Nephroprotective activity of *Solanummelongena* (talong) extract against gentamicin-induced renal toxicity in Sprague Dawley rats

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Abstract: Renal disease also known as kidney failure, is one of the leading causes of death among Filipinos characterized by an increased level of serumcreatinine(SCr) and/or blood urea nitrogen (BUN) levels. Some therapeutic drugs affect kidney function and leads to nephrotoxicity. Gentamicin which is an antibiotic for severe bacterial infections is known to induce nephrotoxicity. *Solanummelongena* (talong) extract was used in the study to determine its nephroprotective activity against gentamicin. Phytochemical analysis of the plant revealed the presence of flavonoids. The lethal dose of the extract was found out to be greater than 225 mg/kg.Test animals treated with gentamicin showed marked elevation in the SCr (147.90±0.84 mg/dL) and BUN (57.13±5.31 mg/dL) parameters which proves the effect of gentamicin in inducing renal toxicity. Moreover, SCr levels of Group III (with 100 mg/kg extract) and Group IV(with 200 mg/kg extract) were 84.40±5.06 mg/dL and 62.15±1.53 mg/dL, respectively. On the other hand, the BUN levels were 41.53±6.51 mg/dL and 29.68±4.42 mg/dL for Groups III and IV. Both values were lower than the group induced with gentamicin which reveals the protective effect of *S. melongena*extract on the rats' kidneys. Using ANOVA followed by Dunnett's test, the obtained p-values for SCr($p=0.000$) and BUN($p=0.007$) showed that the treatments have significant effects in reducing the said parameters. Multiple comparisons also showed the dose-dependent effect of *S. melongena*extract. Therefore, it can be concluded that *S. melongena*has a nephroprotective activity starting at 100 mg/kg suggesting that it can be an alternative agent in treating gentamicin-induced kidney damage.

Keywords: *Solanummelongena*, nephroprotective, renal toxicity, gentamicin

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INTRODUCTION

The kidneys are the major excretory organs of the body comprised of approximately one million functional units known as nephrons that filters the plasma to regulate fluid, electrolyte and acid-base balance while eliminating waste products (Bonventre, Vaidya, Schmouder, Feig,&Dieterle, 2010).

Chronic kidney disease is one of the leading causes of death globally with approximately 850,000 deaths every year and 15,010,167 disability-adjusted life years (Schieppati&Remuzzi, 2005). In the Philippines, 1,212,306 of adult Filipinos experience the disease (National Nutrition and Health Survey, 2004). Chronic kidney disease is characterized by elevation of blood electrolytes and inability of kidney to excrete urine and other body wastes. Kidney damage that leads to nephrotoxicity takes place when body becomes exposed to drugs like aminoglycoside antibiotics (Gaikwad,Dagle, Choughule, Joshi,&Kadam, 2012).

Aminoglycoside antibiotics (AGAs) have been widely used clinically because of high efficacy and of low costs. AGAs, which include gentamicin, are used in the treatment of severe bacterial infections of the abdomen and urinary tract (Sassen, Kim, Kwon, Knepper, Miller, Frokiaer,& Nielsen, 2006).Gentamicin which is the commonly used treatment for Gram-negative bacteria and other microorganisms like Pseudomonas, Proteus and Serratia can induce nephrotoxicity. Gentamicin was reported to induce nephrotoxicity by targeting the proximal tubules causing direct tubular necrosis. Nephrotoxicity occurs once the level of gentamicin accumulates in the renal proximal convoluted tubules at a level 50 to 100 times greater than serum (Dhanarajan, Abraham,& Isaac, 2006). An increased serum creatinine and blood urea nitrogen levels, and decreased glomerular filtration rate are common characteristics of gentamicin-induced nephrotoxicity. Renal injuries also occur due to increased production of super oxide anions, hydroxyl radicals, hydrogen peroxide, and reactive nitrogen species and induced oxidative stress in the kidneys (Tavafi, 2013).

Hemodialysis is considered the most commonly used method in renal therapy. Other countries also uses kidney transplant in the treatment but problems regarding availability of organ for transplant arises (Schieppati&Remuzzi, 2005).Current treatment and preventive measures for chronic kidney diseases and their complications were introduced by the National Kidney Institute in 2002 and include Vitamin D supplements, Recombinant Erythropoietin and Statins (Thomas, Kanso, &Sedor, 2008). These methods were considered high-cost and only few people can afford them which make them resort to traditional medications like herbal medicines.

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Medicinal plants were known to possess curative properties due to the presence of different polyphenolic compounds such as flavonoids (Gaikwad et al, 2012).

Flavonoids which are commonly present in the plant kingdom are known to have increased antioxidant properties and beneficial possibility to human health including the treatment and prevention of cancer and cardiovascular diseases (Abdel-Raheem, Abdel-Ghany, &Mohamed, 2009). The antioxidant activity of flavonoids is considered their most useful property. Protection of the body against reactive oxygen species is considered the most powerful benefit from flavonoids such as flavones and catechins. Flavonoids react with the reactive compound of the radical, therefore stabilizing the reactive oxygen species (Patel, 2008). Many plant extracts which were known to possess these flavonoids have been used as treatment for these reactive oxygen species present in different types of diseases such as renal toxicity. In a study by Tavafi in 2012, the use of olive leaf extract which contains flavonoids was proven to ameliorate nephrotoxicity caused by gentamicin via its antioxidants. Another study by Chaware (2011) which made use of the aqueous extract of *Momordicacharantia* leaves showed the lowering effect in serum creatinine and blood urea nitrogen levels of its flavonoid contents.

In relation to the nephroprotective effect of the plants stated above through their flavonoid contents, *Solanummelongena*which is locally known as "talong" in the Philippines and as aubergine, melanzana, garden egg, brinjal and patlican in other parts of the world is considered an important source of phenolics and flavonoid compounds among other vegetables. *S. melongena*is an economically important crop of tropical and sub-tropical regions with different health benefits due to its antioxidant content in its whole fruit (Kaur, Nagal, Nishad, Kumar,&Sarika, 2013; Akanitapichat,Phraibung, Nuchklang,&Prompitakkul, 2010). Primitive *S. melongena* are tall plants with large, spiny leaves, flowers in clusters with andromonoecy. Its fruits are small, green, and bitter in taste, with thick skin and hard flesh. Fruit color varies from shades of purple, from light to dark, almost black, green, or white. Fruit length is from 4 to 45cm, thickness is 2-35 cm at different shapes and weight ranging from 15-1500g. The fruits are set in single or in clusters, up to five fruits. Ripe fruits physiologically become red, brown or yellow (Sekara,Cebula&Kunicki, 2007). Various studies support the folkloric use of this plant as local food and medicinal preparation. Different studies have reported the effectivity of *S.melongena* as an analgesic, anti-inflammatory, anti-asthmatic, anti-glaucoma, hypoglyceric, hypolipidemic and weigh reduction effects in humans and animals (Chinedu,Olasumbo, Eboji, Emiloju, Arinola,& Dania, 2011).

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Figure 1.*Solanummelongena* fruit

Based from the previous findings, antioxidants from *S.melongena* have been used as chemo-preventive agents. *S. melongena* was known to have hepatoprotective, anti-allergic, anti-inflammatory, anti-microbial and anti-cancer activities. However, this study evaluated the possible nephroprotective effect of *S. melongena* as a natural antioxidant against gentamicin-induced nephrotoxicity in Sprague Dawley rats. Specifically, this study 1) determined the acute toxicity of doses of *S. melongena*being applied in rats and 2) compared the protective effect of varying dosages of the crude extract of the plant.This study hypothesized that *S. melongena*would give a significant effect in reducing the nephrotoxic level of gentamicin-induced kidney damage in Sprague Dawley rats. Once proven correct, an alternative agentwhich is affordable, available and less toxic can replace the current therapeutic regimen for nephrotoxicity.

MATERIALS AND METHODS

Chemical

Gentamicin-Sulphate Ampmycin was procured from InmedSta Cruz Manila.

Reagents

The reagents used in the experiment were obtained from DKL Laboratory Supplies and Belman Laboratories.

Plant

The ripe fruits of *Solanummelongena*were used in this study. The plant was collected from Bolbok, Batangas City. Vouchers of the plant specimen were submitted to the Forestry Department in University of the Philippines-Los Baños, Laguna for authentication.

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Preparation of *Solanummelongena*MethanolicExtract

A total of100g of powdered dried ripe fruits of *S. melongena*were weighed and then soaked in methanol with the ratio of 1:20 (w/v) for 72 hours at room temperature. The solutions were collected and filtered using cotton wool followed by Whatman No. 1 filter paper. This procedure was repeated three times. Then the collected supernatant was pooled together and was evaporated using a rotary vacuum evaporator at 40°C under reduced pressure. The crude dried extract obtained was kept at 4°C prior to use (Kamisan,Yahya, Mamat, Kamarolzaman, Mohtarrudin, et al., 2014).

Phytochemical Analysis for Flavonoids

Phytochemical screening for the presence of flavonoids in crude methanolic extract of S. melongenawas carried out using standard phytochemical procedure by Sumathy, Lachumy, Zakaria,&Sasidharan (2011). Magnesium ribbon and few drops of concentrated HCl were added to 2ml of methanolic extract. Pink or red color indicates the presence of flavonoids.

Test Animals

A total of 21 albino mice and 24 adult male Sprague Dawley rats weighing 180 to 200 grams were used in the study after seven days of acclimatization (Tavafi, Ahmadvand,&Toolabi, 2012). These were obtained from the University of the Philippines-Manila. The animals were fed with standard pellet diet and water ad libitum at all times, maintained at an ambient temperature of 25ºC ± 2°C and relative humidity 50 percent ± 15 percent under 12hr light/dark cycle (Chaware, Chaudhary, Vaishnav,&Biyani, 2011). The study was conducted after approval by the Institutional Animal Care and Use.

Toxicity study (LD50) of the SolanummelongenaMethanolic Extract

The median lethal dose (LD50) of the ethanolic extract was determined in mice intraperitoneally. Briefly, mice of either sex were fasted overnight and the evaluation of the LD50 was carried out in 2 stages. In the first stage, three groups of three mice each were treated with the extract at doses of 10, 100 and 1000 mg/kg, in order to determine the range in which the LD50 falls. In the second stage another four groups of three mice each were further treated with the extract at doses 140, 225, 370 and 600 mg/kg. Animals were observed for 24 h after treatment for signs and symptoms of toxicity such as decreased respiration and inactivity. The number of deaths in each group within 24 h was recorded and the final LD 50 values were calculated as the geometric mean of the highest non-lethal dose (with

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no deaths) and the lowest lethal dose (where deaths occurred) (Salawu, Chindo, Tijani, &Adzu, 2008).

Experimental Design

The rats were randomly divided into four groups containing six animals each:

Group I: Saline Group
Group II: Gentamicin 40 mg/kg
Group III: Gentamicin 40 mg/kg and *S.melongena* methanolicextract 100 mg/kg
Group IV: Gentamicin 40 mg/kg and *S.melongena* methanolic extract 200 mg/kg

The treatment was given for 14 consecutive days. Gentamicin was givenintraperitoneally while the S. melongenaextract was administered orally (Chaware, et al., 2011).

Biochemical Assay

Prior to termination of experiment on the 15th day, blood samples were withdrawn by puncturing retro orbital sinus. Serum creatinine& blood urea were assayed using Human Kits to determine the metabolic function of the kidney through the use of a spectrophotometer (Chaware, et al., 2011).

Statistical Analysis

Results were expressed as mean ± standard error of mean (SEM) of six observation and were statistically analyzed by using one way ANOVA followed by Dunnett's testto correlate the effect of the extract on the serum creatinine and blood urea nitrogen parameters. $p<0.05$ was considered to be statistically significant (Chaware, et al., 2011).

RESULTS AND DISCUSSION

I. Plant Extract

From 100 g of powdered dried fruits of*S. melongena*, 60 mL of methanolic extract was obtained. The obtained extract was then subjected to rotary evaporator and produced 13.5 g of yellowish-brown and oily crude extract. The total % yield was 13.5%.

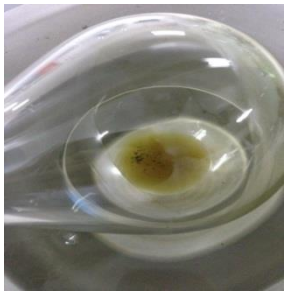

Figure 2. *Solanummelongena* extract

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II. Phytochemical Screening

The phytochemical analysisof the crude extract gave a positive reaction with pink color appearance which implies that flavonoids are present in *S.melongena*. This result can be correlated to a study by Kaur, Nagal, Nishad, Kumar and Sarika in 2013 wherein different eggplant (*S. melongena*) varieties were analyzed and known to contain a range from 3.23 to 25.96mg/100mg of flavonoids.

III. Toxicity Study (LD50) of the Methanolic Extract of *Solanummelongena*

The behavioral signs of toxicity exhibited by mice that received 100 mg extract/kg and above are decreased respiratory rate and inactivity leading to death. The intraperitoneal LD50 of the extract in mice was estimated to be 120 mg/kg.

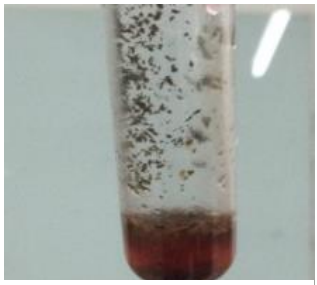

Figure 3.Solanummelongena extract with pink color reaction

Table 1 shows the lethal dose of the methanolic extract of *S. melongena* on mice. This represents the effect of the different doses of *S. melongena*extract given to albino mice to determine whether a specific dose will be toxic to the test animals.

Table 1
Lethal Dose of Methanolic Extract of *S.melongena*on albino mice

	Dosage (MESM)	Signs/Symptoms	No. of deaths
First Stage			
Group 1	10 mg/kg	-	0
Group 2	100 mg/kg	-	0
Group 3	1000 mg/kg	Decreased respiration; Inactivity	3
Second Stage			
Group 4	140 mg/kg	-	0
Group 5	225 mg/kg	Decreased respiration; Inactivity	3
Group 6	370 mg/kg	Decreased respiration; Inactivity	3
Group 7	600 mg/kg	Decreased respiration; Inactivity	3

On the first stage, after the administration of *S. melongena*extract with doses of 10 mg/kg and 100 mg/kg, no signs of toxicity appeared and no deaths occurred. But when a dose of 1000 mg/kg was administered, the rats started to show signs of toxicity such

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as decreased respiration and inactivity. This shows that within the range of 10 mg/kg to 100 mg/kg, the extract is safe to use. On the second stage, no death was observed after administration of the extract with a dose of 140 mg/kg. On the other hand, death occurred at the concentration of 225 mg/kg, 270 mg/kg and 600 mg/kg. The signs of toxicity were observed during the first hours on the rats. After 24 hours, deaths occurred on the said groups. Furthermore, the intraperitoneal LD50 was estimated to a value of 183 mg/kg. This implies that higher doses of *S. melongena*extract are toxic to the rats. The said result is in contrast to a study by Mutalik, Paridhavi, Rao and Udupa (2003) in which higher dosage of *S. melongena*leaf extract (4 g/kg body weight) was found to be safe and produced no mortality in the test animals.

IV. Biochemical Analysis

Serum creatinine (SCr) and blood urea nitrogen (BUN) are two commonly used serum biomarkers in detecting renal toxicity. In gentamicin-induced nephrotoxicity, marked elevations in the value of the serum creatinine and blood urea nitrogen are considered significant indications of renal impairment with serum creatinine being more potent indicator than blood urea nitrogen (Tavafi, et al., 2012).**I**ncrease in serum creatinine is considered the standard biomarker used for the evaluation of kidney dysfunction (Bonventre, et al., 2010).

Table 2 shows the effect of *S. melongena*extract on biochemical parameters such as serum creatinine and blood urea nitrogen. This is important in determining whether the treatment on each group causes significant difference.

Table 2
Mean values of Serum creatinine (SCr) and Blood urea nitrogen (BUN) After Treatment

Groups	Serum Creatinine (mg/dl)	Blood Urea Nitrogen (mg/dl)
Group I Saline Group	69.82±2.41	34.00±4.47
Group II GM 40 mg/kg	147.90±0.84*	57.13±5.31*
Group III GM 40 mg/kg + MESM 100 mg/kg	84.40±5.06*	41.53±6.51
Group IV GM 40 mg/kg + MESM 200 mg/kg	62.15±1.53	29.68±4.42

**Values are mean ± SEM. P<0.05 was considered to be statistically significant.*

Group I acts as the saline group and was administered with NSS only. On the other hand, Group II was made nephrotoxic by

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administering gentamicin only and served as the toxic control. Blood urea nitrogen level (57.13±5.31 mg/dL) and serum creatinine (147.90±0.84 mg/dL) level of Group II showed the highest values for the said parameters after 14 days of gentamicin treatment. This implies that gentamicin can cause damage to the kidney therefore affecting the levels of blood urea nitrogen and serum creatinine. These results can be correlated to the study conducted by Chaware (2011) wherein single daily intraperitoneal injection of gentamicin induced nephrotoxicity associated with increase in levels of different biochemical parameters like blood urea nitrogen, creatinine clearance, serum creatinine and the presence of oxidative stress.

Furthermore, when rats were treated with *S. melongena* extract at 100 mg/kg body weight together with gentamicin 40mg/kg (Group III) the serum creatinine and blood urea nitrogen levels were 84.40±5.06* mg/dL and 41.53±6.51mg/dL, respectively. When compared to Group I which is the saline group, Group III showed increased levels of the two parameters which can be attributed to the presence of the gentamicin. But as compared to the toxic group which is Group II, decreased levels of the parameters can be observed in Group III and may be due to the administration of the *S. melongena*extract after making them nephrotoxic. In the presence of the same extract at 200 mg/kg body weight with gentamicin 40 mg/kg (Group IV) the levels of serum creatinine and blood urea nitrogen were 62.15±1.53 mg/dL and 29.68±4.42 mg/dL, respectively. Group IV shows much lesser values in serum creatinine and blood urea nitrogen when compared to both the saline group which is Group I and the toxic control which is Group II. This implies that administration of the *S. melongena*extract at an increased dosage (200 mg/kg) to a nephrotoxic subject can cause much decreased levels of the serum creatinine and blood urea nitrogen. These indicate that *S. melongena*extract has beneficial effect to the nephrotoxicity in rats. In correlation, a study conducted by Abdel-Raheem et al., (2009) showed that quercetin, an important member of the flavonoid family, causes a significant reduction in the elevated levels of urinary total protein, blood urea nitrogen and serum creatinine which may be due to the antioxidant and free radicals scavenger properties of the flavonoid quercetin.

Table 3
Comparison on the effect of *S. melongena*methanolicextract on serum creatinine and blood urea nitrogen

	p-value	Interpretation
Creatinine	0.000	Significant
BUN	0.007	Significant

**. The mean difference is significant at the 0.05 level.*

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Table 3 reveals the statistical analysis of the biochemical parameters when treated according to group. Statistical evaluation shows that serum creatinine and blood urea nitrogen were significant with p-values of 0.000 and 0.007, respectively. Since their p-values are less than 0.05, they are significant.

The administration of *S. melongena*extract produced a significant improvement in the nephrotoxicity using the serum creatinine and blood urea nitrogen as basis. This result proves the protective influence of *S. melongena* extract against gentamicin-induced nephrotoxicity.

In agreement to the study accomplished by Abdel-Raheem, et al.(2008), such results can be hypothesized to be attributed to the presence of phytochemicals in *S. melongena* such as flavonoids that has increased antioxidant properties thereby reducing the oxidative stress and reactive oxygen species brought about by gentamicin-induced nephrotoxicity.

Table 4 presents the multiple comparison of each group on their serum creatinine levels. Serum creatinine level comparison of Group I to Group II produced a p-value of 0.000 which is considered significant since it is less than 0.05 level of significance. This result can be correlated to the pathological mechanisms present in nephrotoxicity such as increased serum creatinine induced by gentamicin as stated in the study by Tavafi et al. (2012). This significant difference between Group I and Group II is important since they will serve as the saline group and toxic control respectively. Group III which was treated with 100 mg/kg of *S. melongena*extract provided a significant difference when compared to Group I with a p-value of 0.011 (<0.05) as it was still elevated but in a much lesser value than the toxic control Group II implying that the *S. melongena*extract was able to lessen the serum creatinine levels of this group. Treatment with the extract at 200 mg/kg in Group IV showed no significant difference (p=0.282) whencompared to Group I since their serum creatinine levels were of same values even after the induction showing that the extract was able to lessen the toxic effects of gentamicin to the rats.

When all other groups were compared to the toxic control Group II, a significant difference was observed (p=0.000) since they produced low serum creatinine levels than that of Group II. This signifies that gentamicin was truly able to increase the serum creatinine level of the rats in the toxic control Group II.

In the comparison of the serum creatinine levels of Group III to all other groups, it showed significant results as compared to the control groups. Group III, when compared to the toxic control Group II, has lower serum creatinine values but when compared to the normal

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control Group I, has slightly higher levels of serum creatinine; thus, the significant differences between the said groups.

Table 4
Multiple Comparisons on the Serum Creatinine (SCr) when controlled by Saline Group

Groups	Groups		CREA
Group I Saline Group	**Group II** GM 40mg/kg	.000	**Significant**
	Group III GM 40mg/kg + MESM 100mg/kg	.011	**Significant**
	Group IV GM 40mg/kg + MESM 200mg/kg	.282	Not significant
Group II GM 40mg/kg	**Group I** Saline Group	.000	**Significant**
	Group III GM 40mg/kg + MESM 100mg/kg	.000	**Significant**
	Group IV GM 40mg/kg + MESM 200mg/kg	.000	**Significant**
Group III GM 40mg/kg + MESM 100mg/kg	**Group I** Saline Group	.011	**Significant**
	Group II GM 40mg/kg	.000	**Significant**
	Group IV GM 40mg/kg + MESM 200mg/kg	.000	**Significant**
Group IV GM 40mg/kg + MESM 200mg/kg	**Group I** Saline Group	.282	Not significant
	Group II GM 40mg/kg	.000	**Significant**
	Group III GM 40mg/kg + MESM 100mg/kg	.000	**Significant**

**. The mean difference is significant at the 0.05 level.*

Group III and Group IV showed significant difference when compared with each other with p-value of 0.000 (<0.05). Treatment of the *S.melongena*at a dose of 200 mg/kg in Group IV showed a much lesser value of serum creatinine than that of Group III treated with 100 mg/kg of the extract which implies the greater effect of the higher dosage of the extract in lowering the serum creatinine levels; thus, the significant difference between the two groups.

Group IV also showed a significant difference when compared to the toxic control Group II since the serum creatinine of Group IV treated with 200 mg/kg of *S. melongena*extract is lesser than that of Group II justifying the activity of the *S.melongena*extract in lowering

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the serum creatinine level after the induction of gentamicin.However, Group IV showed no significant difference when compared to the normal control Group I which implies that they have comparative levels of serum creatinine.

Table 5
Multiple Comparisons on the Blood urea nitrogen (BUN) when controlled by Saline Group

Groups	Groups		BUN
Group I Saline Group	**Group II** GM 40mg/kg	.026	**Significant**
	Group III GM 40mg/kg + MESM 100mg/kg	.742	Not significant
	Group IV GM 40mg/kg + MESM 200mg/kg	.936	Not significant
Group II GM 40mg/kg	**Group I** Saline Group	.026	**Significant**
	Group III GM 40mg/kg + MESM 100mg/kg	.186	Not significant
	Group IV GM 40mg/kg + MESM 200mg/kg	.007	**Significant**
Group III GM 40mg/kg + MESM 100mg/kg	**Group I** Saline Group	.742	Not significant
	Group II GM 40mg/kg	.186	Not significant
	Group IV GM 40mg/kg + MESM 200mg/kg	.402	Not significant
Group IV GM 40mg/kg + MESM 200mg/kg	**Group I** Saline Group	.936	Not significant
	Group II GM 40mg/kg	.007	**Significant**
	Group III GM 40mg/kg + MESM 100mg/kg	.402	Not significant

**. The mean difference is significant at the 0.05 level.*

Table 5 shows the multiple comparisons on the effect of *S.melongena*extract on the blood urea nitrogen levels of the four groups.

Statistically significant result was shown when Group I (saline group) was compared with Group II (toxic control) with p-value of 0.026.This result can be correlated to the nephrotoxic effect caused by

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increased levels of gentamicin in the study of Abdel-Raheem (2009). The comparison shows that there is a significant difference between Group I and Group II blood urea nitrogen levels. No significant difference is present when Group III treated with 100 mg/kg and Group IV given a dose of 200 mg/kg extract was compared to Group I as their blood urea nitrogen values were on the same levels when being compared implying that the extract provided a lowering effect on the blood urea nitrogen levels of the rats even after the administration of gentamicin.

When Group II was compared to Groups I and IV, significant results can be observed with p-values of 0.026 and 0.007, respectively. These groups had lower blood urea nitrogen levels than that of Group II which means that they are significantly different.

Additionally, Group III shows no significant difference when compared to all other groups which implies that they have comparatively near blood urea nitrogen levels.The comparison of blood urea nitrogen levels of
Group IV to Group II shows significant difference since it has lower values than that of Group II. Group IV has much lesser results than the blood urea nitrogen values of Group II; thus, the significant difference between the two groups.

However, the oral administration of *S.melongena*extract at 100 mg/kg and 200 mg/kg provided no significant difference on blood urea nitrogen levels when compared to Group I. This implies that *S.melongena*extract at a dosage of 100 mg/kg and 200 mg/kg administered simultaneously with gentamicin (40 mg/kg) is effective in reducing the high blood urea nitrogen levels in rats with nephrotoxicity.

These results agree with the study of Tavafi et al.(2012) on nephrotoxicity with significant values of pre-treatment group of olive oil extract compared to the gentamicin-induced group resulting to a p-value of 0.04 (less than 0.05) of blood urea nitrogen levels.

Knowing that *S.melongena*possesses potent antioxidative properties in the form of its phenolics and flavonoids as stated in a study by Kaur et al.(2013), the researchers used its extract in reducing the serum parameters of renal toxicity such as serum creatinine and blood urea nitrogen. A study by Abdel-Raheemet al (2008) supports this claim as they proved the ameliorating effect of quercetin, a polyphenolic flavonoid in plants, in gentamicin-induced nephrotoxicity in Wistar albino rats.

CONCLUSION

The results of the researchers' study revealed that the induction ofmethanolic extract of *S. melongena* prior to gentamicin intoxication can reduce the levels of blood urea nitrogen and serum

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creatinine of rats with renal toxicity.The lethal dose of the extract was found out to be greater than 225 mg/kg.Therefore, it can be concluded that *S. melongena*has a nephroprotective activity starting at 100 mg/kg suggesting that it can be an alternative agent in treating gentamicin-induced kidney damage.

RECOMMENDATION

Evaluation of other present substances in *S. melongena*must also be considered to know the spectrum of its therapeutic effect. Pharmacological evaluation of other parts of the *S.melongena*plant may also be done to identify possible better therapeutic effects of other plant parts than that of the fruit.Histopathological examination may also be carried out to further evaluate the effect of the plant extract against the nephrotoxicity.

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