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-glucosaminidase (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 otoxicity 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-glucosaminidase (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).
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 nucifera_, _N. speciosa_, _N. speciosum_ and _Nymphaea nelsono_ (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 (Dupasorn 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 500 gms of coarsely powdered _Nelumbo 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, glycyglycine, Acetic acid, Sodium carbonate, Sodium bicarbonate, citric acid, Folins’s phenol reagent were obtained from Sisco Research Laboratories Pvt. Ltd. (Mumbai, India).

**Animals**

Male Sprague Dawley rats weighing 200-250 g 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 (100 mg/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-glucosaminidase (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.

**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 protective nature of the NNPE on toxic kidney which was supported by the previous report (Kadkhodaei 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 (Kadkhodaei et al., 2005; Mishra et al., 2014), GGT (Mohamed et al., 2013) and ALP (Kadkhodaei 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-I) 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, Anthoquinones (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.

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