Nephroprotective Potential of Biskhapra (Trianthemaportulacastrum Linn.) Leaves Extract in Cisplatin-Induced Acute Kidney Injury in Wistar Albino Rats: An Experimental Study

ABSTRACT

The kidneys are essential organs responsible for excretion and maintaining homeostasis. Acute kidney injury (AKI) is a severe clinical condition characterized by sudden deterioration in renal function, often resulting from nephrotoxic agents such as cisplatin, which is widely used in chemotherapy. Cisplatin-induced nephrotoxicity is a significant clinical limitation, with oxidative stress, inflammation, and tubular damage being the primary mechanisms involved. The present study aimed to evaluate the nephroprotective potential of aqueous and hydro-alcoholic extracts of Biskhapra (*Trianthemaportulacastrum* Linn.) leaves in a cisplatin-induced AKI rat model.

The experimental study involved forty healthy Wistar albino rats (150–200 g) divided into five groups (n=8). Group I served as plain control, receiving distilled water; Group II was the negative control, receiving a single intraperitoneal injection of cisplatin (5 mg/kg b.w.); Group III was treated with cisplatin plus standard nephroprotective agent silymarin (50 mg/kg p.o.); Group IV and Group V received cisplatin plus aqueous and hydro-alcoholic extracts of Biskhapra leaves (450 mg/kg p.o.), respectively, for 14 days.

Renal function was assessed by serum creatinine, blood urea, blood urea nitrogen (BUN), serum uric acid, total serum protein, serum albumin, and serum globulin. Histopathological examination of kidney tissue was performed to assess structural changes. Physiochemical and phytochemical analyses of the extracts were conducted, including moisture content, pH, extractive values, ash values, and HPTLC profiling.

Results demonstrated a significant rise in serum creatinine, blood urea, and BUN in the cisplatin group, confirming renal injury. Treatment with Biskhapra extracts significantly reduced these levels ($p<0.001$), comparable to the standard control. Serum protein levels, albumin, and globulin, which were reduced in nephrotoxic rats, were restored upon treatment. Histopathology revealed marked

tubular regeneration and reduced necrosis in treated groups. Phytochemical screening confirmed the presence of flavonoids, alkaloids, tannins, saponins, steroids, and phenolics, which may contribute to the observed nephroprotective effect.

In conclusion, both aqueous and hydro-alcoholic extracts of Biskhapra leaves exhibit significant nephroprotective activity against cisplatin-induced AKI in rats, likely due to antioxidant, anti-inflammatory, and regenerative properties. This study validates the traditional Unani claim of Biskhapra as a MuqavviGurdawaMasana (renal tonic) and provides experimental evidence for its potential therapeutic application in AKI management.

Keywords: Biskhapra, Trianthemaportulacastrum, Cisplatin, Acute Kidney Injury

Introduction

The kidneys are vital organs that maintain internal stability by regulating fluid balance, electrolyte composition, acid-base homeostasis, and the elimination of metabolic waste products.[1]They play a

central role in the excretory system and are crucial for maintaining the biochemical equilibrium of the body. Disruption of kidney function has profound systemic effects, and acute kidney injury (AKI) represents a sudden, often reversible deterioration of renal function.[2] AKI, formerly referred to as acute renal failure, is defined clinically by a rapid rise in serum creatinine and/or decreased urine output.[3]

Globally, AKI is a significant health problem, with an incidence ranging from 2% to 7% of hospital admissions and affecting up to 67% of critically ill patients in intensive care units.[3,4] The condition is associated with increased morbidity, prolonged hospitalization, high healthcare costs, and elevated mortality rates.[5] AKI can be caused by prerenal, intrarenal, or postrenal factors. Acute tubular necrosis (ATN), the most common cause of intrinsic AKI, occurs due to ischemic or nephrotoxic injury.[3] Nephrotoxic drugs, including cisplatin, aminoglycosides, and nonsteroidal anti-inflammatory drugs (NSAIDs), directly damage renal tubular cells. Cisplatin, a platinum-based chemotherapeutic agent, is highly effective against solid tumors but is limited by its nephrotoxicity. Cisplatin-induced AKI is characterized by oxidative stress, mitochondrial dysfunction, DNA damage, inflammation, apoptosis, and reduced renal perfusion. Tubular epithelial cell death and inflammatory infiltration lead to impaired filtration and reabsorption, resulting in elevated serum creatinine, blood urea, and disturbances in protein metabolism.[6]

The management of AKI primarily involves addressing the underlying cause, supportive care, and renal replacement therapy in severe cases. Pharmacological interventions are limited to symptomatic relief and do not reverse the underlying injury. Dialysis remains the mainstay in advanced AKI but has limitations including invasiveness, cost, and complications. Furthermore, current treatments do not promote renal tissue regeneration, making the search for effective nephroprotective agents an urgent need.[3]

Alternative and complementary medicine systems, including Unani medicine, have long recognized the importance of natural remedies in preserving organ function. In the Unani system of medicine, the concept of *MuqavviAaza* (organ tonics) emphasizes the maintenance and restoration of organ function by normalizing the temperament (*mizaj*) of specific organs, thus enhancing their resistance to pathological influences. IbnSina defined a *Muqavvi* drug as one that strengthens an organ either through its intrinsic nature or by balancing its temperament—by cooling excessive heat or warming excessive cold. Galen also supported this view, using rose oil as an example of a drug that equilibrates temperament.[7]Within this framework, *MuqavviGurdawaMasana* (tonics for the kidneys and urinary bladder) are recognized for their nephroprotective properties. Many Unani and herbal drugs such as *Emblicaofficinalis* (Amla), *Punicagranatum* (Anar), *Cymbopogonjwarancusa* (Izkhar), *Artemisia absinthium* (Afsanteen), *Matricariachamomilla* (Baboona), and *Cinnamomumzeylanicum* (Darchini) are traditionally used to strengthen renal and urinary functions, along with indirect tonics like *Crocus sativus* (Zafran) and *Strychnosnux-vomica* (Kuchla).[8]

A wide variety of Unani and herbal plants have demonstrated nephroprotective, diuretic, and anti-inflammatory effects in both traditional practice and modern research. Seeds of *Peucedanumgraveolens* (TukhmeShibbat), *Daucuscarota* (Gazar), and *Trachyspermumammi* (Ajwain) are known for their diuretic and lithotriptic actions.[7,9] Plants like *Aerva lanata*,[10]*Cordycepssinensis*, and *Trianthemaportulacastrum* (Biskhapra) have been shown to mitigate drug-induced nephrotoxicity and enhance renal recovery.[11,12] Similarly, *Tribulusterrestris* (Gokhru), *Icacinatricantha*, and *Raphanussativus* (Turb) exhibit protective effects on renal histology and function in experimental models.[13,14] Herbs such as *Taraxacumofficinale*, *Asparagus racemosus* (Satavar), *Ocimum sanctum* (Reehan), *Moringaoleifera* (Sahajna), and *Tinosporacordifolia* (Giloy) further contribute to renal protection through antioxidant and anti-inflammatory pathways.[14,15]

Additionally, compound and polyherbalUnani formulations have shown promising nephroprotective outcomes. Formulations like "Banadequl Buzoor,"[16,17] "NR-AG I," "NR-AG II," and "JawarishZarooniSada" have been effective in preventing drug-induced renal injury and normalizing serum urea and creatinine levels.[18,19] Natural antioxidants such as ginsenosideRb-I, quercetin, and herbal extracts like *Withaniasomnifera* (Asgandh) and *Echinacea pallida* have demonstrated potent protection against oxidative renal damage.[20,21] These findings collectively validate the traditional Unani principle of *MuqavviGurdawaMasana* and highlight the therapeutic potential of herbal nephroprotective agents in both preventive and restorative renal health.

Biskhapra(*Trianthemaportulacastrum*Linn.), a member of the Aizoaceae family, is recognized by various names across languages—*Hand Qooqi*in Arabic, *Dewasapt*in Persian, and *Horse Purslane*in English. It is an annual prostrate herbaceous plant, typically extending 4 to 6 feet in length, and is commonly found in moist environments such as riverbanks or near ponds. This species flourishes as a weed in both cultivated fields and wastelands across tropical and subtropical regions, with widespread occurrence throughout India.[22] It is recognized for its diuretic, resolvent (mohallil), astringent (qabiz), and calorific (musakkhin) properties. The fresh juice of the plant is traditionally administered for treating night blindness, ocular ulcers, and urinary dribbling.[9,22,23] In Unani literature, it is considered effective in treating conditions involving fluid retention, urinary disorders, and kidney dysfunction. The temperament of leavesandseeds of BiskhapraareHotinsecondandDryinfirstdegree.The dose of Biskhapraleaf is1tola.[7,9]

Modern pharmacological studies have confirmed its antioxidant, anti-inflammatory, and diuretic actions, supporting its traditional use.[22,23] Phytochemical analysis reveals the presence of alkaloids, flavonoids, tannins, saponins, steroids, and phenolics, compounds known to exert protective effects against oxidative stress and inflammation.[24,25] Given the high incidence of AKI and the limitations of conventional therapies, there is a pressing need to explore alternative nephroprotective agents.

Biskhapra, with its rich history in traditional medicine and documented pharmacological activity, is a promising candidate. Prior studies have demonstrated its protective effects in adriamycin-induced nephrotic syndrome, but there is limited research on its role in cisplatin-induced AKI. This study aims to fill that gap by systematically evaluating the nephroprotective potential of aqueous and hydro-alcoholic extracts of Biskhapra leaves in a cisplatin-induced rat model. The primary objective of the study is to assess the efficacy of Biskhapra extracts in mitigating renal injury induced by cisplatin. Specific objectives include evaluating renal function parameters including serum creatinine, blood urea, BUN, serum uric acid, serum albumin, serum globulin, and total protein; conducting histopathological examination of kidney tissue to observe morphological changes; and performing physiochemical and phytochemical standardization of Biskhapra leaf extracts. This research provides experimental evidence validating the traditional Unani claim of Biskhapra as a nephroprotective agent. It could pave the way for developing cost-effective, plant-based therapies for AKI, reducing reliance on dialysis and improving patient outcomes. Furthermore, standardization of the drug through physiochemical and HPTLC analysis ensures reproducibility and quality control, laying a foundation for future pharmacological and clinical studies.

Materials and methods

Study Design

This experimental study was designed to evaluate the nephroprotective potential of aqueous and hydro-alcoholic extracts of *Trianthemaportulacastrum* Linn. (Biskhapra) leaves against cisplatin-induced acute kidney injury (AKI) in Wistar albino rats. The study was conducted in accordance with the institutional ethical guidelines, and approval was obtained from the Institutional Animal Ethics Committee (IAEC) of Bihar Animal Sciences University, Patna.

Plant Material Collection and Authentication

Fresh leaves of *Trianthemaportulacastrum* Linn. were collected from authenticated sources in the local area. The plant was identified and authenticated by a botanist Dr Ajay Kumar (Chief Scientist) Cognosmed Laboratories Pvt. Ltd. and a voucher specimen was deposited for reference. The leaves were washed thoroughly under running water to remove dust and impurities and shade-dried for 10–12 days to preserve the phytochemical constituents. The dried leaves were then powdered using a mechanical grinder and stored in airtight containers at room temperature until further use.

Preparationofextract: Biskhapraweremanuallycleaned fromanyinorganic matters and other weeds and coarsely ground into powder by using an electric grinder in pharmacy of GovtTibbi College and Hospital Patna. Two different extracts of aqueous and hydro-alcoholic solvents were extracted. The extracts were prepared by two different methods using maceration method and reflux method to check for the higher yield percentage.

Figure: 01 Aqueous and Hydro-alcoholic extract of Biskhapra

Aqueousextractbymacerationmethod:

Crude powder drug (25 gram) was taken along with 400 ml of distilled water in a beaker and left for 48 hours untouched in cool and dark place. The drug was then subjected to sonicator for sonication process for half an hour. After which it was filtered and kept for evaporation in a China petridish in a

water bathat 70oC and dried until extract was obtained. After cooling down, the extract was weighed to calculate the extractive yield and it stored in an air tight container for phytochemical screening and further study.[26]

Hydro-alcoholic extract by maceration method:

Test drug powder (25 gm) was taken along with 200 ml distilled water and200 ml methanol in a beaker and left for 48 hours untouched in cool and dark place. The drug was then subjected to sonicator for sonication process for half an hour.Afterwhich it was filtered and kept forevaporation in aChinadish in a water bath at 70^{o}C and dried until the extract was finally obtained. After cooling down, the extract was weighed to calculate the extractive yield and stored inan air tight container for phytochemical screening.[26]

Physicochemical parameters such as extractive values, ash values, moisture content, and pH were determined according to standard pharmacognostic procedures. Preliminary phytochemical screening was performed to detect the presence of alkaloids, flavonoids, saponins, steroids, tannins, phenolics, and carbohydrates. Additionally, High-Performance Thin-Layer Chromatography (HPTLC) profiling was conducted for quality standardization and to identify chemical fingerprints of the extracts.

Experimental Animals

Forty healthy Wistar albino rats (150–200 g) of either sex were procured from the Central Animal Research Facility, BASU, Patna. The animals were acclimatized for five days under standard laboratory conditions: temperature 23 ± 2°C, humidity almost 55 ±15%, and a 12-hour light/dark cycle. They were provided free access to a standard pellet diet and water ad libitum.

Before drug administration, all animals were fasted overnight with free access to water to ensure uniform metabolic conditions.

Experimental Grouping

The animals were randomly divided into five groups, each consisting of eight rats (n=8):

- Group I – Plain Control: Received distilled water (3.0 ml, orally) once daily for 12 days.
- Group II – Negative Control: Received a single intraperitoneal injection of cisplatin (5 mg/kg body weight) on day 1.
- Group III – Standard Control: Received cisplatin (5 mg/kg, i.p.) plus silymarin (50 mg/kg, orally) once daily for 14 days.
- Group IV – Test Group A: Received cisplatin (5 mg/kg, i.p.) plus aqueous extract of *Biskhapra* leaves (450 mg/kg, orally) once daily for 14 days.
- Group V – Test Group B: Received cisplatin (5 mg/kg, i.p.) plus hydro-alcoholic extract of *Biskhapra* leaves (450 mg/kg, orally) once daily for 14 days.

Induction of Acute Kidney Injury (AKI)

Acute kidney injury was induced by a single intraperitoneal injection of cisplatin (5 mg/kg body weight) in Groups II, III, IV, and V on day 1 of the experiment. This dose and route of administration were selected based on previous literature reports demonstrating consistent and reproducible induction of nephrotoxicity in experimental rat models.

Biochemical Analysis

At the end of the treatment period, all animals were anesthetized, and blood samples were collected via retro-orbital plexus puncture using sterile capillary tubes. The collected blood samples were allowed to clot at room temperature and then centrifuged at 3000 rpm for 15 minutes to separate the serum. The serum samples were analyzed for renal function markers, including:

- Serum creatinine
- Blood urea
- Blood urea nitrogen (BUN)
- Serum uric acid
- Serum albumin
- Serum globulin
- Total serum protein

All biochemical estimations were performed using standard diagnostic kits (Manufacturer: XXX) and analyzed using an automated biochemical analyzer following the manufacturer's instructions.

Histopathological Examination

After completion of the treatment protocol, animals were sacrificed on the 14th day by cervical dislocation under anesthesia. Both kidneys were carefully excised, washed with ice-cold normal saline, and immediately fixed in 10% formalin solution.

Tissue specimens were processed through dehydration, clearing, and paraffin embedding. Thin sections of 5 µm thickness were prepared and stained with hematoxylin and eosin (H&E) for microscopic examination.

Histopathological evaluation was performed to assess tubular necrosis, degeneration, glomerular changes, interstitial inflammation, and overall renal architecture, and scoring was done according to standard histological grading methods.

Statistical Analysis

All data were expressed as mean ± standard deviation (SD). Statistical analysis was performed using one-way analysis of variance (ANOVA) followed by Tukey's post hoc test for multiple comparisons among groups. A p-value < 0.05 was considered statistically significant. Data visualization and tabulation were done using GraphPad Prism software.

Results& Observation

The physicochemical and phytochemical analysis of *Trianthemaportulacastrum Linn.* (Biskhapra) leaves revealed valuable information regarding its composition and quality parameters.

PhysicoChemicalStudies

The extractive values were recorded as 28.00% w/w for the hydro-alcoholic extract and 27.24% w/w for the aqueous extract. The moisture content was found to be 13.6% w/w, while total ash, acid-insoluble ash, and water-soluble ash were 18.91% w/w, 1.78% w/w, and 13.20% w/w, respectively. The pH of a 5% aqueous solution of Biskhapra leaves was 6.36, indicating a slightly acidic nature suitable for biological compatibility. Preliminary phytochemical screening confirmed the presence of alkaloids, flavonoids, tannins, saponins, steroids, phenolics, proteins, and reducing sugars, which are known to contribute to antioxidant and nephroprotective effects. HPTLC profiling showed characteristic peaks at Rf values 0.04 and 0.05 under UV 254 nm and 366 nm, serving as a chromatographic fingerprint for standardization and quality control.

Blood Urea

In the plain control group (Group I), blood urea was 40.85 ± 0.576 mg/dl**.**In the negative control group (Group II) treated with cisplatin (5 mg/kg b.w.), the value rose markedly to 91.86 ± 0.822 mg/dl ($p < 0.001$), indicating severe nephrotoxicity.The standard control group (Group III) treated with silymarin showed 45.25 ± 0.485 mg/dl**,** significantly lower than the negative control ($p<0.001$). The aqueous extract–treated group (Group IV) showed 52.55 ± 0.499 mg/dl ($p < 0.001$ vs. negative control), while the hydro-alcoholic extract–treated group (Group V) demonstrated 45.4 ± 0.541 mg/dl ($p < 0.01$), indicating a marked reduction in blood urea. [Table No-01]

Serum Creatinine

Serum creatinine in the plain control group was 0.75 ± 0.032 mg/dl, while in the negative control it increased significantly to 3.08 ± 0.056 mg/dl ($p < 0.001$). The standard control group recorded 0.85 ± 0.012 mg/dl ($p< 0.001$ vs. negative control). Treatment with aqueous extract (450 mg/kg b.w.) reduced serum creatinine to 1.50 ± 0.139mg/dl ($p < 0.001$), and hydro-alcoholic extract treatment showed 0.98 ± 0.009 mg/dl ($p < 0.01$), confirming significant nephroprotection. [Table No-01]

Blood Urea Nitrogen (BUN)

BUN in the plain control was 19.04 ± 0.259 mg/dl, which increased to 42.85 ± 0.379 mg/dl in the negative control group ($p < 0.001$). The standard control group showed **21.06 ± 0.222 mg/dl** ($p < 0.001$). Treatment with aqueous extract resulted in 24.49 ± 0.23 mg/dl ($p < 0.001$), while the hydro-alcoholic extract group showed 21.14 ± 0.25 mg/dl ($p < 0.01$), both showing significant improvement compared with the negative control. [Table No-01]

Serum Uric Acid

The plain control group exhibited 2.10 ± 0.047 mg/dl, while the negative control recorded 2.41 ± 0.093 mg/dl ($p < 0.001$). Standard control (silymarin) showed 2.14 ± 0.157 mg/dl ($p< 0.001$ vs. negative

control). The aqueous extract group showed 2.07 ± 0.116 mg/dl ($p < 0.001$), and the hydro-alcoholic extract group **2**.38 ± 0.179 mg/dl ($p < 0.01$). [Table No-01]

Serum Protein

Serum protein in the plain control group was 7.21 ± 0.097 mg/dl, which decreased significantly to 4.97 ± 0.090 mg/dl in the negative control group ($p < 0.001$). The standard control group recorded 6.55 ± 0.106 mg/dl ($p< 0.001$ vs. negative control). The aqueous extract group showed 5.33 ± 0.092 mg/dl ($p < 0.001$), and the hydro-alcoholic extract group 6.05 ± 0.086 mg/dl ($p < 0.01$), indicating significant recovery of serum protein levels. [Table No-01]

Serum Albumin

Serum albumin in the plain control was 3.40 ± 0.064 mg/dl, while in the negative control it decreased to 2.49 ± 0.063 mg/dl ($p < 0.001$). The standard control group recorded 3.53 ± 0.025 mg/dl ($p < 0.001$ vs. negative control). Aqueous extract treatment showed 2.59 ± 0.071 mg/dl ($p < 0.001$), while the hydro-alcoholic extract group recorded 3.13 ± 0.067 mg/dl ($p < 0.001$). [Table No-01]

Serum Globulin

Serum globulin in the plain control group was 3.81 ± 0.064 mg/dl, which reduced to 2.49 ± 0.063 mg/dl in the negative control ($p < 0.001$). The standard control group showed 3.53 ± 0.025 mg/dl ($p < 0.001$). Aqueous extract treatment resulted in 2.59 ± 0.071 mg/dl ($p < 0.05$), while the hydro-alcoholic extract showed 3.13 ± 0.067 mg/dl ($p < 0.01$). [Table No-01]

Table01:Effectofaqueousextractandhydro-alcoholicextractofBiskhapra(*Trianthemaportulacastrum*Linn.)leavesextractoncisplatin induced acute kidney injury.

Groups	Agents	S.Creatinine(mg/dl)	BloodUrea	BUN(gm/dl)	SerumUric Acid	S.Protein	S.Albumin	S.Globulin

			(mg/dl)		(gm/dl)	(gm/dl)	(gm/dl)	(mg/dl)
Plaincontrol	Distilledwater3.0ml	0.75±0.032	40.85±0.576	19.037±0.259	2.098±0.047	7.21±0.097	4.025±0.064	3.18±0.081
Negative control	Cisplatin5mg/kg	3.08±0.056 a***	91.86±0.822 a***	42.85±0.379 a***	2.412±0.093 a#	4.97±0.090 a***	2.487±0.063 a***	2.48±0.058 a***
Standard Control	Cisplatin5mg/kg Silymarin 50mg/kg	0.85±0.012 b***	45.25±0.485 b***	21.062±0.222 b***	2.14±0.157 b#	6.55±0.106 b***	3.525±0.025 b***	3.01±0.093 b***
TestgroupA	Cisplatin5mg/kg Plus Aqueousextractofleavesof Biskhapra450mg/kg	1.50±0.139 b***	52.55±0.499 b***	24.487±0.23 b***	2.07±0.116 b#	5.33±0.092 b***	2.587±0.071 b***	2.75±0.046 b*
TestgroupB	Cisplatin5mg/kg Plus Hydro-alcoholicextractofleaves ofBiskhapra450mg/kg	0.98±0.009 b**	45.4±0.541 b**	21.137±0.25 b***	2.38±0.179 b#	6.05±0.086 b**	3.125±0.067 b***	2.92±0.070 b**

ValuesexpressedinMEAN±SEM,#-nonsignificant,*p<0.05,**p<0.01,***p<0.001,n=10ineachgroup,testusedANOVAonewayfollowedby Tukey Kramer comparison test. a- Vs Plain control and b-Negative control A.

Histopathological Examination of rat kidney

Histopathological observations strongly supported biochemical findings. The negative control group revealed extensive tubular necrosis, epithelial degeneration, and mononuclear infiltration, confirming severe renal damage. In contrast, the plain control group exhibited normal renal histology with intact glomeruli and tubular epithelium. The silymarin-treated group showed regenerative changes in tubular epithelial cells and reduction in inflammation. Notably, the Biskhapra-treated groups displayed significant renal protection: both extracts reduced tubular necrosis, restored epithelial integrity, and

preserved glomerular architecture. Among the two, the aqueous extract (Group IV) showed slightly better histological recovery than the hydro-alcoholic extract (Group V). [Figures 2-6]

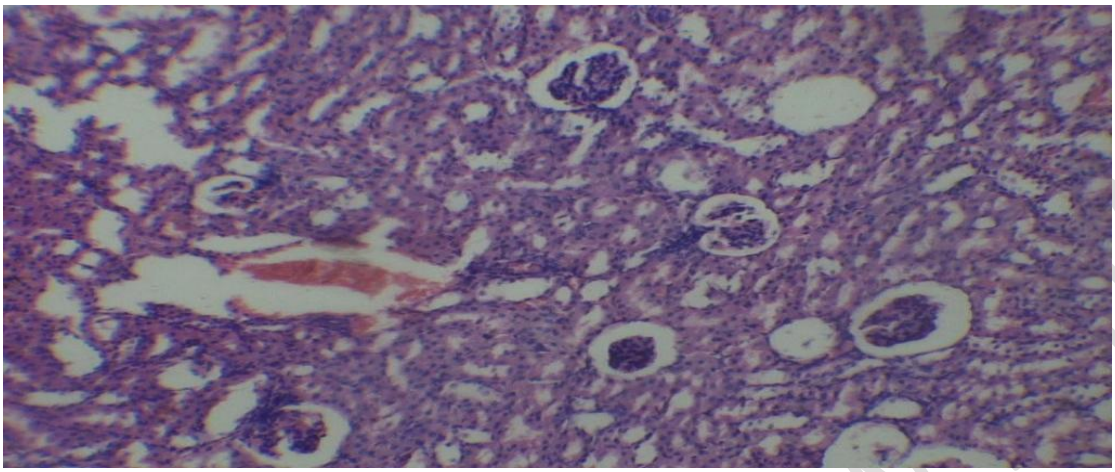

Figure: 2 Plaincontrolgroupshowingnormalstructureoftheratkidney.

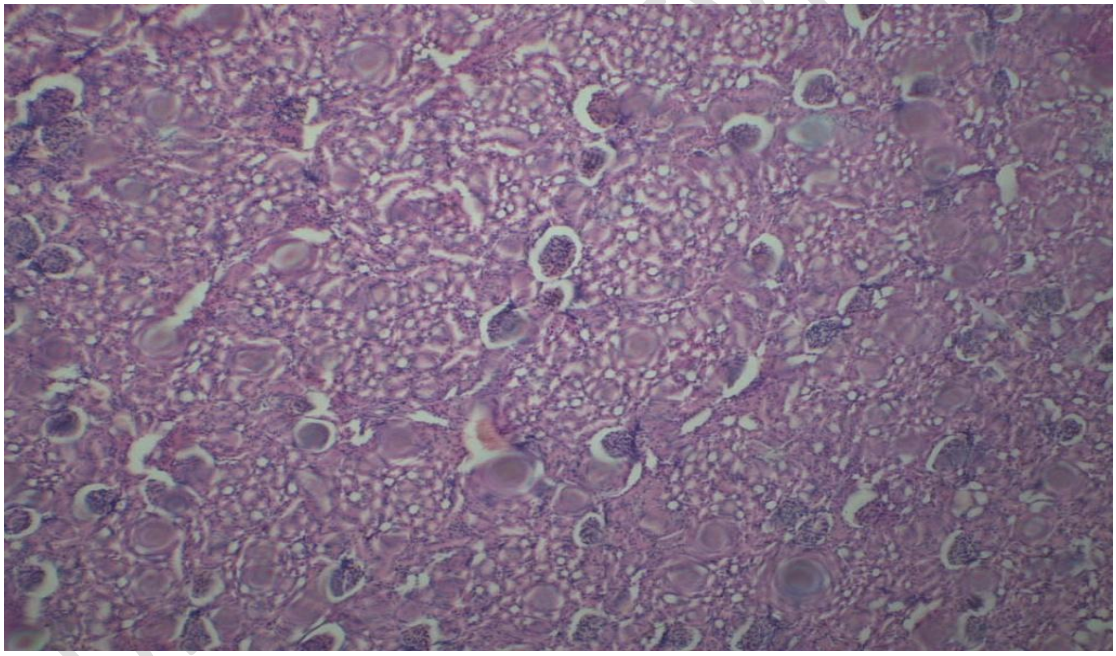

Figure: 3 Negativegroupshowingdegenerationandtubularnecrosiswith mononuclear cell infiltration.

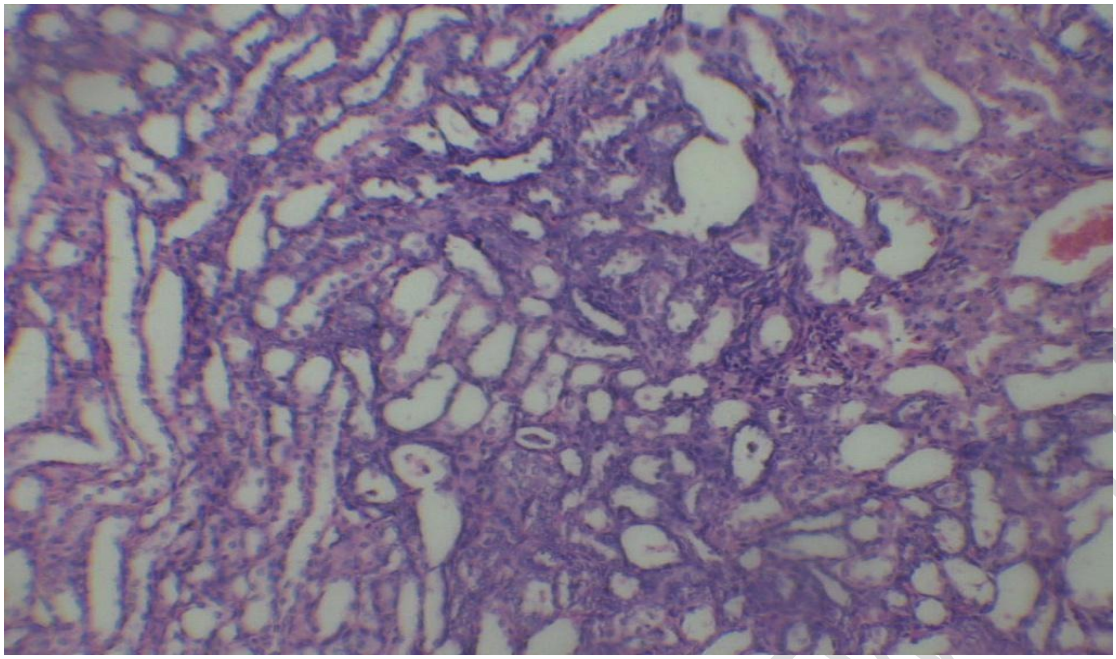

Figure: 4 Standardcontrolgroupshowingregenerativetubularepitheliummildto moderate glomeruli and tubular architecture.

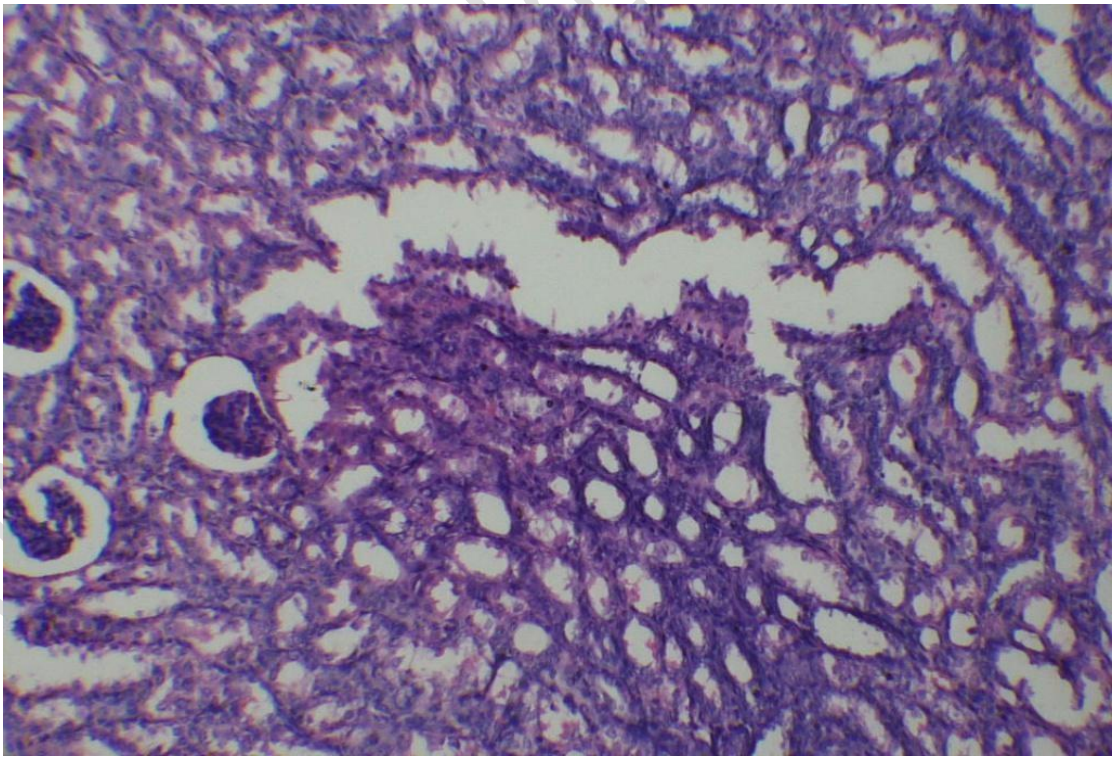

Figure: 5 groupAshowingregenerationofepitheliumlining.

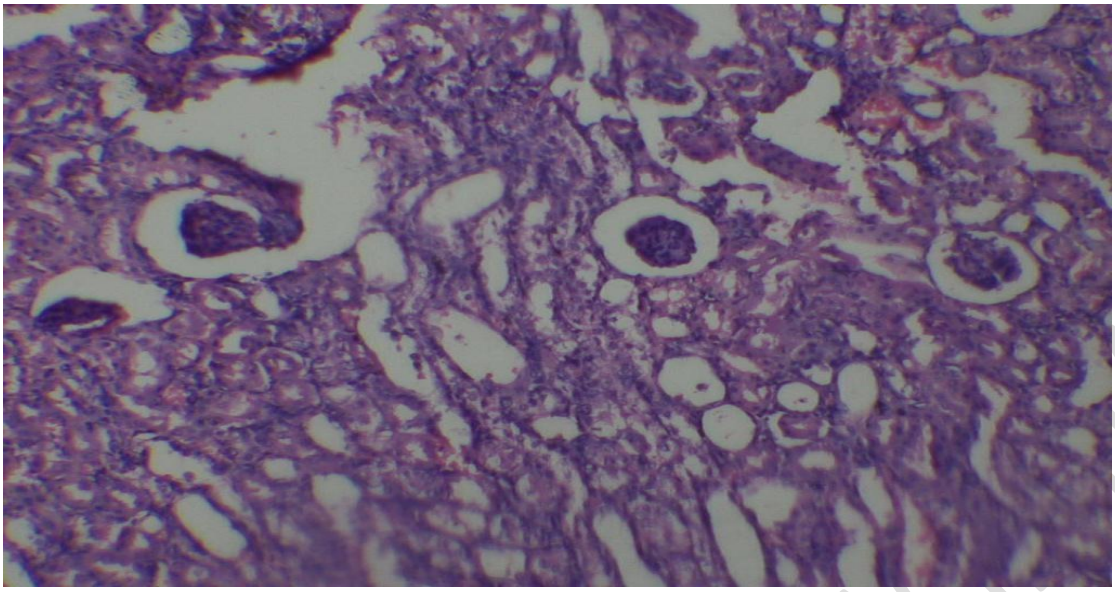

Figure: 6 TestgroupBshowingmildregenerationoftubularcellandsurrounding cytoplasm.

In comparative efficacy, both aqueous and hydro-alcoholic extracts of Biskhapra demonstrated marked nephroprotective effects against cisplatin-induced renal injury. However, the aqueous extract exhibited superior activity across biochemical and histopathological parameters, suggesting greater stability and bioavailability of its active constituents. These findings collectively validate the traditional Unani use of Biskhapra as *MuqavviGurdawaMasana* (kidney and bladder tonic) and affirm its potential as a natural nephroprotective agent.

Discussion

Acute Kidney Injury (AKI) is a serious clinical disorder marked by a sudden decline in renal function, often leading to high morbidity and mortality.[2]In this study, cisplatin was used to induce AKI in Wistar albino rats, providing a reliable experimental model for evaluating nephroprotective agents. Cisplatin-induced AKI closely resembles the pathological features seen in humans, such as tubular necrosis, elevated serum creatinine and urea, and altered protein levels.[28]The present study demonstrated that both aqueous and hydro-alcoholic extracts of *Trianthemaportulacastrum Linn.* (Biskhapra)

significantly attenuated the biochemical and histopathological alterations caused by cisplatin, thus scientifically validating its traditional Unani use as a *MuqavviGurdawaMasana* (kidney and bladder tonic).

The pathogenesis of cisplatin-induced AKI involves oxidative stress, mitochondrial dysfunction, inflammation, and apoptosis.[28]Cisplatin accumulates in proximal tubular cells, generating reactive oxygen species (ROS) that activate MAPK pathways, resulting in DNA damage and tubular epithelial cell death. These effects impair filtration and excretion functions, leading to tubular necrosis and glomerular degeneration, which were clearly observed in the negative control group.[29] In contrast, Biskhapra-treated groups showed marked improvement in both biochemical and histological parameters. The aqueous extract was slightly more effective than the hydro-alcoholic extract, possibly due to better preservation and bioavailability of active constituents in water-based preparations. Restoration of serum creatinine, urea, and total protein levels in treated rats reflected improved glomerular filtration and renal recovery. These results align with the findings of Karimet. al substantiating the use of Biskhapra extracts in ameliorating blood urea levels under nephrotoxic conditions.[32]

Phytochemical analysis confirmed the presence of alkaloids, flavonoids, tannins, saponins, steroids, and phenolic compounds in Biskhapra leaves. These constituents are known for potent antioxidant and anti-inflammatory activities. Flavonoids and phenolics neutralize free radicals, reducing lipid peroxidation and oxidative damage, while alkaloids such as punarnavine protect renal tissues from oxidative stress. Tannins and saponins stabilize cell membranes, decrease inflammation, and contribute to structural recovery. Thus, the synergistic action of these phytochemicals accounts for the observed nephroprotective effects.

Pharmacologically, the nephroprotective potential of Biskhapra arises from its antioxidant, anti-inflammatory, and diuretic properties.[9,30,31] The extracts likely reduce ROS generation, inhibit cytokine-mediated injury, and promote diuresis, which aids in flushing out toxic metabolites. From a Unani perspective, kidney diseases are associated with "Sue MizajBaridRatabMaddi" (cold and moist derangement of temperament), causing morbid humour accumulation and obstruction in renal pathways. Biskhapra, with its "Hot and Dry" temperament,[7] restores normal mizaj, improves renal perfusion, and enhances urine flow. Its *Mohallil* (resolvent) property dissolves morbid matter, while *Qabiz* (astringent) action strengthens renal structures, reducing protein loss and edema.[30]

Histopathological observations supported the biochemical findings, showing regeneration of tubular epithelium, restoration of glomerular structure, and reduced inflammatory infiltration in treated groups compared to the negative control. Between the two extracts, the aqueous extract demonstrated superior nephroprotective activity, likely due to optimal extraction of water-soluble antioxidants and other active compounds. These findings emphasize the importance of extraction methods in preserving phytochemical integrity and therapeutic potency.

The study's outcomes reinforce traditional Unani wisdom regarding the use of organ tonics (*MuqavviAaza*) in maintaining renal health.[8]Biskhapra not only protects against nephrotoxic insult but also promotes functional recovery, bridging classical Unani principles with modern pharmacological validation. Moreover, the nephroprotective and curative properties of *Biskhapra*leaf extract have been established in an Adriamycin-induced nephrotic syndrome rat model, prompting further investigation into its efficacy in other models of renal injury.[32] However, further research is required to isolate and characterize the active compounds, determine molecular mechanisms, and conduct clinical trials to confirm efficacy and safety in humans. In conclusion, Biskhapra exhibits promising nephroprotective potential against cisplatin-induced AKI through antioxidant, anti-inflammatory, and restorative mechanisms, supporting its therapeutic relevance in both traditional and modern medicine.

Conclusion

The present study validates the nephroprotective potential of *Trianthemaportulacastrum* Linn. (Biskhapra) leaves in a cisplatin-induced acute kidney injury model. Both aqueous and hydro-alcoholic extracts significantly mitigated cisplatin-induced elevations in serum creatinine, urea, and BUN, while restoring serum protein levels and preserving renal architecture. Histopathological findings supported these biochemical results, showing reduced tubular necrosis, regeneration of renal tubules, and improved glomerular integrity in treated groups.

Among the extracts, the aqueous preparation demonstrated superior nephroprotective activity, suggesting better retention of active phytoconstituents. The phytochemical profile of Biskhapra revealed the presence of alkaloids, flavonoids, saponins, tannins, steroids, and phenolics, which collectively contribute to its antioxidant, anti-inflammatory, and diuretic actions. From the perspective of Unani medicine, Biskhapra acts as MuqavviGurdawaMasana, restoring renal temperament, enhancing perfusion, and promoting elimination of morbid humours.

These findings provide compelling evidence for the traditional use of Biskhapra in kidney disorders and encourage further clinical and mechanistic studies to establish its role as a nephroprotective therapeutic agent in modern integrative medicine.

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Author's Contribution

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Conflict of Interest

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