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# EFFECT OF STEM BARK EXTRACT OF *Kigelia africana* ON LIVER AND KIDNEY FUNCTION OF ALLOXAN INDUCED DIABETIC RATS

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**ABSTRACT**

Kigelia africana or commonly known as the sausage tree is known to be useful in treating stomach problem, pneumonia, toothache, increases production of milk in the lactating woman, treating sores, skin ulcer etc. The aim of this study was to investigate the effect of methanolic stem bark extract of Kigelia africana (SBEka) on liver and kidney function of alloxan-induced diabetic rats. Gas chromatography-mass spectrometry (GC-MS) analysis was carried out on the plant extract which reveals the presence of 52 different chemical constituents that include n-hexadecanoic acid, nonanoic acid, tetradecanoic acid etc. These constituents are believed to various medicinal attributes such as antioxidant, hypocholesterolemic, nematicide, pesticide, antiandrogenic etc. This study shows that alloxan has less effect on the kidney function of albino rats due to the insignificant difference ($P<0.05$) in urea and creatinine levels between the diabetic control group and the normal control group and the plant extract have less side effect on kidney due to the significant decrease ($P<0.05$) found in all the kidney parameters except urea. The study also shows that alloxan has toxic effect to the liver function of albino rats due to the significant increase ($P<0.05$) in AST,ALT and ALP levels, however the plant extract shows hepatoprotective potential due to the significant decrease in those liver parameters. Hence, this study has revealed the effect of alloxan on liver and the plant extract significantly decreases the liver damage.

**Keywords:** *Kigelia Africana*, alloxan, GC-MS, kidney, liver function.

## INTRODUCTION

*Kigelia africana* (lam) benth k.pinnata belongs to the family of bignoniaceae. The name *'Kigelia'* is a native African name. It's a highly variable monospecific genus of the family Bignoniaceae. Its other names are Worsboom (Afrikaans), Modukghulu, Pidiso (North Sotho), umVongotsi (Siswati); Mpfungurhu (Tsonga), Muvevha (Venda) Sausage tree (English) Pandoro (west nigeria) (Kirby, 1996). *Kigelia Africana* or commonly known as the sausage tree is known to be useful in treating stomach problem, pneumonia, toothache, increases production of milk in the lactating woman, treating sores, skin ulcer and many more (Makoshi *et al*., 2016). Infections of the genito-urinary tract, particularly venereal diseases, are treated both internally and externally with preparations of the roots, bark, leaves, stems and twigs (Forcados, Chinyere & Shu, 2016). In West and Central Africa, palm wine, in which dried and ground bark is macerated, is taken against syphilis. Venereal diseases in children are treated simultaneously with a drink and wash prepared from decocted bark. A commercial product containing *Kigelia africana* stem bark is used to treat Candida albicans infections. In Côte d'Ivoire, renal and bladder ailments are treated with medicaments containing the bark and leaves of *Kigelia africana* and several other medicinal plants (Omage & Azeke, 2014).

## METHODOLOGY

### Collection and Identification of Plant.

The stem bark of the plant was collected from villages around Dutsinma Local government, Katsina state, Nigeria. Botanical identification was done at Botany unit and voucher specimen was deposited in the herbarium of the same institution for reference.

### Preparation of Methanolic Stem Bark Extract

The dried stem bark was pounded using mortal and pistil, and then sieved to powder using a sieve. 200g of the powdered sample was dissolved in 1000ml of methanol and allowed to stay for 48 hours with periodic stirring. The sample was filtered using whatman number 1 filter paper, the filtrate was then placed in the ovum at $80^0$ C, and complete drying took 8 hours.

### Experimental Animal

Twenty five (25) rats weighing 60g – 100g were purchased from National Institute for Trypanosomiasis and Tse-tse fly Reaserch (NITR) Kaduna State, Nigeria. The rats were allowed to acclimatize for two weeks. The rats were fed with starter mesh with full access to distilled water. They were kept in a well-ventilated cage at the animal facility in Federal University Dutsin-ma, Katsina state.

### Animal Induction

The induction of alloxan was done intraperitoneally with 100mg/kg body weight of the alloxan and diabetes was confirmed after 72 hours.

**Experimental design**

Twenty five wister albino male rats were assigned into 5 different groups which had five rats in each of the groups.

**Group 1:** Non-diabetic, no treatment (Normal control).

**Group 2:** Diabetics induced rats without treatment (Negative control).

**Group 3:** Diabetics induced rats treated with standard drug (Glibenclamide 5mg/kg).

**Group 4:** Diabetics induced rats treated with methanolic leaf extracts of *Kigelia africana* (60mg/kg b.w).

**Group 5:** Diabetics induced rats treated with methanolic leaf extracts of *Kigelia africana* (120mg/kg b.w).

Treatment was done orally for a period of 14 days (daily).

**Induction of diabetes by Alloxan**

Diabetes was induced in rats by a single Intraperitoneal (I.P.) injection of a freshly prepared solution of Alloxan (100 mg/kg) after 18 hours of fasting. The blood glucose level was monitored after alloxanization and blood samples collected by tail tipping method using a Glucometer. Seventy two hours later, the rats were observed to be diabetic.

**Administration of Extract and drugs**

About 5mg/kg of Glibenclamide was dissolved in 7ml of distilled water and was administered orally at a dose 1.5ml of 150mg/kg body weight to the rats in group 3.

About 0.06g of the completely dried concentrated sample was dissolved in 15ml of distilled water and 0.3ml of the dissolved sample was administered orally at a dosage of 100mg/kg body weight to the rats in group 4. Also, 0.12g of the completely dried concentrated sample was dissolved in 3ml of distilled water and 0.7ml of the dissolved sample was administered orally at a dosage of 100mg/kg body weight to the rats in group 5.

**GC-MS analysis**

GC-MS analysis is a common confirmation test. It is best used to make an effective chemical analysis. This analysis will provide a representative spectral output of all the compounds that get separated from the sample. The first step of GC-MS was started by injecting the sample to the injected port of the Gas chromatography (GC) device. The GC instrument vaporizes the sample and then separates and analyzes of the various components. Each component was ideally produces a specific spectral peak that may be recorded on a paper chart electronically. The time elapsed between elution and injection is called the "retention time". Differentiate between some compounds was identified using the Retention time. The peak is measured from the base to the tip of the peak.

**Determination of serum creatinine**

Serum creatinine was determined by enzymatic method (Reitman and Frankel, 1957).

**Determination of serum electrolyte.**

Serum sodium and potassium were estimated by flame photometer (Harris, 1995). Serum chloride and bicarbonate were determined by the method (Kenkel, 2003).

**Determination of serum urea**

Serum urea was determined by enzymatic method (Fawcett and Scott, 1960; Chaney and Marbach, 1962).

**Determination of liver function tests**

Plasma enzymes like aspartate aminotransferase (AST), alkaline phosphatase (ALP) and alanine aminotransferase (ALT) were determined using Randox diagnostic kits. The total protein and total bilirubin (BIL) were also determined using Randox diagnostic kits (Johnson *et al.*, 2014).

**Statistical analysis**

The experimental results obtained are expressed as mean±standard deviation (SD). The data was subjected to one-way analysis of variance (ANOVA) and differences between samples were determined by tukey multiple comparison tests using the SPSS 16.0 (statistical program for social sciences) program. The level of significance was set at $p<0.05$.

**RESULTS**

**Table 1: GC-MS Analysis of Stem Bark Extract of *Kigelia Africana.***

| S/N | NAME OF COMPOUND | Retention Time | Area % | Quality |
|---|---|---|---|---|
| 1 | Trichloromethane | 5.095 | 0.5 | 72 |
| 2 | Methane, bromodichloro | 7.398 | 84.29 | 59 |
| 3 | 2-Hexyn-1-ol | 9.131 | 0.14 | 35 |
| 4 | 6-Fluoro-5-(4-methylpiperazin-1-yl )benzo[1,2,5]oxadiazol-1-oxide | 9.450 | 0.09 | 10 |
| 5 | 1,2,3,4-Tetrahydroacetylflazin, thyl(ester) | 9.635 | 0.09 | 15 |
| 6 | 4,7,7-Trimethylbicyclo[2.2.1]hepta n-2,3-dione, 2-O-ethyloxime | 9.724 | 0.05 | 25 |
| 7 | 1,2,3,4-Tetrahydroacetylflazin, thyl(ester) | 9.961 | 0.17 | 11 |
| 8 | 1,4-Dihydro-pyridine-3-carboxylic acid, 5-cyano-6-ethoxy-2-methyl- | 10.094 | 0.12 | 15 |

| | | | | |
|---|---|---|---|---|
| | 4-phenyl- | | | |
| 9 | 1-phosphinolineethanol, 1,2,3,4-tetrahydro-alpha.,.alpha.,4,4,6-pentamethyl-, 1-oxide | 10.302 | 0.39 | 35 |
| 10 | 6-Fluoro-5-(4methylpiperazin-1-yl )benzo[1,2,5]oxadiazol-1-oxide | 10.635 | 0.12 | 11 |
| 11 | 3,5-Dimethylbenzaldehyde thiocarbamoylhydrazone | 10.813 | 0.35 | 25 |
| 12 | 16,22-Epoxycholestan-3-ol | 11.294 | 0.31 | 12 |
| 13 | 1,3,4-Thiadiazole, 2-amino-5-(heptylthio)- | 11.413 | 0.07 | 14 |
| 14 | 1,3,4-Thiadiazole, 2-amino-5-(heptylthio) | 11.413 | 0.07 | 14 |
| 15 | Cyclohexanone, 2,3,3 trimethyl-2-(3-methylenebut-1-en-1-yl)-6-acetyl oxy- | 11.576 | 0.15 | 35 |
| 16 | 1,3,2-Dioxaphospholane, 2-t-butyl-4,5-bis(ethoxycarbonyl)- | 11.650 | 0.12 | 12 |
| 17 | n-Hexadecanoic acid | 11.827 | 0.27 | 25 |
| 18 | 1,3,14,16-Nonadecatetraene | 12.064 | 0.21 | 45 |
| 19 | 10-Methyl-E-11-tridece-1-ol acetat | 12.316 | 0.06 | 44 |
| 20 | 2-Isopropenyl-4,4,7a-trimethyl-2,4,5,6,7,7a-hexahydro-benzofuran-6-o | 12.383 | 0.10 | 47 |
| 21 | Tetradecanoic acid | 12.568 | 0.16 | 35 |
| 22 | 3,5-Dimethylbenzaldehyde thiocarbamoylhydrazone | 12.783 | 0.23 | 30 |
| 23 | Ethyl 5-(furan-2-yl)-1,2-oxazole-3-carboxylate | 13.02 | 0.22 | 22 |
| 24 | Nonanoic acid | 13.286 | 0.21 | 25 |
| 25 | 1-Benzazirene-1-carboxylic acid, 2,2,5a-trimethyl-1a-[3-oxo-1-butenyl] perhydro-, methyl ester | 13.531 | 0.26 | 38 |
| 26 | Ethyl 5-(furan-2-yl)-1,2-oxazole-3-carboxylate | 13.738 | 0.12 | 35 |
| 27 | Hexadecenoic acid, Z-11- | 13.879 | 0.21 | 25 |
| 28 | 2-Butenenitrile, 2-chloro-3-(4-methoxyphenyl)- | 14.042 | 0.08 | 64 |
| 29 | Cyclohexane, 1-(cyclohexylmethyl)-4-ethyl-, trans- | 14.131 | 0.08 | 50 |
| 30 | Formic acid, 1-(4,7-dihydro-2-methyl-7-oxopyrazolo[1,5-a]pyrimidin-5-yl)-, methyl ester | 14.429 | 0.11 | 50 |
| 31 | 3-Isopropoxy-1,1,1,5,5,5-hexamethyl-3-(trimethylsiloxy)trisiloxane | 14.331 | 0.09 | 14 |

| | | | | |
|---|---|---|---|---|
| 32 | Spiro-3-(2-butyl-2,4-diazabicyclo[3.3.0]octan-1-one)-cyclohexane | 14.642 | 0.47 | 38 |
| 33 | Oleic Acid | 15.034 | 0.28 | 38 |
| 34 | 11-Bromoundecanoic acid | 15.146 | 0.19 | 11 |
| 35 | Silanamine, N-[2,6-dimethyl-4-[(trimethylsilyl)oxy]phenyl]-1,1,1-trimethyl- | 15.286 | 0.23 | 42 |
| 36 | Trimethylsilyl-di(timethylsiloxy)-silane | 15.531 | 0.15 | 38 |
| 37 | Ethyl 5-(furan-2-yl)-1,2-oxazole-3-carboxylate | 15.627 | 0.24 | 14 |
| 38 | benzenesulfonyl chloride, 3-(acetylamino)-4-(acetyloxy)- | 15.901 | 0.17 | 27 |
| 39 | Dodecanoic acid | 16.020 | 0.10 | 25 |
| 40 | Cyclohexanecarboxamide, N-furfuryl | 16.086 | 0.06 | 35 |
| 41 | n-Propyl 9-tetradecenoate | 16.160 | 0.10 | 15 |
| 42 | 3-Isopropoxy-1,1,1,5,5,5-hexamethyl-3-(trimethylsiloxy)trisiloxane | 16.624 | 0.15 | 22 |
| 43 | 2-Adamantanecarboxylic acid, 4,8-dioxo-, isopropyl ester | 16.449 | 0.06 | 38 |
| 44 | 2H-1-Benzopyran, 2,2-diphenyl- | 16.568 | 0.20 | 43 |
| 45 | Ethyl 5-(furan-2-yl)-1,2-oxazole-3-carboxylate | 16.738 | 0.49 | 35 |
| 46 | Myristoleic acid | 17.427 | 0.61 | 47 |
| 47 | 2-Ethylacridine | 17.864 | 0.35 | 43 |
| 48 | Propanamide, N-(3-methoxyphenyl)-2,2-dimethyl- | 18.338 | 0.24 | 14 |
| 49 | Tetracosanoic acid | 19.130 | 0.21 | 41 |
| 50 | 6-Chloro-1-ethyl-4-oxoquinoline-3-carboxylic acid | 19.797 | 0.16 | 38 |
| 51 | Dodecahydropyrido[1,2-b]isoquinolin-6-one | 19.945 | 0.28 | 38 |
| 52 | Eicosanoic acid | 20.597 | 0.15 | 15 |

**Table 2: Kidney function test after 7 days of administration of extract of *Kigelia africana***

| Parameters | Urea (mmol/L) | $Na^+$ (mmol/L) | $K^+$ (mmol/L) | $HCO_3^-$ (mmol/L) | $Cl^-$ (mmol/L) | Creatinine (mmol/L) |
|---|---|---|---|---|---|---|
| Normal control | $7.1 \pm 0.1^a$ | $166.5 \pm 0.5^c$ | $10.10 \pm 1.3^a$ | $19.0 \pm 1.00^a$ | $97.0 \pm 1.00^a$ | $71.0 \pm 0.00^a$ |
| Diabetic control | $7.35 \pm 0.68^a$ | $146.5 \pm 15.5^b$ | $9.0 \pm 1.50^a$ | $21.5 \pm 0.50^b$ | $97.5 \pm 2.50^a$ | $72.00 \pm 0.00^a$ |
| 5mg/kg GLB | $9.0 \pm 2.0^b$ | $151.5 \pm 2.50^b$ | $6.15 \pm 2.65^b$ | $19.5 \pm 1.50^a$ | $96.5 \pm 2.50^a$ | $68.0 \pm 2.00^b$ |
| 60mg/kg KASE | $6.85 \pm 0.25^a$ | $138.5 \pm 2.5^a$ | $7.85 \pm 1.05^c$ | $19.5 \pm 3.50^a$ | $92.0 \pm 1.00^b$ | $69.0 \pm 15.0^b$ |
| 120mg/kg KASE | $6.70 \pm 0.30^a$ | $148.5 \pm 0.50^a$ | $8.95 \pm 0.05^c$ | $18.5 \pm 1.50^a$ | $95.0 \pm 1.00^c$ | $68.5 \pm 7.50^b$ |

Values (mean ± standard error of mean) of 5 determination (n=5). Values in the same column with different superscripts differs significantly ($p < 0.05$).
GLB: Glibenclimide, KASE: *Kigelia Africana* stem bark extract

Table 2 shows significant difference ($p<0.05$) in urea only between the group administered 5mg/kg and the other groups. For sodium ion parameter it shows significant difference ($p<0.05$) between the normal control group and diabetic control group, also it shows significant difference ($p<0.05$) between normal control group and the other test groups. For potassium ion parameter a significant difference ($p<0.05$) was observed between both the control groups and the test groups. For bicarbonate ion parameter it shows significant difference ($p<0.05$) only between diabetic control group and the other groups. Also for chloride ion parameter a significant difference ($p<0.05$) was observed between both the control groups and the groups administered the extract. Finally, for creatinine parameter there has been a significant difference ($p<0.05$) observed between the control groups and the other test groups.

**Table 3: Kidney function test after 14 days of administration of extract of *Kigelia africana***

| Parameters | Urea (mmol/L) | $Na^+$, (mmol/L) | $K^+$ (mmol/L) | $HCO_3$ (mmol/L) | $Cl^-$ (mmol/L) | Creatinine (mmol/L) |
|---|---|---|---|---|---|---|
| Normal control | $6.70 \pm 0.06^a$ | $138.0 \pm 3.06^b$ | $12.0 \pm 0.29^a$ | $24.07 \pm 0.33^b$ | $96.00 \pm 1.15^b$ | $73.00 \pm 1.15^a$ |
| Diabetic control | $7.83 \pm 0.03^a$ | $138.7 \pm 0.33^b$ | $13.2 \pm 0.55^a$ | $24.67 \pm 0.88^b$ | $97.00 \pm 1.15^b$ | $77.33 \pm 1.76^b$ |
| 5mg/kg GLB | $5.73 \pm 0.20^a$ | $122.3 \pm 2.03^a$ | $9.13 \pm 0.33^b$ | $22.00 \pm 1.15^a$ | $88.00 \pm 1.15^c$ | $66.00 \pm 1.15^c$ |
| 60mg/kg KASE | $6.87 \pm 0.98^a$ | $131.3 \pm 0.33^c$ | $11.07 \pm 1.56^a$ | $23.70 \pm 0.58^a$ | $85.67 \pm 1.45^a$ | $66.67 \pm 2.03^c$ |
| 120mg/kg KASE | $5.27 \pm 0.47^a$ | $118.0 \pm 4.62^d$ | $12.2 \pm 0.57^a$ | $23.00 \pm 0.58^a$ | $84.67 \pm 4.09^a$ | $63.67 \pm 3.20^d$ |

Values (mean ± standard error of mean) of 5 determination (n=5). Values in the same column with different superscripts differs significantly ($p < 0.05$).
GLB: Glibenclimide, KASE: *Kigelia africana* stem bark extract

Table 3 shows no significant difference in urea parameter. It shows a significant difference ($p<0.05$) in sodium ion parameter between both control groups and the other test groups. It also shows significant decrease ($p<0.05$) between the group administered 60mg/kg of extract and the group administered 120mg/kg of the extract. For the potassium ion parameter it shows a significant difference ($p<0.05$) only between the group administered the standard drug and all the other groups. For the bicarbonate ion parameter it shows a significant decrease ($p<0.05$) between both the control groups and all the test groups. For chloride ion parameter it shows a significant decrease ($p<0.05$) between both the control groups and all the test groups. It also shows significant difference ($p<0.05$) between the group administered the drug and the two groups administered the plant extract. For the creatinine parameter it shows a significant difference ($p<0.05$) between the normal control group and diabetic control group, also a significant decrease ($p<0.05$) was observed between both the control groups and all the test groups, also a significant difference ($p< 0.05$) was observed between the group administered 60mg/kg of extract and the group administered 120mg/kg of the extract.

**Table 4: Effect of stem bark extract of Kigelia africana on liver function parameters of alloxan induced diabetic rats after 7 days.**

| PARAMETERS | ALP (U/L) | ALT (U/L) | AST (U/L) | Total bilirubin (umol/L) | Direct bilirubtin (umol/L) | Total protein (g/L) | Albumin (g/L) | Globulin (g/L) |
|---|---|---|---|---|---|---|---|---|
| Normal Control | $104.0 \pm 1.35^a$ | $31.5 \pm 0.5^a$ | $41.0 \pm 2.0^a$ | $4.0 \pm 0.0^a$ | $2.5 \pm 0.5^a$ | $93.0 \pm 6.0^a$ | $35.0 \pm 0.0^a$ | $72.5 \pm 8.5^a$ |
| Diabetic control | $421.5 \pm 98.5^b$ | $94.5 \pm 7.50^b$ | $292.5 \pm 45.5^b$ | $4.0 \pm 0.0^a$ | $2.0 \pm 0.0^a$ | $96.5 \pm 6.5^b$ | $35.0 \pm 0.0^a$ | $52.5 \pm 0.5^b$ |
| GLB(5mg/kg) | $120.0 \pm 8.0^c$ | $47.5 \pm 5.50^c$ | $77.0 \pm 32.0^c$ | $4.0 \pm 0.0^a$ | $2.0 \pm 0.0^a$ | $90.5 \pm 0.5^d$ | $35.0 \pm 0.0^a$ | $56.5 \pm 2.5^b$ |
| KSBE(60mg/kg) | $288.5 \pm 11.5^d$ | $67.5 \pm 0.50^d$ | $89.0 \pm 5.00^e$ | $4.0 \pm 0.0^a$ | $2.0 \pm 0.0^a$ | $74.0 \pm 8.0^c$ | $35.0 \pm 0.0^a$ | $45.0 \pm 6.0^c$ |
| KSBE(120mg/kg) | $220.5 \pm 8.5^e$ | $50.5 \pm 3.50^c$ | $63.0 \pm 0.00^d$ | $4.0 \pm 0.0^a$ | $2.0 \pm 0.0^a$ | $89.0 \pm 5.0^d$ | $35.0 \pm 0.0^a$ | $54.0 \pm 3.0^b$ |

Values (mean ± standard error of mean) of 5 determination (n=5). Values in the same column with different superscripts differs significantly ($p < 0.05$).
GLB: Glibenclimide, KASE: *Kigelia Africana* stem bark extract,

Table 4 shows significant difference in ALP parameter between both the control groups and the other test groups, also it has shown that there is significant difference between the two groups administered kigelia extract and the group administered the standard drug, also there is significant difference between the normal control group and the diabetic control group. This study also shows significant difference in ALT parameter between the normal control group and the

diabetic control group, also it has shown a significant difference between both the control groups

and all the treated groups. Also, the study shows significant difference in AST, total protein and globulin parameter between the normal control group and diabetic control group. There is significant difference in AST parameter between diabetic control group and all the test groups. The table also shows significant difference in the Globulin parameter between diabetic control group and the group administered 60mg/kg of kigelia extract. However, the study shows no significant difference in total bilirubin, direct bilirubin and albumin.

**Table 5: Effect of stem bark extract of Kigelia africana on liver function parameters of alloxan induced diabetic rats after 14 days.**

| PARAMETERS | ALP(U/L) | ALT(U/L) | AST(U/L) | Total bilirubin (umol/L) | Direct bilirubin (umol/L) | Total protein (g/L) | Albumin (g/L) | Globulin (g/L) |
|---|---|---|---|---|---|---|---|---|
| | | | | . | | | | |
| Normal Control | 109.0±2.0$^{a}$ | 29.5±0.5$^{a}$ | 33.0±3.0$^{a}$ | 5.0±1.0$^{a}$ | 2.5±0.5$^{a}$ | 86.0±2.0$^{a}$ | 33.0±1.0$^{a}$ | 53.0±1.0$^{a}$ |
| Diabetic control | 627.5±73.5$^{c}$ | 132.5±1.50$^{b}$ | 262.5±31.50$^{b}$ | 4.5±0.5$^{a}$ | 3.0±1.0$^{a}$ | 85.0±3.0$^{a}$ | 31.0±1.0$^{a}$ | 53.0±3.0$^{a}$ |
| GLB(5mg/kg) | 109.5±1.5$^{a}$ | 35.0±1.0$^{c}$ | 45.5±2.50$^{c}$ | 4.0±0.0$^{a}$ | 2.5±0.5$^{a}$ | 93.5±0.5$^{b}$ | 36.0±1.0$^{b}$ | 58.5±0.5$^{b}$ |
| KSBE(60mg/kg) | 169.0±3.0$^{b}$ | 49.0±4.0$^{d}$ | 55.0±10.0$^{d}$ | 3.5±0.7$^{a}$ | 2.0±0.0$^{a}$ | 78.5±2.5$^{c}$ | 26.0±2.0$^{c}$ | 52.5±4.5$^{a}$ |
| KSBE(120mg/kg) | 109.3±2.5$^{a}$ | 31±1.3$^{a}$ | 45.0±4.0$^{c}$ | 4.0±0.0$^{a}$ | 2.0±0.0$^{a}$ | 87.0±10.0$^{a}$ | 30.0±4.0$^{a}$ | 57.5±5.5$^{b}$ |

Values (mean ± standard error of mean) of 5 determination (n=5). Values in the same column with different superscripts differs significantly ($p < 0.05$).
GLB: Glibenclimide, KASE: *Kigelia Africana* stem bark extract

Table 5 shows significant difference ($p< 0.05$) in ALP parameter between the diabetic control group and the other test groups, also there is significant difference ($p<0.05$) between the normal control group and the diabetic control group. The table also shows significant difference ($p<0.05$) in ALT parameter between the normal control group and the diabetic control group, also there is significant difference ($p<0.05$) between the diabetic control group and the other test groups. A significant difference ($p<0.05$) was observed between the group administered 60mg/kg of extract and the group administered 120mg/kg of the extract. Also, the study shows significant difference in AST parameter between the normal control group and diabetic control group. There is significant difference ($p<0.05$) in AST parameter between diabetic control group and all the test groups. A significant difference ($p<0.05$) was observed between the group administered 60mg/kg of extract and the group administered 120mg/kg of the extract. The table also shows significant difference ($p<0.05$) in the total protein and albumin parameter between the group administered 60mg of kigelia Africana and all the other groups. A significant difference ($p<0.05$) was also observed between the group administered 60mg/kg of extract and the group administered 120mg/kg of the extract. This study shows significant difference ($p<0.05$) in globulin parameter between the diabetic control group and the group administered 120mg/kg of the extract. A significant difference ($p<0.05$) was also observed between the group administered 60mg/kg of extract and the group administered 120mg/kg of the extract. However, the study shows no significant difference ($p<0.05$) in total bilirubin and direct bilirubin.

**DISCUSSION**

GC-MS is the best techniques to identify the constituents of volatile matter, long chain, branched chain hydrocarbons, alcohols acids, esters, etc Rukshana *et al*, 2017. The GC-MS analysis of *C. italica* leaves revealed the presence of 52 compounds (phytochemical constituents) that could contribute the medicinal quality of the plant. These compounds have various attributes such as n-hexadecanoic acid with antioxidant, hypocholesterolemic nematicide, pesticide, lubricant, antiandrogenic, flavor activity (Sermakkani and Thangapandian, 2012)**,** tetradecanoic acid and nonanoic acid both with nematicide and pesticide activity (Saroja *et al.*, 2009).

Electrolytes, creatinine and urea are makers of kidney function (Oduola *et al.*, 2007). Diabetes often results in an increase in the glucose leading to cell dehydration and migration of $K^+$ into the extracellular fluid of kidney cells. This leads to increase in the activity of parietal cells of the distal and cortical collecting tubules of the kidneys, resulting in increased renal $K^+$ excretion (Kang et al., 2005). It is therefore possible that the increased electrolyte and water levels usually observed in diabetes could lead to depletion of the extracellular fluid electrolyte and thus lead to the excretion of electrolyte by parietal and non-parietal cells (Onunogbo et al., 2012). This phenomenon can explain the reduction of sodium and potassium ion in diabetic control as compared to the normal control seen at the end of 1$^{st}$ week of the experiment. Therefore, in this study at the end of 1$^{st}$ week of the experiment there was no much effect on the kidney due to the insignificant differences observed in most of the parameters. However, at the 2$^{nd}$ week of extract administration it does not show any significant difference in

some renal function parameters (sodium ion, bicarbonate ion and chloride ion) between normal control groups and the diabetic control groups. However, a significant increase in creatinine level was observed in diabetic control as compared to the normal control group and this is due to the fact that an increase in urea and creatinine level is seen when kidney is not functioning properly, hence the rise in blood glucose level has some damaging effect to the kidney since the nephrogenic impact is more effectively represented by serum creatinine levels than blood urea concentration (Yadav and Bhattacharya, 2018). Moreover, there is a significant decrease in creatinine parameter among the group administered the plant extract as compared to the control groups this finding is in conformity with the work of (Yakubu, *et al.*, 2013). Therefore, the use of this extract at this does dose during the given period of time may be safe.

Liver is an important organ which plays a pivotal role in glucose and lipid homeostasis and is severely affected in disease state (Etuk and Muhammed, 2010). In this study, there was mark elevation in the liver marker enzymes in experimental rats which caused a marked elevation in the levels of serum AST and ALT which is an indicative of hepatocellular damage. The extract of *K. africana* caused significant decrease ($P<0.05$) in the level of plasma AST, ALT and ALP values as shown in (Table 5) both at the 1st week and 2nd week of the administration of the extract. This indicate that the extract has hepato-protective potentials (Johnson *et al.,* 2014). This observation is consistent with earlier report on hepatoprotective potentials of the leaf extracts of *V. amygdalina* in mice (Iwalokun, *et al.,* 2006). The levels of AST, ALT and ALP have been reported to be increased in alloxan-induced diabetic rats (Nwanjo, 2007). The increased in the activities of AST, ALT, ALP in plasma may be mainly due to the leakage of these enzymes from the liver cytosol into the blood stream (Navarro, *et al.,* 1993), which gives an indication of the hepatotoxic effect of alloxan (Johnson *et al.,* 2014). However, the extract as well as the alloxan has very less effect on the level of total protein and globulin, with no any significant difference in direct and total bilirubin.

**CONCLUSION**

In conclusion, the results of this study has revealed that the plant extract was able to ease the complications of both liver and kidney which was due to the induction of diabetics.

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