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Study of Renal enzymuria and albuminuria activity in the Petals of Pink *Nelumbo nucifera* Gaertn.

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ABSTRACT

Aim: The aim of the present study was to assess the activity of *Nelumbo nucifera* Gaertn. Petal extract (NNPE) in tubular enzymes and in urinary albumin of Gentamicin (GM) induced renotoxic rats.
Material and methods: The study was conducted for fourteen days in twenty-four rats in four groups and the study was designed as ,Group I: Control group received 0.5% CMC; Group II: GM 100mg/kg/day i.p. Group III: NNPE extract (200mg/kg/day p.o.) + GM (100mg/kg/day i.p.); Group IV: NNPE extract (400mg/kg/day p. o) + GM (100mg/kg/day i.p.).After the last injection of GM, 24-hour urine samples were collected from all the groups to analyze the levels of tubular marker enzymes N-acetyl-β-D-glusosaminidase (NAG), Gama Glutamyl transpeptidase (GGT), Alkaline phosphatase (ALP) and Lactate dehydrogenase (LDH) and Albumin in urine to determine the extent of renal tubular damage by measuring renal enzymuria and albuminuria in toxic rats induced by Gentamicin.
Results: Levels of tubular marker enzymes and albumin were increased in Group-II and in treatment with *N. nucifera* Gaertn. Petal extract with different doses brought back to normal levels in tubular marker enzymes as well as albumin in urine for Group- III and Group- IV.
Conclusions: The present study revealed that *N. nucifera* Gaertn. Petal extract possess potent protective effect in both doses due to its high antioxidant property against renal enzymuria and albuminuria.

INTRODUCTION

The kidney is a common target for toxic xenobiotics, due to its specific capacity in clearing the toxic substances. A number of drugs, chemicals, heavy metals play a role to alter its structure and function but acute and chronic intoxication have been demonstrated to cause nephropathy with various levels of severity ranging from tubular dysfunctions to acute renal failure (Barbier *et al.,* 2005). Gentamicin (GM), an aminoglycoside antibiotic, very effective in treating against life threatening gram-negative bacterial infections (Ho and Barza, 1987; Ihab Talat Abdel-Raheem *et al.*, 2009). The use of GM was limited due to its ototoxicity and reno toxicity (Well wood *et al.,* 1976). GM was essentially eliminated by glomerular filtration and partially reabsorbed by proximal tubular cells (Black *et al.,* 1963; Silverblatt and Kuehn, 1975) and this was simplified as, an increased kidney uptake of antibiotic, mainly in the proximal tubular cells (Beauchamp *et al.,* 1985).Earlier detection of renal impairment might provide an opportunity to minimize the risk of severe or persistent of the renal injury caused by the nephrotoxic drugs. Clinical manifestations of impairment, such as elevations in blood urea nitrogen (BUN) or serum creatinine, not become evident until 50-75% of the nephrons have been damaged (Lilis and Landrigan, 1988). Hence, there has become an ongoing interest in developing innovative and early biomarkers of renal damage (Sara Taylor *et al*., 1997; Periyasamy *et al*., 2009). Measurements of the activities of urinary enzymes were considered as a useful non-invasive test in detecting the deterioration of renal function in the initial stage. The renal enzyme such as Nacetyl-β-D-glusosaminidase (NAG), and the brush border enzyme Gama glutamyl transpeptidase (GGT) have also been used to assess renal toxicity (Periyasamy *et al*., 2009; Gibey *et al.,* 1981). The damage in the tubules leads to the excretion of NAG and GGT into the lumen of the tubules that were detected in the urine. However, limiting factors in the use of these enzymes, particularly NAG is the considerable intra/inters individual variation in urinary enzyme activity (Naidu and Lee, 1994).

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Interest in the antioxidants related to food and herbal medicines was popularized owing to their multifaceted activities like natural origin, cost effectiveness, and it is less repercussion. These provide enormous scope in correcting the disease conditions, serving humans as food components, seasonings, beverages, cosmetics as well as medicine. Several organic products were utilized to protect the toxicities induced by drugs. Herbs were usually considered safe and proved effective against various human ailments and their medicinal uses have been gradually increasing in developed countries (Kaur and Kapoor, 2002).

Nelumbo nucifera Gaertn., (Nelumbonaceae) with numerous common names (e.g. Indian lotus, Chinese water lily and sacred lotus) and synonyms *Nelumbium nelumbo, N. speciosa, N. speciosum* and *Nymphaea nelumbo* (Duke *et al*., 2002).In ancient medicine, lotus petals were utilized to prepare wholesome beverage to treat hypertension, cancer, diarrhea, fever, weakness, infection and body heat imbalance (Yen *et al*., 2006). So far, the researchers have reported as hepatoprotective (Rao *et al*., 2005), antimicrobial (Brindha and Arthi, 2010a), anti platelet (Brindha and Arthi, 2010b), hypoglycemic and hypolipidemic (Supasorn Sakuljaitrong *et al.*, 2013), whitening and anti wrinkle (Kim *et al.*, 2011) and Antioxidant (Brindha and Arthi, 2011; Kirithika *et al*., 2013) activities in the flower and floral parts of *N. nucifera.* The *N. nucifera* flowers were rich in flavonoids, particularly Kaempferol derivatives, Quercetin derivatives and Anthocyanins (Chen *et al*., 2013). The researchers in the same plant did common parameters for GM induced renotoxicity. However, the activities of tubular marker enzymes were not yet studied in this plant extract. Therefore, our present study aims to evaluate the efficacy of *Nelumbo nucifera* Gaertn. Petal extract (NNPE) with two different doses on the activity of tubular marker enzymes of GM induced renotoxic rats.

MATERIALS AND METHODS

Plant material

Nelumbo nucifera Gaertn. Flowers were purchased from the Koyambedu flower bazaar, Chennai, Tamil Nadu, India. The petals were washed thoroughly with water to eliminate the earthy matters, freed from the debris, shade dried under room temperature for a few weeks, and coarsely powdered in a food processor. The collected flower was identified and authenticated by Prof. P. Jayaraman, Plant Anatomy Research Centre, and Chennai, India by comparing with the voucher specimen.

Preparation of plant extract

Extraction was performed by hot continuous percolation method using Soxhlet' apparatus. About 500gms of coarsely powdered *Nelumo nucifera* petal was extracted in 70% ethanol by the continuous hot extraction method at 50°C. The extract with 70% ethanol was decanted from the Soxhlet apparatus and the filtrate was evaporated for the total elimination of alcohol using a Rota flash Vacuum evaporator. The concentrated liquid extracts obtained were transferred to a China dish and kept in a water bath for 50°C for dryness. The residual extracts were transferred to an airtight container free from contamination for further experimental works.

Drug & chemicals

Main drug Gentamicin (GM) procured from Aptus Therapeutics Pvt. Ltd (Hyderabad, India).The Standards such as p-nitrophenol, p-nitroaniline, pyruvate and crystalline phenol for the assay were obtained from Sisco Research Laboratories Pvt. Ltd., (Mumbai,India). The Substrates pnitrophenol N-acetyl- β -D-glucosaminide from HimediaLaboratories (Mumbai,India). The other substrates such as L-γ-glutamyl-p-nitroanilide, NAD+, Disodium phenyl phosphate were procured from Sisco Research Laboratories Pvt. Ltd., (Mumbai, India). The other chemicals such as sodium citrate, sodium hydroxide, glycine, trispowder, hydrochloric acid, glycyl glycine, Acetic acid, lithium lactate, DNPH, sodium carbonate, sodium bicarbonate, citric acid, Folin's phenol reagent were obtained from Sisco Research Laboratories Pvt. Ltd. (Mumbai, India).

Animals

Male Sprague Dawley rats weighing 200-250g were obtained from the Central Animal Facility, Sri Ramachandra University and Chennai, India was used for the study. Animals were housed in individual polypropylene cages in a ventilated room (air cycles: 15/min; 70:30 exchange ratio) under an ambient temperature of 22±2°C and 40–65% relative humidity, with a 12-h light/dark artificial photoperiod. They were provided with food (M/s: Provimi Animal Nutrition Pvt Ltd, Bangalore, India) and purified water ad libitum. All the animals were acclimatized at least for 7 days in the laboratory conditions prior to experimentation. CPSCEA guidelines were followed throughout the study. The Institutional Animal Ethical Committee of Sri Ramachandra University, Chennai, India (IAEC/XXVIII/SRU/ 208/2012), approved the experimental study.

Experimental Study Design

After acclimation, the rats were grouped into four of six animals each. The group I serve as Normal control (0.5% CMC); Group II serves as a Toxic control (100mg/kg i.p GM, +0.5% CMC); Group III serves as Test control with low dosage (200 mg/kg p. o NNPE +100mg/kg i.p GM); Group IV serves as +GM group (400 mg/kg p o NNPE +100mg/kg i.p GM).GM 100 mgs/kg/d was injected intra peritoneal for 14 days, except for Group I and NNPE extract was administered orally every day with two different doses, one hour before Gentamicin injection.

Collection of Urine Sample

After the last injection of Gentamicin (on day 14), all the animals were kept in individual metabolic cages to collect 24-hour urine samples, Sodium azide were added to the urine samples, Sodium azide were added to the urine collection vessels as a preservative and a small portion of the urine was used to assay the

albumin content. The remaining part of the Urine samples was centrifuged for 10 minutes at 1000g in a refrigerated centrifuge and separated from the sediment. The supernatant considered as crude urine. This crude urine sample was used for dialysis (Berscheid *et al.,* 1983) using the standard RC Dialysis tubing, Part. No 132655 (Spectrum laboratories, Rancho Dominguez, California) at room temperature for 90 minutes against flowing tap water and later was used for the determination of various enzyme levels in urine.

Analysis of Albumin and Tubular enzyme levels in urine

The activity of N-acetyl-β-D-glusosaminidase (Moore and Morris, 1982), Gama glutamyl transpeptidase (Rosalki and Rau, 1972), alkaline phosphatase (King, 1965b) and Lactate dehydrogenase (King, 1965c) were determined using the above-cited references. Albumin levels in urine were assayed using commercially available kits from Accurex biomedical Pvt. Ltd. (Mumbai, India). All the assays were measured using Semi Automatic Biochemical Analyzer (BTS 350, Bio-system, and Barcelona, Spain) and assays were done in replicate to determine the concordant values.

Statistical analysis

The results were given as Mean ± Standard error of Mean (SEM). Data were analyzed using one-way analysis of variance (ANOVA) followed by Tukey's multiple comparison tests using the Graph Pad Prism 5.03 (Graph Pad Software, San Diego, CA, USA). The statistical significance of the difference was taken as P< 0.05. P<0.01 and P<0.001.

RESULTS

The present study was attempted to test the protective activity of hydroethanolic petal extract of *N. nucifera* in the albumin and tubular marker enzyme levels in experimental animals were shown in Table -1.

Table 1: Effect of hydro ethanol petal extract of *N. nucifera*on GM induced renotoxicity in rats.

Experiments	Groups			
	Control	GM	NNPE+GM	NNPE+GM
Albumin(mg/dl)	0.35±0.08	0.84±0.06$^{\#\#}$	0.38±0.11**	0.25±0.07***
NAG	0.55±0.10	1.30±0.06$^{\#\#\#}$	0.72±0.14**	0.42±0.10***
GGT	1.58±0.08	3.62±0.55$^{\#\#}$	1.10±0.34*	1.85±0.17**
LDH	0.22±0.05	0.55±0.10$^{\#\#}$	0.23±0.02*	0.22±0.05**
ALP	0.13±0.03	0.36±0.03$^{\#\#\#}$	0.23±0.03*	0.19±0.04**

GM:Gentamicin; NNPE: *N. nucifera* petals extract; NAG: N-acetyl-β-D-glusosaminidase;

γ - GT: Gama glutamyl transpeptidase; LDH: Lactate dehydrogenase; ALP:Alkaline phosphatase;

Units: NAG: µmoles of phenol liberated/ mg ptn./min; γ - GT-(IU/l); LDH-µmoles of pyruvate liberated/mg ptn. / min;ALP - µmol of p-nitrophenol liberated/ mg ptn./ min.

Data's were expressed as mean ± SEM (n=6).

$^{\#\#}$P <0.01 and $^{\#\#\#}$P<0.001 when compared to control.

*P <0.05, **P<0.01 and ***P<0.001 when compared to Toxic Group.

The albumin level in urine was found to be significantly increased (P<0.01) in the GM induced group and it was reverted towards normal with significance (P<0.01 and P<0.001) in both the doses of NNPE (200mg and 400mg/kg/day). Well-marked responses have been observed in the high dose (400mg/kg/day) of NNPE as showed in Table-1. The levels of γ - GT, LDH and ALP were considered to be increased with significance (P< 0.01) in the urine of GM induced tubular toxic rats. On the other hand, the activities of GGT, LDH, and ALP was reverted towards normal with significant (P<0.05 and P<0.01) in low and high dose of NNPE (200mg and 400mg/kg/day). NAG activity was significantly (P<0.001) increased in the urine of GM induced toxic rats and in turn the activity was reverted towards normal with significant (P<0.01 and P<0.001) in low and high doses of NNPE.

DISCUSSION

The following studies report (Ali *et al.,* 2005 and Reiter *et al.,* 2009) that oxidative Stress is the major contributor in GM-induced nephrotoxicity. The increased excretion of albumin in urine shows, the extent of renal tubular injury caused by GM in the toxic group, which comes to a normal level in the present study by the dose dependent administration of NNPE with GM and the present report, was agreement with the earlier report (Kakalij *et al*., 2014). GM induces conspicuous and characteristic changes in lysosomes of proximal tubular cells consistent with the accumulation of polar lipids (myeloid bodies). These changes are preceded and accompanied by signs of tubular dysfunctions or alterations leads to release of brush border and lysosomal enzymes; decreased re-absorption of filtered proteins. Under normal conditions, only few enzymatic activities of the serum enter the urine through glomerular filtrations.NAG is discovered predominantly in lysosomes of proximal tubule (Ali *et al*., 2008) of kidney and excreted in increased concentration in urine during GM induced renal tubular toxicity (Whiting and Brown, 1996; Li *et al.,* 2009) and it is the indication of proximal tubular injury of the kidney (Waring and Moonie, 2011).

In the present study, the NAG excretion in urine is increased in the GM induced group because of proximal tubule lesions (Emeigh Hart, 2005; Vaidya *et al*., 2009) but the condition is reversed by oral graded dosage of NNPE even in the presence of GM proving the protectiveness of the NNPE on toxic kidney which was supported by the previous report (Kadkhodaee *et al.,* 2005; Adel *et al*., 2008). GGT, LDH and ALP the enzymes of the brush border located in the proximal renal tubule are usually present in small amount in urine because of tubular cell shedding. An elevated level of these enzymes in urine is the major indication of proximal tubular Injury (Racusen *et al.,* 1991; Santos *et al.,* 2010; Spasovski *et al.,* 2011; National Toxicology Program, 2011) which was said to be the earlier biomarkers of renal damage (Sarah Taylor *et al.,* 1997; Periyasamy *et al.,* 2009).

A GM administration for 14 sequential days in the present study indicates, a well-developed tubular injury caused by GM induction by the excretion of tubular enzymes LDH (Kadkhodaee *et al.,* 2005; Mishra *et al.,* 2014), GGT (Mohamed *et al.,* 2013) and ALP (Kadkhodaee *et al.,* 2005) in urine. Oral

administration of graded doses of NNPE even in the presence of GM in rats reverts to the normal level of these tubular marker enzymes LDH (Kadkhodaee *et al.,* 2005; Mishra *et al.,* 2014), GGT (Mohamed *et al.,* 2013), ALP (Kadkhodaee *et al.,* 2005) and albuminuria (Table-1) implies restoring the normal function of proximal tubular cells from toxic injury caused by GM. Most of the Medicinal plants are rich in bioactive constituents tannins, phenols, flavonoids, alkaloids, saponins, glycosides, carbohydrates which possess antioxidant property (Annie *et al.,* 2005) Data's strongly reveals that above mentioned bioactive constituents are present in the *Nelumbo nucifera* flower petal (Kirithika *et al.,* 2013) except quinines, Anthroquinones (Saraswathi *et al.,* 2015). Kirithika *et al.,* and Mathew and Subramanian strongly conclude its high antioxidant activity (Kirithika *et al.,* 2013, Mathew and Subramanian, 2014).

CONCLUSION

The present study concludes from the discussion part, that the *Nelumbo nucifera* flower petal are rich in phytoconstituents proving its antioxidant property from the researchers report, may contributes to its renoprotective activity against tubular enzymuria and albuminuria of GM induced renotoxic rats. However, further studies are required to identify the exact mechanism and active phyto-constituents involved behind this Reno protective effect.

REFERENCES

Adel AKE, Amira AS, Hanan MAE and Nagwa IS. Protective effect of taurine and quercetin against renal dysfunction associated with the combined use of Gentamicin and diclofenac. Indian Journal of Biochemistry & Biophysics, 2008; 45:332-340.

Ali BH, Al-Wabel N, Mahmoud O, Mousa HM, Hashad M. Curcumin has a palliative action on gentamicin-induced nephrotoxicity in rats. Fundamental Clinical Pharmacology, 2005; 19:473 –477.

Ali BH, Al-Moundhri M, Eldin MT, Nemmar A, Al-Siyabi S, Annamalai K. Amelioration of cisplatin-induced nephrotoxicity in rats by tetramethylpyrazine. A major constituent of the Chinese herb *Ligusticum wallichi*. Experimental Biology and Medicine, 2008; 233: 891–896.

Annie S, Rajagopal PL, Malini S. effect of C.auriculata root extract on cisplatin and Gentamicin induced renal injury.phytomedicine, 2005; 8:555-560.

Barbier O, Jacquille GT, Tauc M, Cougnan M, Poujeol P. Effect of heavy metals on and handling by kidney. Nephron Physiology, 2005; 99:105-110.

Beauchamp D, Poirier A, Bergeron MG. Increased nephrotoxicity of gentamicin in pyelonephritic rats. Kidney International, 1985; 28:106–113.

Berscheid G, Grotsch H, Hropot M and Klaus E. Enzymuria of the Rat: ThePreparation of Urine for Enzyme Analysis. Journal of clinical chemistry and clinical biochemistry, 1983; 21:799-804.

Black J, Calesnick B, Williams D, Weinstein MJ. Pharmacology of gentamicin a new broad-spectrum antibiotic. Antimicrobial Agents and Chemotherapy, 1963; 5:138–147.

Brindha D and Arthi D. Antimicrobial activity of white and pink *Nlumbo nucifera* gaertn flowers. Journal of Pharmaceutical Research and Health Care, 2010(a); 2:147-155.

Brindha Durairaj and Arthi Dorai. Antiplatelet activity of white and pink *Nelumbo nucifera Gaertn* flowers. Brazilian Journal of Pharmaceutical Sciences, 2010(b); 46:579-583.

Brindha Venkatesh and Arthi Dorai. Antibacterial and Antioxidant potential of White and Pink *Nelumbo Nucifera Gaertn* Flowers. International Proceedings of Chemical, Biological and Environmental Engineering, 2011; 5:213-217.

Chen S, Xiang Y, Deng J, Liu Y, Li S. Simultaneous Analysis of Anthocyanin and Non-Anthocyanin Flavonoid in Various Tissues of Different Lotus (Nelumbo) Cultivars by HPLC-DAD-ESI-MSN. PLOS ONE, 2013; 8: e62291.

Duke JA, Bogenschutz-Godwin MJ, du Cellier J, Duke AK. Handbook of Medicinal Herbs, 2ndedn. CRC Press.2002, 473.

Emeigh Hart SG. Assessment of renal injury in vivo. Journal of Pharmacological and Toxicological Methods,2005; 52:30–45.

Gibey R, Dupond JL, Alber D, Leconte des Floris R, Henry JC. Predictive value of urinary N-acetyl-beta-D-glucosaminidase (NAG), alanine-aminopeptidase (AAP) and beta-2-microglobulin (beta 2M) in evaluating nephrotoxicity of Gentamicin. Clin Chem Acta, 1981;116:25-34.

Ho JL and Barza M. Role of aminoglycoside antibiotics in the treatment of intra-abdominal infection. Antimicrob Agents Chemotherapy, 1987; 31:485-491.

Ihab Talat Abdel-Raheem, Ahmed Ali Abdel-Ghany, Gamal Abdallah Mohamed. Protective Effect of Quercetin against Gentamicin-Induced Nephrotoxicity in Rats. Biological and Pharmaceutical Bulletin, 2009; 32: 61-67.

Kakalij RM, Alla CP, Kshirsagar RP, Kumar BH, Mutha SS, Diwan PV. Ameliorative effect of *Elaeocarpus ganitrus* on gentamicin-induced nephrotoxicity in rats.Indian Journal of Pharmacology, 2014; 46:298-302.

Kaur C and Kapoor HC. Antioxidant activity and total phenolic content of some Asian vegetables. International Journal of Food Science & Technology, 2002; 37:153-161.

Kim T, Kim HJ, Cho SK, Kang WY, Baek H, Jeon HY, Kim BY, Kim D. *Nelumbo nucifera* extracts as whitening and anti-wrinkle cosmetic agent. Korean Journal of Chemical Engineering, 2011; 28:424–427.

King J. The hydrolases acid and alkaline phosphatases, In: Practical clinical enzymology, Van D.(Ed,), Nostrand Company Limited, London: 1965b, 191-208.

King J. the dehydrogenase of oxido-reductase-lactate dehydrogenase. In: *Practical Clinical Enzymology*, Van, D. (Ed.).Nostrand Company Ltd, London: 1965c; 83-93.

Kirithika.T, Bhaigyabati Thoudam , Gomathi R, Usha K. Preliminary phytochemical screening and free radical scavenging activity on aerial plant of *Nelumbo Nucifera* Flowers. American Journal of PharmTech Research, 2013; 3: 659-665.

Li J, Li QX, Xie XF, Ao Y, Tie CR, Song RJ. Differential roles of dihydropyridine calcium antagonist nifedipine, nitrendipine and amlodipine on gentamicin-induced renal tubular toxicity in rats. European Journal of Pharmacology, 2009; 620:97–104.

Lilis R and Landrigan PJ. Renal and urinary tract disorders. In Occupational Health:

Recognizing and Preventing Work Related Disease (Levy BS, Wegman DH. Eds.), 2nd ed. Boston: Little, Brown and Co.; 1988.465-476.

Mathew M, Subramanian S. In Vitro Screening for Anti-Cholinesterase and Antioxidant Activity of Methanolic Extracts of Ayurvedic Medicinal Plants Used for Cognitive Disorders. PLOS ONE, 2014; 9: e86804.

Mehri Kadkhodaee, Hossein Khastar, Mahdieh Faghihi, Rana Ghaznavi, Maryam Zahmatkesh. Effects of co-supplementation of vitamins E and C on gentamicin-induced nephrotoxicity in rat. Experimental Physiology, 2005; 90:571–576.

Mishra S, Pani SR, Sahoo S. Anti-nephrotoxic activity of some medicinal plants from tribal rich pockets of Odisha. Pharmacognosy Research , 2014;6:210-217

Mohamed FA, Mabruka S. Elashheb, Fatma M. Ben Rabha. Protective Effect of L-Carnitine against Gentamicin-Induced Nephro-toxicity in Rats. International Scholarly and Scientific Research & Innovation, 2013; 7: 761-766.

Moore JC and Morris JW. A simple automated colorimetric method for determination of N-acetyl-β-D-glucosaminidase. Annals of Clinical Biochemistry, 1982; 19:157–159.

Naidu SG and Lee FT Jr. Contrast nephretoxicity: predictive value of urinary enzyme markers in a rat model. Academic Radiology, 1994; 1: 3-9.

National Toxicology Program. Toxicology and carcinogenesis Studies of tetralin (CAS No. 119-64-2) in F344/N rats and B6C3F1 mice (inhalation studies).National Toxicology Program technical report series, 2011; 561: 1–198.

Periyasamy Balasubramanian.M, Thangavel Jayakumar, Metharmitla Perumal Sridhar, Tanguturi Raghavaiah BharathPrasad, Muthaiyan Ilayaraja *et al*. experimental studies of achyranthesaspera (L) preventing nephrotoxicity induced by lead in albino rats. Journal of health sciences, 2009; 55:701-708.

Racusen LC, Fivush BA, Li YL, Slatnik I, Solez K. Dissociation of tubular cell detachment and tubular cell death in clinical and experimental acute tubular necrosis. Laboratory Investigation, 1991:64; 546–556.

Rao GMM, Pushpangadan P and Shirwaikar A. Hepatoprotective activity of NelumbonuciferaGeartn. Flower an Ethnopharmacological study. Acta Pharmaceutica Turcica, 2005;47:79-88.

Reiter M, Rupp K, Baumeister P, Zieger S, Harreus U, Antioxidant effects of quercetin and coenzyme Q10 in mini organ cultures of human nasal mucosa cells, Anticancer Research, 29, 2009, 33-40.

Rosalki SB and Rau D. Serum gamma-glutamyltranspeptidase activity in alcoholism. Clinica Chimica Acta, 1972; 39:41-47.

Santos C, Marcelino P, Carvalho T, Coelho J, Bispo M, Moura OL et al. The value of tubular enzymes for early detection of acute kidney injury after liver transplantation: an observational study. Transplantation Proceedings, 2010; 42: 3639–3643.

Sarah A. Taylor, Ian D. Chivers, Robert G. Price, Maria Arce-Tomas, Peter Milligan, Innocente Francini et al., The Assessment of Biomarkers to Detect Nephrotoxicity Using an Integrated Database. Environmental Research, 1997; 75: 23–33.

Saraswathi RV and Gricilda Shoba F.physio-chemical and phytochemical study of hydroethanolic petal extract of pink nelumbo nucifera gaertn. Indo American Journal of Pharmaceutical Research.2015; 5:2530- 2538.

Silverblatt FJ and Kuehn C. Autoradiography of gentamicin uptake by the rat proximal tubule cell. Kidney International, 1975; 15: 335– 345.

Spasovski D, Masin-Spasovska J, Nada M, Calovski J, Sandevska E, Osmani B, Sotirova T, Balkanov S, Dukovski D, Ljatifi A, Spasovski G. Diagnostic value of brush border enzymes of the proximal renal tubules in rheumatoid arthritis. Clinical Laboratory, 2011; 57:305–314.

Supasorn Sakuljaitrong, NopparatBuddhakala, SanongChomko and Chusri Talubmook. Effects of Flower Extract from Lotus (*Nelumbonucifera*) on Hypoglycemic and Hypolipidemic in Streptozotocin-induced Diabetic Rats. International Journal of Scientific Engineering and Research, 2013; 4:1441-1446.

Vaidya VS, Ford GM, Waikar SS, Wang Y, Clement MB, Ramirez V, et al. A rapid urine test for early detection of kidney injury. Kidney International, 2009; 76:108-114.

Waring WS and Moonie A. Earlier recognition of nephrotoxicity using novel biomarkers of acute kidney injury. Clinical toxicology (Philadelphia), 2011; 49: 720–8.

Well wood JM, Lovell D, and Thompson AE. Renal damage caused by Gentamicin. The Journal of Pathology, 1976; 118:171-182.

Whiting PH and Brown PA. The relationship between enzymuria and kidney enzyme activities in experimental Gentamicin nephrotoxicity. Renal Failure, 1996; 18:899–909.

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