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Research Article
Effects of Aqueous Extract of Leaves of *Abrus precatorius* (Linn) on some Biochemical Parameters in Normal and Alloxan Induced Diabetic Rats

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Abstract

Objective: This study was targeted at valuing a claim by traditional herbal practitioners that the leaves of *Abrus precatorius* (Linn) possess hypoglycemic property by assessing the hypoglycemic effects of the aqueous extract of the leaves of *Abrus precatorius* (Linn) on some biochemical parameters in normal and alloxan-induced diabetic albino rats. **Materials and Methods:** Diabetes was induced by a single dose of intraperitoneal injection of 150 mg kg^{-1} b.wt., of alloxan to 4 groups of experimental rats (group 2,3,4 and 5) and a daily oral administration of different concentrations 100, 200 and 400 mg kg^{-1} b.wt., of the aqueous leaf extract of *A. precatorius* was administered to groups 3,4 and 5, respectively for 21 days based on traditional practices. Group 2 was used as diabetic control. Student t-test was used to determine the statistical difference between two mean values at 95% level of confidence ($p<0.05$) and glycemic index and liver marker enzymes were then measured. **Results:** The results of the study showed a significant decrease 18.90±0.81 ($p<0.05$) in the mean values of blood glucose and significant increase ($p<0.05$) in total bilirubin of the treated rats in both normal (16.65±3.29) and diabetic rats (17.60±0.2), it also showed an observed decrease in the mean values of aspartate transaminase, alanine transaminase and alkaline phosphatase in diabetic rats and an increase in the normal rats. **Conclusion:** The study indicates that the crude leaves extract of *A. precatorius* possesses hypoglycemic activity which is effective in glycemic control at dose 400 mg kg^{-1} b.wt., it also possess potential toxic property as seen to affect the liver marker parameters, hence care should be taken when using the plant.

Key words: *Abrus precatorius*, diabetes, liver marker, enzymes, herbal medicines

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Competing Interest: The author has declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

In the past decades, traditional systems of medicine have become a practice of global importance and have increasingly become an integral part of the human society with regards to their therapeutic uses[1] and current estimates suggest that in many developing countries, a large proportion of the population relies heavily on traditional practitioners and medicinal plants to meet primary health care needs. Although modern medicine may be available in those countries, herbal medicines (phytomedicines) have often maintained popularity for historical and cultural purposes[2]. *Abrus precatorius*, is one of the medicinal plants that have received attention in management and treatment of many diseases, it is widely found in Africa, India and many other parts of the world[3] and is used as a vegetable as well as artefact in many cultures. The leaves have been reported to have a characteristic sweet taste and have been employed as a sweetener in food and certain medicines[4]. Published reports showed it protects the liver against CCl_4 induced liver damage in rats[5], anti-tumor, immunomodulatory[6], anti-ulcerative and anti-inflammatory properties[7-9], anti-diabetic effects[10-12]among other medicinal use in combating diseases and ailments.

Many of such diseases like diabetes mellitus have received great care both in modern and traditional medical specialty. Diabetes is a chronic metabolic disorder characterized by abnormally high blood glucose level and the evacuation of excess glucose in urine[13] and is the most common endocrine disorder currently affecting a large ratio of the population worldwide and the number of people with diabetes is on the increase due to population growth, aging and increasing prevalence of obesity and physical inactivity[14].

According to recent estimates, by the year 2030, approximately 7.8% of the adult population is anticipated to have diabetes[15] and some reasons like stress, rapid evolution of cities, substantial increase in purchasing power, lifestyle, ease and metro life have contributed to health matters and higher number of people suffering from this disease[16]. This study was thus designed to evaluate the effects of the aqueous leaf extract of the *A. precatorius* in normal and diabetic rats. The findings of the study will help in advancing the search for natural compounds that could be used as remedies or incorporated into drugs to manage/treat the ailment.

MATERIALS AND METHODS

Chemicals: Diagnostic kits for serum glucose, alanine aminotransferase (ALT), aspartate aminotransferase (AST), alkaline phosphatase (ALP) and bilirubin were purchased from Randox Laboratories Ltd. Other chemicals and solvents were of the highest grade commercially available.

***Abrus precatorius* leaves:** Freshly harvested leaves of *A. precatorius* was used for the preparation of the crude leaves extract. It was gathered from an uncultivated farm land in Girei LGA of Adamawa State, Nigeria and was authenticated in the Plant Science Department of the Modibbo Adama University of Technology, Yola and given a voucher specimen number WH/APL015/20, it was dried under room temperature.

Extract preparation: The freshly dried leaves of *A. precatorius* were grounded into powdered forms using laboratory grinder machine) (FGR-350, Quest Scientific), extraction was done using distilled water (as it was the method used by traditional herbal practitioners) by placing 150 g of the powdered samples into an Erlenmeyer flask and distilled water (three times the weight of the extracts) was added, the solution was covered and shaken at time interval of an hour and then allowed to stand for 7 days at room temperature. The mixtures were then filtered using Whatman filter paper No. 4 and the solvent was evaporated using a rotary evaporator (Heidolph Laborato 400) under reduced pressure below 50 EC. It was then stored under a frozen condition until use.

Breeding of animals: Thirty-six male albino rats weighing between 90 and 120 g body mass were purchased from the animal farm, National Veterinary Research Institute Vom, Jos Plateau State, Nigeria. They were put in cages at room temperature (20-27°C) under 12/12 night/dark and were fed with pelleted standard laboratory feed (Vital Feeds, Grand cereals and oil mills Jos) and water *ad libitum* and were allowed for 7 days to acclimatize before the commencement of the work.

Experimental protocol: The rats were randomly divided into 5 groups (for diabetic studies, this includes diabetic control) and 4 groups (for non-diabetic studies), of 4 rats per group (this is because the study on the rats in the non-diabetic studies were without diabetic induction, thus diabetic control is unnecessary) and were given the extract randomly selected dose not exceeding the LD_{50} of the plant (oral limit dose) as follows:

- **Group 1:** Normal Control (diet/water)
- **Group 2:** Rats were given single dose of 150 mg kg^{-1} b.wt., alloxan + diet/water

- **Group 3 (treated):** Rats were given 100 mg kg^{-1} b.wt., Leaf extract + 150 mg kg^{-1} b.wt., alloxan + diet/water
- **Group 4 (treated):** Rats were given 200 mg kg^{-1} b.wt., Leaf extract +150 mg kg^{-1} b.wt., alloxan + diet/water
- **Group 5 (treated):** Rats were given 400 mg kg^{-1} b.wt., Leaf extract + 150 mg kg^{-1} b.wt., alloxan + diet/water

The 150 mg kg^{-1} b.wt., alloxan was administered intraperitoneally to induce diabetes[17].

Blood collection: All the rats from the various groups were sacrificed using standard laboratory procedures and then blood samples were collected via ocular vein into clean containers and allow standing for 10 min. It was then centrifuged at 3000 rpm for 15 min to obtain serum, the serum was then separated for the estimation of glucose and liver marker enzymes (transaminases and alkaline phosphatase) and total bilirubin.

Statistical analysis: All the data generated from the study were subjected to statistical analysis and the result was expressed as Mean±SEM. Student t-test was used to determine the statistical difference between two mean values at 95% level of confidence ($p<0.05$).

RESULTS

The results in Table 1 show the findings of the study in diabetic rats, there was an observed concentration dependent decrease in the treated groups (group 3, 4 and 5) as against the diabetic group (group 2) in the levels of AST, ALP and Glc and an observed increase in the level of TB. The extract was observed to be most effective in group 5 treated rats. Table 2 also shows the findings in normal rats and there was an observed concentration dependent increment in the treated groups (group 2, 3 and 4) in the levels of ASP, ALT, ALP and TB ad observed decrease in the level of Glc.

DISCUSSION

Measurements of aspartate transaminase (AST) and alanine transaminase (ALT) are two of the most common tests employed in investigating hepatic integrity. The AST and ALT are widely distributed throughout the body and participate in gluconeogenesis by catalyzing the transfer of amino groups from aspartate and alanine to α-ketoglutaric acid to form oxaloacetate and pyruvate, respectively, as well as glutamate. The AST is found primarily in the heart, liver, skeletal muscle, red cells and kidney, whereas ALT is found mainly in the liver and kidney, with lesser amounts in the heart and skeletal muscles.[18], thus literature has provided evidence that an AST: ALT ratio > 1 signifies hepatic damage[19].

The average levels of AST, ALT and ALP (Table 1) showed a substantial decrease in groups 4 and 5 against a significant increase ($p<0.05$) in group 2, the reduction in average levels of AST and ALT in the treated groups (which may be due to bone activities) and the liver ALP is an indirect measure of bone turnover and it is made by many tissues including the

Table 1: Effects of *Abrus precatorius* leaves extract on biological parameters in diabetic rats

	Groups				
Parameters	1	2	3	4	5
AST (μL)	13.33±4.37	29.00±3.86[a]	27.75± 2.75	21.50±1.94[d]	18.67±4.91[d]
ALT (μL)	8.67±1.76	20.33±4.67[a]	17.50±1.50	15.50±0.96[d]	15.00±1.73[d]
ALP (μL)	285.30±3.38	338.13±5.10[a]	331.20±5.9	295.40±4.30[d]	292.53±2.07[d]
TB (μmol L^{-1})	11.80±0.69	13.07±2.22[a]	13.88±4.10	16.65±3.29[d]	15.82±5.18[d]
Glc (mmol L^{-1})	13.47±0.20	29.10±0.08[a]	26.73±0.58	20.33±0.84[b]	18.90±0.81[b]

Results are Mean±SEM, N = 4, Super-scripted items indicate significant values ($p<0.05$), AST: Aspartate transaminase, ALT: Alanine transaminase. ALP: Alkaline phosphatase, TB: Total bilirubin, Glc: Glucose

Table 2: Effects of *Abrus precatorius* leaves extract on biological parameters in non-diabetic rats

	Groups			
Parameters	1	2	3	4
ALT (μL)	29.20±1.4	31.40±1.4	35.8±2.4[a]	40.40±1.4[a]
ALT (μL)	21.20±2.43	21.90±2.9	35.0±2.4[a]	41.00±1.45[a]
ALP (μL)	5.62±1.4	5.92±1.4	8.50±2.5[a]	9.10±5.6[a]
TB (μmol L^{-1})	14.80±0.6	15.30±0.9	15.81±0.3	17.60±0.2[a]
Glc (mmol L^{-1})	20.80±1.6	19.60±2.3	16.6±1.7[b]	16.00±2.0[b]

Results are Mean±SEM, N = 4, Super-scripted items indicate significant values ($p<0.05$), AST: Aspartate transaminase, ALT: Alanine transaminase. ALP: Alkaline phosphatase, TB: Total bilirubin, Glc: Glucose

biliary system[20]. The mean level of total bilirubin was shown to significant increase ($p<0.05$) in the diabetic and the treated groups, increase in total bilirubin may be because of hemolytic anemia due to destruction of red blood cells, whether through extra vascular or intra vascular hemolysis and low levels of the enzyme that attaches sugar molecule to bilirubin. It does seem, therefore, that hepato-cellular damage may accompany alloxan-induced diabetes mellitus in rats, as observed by Lucchesi *et al.*[21], that alloxan-induced diabetes triggered liver morphological and ultra-structural changes also presented biochemical changes in blood and morphological ultra-structural lesions in the liver that largely resembled chronic liver disease in humans, mostly due to the toxic nature of alloxan, this is reflected in the changes in the levels of the marker enzymes of liver impairment. Also, Nsiah *et al.*[22], reported that elevated aminotransferase levels are usually associated with compromised hepatic integrity from various abuses.

The average levels of glucose significantly decrease ($p<0.05$) in group 4 and 5, this is shown in their similar percentage reduction in blood glucose level with the Mean±SEM as dose dependent as seen in Table 1, similar decreased level was observed in groups 3 and 4 (Table 2). An increase in insulin-stimulated glucose uptake, inhibition of the intestinal GLUT system and decrease in expression of genes that control gluconeogenesis are the possible mechanisms observed for the hypoglycemic effect of the leaf extract. Works are still ongoing to ascertain the mechanism of action of medicinal plants on these medical/health related effects of *A. precatorius* (Linn). The findings in this study clearly showed the oral administration of *A. precatorius* leaves extract improved the levels of glycemic control as observed in other studies[10-12]. Malvi *et al.*[16], reported that flavonoid and alkaloid from methanol extract of the seed of *A. precatorius* (Linn) has shown anti-diabetic property like chlorpropamide.

The results in Table 2 indicate an increase in the average levels of AST, ALT, ALP and bilirubin in group 3 and 4, with an observed decrease in glucose levels. The increase in the levels of these parameters may be due to hepatic insufficiency, cholestasis or obstruction of the bile ducts, muscle infection or following liver involvement[23], it may also give an indication that the leaves of the plant may have a toxic effect on the parameters and that prolong exposure to this plant can cause liver obstruction, as it was reported to have a potential toxic effect on the red blood cell parameters in normal rats[24]. This indicates the plant should be used with care since it can cause irregularity in the functioning of the liver as observed from the changes on the liver function indices (AST, ALT and ALP). The finding of this work suggests that leaf extract of *A. precatorius* (Linn) has hypoglycemic effect and lesser toxicity on the liver enzyme.

CONCLUSION

This study clearly demonstrated that oral administration of the crude leaves extract of *A. precatorius* has a positive effect on glycemic control and a potential toxic effect on the liver and the most effective dose was obtained in group 5 (400 mg kg^{-1} b.wt.,) in diabetic treated groups and group 2 (100 mg kg^{-1} b.wt.,) in normal rats, thus it may be safe to conclude the extract of the leaves possesses hypoglycemic properties and a potentially toxic effect, hence the plant should be used with caution since it can cause abnormality in the functioning of the liver.

SIGNIFICANCE STATEMENT

The result of the study indicated that the extract was effective in glycemic control in both the diabetic group (at 400 mg kg^{-1} b.wt.,) and non-diabetic group (at 200 mg kg^{-1} b.wt.,). Sequel to a claim by traditional herbal practitioners that *A. precatorius* leaves extract contains compounds that are potential sources for glycemic control.

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