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HYPOGLYCAEMIC POTENTIAL OF METHANOL STEM-BARK EXTRACT OF MANGIFERA INDICA IN ALLOXAN INDUCED DIABETIC ALBINO RATS AND ITS TOXICITY EFFECT TO LIVER AND KIDNEY

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Abstract

Mangifera indica (MI), popularly known as mango belong to the genus Mangifera and family Anacardiacea. The leaves, stem bark and roots are used as herbal medicines worldwide. Mango possesses anti-diabetic, anti-bacterial, anti-oxidant, anti-viral and anti-inflammatory properties. This research focuses on the hyperglycemic and antibacterial capacity of methanol stem bark extract of Mango tree in alloxan induced diabetic albino rats to combat its fatal consequences in humans. This work is carried out to determine the hypoglycemic capacity of methanol stem bark extract of *Mangifera indica* in alloxan-induced diabetic albino rats at different volumes (ml) of administration, to also determine the antibacterial capacity of methanol stem bark extract of *Mangifera indica* in alloxan-induced diabetic albino rats at different volumes (ml) of administration and to test the efficacy of methanol stem bark extract of *Mangifera indica* in alloxan-induced diabetic albino rats. Fresh stem bark (trunk) of *Mangifera indica* were collected in the Federal University Wukari school

premises, were air dried for 21 days, pounded into powder, cold macerated in methanol, filtered and extract was gotten. 27 diseased-free (healthy) albino rats which were purchased at Yola, Adamawa State, were kept in different cages to enable proper analysis at the cause of the work. Results of liver function indices showed that treatments with 100 mg/kg, 200mg/kg and 400mg/kg body weight of *Mangifera indica* stem bark methanolic extract were able to restore liver function parameters at different levels of concentrations. Treatments with standard drug and all the doses of the extract were able to counteract the elevated effect of alloxan in some kidney parameters such as serum urea level at 200mg/kg with (25.23±1.98a) and (1.05 ±0.14a) for creatinine at 200mg/kg respectively. The result of this study shows that the stem back extract possessed as an agent for hypoglycaemic. These can serve as possible source of raw material for pharmaceutical products. However, the extract is found not to be harmful to the liver and kidney and should be used as health remedy for certain diseases such as hyperglycaemic and bacterial effects.

Keyword: Hypoglycaemic, Methanol, Stem-Bark, Extract, Mangifera Indica, Alloxan, Diabetic, lbino Rats Toxicity, Liver, Kidney

INTRODUCTION

Medicinal plants have served through the ages, as a constant source of medicaments for the exposure of variety of diseases. The history of herbal medicine is as old as human civilization. The plants are known to provide a rich source of botanical anthelmintics, antibacterials and insecticides (Satyavati, Raina, and Sharma, 1976; Lewis and Elvin-Lewis, 1977).

Diabetes is the number one cause of kidney failure, lower-limb amputations, and adult blindness (Centers for Disease Control and Prevention, 2023). It is a chronic disease that is associated with elevated blood sugar level, it is relatively common throughout the world. In recent times, different epidemiological studies have been carried out on prevalence of diabetes mellitus. According to the World Health Organization reports in the year 2004, more than 150 million people throughout the world suffered from diabetes (W. H. O), as such, the problem has been left unsolved. What seems to be the only simple, inexpensive, easy and available way is to refine the Langerhans islets and to graft them under the testis subcutaneous. The first step in the plan for transplanting the pancreatic Langerhans islets under the testis subcutaneous is inducing experimental diabetes mellitus. Experimental

diabetes mellitus has been induced in the laboratory with animals using different methods. Generally, an effective method is to take the pancreas out of the body. However, to induce a notable form of diabetes, at least 90-95% of the pancreas has to be removed, otherwise, the Langerhans islets in the remaining pancreas may undergo hypertrophy and secrete a sufficient amount of insulin for fulfilling the natural metabolic needs. Another method for creating diabetes in animals is injecting drugs such as alloxan or Alloxan, for the sake of this research, alloxan was used.

These materials inflate and ultimately degenerate the Langerhans islets beta cells (Ikebukuro et al 2002). One of the methods used as remedy for treatment of diabetes mellitus is the use of Mangifera indica (Mango) stem bark. Mango (Mangifera indica L.) is a juicy fruit that belongs to the family of Anacardiaceae and is grown in different parts of the world, especially in tropical countries. Different varieties of mango are available, out of which few are traded commercially in about 87 countries, Solís-Fuentes and Durán (2011). The major phytochemical components in mango stem bark include; Mangiferin, Quercetin, catachin and epicatechin are considered as some of the other flavonoids and flavonol constituents found in mango. Okwu and Ezenagu (2005). Mango stem bark also contains polyphenols, terpenoids, sugars and saponins. Okwu and Ezenagu (2005).

Roots and bark are used as astringent, acrid, refrigerant, styptic, anti-syphilitic, vulnerary, anti-emetic, anti-inflammatory and constipating. They are useful in vitiated conditions of diabetes mellitus, pitta, metrorrhagia, calonorrhagia, pneumorrhagia, leucorrhoea, syphilis, uteritis, wounds, ulcers and vomiting. The juice of fresh bark has a marked action on mucous membranes, in menorrhoea, leucorrhoca, bleeding piles and diarrhoea. Leaves are used as astringent, refrigerant styptic, constipation, cough, hiccup, hyperdipsia, burning sensation, haemorrhages, haemoptysis, haemorrhoids, wounds, ulcers, diarrhoea, dysentery, pharyngopathy and stomachopathy. Leaves ashes are useful in burns, scalds and smoke from burning leaves is inhaled for relief of throat disease (Jouad et al., 2001).

The aim of this research work focuses on the hypoglycaemic, and antibacterial capacity of methanol stem bark extract of Mangifera indica in alloxan-induced diabetic albino rats.

Statement of Problem

Diabetes ranks among the deadliest diseases that exist in the world. Several attempts and measures have been carried out to ensure this disease has a cure, and/or reduce its effects to the barest minimum. Medical sciences have administered other drugs to treat diabetes,

but man suffers still. To curb this problem, this research focuses on the hyperglycaemic and antibacterial capacity of methanol stem bark extract of Mango tree in alloxan induced Diabetic albino rats to combat its fatal consequences in humans.

Justification of the Study

With the death rate of diabetic patients across the globe due to non-availability of medically potent drug to cushion the damages caused diabetes in humans, there is a dire need for an alternative measure to the cure of this disease, to reduce its virulence, and further save lives by administering Methanol stem bark extract of Mangifera indica to diabetic patients.

Alloxan

Alloxan is a permanent diabetes inducing drug. It is synthesized by a strain of the soil microbe Streptomyces achromogenes (gram positive bacterium) with broad spectrum of antibacterial properties. Alloxan is an unusual aminoglycoside containing a nitrosoamino group discovered in 1959 as an antibiotic, now marketed as a generic drug. The nitrosoamino group enables the metabolite to act as a nitric oxide (NO) donor. NO is an important messenger molecule involved in many physiological and pathological processes in the body. Alloxan is widely used to induce diabetes in rodent models by inhibition of β-cell O-GlcNAcase (Vivek, 2010; Eleazu et al., 2013; Akbarzadeh, 2007).

DNA synthesis in mammalian and bacterial cells is inhibited by action of Alloxan (Bolzan and Bianchi, 2002). Alloxan is widely used to induce both insulin-dependent (IDDM) and non-insulin-dependent diabetes mellitus (NIDDM) (Szkudelski, 2001). Alloxan is an antibiotic and antitumor agent, induces diabetes mellitus via reduction of nicotinamide adenine dinucleotide in pancreatic β-cells in vivo (Szkudelski, 2001).

Structural Features of Alloxan

Alloxan (2-deoxy-2-(3-methyl-3-nitrosourea) 1-D-glucopyranose) occurs in two anomeric forms, α and β (in the figure below), which can be separated by Chromatographic technique (HPLC) (Eleazu et al., 2013). It appears as pale yellow or off-white crystalline powder. Alloxan has a molecular weight of 265 g/mol, with molecular formula C8H15N3O7

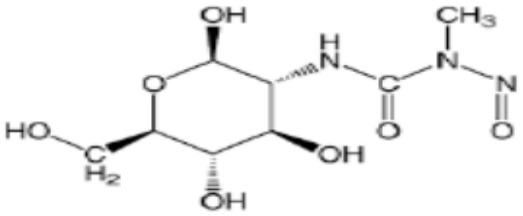

Figure 1: Structure of Alloxan

Alloxan Model of Diabetes Mellitus

Alloxan prevents the development of DNA in bacterial cells and mammalian cells. It acts on cytosine groups in bacteria, causing relapse and damage of DNA (Adam et al., 2012). The invasion of Alloxan in pancreatic cell is through a glucose transporter-GLUT2 and causes alkylation of DNA (as shown in the figure below). Alloxan also persuade activation of poly adenosine diphosphate ribosylation and nitric oxide release. With the consequence of alloxan action, pancreatic-cells are destroyed by necrosis (Krisanapun et al., 2009).

Procedure

Adult male Wistar rats were maintained under controlled laboratory conditions at the temperature of 25±3°C with 60±15% humidity and 12 h dark/light cycle. Male wistar rats (160-240 gm) were maintained on standard chow diet and water ad libitium. Alloxan (60 mg/kg) was administered intraperitonially. Initially blood glucose increases to 150- 200 mb % within three h after administration of alloxan. A phase of hypoglycemia occurs due to four-fold increase in serum insulin level, and this phase is followed by persistence hyperglycemia (Ramakrishnan et al., 2017).

In recent times a new animal model of Type 2 diabetes has been suggested by combining alloxan and NAD in adult rats (160-240 gm). The rats were injected NAD (230 mg/kg) 15 min before alloxan (65 mg/kg) administration. With combining this, it showed evenhanded and stable nonfasting hyperglycemia without any significant change in insulin level. NAD is an

antioxidant which exerts its defensive effect on the cytotoxic action of alloxan by scavenging free radicals (Ghasemi, Khalifi and Jedi, 2014).

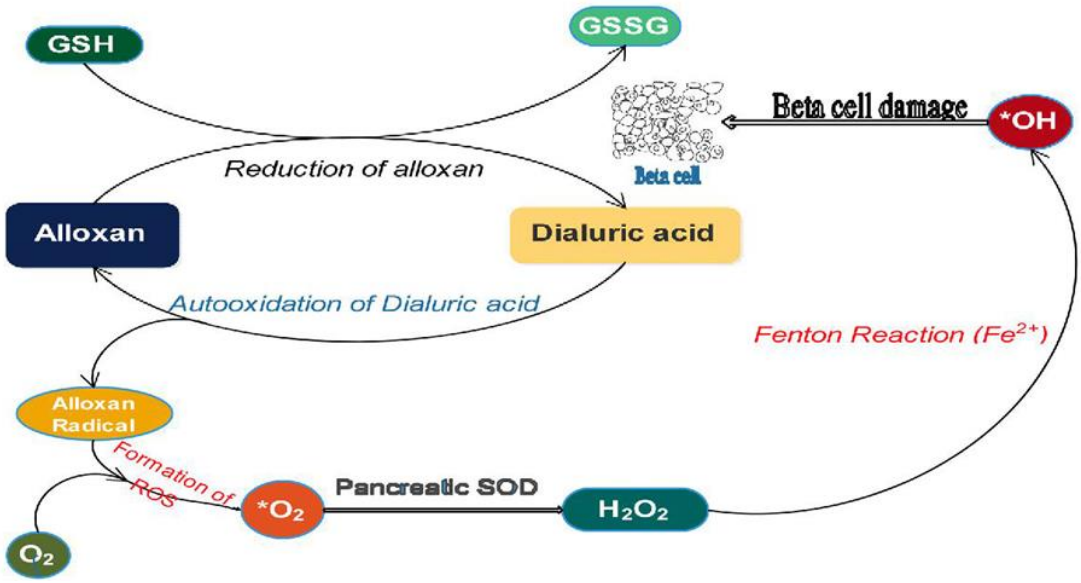

Figure 2: Mechanism of action of Alloxan

MATERIALS AND METHODS

Collection of Plant Material

Fresh stem bark (trunk) of Mangifera indica were collected in the Federal University Wukari school premises. A selected specie of mango tree (Mangifera indica) was identified and the stem bark was extracted from the tree.

The extracted fresh plants were properly washed with clean water and air dried for a period of 21 days, pounded into powdery form and cold macerated in methanol in round bottom flask and shaken at intervals for one and they were left to stand at room temperature for three days. It was filtered using a clean, white chiffon handkerchief. The extracts were then concentrated to dryness using a rotary evaporator and it was stored frozen until when needed.

Equipment and Materials

Weighing balance, syringes (1ml, 2ml, 5ml, 10ml), Mangifera indica stem bark extract, distilled water, animal feed (Top feed), cages, formaldehyde, drinking bottles, alloxan, measuring cylinder, cotton wool, methylated spirit, hand gloves, reagent bottles, methanol.

Extract Preparation

10g of crude extract taken into a conical flask, and 100ml of distilled water was added to the sample and mixed to form a solution.

Preparation of Standard Drug (Metformin)

1000mg of metformin was properly dissolved in 10ml of distilled water.

Breeding of Animals (Albino Rats)

Samples used for this work were 27 disease-free (healthy) albino rats which were purchased at Yola, Adamawa State. The rats were carefully selected and separated into cages. 7 albino rats were used for normal control while 4 rats were kept in each of the remaining cages, and 6 replications were obtained. The test was carried out carefully by injecting the alloxan into the rats intra-peritoneally and infecting them with diabetes mellitus. The rats were maintained under standard laboratory conditions and were allowed free access to standard diet and water ad libitum (as often as necessary). They were also allowed to acclimatize for 24 hours and feeding was done regularly.

Experimental Design

After the albino rats were randomly divided into different groups, the following sets were made: normal group, negative and positive control group, while three groups were for extracts dosage. With exception of the normal control, all the groups were induced with diabetes.

The extract (stem bark of Mangifera indica) will be administered orally to the three set of groups separately (i.e., one extract to one set) as shown in Table 1 below for 14 days.

Liver/Kidney Function Test

The blood samples were taken from the heart of the rats and centrifuged for five minutes at 3000 rpm to prepare the serum for biochemical analysis. The ALT, AST, ALP, Bilirubin, Protein, albumin, urea, sodium, potassium, chloride, creatinine and carbon dioxide levels were determined by colorimetric methods.

Method of Data Analysis

The data was analysed using One-Way Anova and the statistical program SPSS 21.0 (Statistical Package for the Social Sciences). The results were presented as the mean ± standard deviation. Significance level for the differences was set at $p<0.05$.

RESULTS

Blood Glucose Level

Table 1: Blood Glucose Parameters

Fasting blood glucose	Group1 (Normal control)	Group 2 (negative control)	Group3 (positive control)	Group 4 (100 mg/kg extract)	Group 5 (200 mg/kg extract)	Group 6 (400 mg/kg extract)
Day 1	5.65 ± 0.19^{a}	23.78 ± 0.30^{c}	6.23 ± 0.47^{a}	16.40 ± 1.0^{b}	20.56 ± 0.83^{c}	27.40 ± 1.17^{d}
Day 3	5.76 ± 0.21^{a}	24.73 ± 0.58^{c}	5.49 ± 0.37^{a}	5.66 ± 0.25^{a}	21.89 ± 0.88^{b}	28.43 ± 0.44^{d}
Day 7	5.74 ± 0.16^{a}	25.37 ± 1.93^{c}	5.41 ± 0.33^{a}	5.21 ± 0.28^{a}	22.47 ± 0.43^{b}	28.42 ± 1.03^{d}
Day 14	5.25 ± 0.22^{a}	27.07 ± 0.51^{c}	4.78 ± 0.18^{a}	5.11 ± 0.14^{a}	22.57 ± 0.63^{b}	27.94 ± 0.42^{c}

Note: Results are expressed in Mean ± SD (Standard Deviation) value with same superscript within column are statistically not significant while values with different superscript within a column are statistically significant ($P<0.05$).

LEGEND: Group 1 = Normal control, Group 2 = Negative control, Group 3 = Positive control, Group 4 = Treatment one; 100mg/kg.bw, Group 5 = Treatment two; 200mg/kg.bw, and Group 6 = Treatment four; 400mg/kg.bw

Table 1 above showed the result analysed for blood glucose level of wistar albino rats to which alloxan and Mangifera Indica stem bark extract was administered for 14 days. Group 3 showed no significant difference when compared to group 1 (normal control) for day 1, however, there is significant ($p < 0.05$) increase between groups 2, 4, 5 and 6 when compared to group 1 (normal control). In day 3, there is no significant difference between group 3 and 4 when compared to group 1 (normal control) while groups 2, 5 and 6 increased significantly. In day 7, there is no significant difference between group 3 and 4 when compared to the group 1 (normal control) whereas, there is a significant ($p < 0.05$) increase between groups 2, 5 and 6. In day 14, groups 3 and 4 showed no significant increase with normal control while groups 2, 5, and 6 increased significantly.

Concentration of Selected Liver Function Parameters

Table 2: Liver Function Parameters (Concentration of Selected Liver Function Parameters)

Parameters	Group1 (Normal control)	Group 2 (negative control)	Group3 (positive control)	Group 4 (100 mg/kg extract)	Group 5 (200 mg/kg extract)	Group 6 (400 mg/kg extract)
AST (IU/L)	11.90±1.16^{a}	45.09±4.14^{d}	12.00±1.11^{a}	25.67± 4.32^{c}	20.00 ±1.53^{b}	33.86±1.35^{d}
ALT(IU/L)	18.11±0.85^{b}	20.00±0.82^{b}	15.15±0.24^{a}	13.82±1.88^{a}	23.63 ±0.67^{b}	26.11±1.28^{b}
ALP(IU/L)	80.21±0.88^{b}	225.80±6.24^{d}	80.69±2.98^{b}	127.36±6.98^{c}	128.12±6.79^{c}	77.43±2.01^{a}
TP (gm/dL)	12.95±0.75^{c}	14.13±1.09^{d}	14.42±0.52^{d}	10.69±0.75^{c}	9.57 ± 0.68^{b}	7.05 ± 0.12a
ALB (gm/dL)	8.82±0.65^{c}	9.30 ± 0.09^{c}	11.60±0.26^{d}	6.41 ± 0.26^{d}	3.67 ± 0.21^{a}	3.96±0.43^{b}
TB (mg/dL)	4.58 ± 0.54^{a}	4.36 ± 0.28^{a}	6.10 ± 0.35^{d}	3.51 ± 0.26^{a}	6.45 ± 0.39^{c}	3.76±0.09^{a}
DB (mg/dL)	1.46±0.19^{a}	3.29 ± 0.24^{b}	4.42 ± 0.24^{c}	1.81 ± 0.19^{a}	4.32 ± 0.18^{c}	1.67±0.29^{a}

Note: Results are expressed in Mean ± SD (Standard Deviation) value with same superscript within column are statistically not significant while values with different superscript within a column are statistically significant ($P<0.05$).

LEGEND: Group 1 = Normal control, Group 2 = Negative control, Group 3 = Positive control, Group 4 = Treatment one; 100mg/kg.bw, Group 5 = Treatment two; 200mg/kg.bw, and Group 6 = Treatment four; 400mg/kg.bw

ALT = alanine transaminase, AST = Aspartate aminotransferase, ALP = alkaline phosphatase, TP = total protein, ALB = albumin, TB = total bilirubin and DB = direct bilirubin.

Table 2 above showed the results of the liver enzyme analysis of hyperglycaemic rats administered with ethanolic stem bark extract M. Indica for 14 days. AST levels when compared to group 1 (normal control) decreased significantly ($p <0.05$) in groups 2, and 3 while group 4, 5 and 6 have moderate decrease when compared with the normal control. The result showed that the concentration of ALT increased significantly ($p <0.05$) in group 6 and moderately increased in group 5, slightly decreased in groups 2, and significantly decreased in group 3 and 4. There is no significant difference of ALP level in group 3.

Concentration of Selected Kidney Function Parameters

Table 3. Kidney Function Parameters (Concentration of Selected Kidney Function Parameters)

Parameters	Group 1 (Normal contro)	Group 2 (negative control)	Group 3 (positive control)	Group 4 (100 mg/kg extra)	Group 5 (200 mg/kg extract)	Group 6 (400 mg/kg extrac)
Urea(mg/dL)	42.96 ± 3.36^{a}	70.03 ± 2.42^{e}	56.62 ± 1.49^{d}	47.03 ± 2.36^{c}	25.23 ± 1.98^{a}	41.49 ± 2.30^{b}
Creatinine (mg/dL)	1.35 ± 0.18^{b}	1.12 ± 0.07^{a}	1.50 ± 0.03^{c}	1.34 ± 0.05^{b}	1.05 ± 0.14^{a}	$1.10 \pm 0 .09^{a}$
Sodium (mmol/L)	10.67 ± 0.33^{a}	55.32 ± 2.91^{b}	121.11 ± 6.23^{e}	104.35 ± 6.62^{d}	91.19 ± 9.02^{c}	55.37 ± 7.58^{b}
Chloride (mmol/L)	87.65 ± 5.07^{a}	$126.76\pm5.72^{c,d}$	100.11 ± 1.80^{b}	116.58 ± 4.81^{b}	100.51 ± 15.31^{a}	94.85 ± 11.26^{a}
Potassium (mmol/L)	5.36 ± 0.30^{a}	7.87 ± 0.61^{d}	4.98 ± 0.23^{a}	7.36 ± 0.35^{d}	9.62 ± 0.56^{e}	11.00 ± 0.35^{f}
Carbon dioxide (mmol/L)	48.22 ± 1.17^{a}	61.46 ± 0.82^{c}	54.82 ± 1.45^{b}	34.74 ± 3.29^{a}	52.30 ± 1.49^{c}	58.28 ± 3.07^{d}

Note: Results are expressed in Mean ± SD (Standard Deviation) value with same superscript within column are statistically not significant while values with different superscript within a column are statistically significant ($P<0.05$).

LEGEND: Group 1 = Normal control, Group 2 = Negative control, Group 3 = Positive control, Group 4 = Treatment one; 100mg/kg.bw, Group 5 = Treatment two; 200mg/kg.bw, and Group 6 = Treatment four; 400mg/kg.bw

BUN = Blood Urea Nitrogen, sCr = Serum Creatinine, Na = Sodium, CL = Chlorine, K+ = Potassium ion, and CO2 = Carbon dioxide

Result of kidney function test shows that for Blood Urea Nitrogen, there is a significant increase ($P<0.05$) in groups 2, 3 and 4 when compared to group 1 (normal control), and a slight decrease in group 6 and a significant decrease in group 5. sCr shows moderate decrease in group 2, 5 and 6 while group 4 shows no significant difference and group 3 shows slight increase. In the result for sodium, there is a significant increase ($P<0.05$) in all the groups when compared to the normal control. Chloride level increased significantly

(P<0.05) in all groups. K+ levels were increased significantly (P<0.05), except group 3 which was lowered almost to the same level with the normal control. Level of carbon dioxide significantly (P<0.05) increased in all the groups except for group 4 which shows moderate decrease when compared to the normal control.

DISCUSSION

Glucose Test

Blood glucose level shows that administering standard drug from day one to day fourteen was able to contradict the effect of alloxan induced diabetes to a level that is almost the same as normal control (group 1).

Administration of 100 mg/kg body weight of Mangifera indica stem bark methanolic extract showed hypoglycemic activity in day 3, day 7 and day 14 of treatment, whereas, day one treatment showed slight hypoglycemic activity; treatments with 200 mg/kg showed moderate reduction in glucose level whereas, 400mg/kg body weight of Mangifera indica stem bark methanolic extract showed that there is no effect when 400mg/kg concentration is administered. This implies that the hypoglycemic activity of Mangifera indica stem bark methanolic extract can only be achieved after treatment for 3 to 14 days using 100mg/kg dosage only while, 200mg/kg is moderately effective and 400mg/kg dosage tends to have no effect on hyperglycaemic activity. The result of this study is in tandem with the report of Adedosu et al (2019) which reported the hypoglycemic activities of stem bark extracts of Mangifera indica. However, the result of this research is in contrast with Luka, C.D. and Mohammed, A. (2012) which reported that aqueous extract of M. indica leaf decreased blood sugar level in diabetic rats at a dose of 400mg/kg. Therefore, result of this present study supports the use of Mangifera indica stem bark methanolic extract as an antidiabetic agent.

Liver Function Test

Results of liver function indices showed that treatments with 100 mg/kg, 200mg/kg and 400mg/kg body weight of Mangifera indica stem bark methanolic extract were able to restore serum AST activity close to normal control, while the rest of the treatments did not show any AST restoration activity. Alloxan induced diabetes did not affect serum ALT activity, treatment with standard drug lowered serum ALT activity, while treatments with

200 mg/kg and 400 mg/kg body weight of Mangifera indica stem bark methanolic extract concentration were increased when compared with the normal control, although, treatment with 100mg/kg body weight lowered ALT level. Induction of diabetes significantly elevated serum ALP activity, while treatments with standard drug, 100 mg/kg, 200 mg/kg and 400 mg/kg body weight of Mangifera indica stem bark methanolic extract were able to restore serum ALP levels close to normal level. (Galighor, A. E. and Kozloff, E. N., 1976) conducted a research on hepatoprotective activity of ethanol extract of Mangifera-indica dried leaves against CCl4 induced acute liver damage on albino rats; after treatment with Mangifera indica there was significant reduction in the elevated levels of biochemical markers of liver enzymes. These results suggest that this MI leaf Extract may have the potential therapeutic value in the treatment of CCl4 induced hepatic damage and some liver diseases. Elevated levels of tissue aspartate transaminase and alanine transaminase enzymes point out the abnormal functions of liver, due to cellular necrosis and increased membrane permeability, Esmaeili et al (2012). Induction of diabetes causes lowering of serum total protein and albumin. Treatment with standard drug only was able to restore serum total protein and albumin almost to normal level, while treatment with all the doses of the extracts did not restore serum total protein and albumin levels.

Administration of standard drug and administration at 200mg/kg elevated Direct bilirubin while treatment with extract at 100mg/kg and 400mg/kg lowered direct bilirubin level indicating that the extract has effect in a lower and much higher concentration

Kidney Function Test

Results of kidney function parameters showed treatments with standard drug and all the doses of the extract were able to counteract the elevated effect of alloxan in serum urea level. Since kidney is a key organ for filtering urea and creatinine out of the blood, urea and creatinine are frequently employed as indicators of renal function, Iseghohi et al (2017). The increase in sodium concentration in all the treatment groups can lead to a disease condition known as hypernatremia which is as a result of elevated blood sodium level. Chloride level across the various groups were lowered to almost the normal control. The elevation of serum potassium in all treatments shows that M.Indica extract does not have any effect on serum potassium, except for the standard drug which lowered it close to the normal control. However, increase in potassium concentration in all the treatment groups may result to hyperkalemia which is caused by various factors such as excessive intake of

leakage of potassium from the intracellular space and reduced renal excretion, (Kovesdy, 2014). However, the lowering effects of serum potassium, chloride and carbon dioxide in all the treatment groups indicates that the extract was able to facilitate the excretion of these metabolites by the kidney, this may tend to increase the efficiency of the kidney.

CONCLUSION

In this research, Mangifera indica stem bark extract have been studied to contain Mangiferin which is a major chemical for anti-fungal and anti-bacterial activities. The result of this study shows that the stem back extract possessed higher antidiabetic agents compared to leaf and root extracts as carried out by other researchers. These can serve as possible source of raw material for pharmaceutical products. However, the extract is found not to be harmful to the liver and kidney.

The hypotheses of this study is stated below

H1: Methanol stem bark extract of Mangifera indica has an effect on the hyperglycaemic capacity of alloxan-induced diabetic albino rats

Recommendation

Further investigations as regards toxicological studies and purification of active components should be considered in novel drug development. The plant should be considered a traditional drug for health remedy. The extract is a promising source for therapeutic agent that can be used in combating infectious diseases caused by drug-resistant bacteria, since this study shows that the extract exhibited significant levels of hypoglycaemic activities against albino Wister rats, further studies should be carried out for the isolation and identification of individual bioactive compounds which are responsible for this therapeutic activity and the investigation of their mechanism(s) of action.

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Competing Interests

Authors have declared that no competing interests exist.

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