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Original Research Article

Nephroprotective Role of Nigella Sativa Oil Against Gentamicin Induced Nephrotoxicity: An Experimental Study in Rats

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Abstract

The objective of this study is to evaluate the nephroprotective activity and antioxidant potential of *Nigella sativa oil* against Gentamicin-induced nephrotoxicity. Healthy adult albino rats of either sex (100-200 g) was randomly divided into six groups of five animals each. Group I (normal control) were administered distilled water intra peritoneally for 8 days. Group II (LNSO). were administered low dose nigella sativa oil 1ml/kg orally for 10 days. Group III (HNSO) were administered High dose nigella sativa oil 2ml/kg orally for 10 days. Group IV (GNCG)Gentamicin negative control group. were administered Gentamicin (80mg/kg) From day 1-8 Intra-peritoneally. Group V (GLNSO) were administered Low dose of Nigella sativa oil (1ml/kg) orally (From day 1-10) + Gentamicin (80mg/kg) (From day 3-10) Intra-peritoneally. Group VI (GHNSO) were administered high dose Nigella sativa oil.(2ml/kg) orally (From day 1-10) + Gentamicin (80mg/kg) (From day 3-10) intra-peritoneally. On the 10^{th} day (8^{th} day for normal control group), blood was collected for biochemical tests and the rats were sacrificed. The kidney was removed for histology and lipid peroxidation-antioxidant test. Gentamicin caused nephrotoxicity as evidenced by elevated BUN, blood urea and serum creatinine. Co-administration of Nigella sativa oil at doses of 1ml/kg and 2ml/kg in Group V and Group VI caused a dose-dependent reduction in the rise of BUN, blood urea and serum creatinine as compared to Group IV (gentamicin negative control group).There was increased catalase and glutathione and decreased malondialdehyde levels in Group IV, while Group V (GLNSO) and Group VI(GHNSO) treatment with low dose and high dose of Nigella sativa oil significantly reversed the changes toward normal values. Histological examination of the kidney revealed renoprotection in Group V and Group VI compared with Group IV. The Nigella sativa oil has a nephroprotective activity against Gentamicin-induced nephrotoxicity in rats.

Keywords: Nigella sativa oil, nephroprotective, nephrotoxicity; aminoglycosides, gentamicin, oxidative stress, histopathology, animal study, rats

Introduction

Nephrotoxicity is one of the most important side effects and therapeutical limitations of aminoglycoside antibiotics, especially gentamicin. Despite rigorous patient monitoring, nephrotoxicity appears in 10–25% of therapeutic courses (Lopez-Novoa JM et al 2011).

The ability of the kidney to concentrate the tubular fluid contents is a hallmark of renal function. Any nephrotoxic or potentially nephrotoxic compound present in the tubular fluid would be concentrated in a similar manner (William O Berndt 1998) .The large surface area of tubular epithelium provides sites for toxin interaction and uptake, specific transport mechanism which are responsible for cellular uptake and the normal concentrating mechanisms of the kidney can increase the concentration of the toxin. (Weinberg J.M et al., 1991) [1-3].

Aminoglycosides

The aminoglycoside group includes gentamicin, tobramycin, amikacin, netilmicin, kanamycin, streptomycin, paromomycin, and neomycin. Aminoglycosides are indicated in treatment of infections caused by aerobic gram-negative bacteria Gentamicin is an effective therapeutic alternative against microbes insensitive to other antibiotics. This is primarily because of their chemical stability, fast bactericidal effect, synergy with betalactamic antibiotics, little resistance, and low cost. (Edson RS et al 1999) [4-5]. Aminoglycoside are taken up by renal proximal tubular cells and remain there for an extended period this leads to renal damage in the form of structural and functional impairment of the plasma membrane, mitochondria and lysosome (Mingeot-Leclerq MP et al 1999). Histopathological studies strongly support the concept that tubular necrosis (and related phenomena) is the primary cause of functional toxicity [6-9].

nephroprotection aims at early detection and subsequent prevention of progression of kidney disease, mainly through lifestyle adjustment and the use of new pharmacological agents (Lameire N et al.,2005). The facts that: 1) Global burden of CKD and other renal diseases is increasing 2) Till date there's no drug which could be used solely for the purpose of renoprotection without causing serious side effects alongwith the fact that 3) Aminoglycosides are still widely used, more so, in treatment for cases of microbes resistant to other antibiotics 4) Traditional medicinal plants may offer a suitable alternative for nephroprotection having very few if any toxic side effects, were the propellants to carry out this study.

Nigella sativa seed has a long history as a diversely beneficial herb, In Egypt society, the rich golden (Nigella sativa) oil was named 'pharaohs oil (Zohary et al, 2000). An authentic saying of the Prophet Muhammad (Peace Be Upon Him) about black seed Allah's Apostle (peace be upon him) said "Use the black seed, which is a healing for all diseases except 'As-Sam" and As-Sam is Death (Al-Bukhari) [10-13]. In Ayurveda system of medicine, it is also considered a great metabolic enhancer. Ayurveda utilizes Black seed for its ability to heal nervous disorders, anorexia, and gynaecological problems and also uses this herb to heighten mood, stimulate metabolism, and provide the harmonizing benefits of an overall body tonic. Saleem U et al observed the nephro-protective effect of vitamin C and N. sativa oil against gentamicin induced nephrotoxicity in rabbits.

Materials and Methods

Plant material: Nigella sativa oil – Nigella sativa oil (Kalonji oil, Mohammedia products, Aamirnagar, Shah Sahab Mohalla, Karimnagar – 505001, A.P., India) was procured from local market at Aligarh. As per

manufacturer's information, it was prepared by steam distillation.

Experimental animals: Healthy adult albino rats weighing 100-200g of either sex was procured from Central Animal House, J.N. Medical College, AMU, Aligarh. The animals were placed in polypropylene cages bedded with paper strips. They were maintained at a temprature of 27°C ± 2°C, also, the animals were kept under 12 hours dark-light cycle and were fed with standard pellet diet and water ad libitum. The paper strips were changed every day to maintain proper hygiene and comfort for animals. The animals were acclimatized for one week under laboratory conditions before experimentation [14-16].

Ethical clearance for experimental study of the animals was obtained from the Institutional animal ethical committee, JNMC, AMU, Aligarh before commencement of the experiments.

IAEC Approval: The study protocol was approved by the Institutional Animal Ethics Registration no.: 401/RO/C/2001/CPCSEA. All animal experiments were carried out as per the rules and regulations of IAEC & CPCSEA (Committee for the Purpose of Control and Supervision of Experiments on Animals) under the "Guidelines for Care and Use of Animals in Scientific Research" (INSA 1992 & 2000).

Experimental models

1. Gentamicin induced nephrotoxicity. Nephrotoxicity was induced by Gentamicin in the dose of 80mg/kg/day (Naidu et al 2000, Singh et al 2009) through i.p route daily for 8 days.
2. Nigella sativa Nephroprotectivity model

Nigella sativa oil was administered in two different doses in the study i) low dose 1ml/kg body weight/day and ii) high dose 2ml/kg body weight/day for evaluating the nephroprotective role of the Nigella sativa oil (Hafez 2013, Ali 2004, Danladi 2013).

Experimental design. Healthy adult albino wistar rats of either sex weighing 100-200gm were randomly divided into 6 groups of 5 rats each as follows: (n = number of rats in each group)

Table 1: Experimental models

Groups	Treatment and Duration	Route of Drug Administration
Group I (normal control): (n=5)	Distilled water 1ml/kg (From day 1-8)	Intra-peritoneally
Group II (normal control): (n=5)	Nigella sativa oil – 1ml/kg (From day 1-10)	Oral
Group III (normal control): (n=5)	Nigella sativa oil – 2ml/kg (From day 1-10)	Oral
Group IV: (n=5) (Gentamicin negative control)	Gentamicin (80mg/kg). (From day 1-8)	Intra-peritoneal
Group V: (n=5) (Gentamicin and low dose- -nigella sativa oil treatment group)	Low dose Nigella sativa oil. (1ml/kg). (From day 1-10) + Gentamicin(80mg/kg) (From day 3-10)	Oral Intra-peritoneal
Group VI: (n=5) (Gentamicin and high dose- nigella sativa oil treatment group)	High dose Nigella sativa oil. (2ml/kg) (From day 1-10) + Gentamicin(80mg/kg) (from Day 3-10)	Oral Intra-peritoneal

Administration of Nigella sativa oil was started two days prior in groups V and GroupVI in which gentamicin was co-administered (Ali BH 2004).

Twenty-four hours after the last dose in respective treatment group was administered following procedures were carried out:

1. Blood samples were collected for measurement of following biochemical parameters:
2. Blood urea nitrogen (BUN). 2) Blood urea 3) Serum creatinine
3. Animals were dissected and sacrificed (under pentobarbitone sodium 50mg/kg i.p.
   anaethesia). The kidneys were dissected out for histopathological examination
4. Oxidative stress studies were carried out on renal tissue samples from rats of all groups for following parameters 1) Malondialdehyde (MDA) 2) Catalase 3) Reduced glutathione (GSH).

Histological examination

All the kidney tissue specimens were preserved in 10% Formalin and processed in the neuroanatomy & histology research laboratory, Department of Anatomy, J.N. Medical College, A.M.U., Aligarh.

Statistical analysis

The results are presented as Mean ± Standard Deviation (SD). The groups were compared by one-way Analysis of Variance (ANOVA) followed by post hoc "Dunnett's Multiple comparison test" to analyze statistical significance. A "p" value of less than 0.05 ($p<0.05$) was considered to be significant.

Results

Biochemical parameters

Effect of Distilled water Nigella Sativa oil low dose (1ml/kg) and Nigella sativa oil high dose (2ml/kg): Administration of Distilled water alone for 8 days, Nigella sativa oil alone in low dose (1ml/kg p.o) and high dose (2ml/kg p.o) for 10 days produced no significant change in BUN, Blood urea and Serum creatinine levels as compared to normal control.

Table 2: Biochemical parameters

S. No.	Groups	BUN (mg/dl)	Blood Urea (mg/dl)	Serum creatinine (mg/dl)
I	Normal Control	19.14 ± 1.02	40.96 ± 2.19	0.61 ± 0.03
II	LNSO	18.64 ± 2.54	39.88 ± 7.68	0.57 ± 0.08
III	HNSO	19.04 ± 1.76	40.74 ± 5.32	0.59 ± 0.05

The values are expressed as Mean ± Standard Deviation (SD). LNSO = Low dose (1ml/kg) Nigella sativa oil. HNSO = High dose (2ml/kg) Nigella sativa oil.

Gentamicin Induced Nephrotoxicity Model

In the normal control group, which was given only distilled water; BUN, Blood urea and Serum creatinine were within normal range. In the animals treated with gentamicin, the level of BUN, Blood urea and serum creatinine were significantly elevated ($p<.001$). There was a decrease in the levels BUN and blood urea in the groups treated wit Blood Urea in the groups treated with low dose Nigella sativa oil along with gentamicin and this decrease was significant ($p<0.05$) when compared with negative (gentamicin) control group whereas as the decrease in the levels of serum creatinine was not significant. In the treatment group which received high dose of Nigella sativa oil along with gentamicin it was seen that decrease in the levels of BUN, Blood Urea and serum creatinine were highly significant ($p<0.001$) when compared with levels of BUN, Blood Urea and serum creatinine in the negative(gentamicin) control group.

Table 3: Biochemical parameters

S. No.	Groups	BUN (mg/dl)	Blood Urea (mg/dl)	Serum creatinine (mg/dl)
I	Normal Control	19.14 ± 1.02	40.96 ± 2.19	0.61 ± 0.03
II	GNCG	65.79 ± 4.25$^{\#}$	140.80 ± 9.10$^{\#}$	2.37 ± 0.34$^{\#}$
III	GLNSO	56.91 ± 5.57^{a}	121.80 ± 11.9^{a}	2.08 ± 0.16
IV	GHNSO	40.75 ± 2.90^{c}	87.20 ± 6.22^{c}	1.53 ± 0.08^{c}

The values are expressed as Mean ± Standard Deviation (SD) where "a" is $p<0.05$ and "c" is $p<0.001$ when compared with the Gentamicin negative control group. Also "#" is $p<0.001$ when comparison is made with Normal control group. GNCG = Gentamicin negative control. GLNSO= Gentamicin + Low dose (1ml/kg) N. sativa oil. GHNSO= Gentamicin + High dose (2ml/kg) N. sativa oil

Parameters of oxidative stress

Effect of Nigella Sativa oil low dose (1ml/kg) and Nigella sativa oil high dose (2ml/kg): Administration of Nigella sativa oil alone in low dose 1ml/kg and high dose 2ml/kg did not show much deviation in parameters MDA, Catalase and GSH from normal control. The values were statistically similar to normal control ($p>0.05$).

Table 4: Parameters of oxidative stress

S. No.	Groups	MDA (nmoles/g wet tissue wt.)	Catalase (nmoles H_2O_2consumed/min /mg protein)	GSH (nmoles/mg protein)
I	Normal Control	48.5 ± 1.57	131.19 ± 2.36	18.35 ± 0.45
II	LNSO	46.15 ± 2.10	135.57 ± 2.65	18.90 ± 1.07
III	HNSO	46.80 ± 1.40	133.21 ± 3.80	18.75 ± 0.84

The values are expressed as Mean ± Standard Deviation (SD). LNSO = Low dose (1ml/kg) Nigella sativa oil. HNSO = High dose (2ml/kg) Nigella sativa oil.

Gentamicin Induced Nephrotoxicity Model

In the normal control group, which was given only distilled water, the levels of MDA, Catalase and GSH were measured. In the animals treated with gentamicin the levels of MDA were significantly elevated, whereas Catalase and GSH levels were significantly decreased as compared with normal control group. Administration of N. sativa oil in doses of 1ml/kg (low dose) and 2ml/kg (high dose) led to decrease in the levels of MDA which was highly significant ($p<0.001$). The increase levels of catalase were highly significant ($p<0.001$) as compared with the negative (gentamicin) control group (group IV). Increase levels of GSH was highly significant ($p<0.001$) in group which received Nigella sativa oil in high dose along with gentamicin whereas the increase in levels of GSH in group receiving Nigella sativa oil in low dose was significant upto $p<0.05$, when compared with levels of GSH in the negative (gentamicin) control group (group IV).

Table 5: Gentamicin Induced Nephrotoxicity Model

S. No.	Groups	MDA (nmoles/g wet tissue wt.)	Catalase s(nmoles H_2O_2consumed/min /mg protein)	GSH (nmoles/mg protein)
I	Normal Control	48.5 ± 1.57	131.19 ± 2.36	18.35 ± 0.45
II	GNCG	126.5 ± 3.64$^{\#}$	91.40 ± 1.33$^{\#}$	8.40 ± 0.49$^{\#}$

III	GLNSO	110.65 ± 1.40^{c}	97.31 ± 1.75^{c}	9.52 ± 0.54^{a}
IV	GHNSO	90.83 ± 3.01^{c}	116.65 ± 2.25^{c}	11.28 ± 0.81^{c}

The values are expressed as Mean ± Standard deviation (SD) where "a" is $p<0.05$, and "c" is $p<0.001$ when compared with the Gentamicin negative control group. Also "#" is $p<0.001$ when comparison is made with Normal control group. GNCG = Gentamicin negative control. GLNSO= Gentamicin + Low dose (1ml/kg) N. sativa oil. GHNSO= Gentamicin + High dose (2ml/kg) N. sativa oil.

Histopathology

Kidney sections showing inflammatory cells infiltration, atrophied glomerulus, degeneration, desquamation of tubular epithelium and hyaline casts are suggestive of tubular necrosis and interstitial edema.

Table 6: Effect of N. sativa oil on Gentamicin induced nephrotoxicity in rats Histopathological grading.

Histopathological features	Normal control group	GNCG	GLNSO	GHNSO
Glomerular and tubular congestion,	-	++++	+++	++
Interstitial oedema	-	+++	++	+
Inflammatory cells infiltration	-	+++	++	++
Tubular necrosis	-	++++	+++	++
Tubular casts(hyaline)	-	+++++	++	+

GNCG = Gentamicin negative control.
GLNSO= Gentamicin + Low dose(1ml/kg) N.sativa oil.
GHNSO= Gentamicin + High dose(2ml/kg) N.sativa oil

Discussion

Aminoglycosides drugs are known to cause nephrotoxicity. Results have indicated that aminoglycosides are taken up by receptor-mediated endocytosis following the binding of aminoglycosides to the brush-border membrane (Baylis et al 1977) [18-24]. Selective accumulation of these drugs in renal tissues is proposed to be responsible for their nephrotoxic effects. This causes disturbances in renal functions as evident by derangements in biochemical parameters like BUN (Blood Urea Nitrogen), Blood urea and Serum creatinine levels [25].

Many compounds and Medicinal plants offer nephroprotection and are being researched upon over past decades. Synthetic compounds Piperacillin (Hayashi et al 1988), polyaspartic acid (Gilbert et al 1989), pyridoxal 5'phosphate (Kacew et al 1989), diphenyl phenylenediamine (Ramasammy et al 1986), have shown nephroprotective activity against aminoglycoside induced nephrotoxicity but their possible clinical usefulness is still uncertain. Also, various adverse reaction which are associated with these drugs may prove to be a hinderance in their clinical application. Under such circumstances natural substances obtain from medicinal plants or other natural sources may provide for a clinically useful nephroprotective agent with fewer side effects. Several such agents: Rheum officinalis (Yokozawa et al 1986,1991), Zingiber officinale (Narora et al 1992), Withania somnifera (Panda et al 1997), Honey (Abd Ali 2012), Allium sativum (Abdelaziz et al 2011) and more have been

tested for their role in improving renal function or in offering nephroprotection in various studies. In this study Nigella sativa oil was selected for evaluating it's nephroprotective role although studies have been conducted to test for nephroprotection offered by this amazing plant source but very few studies have been conducted on the oil obtained from seeds of Nigella sativa in regard to nephroprotective activity against nephrotoxicity induced by gentamicin and other aminoglycosides. Treatment with Nigella Sativa oil led to improvement in renal functions as evident by measurement of biochemical parameters and also there was evidence of preservation of renal tubular cell morphology as is evident from histopathological grading and gross tissue (renal) sample [26-29].

In the present study it was found that administration of gentamicin led to derangements in biochemical parameters. These findings were in accordance with studies conducted by Luft et al 1978, Naidu et al 2000, Ali 2004 and Saleem et al 2012. The present study also evaluated the effect on biochemical parameters related to renal functions upon administration of Nigella sativa oil in low dose and a high dose alone. It was seen that the administration of Nigella sativa oil alone in low dose 1ml/kg body weight and a high dose 2ml/kg body weight did not show much deviation in values of biochemical parameters and the values were statistically similar to normal control($p>0.05$). This signifies that significant deviation in values of biochemical parameters from the normal amongst the treatment groups which were administered Nigella sativa oil along with aminoglycosides were due to the effect of aminoglycosides themselves [29-32].

Effects on levels of biochemical parameters: BUN, blood urea and S.Creatinine due to co-administeration of Nigella Sativa oil and Gentamicin

Gentamicin treatment Groups

Nigella sativa oil when administered along with gentamicin led to dose dependent decrease in BUN, Blood urea and S. Creatinine as compared to group treated with gentamicin alone. When Nigella Sativa oil was administered in low dose (1ml/kg) along with gentamicin there was decrease in level of BUN and Blood Urea which was significant ($P<0.05$), whereas the decrease in level of S. Creatinine was not significant as compared to group which was treated with gentamicin alone. In the group treated with high dose (2ml/kg) of Nigella sativa oil there was decrease in levels of BUN, Blood urea and S. creatinine and this difference was significant ($p<0.001$) when compared with group treated with Gentamicin alone.

Histopathological examination

Histopathological examination revealed that there was damage to the nephrons of cortical region, mainly in PCT due to administration of gentamicin. This is in accordance with various other studies conducted to evaluate nephrotoxic potential of aminoglycosides. On the basis of histopathological examination and grading gentamicin was found to be the highly nephrotoxic. It was also seen that administration of low dose of Nigella sativa oil in gentamicin treated animals led to decrease in the damage as compared to damage caused by gentamicin alone, also when the Nigella sativa oil was given in a higher dose along with gentamicin this also led to decrease in nephrotoxicity and the evident damage was graded as lesser when as compared to that observed in the group treated with low dose of Nigella sativa oil.

In the present study the histopathology of renal tissues obtained from the groups receiving only Nigella sativa oil in low dose and high dose was also observed for histopathological changes. And it was seen that the histopathological appearance of these samples were similar to those of the normal control group. These results were in

accordance with results of the study conducted by Zaoui et al (2002).

Aminoglycosides are polycationic molecules capable of binding to phospholipids of the renal brush border and particularly the basolateral membranes, thus inhibiting the activity of lysosomal phospholipases (Commandeur et al 1990). Gentamicin causes oxidative stress and subsequent oxidative damage to cell membrane and other organelles of the cell. This was evident in studies conducted by Walker et al (1999), and Karahan et al (2005), who reported that gentamicin induced increase in oxidative free radicals were responsible for injury to renal tissues. Likewise it was reported from that gentamicin induces oxidative stress in rat kidney, as evidenced by the significant increase in lipid peroxidation and significant decline of endogenous antioxidants such as reduced Glutathione, Superoxide dismutase and Catalase [33-35].

Effects on levels of oxidative stress markers: MDA, catalase and GSH due to administeration of Nigella Sativa oil concurrently with gentamicin

Gentamicin treatment Groups: In the normal control group, which was given only distilled water; the levels of MDA, Catalase and GSH were measured. In the animals treated with gentamicin alone, the level of MDA was significantly elevated, whereas Catalase and GSH levels were significantly decreased as compared with normal control group. Administration of N. sativa oil in doses of 1ml/kg and 2ml/kg led to dose dependent decrease in the level of MDA, whereas levels of Catalase and GSH showed a dose dependent increase as compared with the negative (gentamicin) control group (group IV). The decrease in the level of MDA was significant ($p<0.001$) in Nigella sativa oil treated groups and this decrease was more in groups treated with higher dose of Nigella sativa oil. The increase in levels of catalase was significant ($p <0.01$) in group receiving low dose of Nigella sativa oil and was significant upto $p <0.001$ in group receiving high dose of Nigella sativa oil. The increase in GSH levels was significant ($p<0.05$) in group receiving low dose of Nigella sativa oil and was significant upto ($p<0.001$) in group receiving high dose of Nigella sativa oil. The effect on oxidative stress parameters upon administration of Nigella sativa oil in low dose and a high dose alone was also evaluated in the present study. It was seen that the administration of Nigella sativa oil alone in low dose 1ml/kg and a high dose 2ml/kg body weight did not show much deviation in these parameters and the values were statistically similar to normal control($p>0.05$).

Gentamicin may enhance the formation of reactive oxygen species. Gentamicin inhibits the mitochondrial state 3 respiration of isolated mitochondria, while it stimulated state 4 respiration. Because this effect was inhibitable with catalase, production of hydrogen peroxide might be involved in gentamicin nephrotoxicity (Walker et al 1987). Scavengers of hydroxyl radicals (dimethyl sulfoxide, sodium benzoate, dimethylthiourea or iron chelator deferoxamine) inhibit Fenton reaction protected rats against acute renal failure of gentamicin in vivo, which suggests a pivotal role for hydroxyl radicals in causation of nephrotoxicity due to gentamicin (Walker et al 1988) [36,37].

Nephroprotective role of Nigella Sativa

In the present study it was evident from the results that Nigella sativa oil given concomitantly with aminoglycosides led to decrease in deviation in biochemical parameters when compared with negative control group. And there was decrease in damage to renal tissue which was evident from histopatholical findings. These positive findings in favour of the Nigella sativa oil coadministration can be due to it's ability to decrease the damage to the cells of renal tissue by decreasing the MDA levels,

increasing the Catalase and GSH levels which would inturn lead to decrease in oxidative stress to the cells and thus leading to lesser cellular damage. Similar results were reported by Rehman et al (2012) when Nigella sativa oil was concomitantly administered with gentamicin which led to morphological and histopathological changes to tubular parts of kidneys by potentiating the existing antioxidant defense mechanism at the levels of tubular parts of kidneys along with the reduction of serum creatinine and urea levels.Also Salama et al (2011) who reported that the beneficial effects of the use of the N. sativa seeds and thymoquinone (one of its constituent) might be related to their cytoprotective and antioxidant actions.

Conclusion

The present study entitled "Nephroprotective role of nigella sativa oil against gentamicin induced nephrotoxicity: an experimental study in rats" is conducted on thirty rats which are equally and randomly divided in 6 groups. The work was carried out in Department of Pharmacology and Department of Anatomy J.N. Medical College, AMU, Aligarh. In the present study the aminoglycosides namely gentamicin was used to induce nephrotoxicity in rats. It was evident from biochemical parameters, parameters for oxidative stress and histopathological examination of renal tissues that gentamicin is a nephrotoxic drug.

Nigella sativa oil used for studying its nephroprotective potential is found to be nephroprotective against gentamicin induced nephrotoxicity. Neproprotective effect may be attributed to it's ability to decrease oxidative stress, which is thought to be the main mechanism involved in causing nephrotoxicity upon aminoglycoside administration.

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