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RESEARCH ARTICLE

EFFECT OF *ADANSONIA DIGITATA* FRUIT PULP EXTRACT ON WEEKLY GLUCOSE LEVEL IN ALLOXAN INDUCED DIABETIC RATS

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ABSTRACT

This study was designed to evaluate the anti diabetic activity of aqueous extract of *Adansonia digitata* fruit pulp in alloxan induced diabetic rats. Phytochemical screening, promate and elemental analyses of *Adansonia digitata* fruit pulp were determined. Alloxan was used to induce diabetes in diabetic groups at concentration of 80 mg/kg body weight intraperitonially. Albino rats were divided into seven groups, the first three groups serve as normal, diabetic and metformin controls while the remaining were treated with 100, 200, 500 and 1000 mg/kg body weight of *Adansonia digitata* fruit pulp aqueous extract for a period of 28 days and weekly glucose levels were determined. Phytochemical screening shows the presence of saponins, tannins, flavonoids, glycosides and absence of rennins and alkaloids. Proximate analysis showed high content of carbohydrate, (78.8 %), moisture (6.5 %), crude fiber (5.7 %), ash (5.5 %), protein (3.2 %) and fat (0.3 %). *Adansonia digitata* fruit pulp contain high concentration of potassium, calcium, magnesium, iron and low concentration of copper, lead and cadmium were not detected. There was significant increased in diabetic control of glucose level. Groups treated with *Adansonia digitata* fruit pulp extract and metformin significantly reduced. The highest activity of the extract was observed at concentration of 500 mg/kg body weight which posses 61.5 % activity of metformin drug. The finding of this study suggests that *Adansonia digitata* fruit pulp extract posses a hypoglycaemic effect at 500 mg/kg boy weight, therefore it can be used in management of diabetes mellitus.

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INTRODUCTION

Diabetes mellitus, often simply referred to as diabetes, is a good metabolic disease in which a person has high blood sugar, either because the body does not produce enough insulin, or cells do not respond to the insulin that is produced (Shoback, 2011). This high blood sugar produces the classical symptoms of polyuria (frequent urination), polydipsia (increased thirst) and polyphagia (increase hunger). All form of diabetes increase the risk of long term complications these typically develop after many years (10-20), but may be the first symptoms in those who have otherwise not received a diagnosis before that time. The major long-term complications relate to the damage to blood vessels. Diabetes doubled the risk of cardiovascular disease (Riserus *et al.,* 2009).

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The main "macro vascular" disease (relate to atherosclerosis of larger arteries) are ischemic heart disease (angina and myocardial infarction), stroke and peripheral vascular disease. Diabetes also causes "micro vascular" complication- damage to small blood vessels (Boussageon *et al.,* 2011 and Narayan *et al.,* 2003). Diabetic retinopathy in the retina of the eye, can lead to visual symptoms, reduced vision and potentially blindness (Narayan *et al.,* 2003). Diabetic nephropathy, the impact of diabetes on the kidneys, can lead to scarring changes in the kidney tissue, loss of small or progressively larger amount of protein in the urine and eventually chronic kidney disease requiring dialysis (Vasudevan, and Sreekumari, 2006). Diabetes neuropathy is the impact of diabetes on the nervous system, most commonly causing numbness, tingling and pain in the feet and also increasing the risk of skin damage due to altered sensation. Together with vascular disease in the legs, neuropathies contribute to the risk of diabetes related foot problem, such as (diabetic foot ulcers) that can be difficult to treat and occasionally require amputation (Piwernetz *et al.,* 1993).

The fruit of *Adamsonia digitata* is a large egg-shape capsule (often > 120mm), covered with a yellowish brown hairs. The fruit consist of a hard woody outer shell with a dry, powdery substance, inside that covers the hard, black, kidney shaped seeds. The off white powdery substance is apparently rich in ascorbic acid (Chadare *et al*., 2009). It is the white powdery substance which is socked in water to provide a refreshing drink somewhat reminiscent of lemonade. This is also used to treat fevers and other complaints (Wild's *et al.,* 2004). The aim of this study is to determine the effect of aqueous extract of *Adamsonia digitata* fruit pulp on blood glucose.

MATEIALS AND METHODS

Laboratory Animals (Experiments Animals)

Adults' rats weighing between 90 and 120g were purchased from the farm of Mrs H. A. Umaru of Biochemistry Department Modibbo Adama University of Technology, Yola. Animals that showed apparent ill health were excluded from the experiment. The animals were allowed food and water *at libitum*. Growers mash was used to feed the animals throughout the study period. The rats were housed in a plastic cage.

Plant

Adamsonia digitata fruit pulps were obtained locally at Sangere, near Modibbo Adama University of Technology, Yola, and were authenticated in Department of Plant science.

Preparation of crude extract

The shade dried leaves of Adamsonia digitata at 28±2^{o}C was powdered using pestle and mortar. The powder was sieved using 0.33mm Endicott-test sieve. The powder was extracted with water in a soxhlet apparatus for 24 hours according to the Association of Official Analytical Chemists 2000.

Induction of experimental diabetes mellitus

Experimental diabetes mellitus was induced in the diabetic group with alloxan administered intraperitoneally at a dose of 80 mg/kg. Rats were left for a period of one week prior to commencement of experiments.

Experimental Design

The animals were grouped into seven A, B, C, D, E, F and G and distributed seven per group. Groups A, B and G were the experimental, normal and matformin controls respectively. The group C, D, E, and F were treated with aqueous extract for twenty eight days once daily with 100, 200, 500 and 1000mg/kg bw respectively. The blood glucose was tested before and after the induction by cutting the tail tip of the rats using a standard method described by Beach and Turner, (1958). Blood glucose level above 126mg/dl is considered to be diabetic.

Analyses

Phytochemical screening of Adamsonia digitata fruit pulp was carried out as described by Sofowara, 1984 and Trease and Evans, 1989. Zn, Fe, Cu, Pb, Mg, Ca, Cd and Mn were determined using VPG210 AAS machine while Na and K were determined using PFP7 flame photometer and AOAC 1990 method was adopted. Blood sugar levels were checked weekly throughout the study period by cutting the tail-tip of the rats, for blood glucose determination. Determination of the blood glucose level was done by the glucose – oxidase principle (Beach and Turner, 1958) using ONE TOUCH Basic (Lifescan, Milpitas, CA) instrument and results were reported in mg/dl (Barham and Trinder, 1975). All the chemicals used are of analytical grade.

Statistical analysis

The data obtained are statistically analyzed using student's't' test. Results were expressed as mean and standard error means (S.E.M) and significant level at $p<0.05$. The phytochemical screening of *Adansonia digitata* fruit extracts was carried out, saponins, tannins, glycosides and flavonoids were detected in the aqueous extract. The hypoglycaemic effect of the fruit extract may be attributed to their saponins content (Li, *et al.,* 2002) and glycosides content (Kako *et al.,* 1997). Since extracts of the fruit are usually known to contain many chemical compounds, each of which is capable of producing definite biological activities via different mechanisms. It is difficult to draw any logical conclusion on the mechanism of the hypoglycaemic effect of such a diverse mixture of chemical compound contained in the aqueous extracts of *Adansonia digitata* fruit as shown in Table 1.

Table 1. Phytochemical screening

Constituents	Result
Resins	-
Alkaloids	-
Saponins	+
Tannins	+
Glycosides	+
Flavonoids	+

Key: -= Absent+= Present

Table 2. Proximate analysis

Parameter	Result (%)
Moisture	6.50±0.42
Protein	3.20±0.13
Fat	0.30±0.31
Carbohydrate	78.8±2.06
Ash	5.50±0.90
Crude fiber	5.70±0.60

Values are mean± standard error (n=3)

The result of proximate composition of *Adansonia digitata* fruit extract showed relative high amount of carbohydrate. This is beneficial since carbohydrate constitutes a major class of naturally occurring organic compounds that are essential for the maintenance of plant and the animal life and also provides raw material for many industrial uses (Ebun-Oluwa and Alade, 2007). The result also showed that the fruit pulp was high in crude fibre.

Nutritionally, this is of beneficial effect since it had been reported that food fibre aids absorption of trace elements in the gut and reduce absorption of cholesterol (Eastwood and Kritchevsky, 2005).

Table 3. Mineral content

Mineral	Result (mg/100g dw)
Sodium (Na)	0.8±0.01
Potassium (K)	1230±11.92
Zinc (Zn)	1.1±0.31
Iron (Fe)	8.5±0.70
Copper (Cu)	Trace
Lead (Pb)	Not detected
Magnesium (Mg)	77±4.33
Calcium (Ca)	290±9.27
Cadmium (Cd)	Not detected
Manganese (Mn)	0.5±0.02

Values are mean± standard error (n=3)

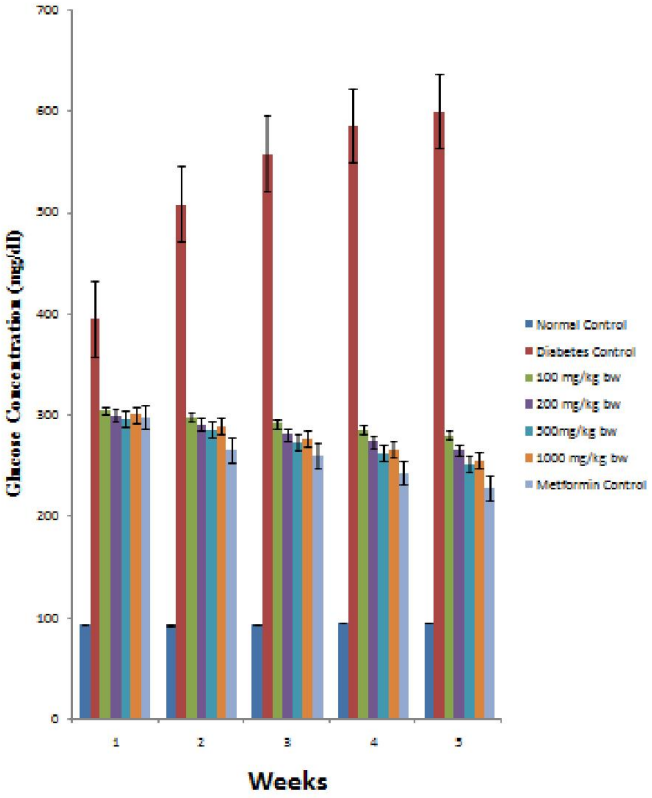

Figure 1. Effect of *Adamsonia digitata*fruit extract on weekly blood glucose levels of alloxan-induced diabetic rats

The fruit pulp also contains protein, ash and moisture. Nutritionally, this is beneficial as proteins contain amino acids utilized by the cells of the body to synthesize all the numerous proteins required for the function of the cell and also to furnish energy (Robinson, 1998). Ash value is useful in determining authenticity and purity of sample and also these values are important qualitative standards. Lower value of moisture content shows high calorific value in the fruit pulp. Fat and protein content were significantly low, this agrees with the findings of Osman, (2004). Elemental analysis of *Adansonia digitata* fruit, Sodium, Potassium, Zinc, Copper, Magnesium, Calcium, Manganese and Iron were detected while lead and cadmium were absent. Inorganic trace element such as Vanadium, Zinc, Chromium, Copper, Iron, Potassium, Sodium and Nickel play an important role in the maintenance of normoglycemic by activating the B cells of pancreas (Narendhirakannan *et al.,* 2005). Although literature review revealed a great variation in reported values of elemental analysis and proximate analysis of *Adansonia digitata* fruit; the causes of this variation may be due to the quality of the sample, the provenance of the sample, the age of the sample, the treatment before analysis, the storage conditions, the processing methods, a probable genetic variation, and the soil structure and its chemical composition. Apart from the variability in the material, the analytical methods and inherent variability are the likely source of variation. Moreover, some of the micronutrients, such as vitamins and minerals are biologically active. They can interact with other nutrients and change their bioavailability (Chadare *et al.,* 2009).

In this study, diabetics were induced with the help of alloxan. Alloxan is one of the usual substances used for the induction of diabetes mellitus apart from streptozotocin. Alloxan has a destructive effect on the beta cells of the pancreas (Prince and Menon, 2000). The pancreas is the primary organ involved in sensing the organism's dietary and energetic states via glucose concentration in the blood. In response to elevated blood glucose, insulin is secreted. Weekly blood and serum glucose study of diabetic rats showed a significant increase in blood glucose concentration in the diabetic experimental control group, which was due to alloxan used in this study. This probably gave rise to insulin deficiency. Insulin deficiency (or diabetes mellitus) causes excessive elevation of blood glucose and underutilization leading to hyperglycemia (Shah *et al.,* 2008). The study of weekly blood and serum glucose of the fruit pulp and metformin treated groups showed a significant ($P<0.05$) decrease in glucose concentration. Highest activity of the extract was observed at 500mg/kg bw with the lowest at 100mg/kg bw. Flavonoid isolated from other anti-diabetic medicinal plants has been found to stimulate secretion or possess an insulin like-effect (Marles and FansWorth, 1995). Effect of flavonoids on pancreatic β-cells leading to their proliferation and secretion of more insulin has been proposed by Mehesh and Menon (2004) and Sri Balasubashini *et al.* (2004) as the mechanisms by which they reduced hyperglycaemia.

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