol solvent obtained as much as 14.32 grams of the extract with a yield of 24.16%. Subsequent tests were carried out on the obtained extracts. The test results are shown in the tables below .[9,19]

Table 2. Qualitative Test Results of O.stamineus's Leaf Exstract

Test Substance	Reactor	Result	Literature	Conclusion

Flavonoid	Magnesium + HCl	yellow solution	color change occurs	contains flavonoid

Table 3. Content of Total Flavonoids as Quercetin in O.stamineus's Leaf Exstract

Replication	Extract Weight	Absorbance	% b/b	Mg QE/g equivalent
1	0,054	0,2394	0,705444	7,05444
2	0,0552	0,3311	0,962298	9,2298
3	0,0553	0,18463	0,534732	5,34732
	Mean		0,734158	7,344158

Table 4. Antioxidant Activity of O.stamineus Leaf Exstract Based on Attenuation Percentage & IC_{50}

Test	concentration (ppm)	% immersion	IC_{50} (ppm)	Average IC_{50} (ppm)
1	15	10,66061	65,19452	65,62513
	30	29,69203		
	45	33,21857		
	60	45,36568		
	75	57,48038		
2	15	8,559816	65,79111	
	30	26,40852		
	45	33,30228		
	60	45,097		
	75	56,80802		
3	15	8,759663	65,88977	
	30	22,32033		
	45	33,30498		
	60	44,73382		
	75	57,45743		

Table 5. Antioxidant Activity of Quercetin Based on Absorbance Percentage and IC_{50}

Concentration (ppm)	% Immersion	IC_{50} (ppm)
3	11,7289	13,84515
6	20,07023	
9	31,34746	
12	45,83046	
15	53,21649	

Several previous studies evaluating the diuretic activity of herbal medicine extracts stated another mechanism of flavonoids in addition to those presented above. Flavonoids play a role in stimulating the release of renal prostaglandins. Another mechanism is said to increase the activity of prostacyclin formation. Diuresis occurs because of the role of nitric oxide (NO) and prostaglandin mechanisms systemically and regulates arteriolar tone and blood pressure. The kidneys regulate afferent dilation of arterioles and glomerular filtration rate. Flavonoids and derivatives are compounds that play a role in activating bradykinin B2 receptors and muscarinic receptors and stimulating NO nerves and prostaglandin.[20,21]

It is evidenced by the study of diuretic activity and mineral analysis of cat's whiskers plant extract in male rats by testing the quality of urine using the parameters of volume, diuretic activity index, pH, and urinary mineral levels. The urine pH value of rats ranges from 7.3 to 8, determined by the acid and alkaline settings in the kidneys.[20,21]

Table 6. The Average Value of Urin pH

Urine pH groups			
Control (-)	**Control (+)**	**Cat's Whisker Plants dose 1**	**Cat's Whisker Plants dose 2**
7,14 ± 0,10	7,15 ± 0,05	7,18 ± 0,05	7,26 ± 0,04

Table 7. The Levels of Sodium and Potassium (ppm) in the Urine of Rats for Each Treatment Group

Group	Natrium	Kalium	Ratio Na/K
Control (-)	731,22	867,97	0,84
Control (+)	1892,99	3728,06	0,55
Cat's Whisker Plants dose 1	1134,55	1315,44	0,86
Cat's Whisker Plants dose 2	1365,5	2561,3	0,53

A certain amount of HCO_3-filtered continuously into the renal tubules and excreted into the urine will cause the urine to be alkaline. Conversely, a certain amount of H+ ions always filtered into the renal tubules and excreted into the urine will cause acidic urine. Regulating the concentration of H + ions, the kidneys secreted H + ions into the tubules, reabsorb HCO3-ions, and produce new HCO3-to reduce and neutralize excess H + ions in the body. [19,21]

Furosemide can cause side effects of fluid and electrolyte balance disorders, especially sodium and potassium. Both ions are widely excreted, causing hyponatremia and hypokalemia (Erlina et al. 2006). The administration of the extract can modulate the excretion of sodium and potassium minerals in the urine so that they are not excreted as much. Increased excretion of sodium and potassium ions through continuous urine can disrupt ion homeostasis in the body, ion dehydration, and chronic conditions can interfere with the work of the heart. The extract group's measurements show potassium ions' excretion is higher than sodium, including kaliuretic diuretics. The calculation ratio at low doses was almost close to 1, meaning that sodium and potassium ions excretion is practically balanced. Low sodium and high potassium levels indicate the mechanism of diuretics' action in Henle's loop. Henle loop diuretics block CL transport resulting in increased Na+ reabsorption, K+ excretion, and water in the urine. It is known from this study that the extract of the cat's whiskers plant has diuretic activity and could modulate the excretion of sodium and potassium ions in the urine. Flavonoids, saponins, and phenolic compounds contribute to diuresis activity. The most effective dose is indicated by an amount of 250 mg/kg BW.[2,8,19,20]

CONCLUSION

The kidneys are one of the vital organs that play an important role in regulating fluid and electrolyte needs, such as regulating water, regulating salt concentration in the blood, and regulating waste or excess salt excretion, which includes regulatory functions, excretory functions & secreting renin. So it is fatal if there is damage to kidney function. Many

factors can trigger kidney disease, including substrate/diet consumption, infection, tumor, lifestyle, race/ethnicity, and geographical condition. Kidney disease that generally often occurs is kidney stones, and the most cause of death is *Chronic Kidney Disease* (CKD). To treat the disease, we could use alternative medicine from herbal plant extracts, one of which is the cat's whiskers *(Orthosiphon aristatus). C*at's whisker plant extract has diuretic activity and could modulate the excretion of sodium and potassium ions in the urine. The presence of flavonoids, saponins, and phenolic compounds contribute to the activity of diuresis, so it can be concluded that the plant-efficacious cat whiskers could treat kidney stone disease because they had the effect of crushing kidney stones, urine decay (diuretic), and anti-inflammatory.

CONFLICT OF INTEREST

In this article, we state that there is no conflict of interest.

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