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Research Article

Ameliorative Effect of Vitamin E and C on Paraquat Induced Nephrotoxicity in Rat

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Abstract: The kidney is an exceptionally essential organ required for metabolic byproducts elimination in the body and when the kidney is impaired, this role is compromised. Paraquat is a poison that is known to have harmful effect in various organs. Subsequently, the point of this study was to reveal the treatment impact of vitamin E and C in paraquat poisoned kidney in rat. The rat were 200 and they were classified into 4 groups assigned as A, B, C and D. The A group was the control, B, C and D were test groups classified in light of dose of paraquat given. "A" was not treated with paraquat, B, C and D were treated with 0.02g, 0.04g and 0.06g of paraquat separately at regular intervals of 2 weeks for 3 months. Each group had subgroups assigned "0" and "VEC"; "0" subgroups were subgroups not treated with vitamin E while "VEC" were subgroups treated with 500mg of vitamin E and 2000mg/dl vitamin C. Treatment of vitamin E and C happened week after week for one month. Both vitamins and paraquat treatment happened orally. After treatment period, the rats were sacrificed and blood sample collected through cardiac puncture for urea and creatinine assay. The outcomes showed that there was no significant difference in urea levels among only paraquat treated groups yet there was a significant increase in creatinine levels among only paraquat treatment groups. There was a significant decrease in creatinine level after vitamin E and C treatment. This study has shown that vitamin E and C is capable of restoring kidney function paraquat induced nephrotoxicity in rat.

Keywords: kidney, paraquat, rat, treatment, vitamin.

1. Introduction

The kidney has few roles that are best described in the term "A WET BED". "A" addresses the regulation of acid-base balance, "W" represents regulation of water balance, "E" addresses control of electrolyte balance, "T" addresses toxins elimination, "B" addresses blood pressure control "E" represents erythropoietin production, "D" represents vitamin D synthesis (Lisa *et al*., 2016). The capacity of the kidney to carry out these roles relies upon the three major functions which are; filtration, reabsorption and secretion. Besides, the renal function is partitioned into three; glomerular filtration, tubular reabsorption and tubular secretion. The nephron, the functional unit of the kidney is partitioned into the following; proximal convoluted tubule, proximal straighted tubule, loop of henle, distal convoluted tubule and

collecting duct. The loop of henle has three compartments; thin descending, thin ascending and thick ascending (Snare and Hewitt, 1977).

An economically accessible herbicide called paraquat has been used internationally to work on horticultural yields by destroying weeds that might compete for same nutrient with the plants (Akram 2014). It kills non-selectively plants it touches contacts. While it is helpful in weed management in the horticultural area, its high poisonous impact has been accounted for to be unsafe to animals and people who get exposed to it. Human ingestion of paraquat was reported to be responsible for organ impairment due production of reactive oxygen species (ROS) which portrays the pathogenesis of organ failure (Akram 2014).

Over a chronic period of ingestion, it causes oxidative damage because of increased production of free radicals or reactive oxygen species which are agents of carcinogenesis (Ranjbar et al., 2002). Studies demonstrated the remedial role of antioxidant in the therapy of oxidative damage. Thus, antioxidants are considered as antidotal therapy for the treatment of tissue damage inflicted by free radicals (Beam et al. 2007; Abdollahi et al. 2004).

Vitamin E and C are considered as vitamins with significant antioxidative effect and by this extension, could be exceptionally gainful in the therapy of oxidative induced organ damage. Since studies by Block (1979) and Transport et al. (1975) revealed that L-ascorbic acid, and its antioxidative partner vitamin E improved the poisonousness impact of paraquat exposure in rats and lack of vitamin E and C have shown to potentiate rise in free radical and decline in survival rate, this study focused on assessing the restorative impact of vitamin E and C supplementation in kidneys of rats damaged with paraquat.

2. Materials and Methods

2.1. Experimental Design

This was an experimental study designed with 200 rats which were separated into four groups (A, B, C, and D) based on paraquat dosage. “A” group referred to as control group was without paraquat treatment while “B” group had 0.02g of paraquat treatment, “C” group had 0.04g of paraquat treatment, and “D” group had 0.06g of paraquat treatment. Every one of the group was further partitioned into two subgroups; those without vitamin E and C treatment and those with vitamin E and C treatment. Precisely 500mg of vitamin E and 2000mg/dl of vitamin C were orally administered. The selection of doses administered in this study was acquired from previous work (Okolonkwo et al. 2022a).

For paraquat treatment, it was given once every two weeks for three months while vitamin E and C was given once every week for one month.

Both paraquat and vitamin E and C were orally administered as indicated by their frequencies and duration.

After the span of the treatment timeframe, the rats were sedated using chlorofoam, sacrificed and blood test was collected via cardiac puncture (Okolonkwo et al. 2022b).

2.2. Laboratory Analysis

Urea – Berthelot enzyme – colorimetric test method as applied by Fyneface et al. (2018).

Procedures

Exactly 1.0ml working reagent was dispensed into three tubes labeled 'Blank', 'Standard' and 'Sample', after which 10µl each of standard reagent and sample was dispensed into their respective tubes. The tubes were mixed and incubated for 5 minutes at 37^0C. At the end of the incubation, 1.0ml of sodium hydroxide/sodium hypochlorite solution was then dispensed into the three tubes, mixed and incubated again for another 5 minutes at 37^0C, at the end of which, the absorbance (A) of the sample and standard was read against the blank. The colour was stable for at least 30 minutes at room temperature.

Creatinine (Jaffe colori–kinetic method) as applied by Fyneface et al. (2020).

Procedure

A working reagent (WR) was produced by mixing equal volumes of Picric acid (17.5mmol/L) and Sodium hydroxide (0.29mol/L). 1.0ml of WR was dispensed into each of the three tubes labeled 'Blank', 'Standard' and 'Sample'. 100µl of standard reagent and sample was then added to the respective tubes, mixed and the stopwatch started. The absorbance (A_1) was read after 30 seconds and after 90 seconds (A_2) of the sample addition at 492nm (490 – 510) wavelength.

Statistical Analysis

Data gathered from this study was analyzed for descriptive and inferential statistics. Descriptive data were presented as Mean±SD while ANOVA and T-test were analyzed for inferential decisions. P-value less than 0.05 was considered significant.

Results

The results in Table 1.0 show the comparison of urea and creatinine mean values among the groups treated with paraquat. The results showed that there was no significant difference (p-value>0.05) in urea levels among the groups but there was a significant increase (p-value<0.05) in creatinine levels among the groups.

Table 1. Comparison of urea and creatinine levels among paraquat treated groups

Sub-groups	Urea (mmol/L)	Creatinine (µmol/L)
A_0	3.10 ± 0.05	1.07 ± 0.03
B_0	4.65 ± 0.07	21.52 ± 0.60
C_0	4.97 ± 0.06	51.95 ± 1.53
D_0	5.33 ± 0.08	98.22 ± 2.49
p-value	>0.05	<0.05

Table 2.0 shows the treatment effect of vitamin E and C on urea and creatinine levels. The results showed that there was no significant difference (p-value>0.05) in urea level between subgroups treated with paraquat alone and subgroup treated with paraquat and vitamin E and C. But there was a significant decrease (p-value<0.05) in creatinine levels in subgroups treated with vitamin E and C after paraquat intoxication.

Table 2. Changes in some biochemical data after one month treatment period.

Sub-groups	Urea (mmol/L)	Creatinine (µmol/L)
A_0	3.10 ± 0.05	1.07 ± 0.03
A_{VEC}	3.02 ± 0.05	1.23 ± 0.02
B_0	4.65 ± 0.07	21.52 ± 0.60
B_{VEC}	5.13 ± 0.05	12.45 ± 0.35[b]
C_0	4.97 ± 0.06	51.95 ± 1.53
C_{VEC}	3.98 ± 0.10	16.17 ± 0.40[b]
D_0	5.33 ± 0.08	98.22 ± 2.49
D_{VEC}	4.95 ± 0.06	38.04 ± 0.86[b]

3. Discussion

This study assessed the impact of vitamin E and C treatments on paraquat induced nephrotoxicity in rats with the aim provide answer to the research question, "Can Vitamin E and C treatment ameliorate kidney damage instigated by paraquat intoxication?"

The finding from this study uncovered that paraquat caused renal damage in rats in a dose dependent manner to such an extent that the group with the most highest dose of paraquat had the highest degree of nephrotoxicity while the rats with minimal dose of paraquat had the least level of nephrotoxicity. In any case, in all paraquat treated groups, it caused nephrotoxicity in all doses in the rats. Correspondingly to the work completed by Garba, et al. (2007), the significant rise in creatinine levels were traditional signs or indications of toxic impact of PQ administration on kidney. This was additionally upheld by Wershana (2011), who revealed increase in urea and creatinine levels in PQ treated rats. In any case, the outcome varied from the work done by Ogbama, et al. (2010) on fish, where they reported decrease in urea and creatinine levels in gills of *Clarias gariepinus*. The renal markers examined were urea and creatinine but only creatinine showed significant rise with increasing doses of paraquat. Urea showed no significant level change among the groups. The non-significant change in urea level may not mean normal kidney function since works led by same creator uncovered that paraquat intoxication brought about significant decrease in total protein levels. Since urea is the end product of protein metabolism, urea may not increase since protein levels are typically low in paraquat intoxication (Okolonkwo et al. 2022a; Okolonkwo et al. 2022b).

After paraquat induction, the rats were treated with vitamin E and C to assess the ameliorative function of the vitamins. The outcome showed that in all groups treated with various doses of paraquat, vitamin E and C reestablished renal function which

was demonstrated by the decline creatinine levels in all groups. Regardless of the paraqaut intoxication or dose administered, a week by week treatment with vitamin E and C restored the kidney function. This was proven by the research outcomes present in table 2.0. This study is in concurrence with the investigation of Wershana (2001) who expressed that vitamins prevented renal injury in the event of toxicant exposure.

4. Conclusion

The finding of this study has shown that vitamin E and C are impactful in treating or ameliorating nephrotoxicity in rats poisoned by paraquat intoxication in a month of week after week treatment.

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