

## Effects of *Aloe vera* (Elsabar) Ethanolic Extract On Blood Glucose Level in Wistar Albino Rats

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**Abstract:** The present study aimed to evaluate the antidiabetic activity of *Aloe vera* ethanolic extract in an induced hyperglycemic and normal rats. In the induced hyperglycemic experiment twenty rats were divided into 4 groups. They were fasted for 18 hours and then injected intraperitoneally with 2 mg/kg Body weight (Bwt) of 50% glucose solution. The first group served as a control, the second was administered orally with 10 ml/kgBwt glibenclamid (hypoglycemic drug) and the other two groups were given 100 and 500 mg/kgBwt of *Aloe vera* extract. The plasma glucose level was determined after 1, 2 and 4 hours following glucose loading. In the normoglycemic experiment, fifteen rats were divided into three groups; one as control and the other two were given 100, 500 mg/kgBwt *Aloe vera* extract orally. The extract was given for 6 days. Clinical signs, body weight and plasma glucose level were recorded. The results in the hyperglycemic experiment revealed highly significant decrease ( $P < 0.01$ ) in plasma glucose in the group received 500 mg/kgBwt of *Aloe vera* ethanolic extract. However, the reduction in plasma glucose level at a dose of 100 mg/kgBwt *Aloe vera* extract and glibenclamide was similar. In the normoglycemic rats administration of *Aloe vera* extract caused diarrhea and reduction in body weight but no changes in the relative liver weight. The plasma glucose level was not affected by administration of *Aloe vera* ethanolic extract. There were no pathological changes occurred in tissues except an increased number of goblet cells in the intestinal mucosa.

**Key word:** *Aloe Vera*, glibenclamide, antidiabetic

### INTRODUCTION

Diabetes mellitus is one of the most famous and wide spread diseases. It is a multifunctional disease with several causes and complex consequences. It remains an important risk factor for cardiovascular disease and increasing rate of childhood and adult obesity. Diabetes is likely to become even more prevalent over the coming decade<sup>[18]</sup>.

Many drugs are used for treatment of diabetes but some of them have side effects, the main of which is an increased risk of hypoglycemia. Hence many studies were carried out to investigate the hypoglycemic effect of some plants used traditionally to treat diabetes beside identification of active ingredients, mode of action and safety. Herbal extracts have been confirmed for its hypoglycemic effect in human and animals for type II diabetes<sup>[15]</sup>.

In Sudan the use of medicinal plants in the treatment of diabetes mellitus are common practices in wide areas especially in Eastern States where people depend solely on herbal treatment<sup>[10]</sup>.

*Aloe* species a perennial plant, belonging to the family Liliaceae is native to North Africa and cultivated in warm climates areas. The plant is the source of two herbal preparations, latex and Aloe gel which is often called *Aloe vera*<sup>[21]</sup>. The gel is composed of mannose-phosphate, beta-1,4 acetylated mannan, glucomannans<sup>[21]</sup>, alprogen glucoprotein<sup>[16]</sup> and C-glucosylchromone<sup>[12]</sup>.

*Aloe vera* has been used in folk medicine as a remedy for various diseases. However there have been controversial reports on the hypoglycemic activity of *Aloe* species<sup>[19]</sup>.

The present study was conducted to evaluate the effect of *Aloe vera* ethanolic extract on blood glucose level in normal and glucose loaded rats and its effect on the vital organs.

### MATERIALS AND METHODS

**Plant:** *Aloe vera* was collected from Khartoum Botanical Garden and authenticated by the Botanists in Medicinal and Aromatic Plant Research Institute,

Khartoum, Sudan. Fresh leaves, the part used in the experiment, were washed with fresh water, sliced and left to dry under shade.

141 gm of the dried leaves were extracted using 95% ethanol according to Harbone<sup>[9]</sup>. The filtrate was evaporated and the residue was stored until use. The aqueous extract was prepared freshly at the time of administration.

**Drug:** Glibenclamide, an oral hypoglycemic drug, belongs to the group sulphonylurea (second generation) was used.

**Animals:** Wister albino rats of either sex were used. They were housed in standard environmental condition of temperature, humidity and fed a fixed diet. They were left for a week as an adaptation period.

**Experimental Procedure:** Two experiments were carried out, one in rats with an induced hyperglycemia and the other in normal animals.

In induced (hyperglycemic) experiment 20 rats, divided randomly into 4 groups, 5 rats each, were used. Group A was left as control, group B received glibenclamide hypoglycemic drug and groups C and D received different concentration of *Aloe vera* ethanolic extract.

All animals were fasted for 18 hours. Then 50% glucose solution was administered intraperitoneally at a dose of 2 mg/kg Body weight (Bwt) to induce hyperglycemia to all groups except group A which was used as control. Immediately after using gastric tube group A received 20 ml/kg Bwt distilled water, group B given glibenclamide at a dose of 10 mg/kgBwt. While groups C and D received 100 and 500 mg/kgBwt *Aloe vera* ethanolic extract respectively.

Plasma glucose level was determined at zero time then at 1, 2 and 4 hours after glucose loading according to Siest and Schiel<sup>[22]</sup> method.

Blood was collected from the orbital plexus by capillary tubes into fluorinated test tubes under inhalation anesthesia using halothane according to Khana *et al.*<sup>[14]</sup>. The Blood was centrifuged at 3000 rpm for 5 minutes to separate plasma.

In the second experiment, normal fifteen rats were randomly divided into three groups, 5 rats each. Group A was given 10 ml distilled water, groups B and C received 100 and 500 mg/kgBwt of *Aloe vera* ethanolic extract orally for 6 days using gastric tube. Clinical signs and body weight were recorded. The plasma glucose level was determined at zero time and at the end of the experiment. Animals were slaughtered and liver weights were recorded. Slices of liver, kidney, spleen, gastrointestinal tract, pancreas and brain were

fixed in 10% buffered formalin embedded in paraffin wax, sectioned at 5  $\mu$ m and stained with hematoxylin and eosin<sup>[6]</sup>.

**Statistical Analysis:** Data were statistically evaluated using one way analysis of variance (ANOVA) according to Mendenhall<sup>[17]</sup>.

## RESULTS AND DISCUSSION

**Results:** The data of the plasma glucose level of hyperglycemic rats treated with *Aloe vera* ethanolic extract are shown in Table (1), Figure (1). After one hour all groups showed an increase in the plasma glucose level compared to zero time. The increase varies from 51% in the control group to 43.7% in the group received glibenclamide. However in the groups received 100 and 500 mg/kg Bwt of *Aloe vera* ethanolic extract, the glucose level increased by 33.5 and 30.8% respectively. Two hours later the glucose level was reduced by 4.7% in the controls and 16.4% in the glibenclamide treated groups while in groups C and D the reduction was 12.7 and 23.1 respectively. After four hours the control reached the starting level i.e. a 37.5% reduction compared to the two hours level. The plasma glucose level in animals received glibenclamide and 100 mg/kgBwt of *Aloe vera* ethanolic extract were still remained above the starting level and was before reduced by 11.5 and 5.8% compared to the two hours level respectively. Meanwhile a noticeable decrease in the plasma glucose level was recorded in rats receiving 500 mg/kgBwt *Aloe vera* and almost reached the starting level.

In the second experiment where the normal rats received *Aloe vera* ethanolic extract, there was watery diarrhea after two days till the end of the experiment and was more profound in the group received 500 mg/kgBwt of *Aloe vera* ethanolic extract.

The body weight of the control rats increased by 5.6% while the groups received ethanolic extract of *Aloe vera* decreased by 12.2 and 20.8% at the dose of 100 and 500 mg/kgBwt respectively Table (2), Figure (2). Meanwhile the relative livers weights were not significantly different between the controls and the groups treated with *Aloe vera* ethanolic extract (Table 2).

The blood glucose level in the groups of rats treated with ethanolic extract of *Aloe vera* were not significantly different from the the control. However, slight decrease in the blood glucose level in all the groups occurred. The reduction in the control was 1.4% and in the groups received 100 and 500 mg/kgBwt of *Aloe vera* ethanolic extract was 7.1 and 12% respectively Table (3), Figure (3).

**Table 1:** The effect of the ethanolic extract of Aloe vera and glibenclamid on blood glucose level on induced hyperglycemic Wistar albino rats.

Groups	Dose (Per Kg body weight)	Starting level	After glucose loading		
			1 hour	2 hours	4 hours
(A)	10ml distilled	94.0 ±13.3	191.0 ±10.9	163.2± 8.8	102.0±10.3
(B)	10 ml glibenclamid	104.0±2.1	184.6±8.9	154.6±29.8*	136.8±18.3
(C)	100 mg Aloe vera extract	105.0±3.7	158.0±20.3	138.0±20.4*	130.0±20.0
(D)	500 mg Aloe vera extract	103.2±7.1	149.2±28.8	114.8±2.2**	102.8±12.6

\* Significant at (P< 0.05)

\*\* Significant at (P< 0.01)

**Table 2:** The effect of Aloe vera extract on body weight (g) and relative liver weight (%) of Wistar albino rats.

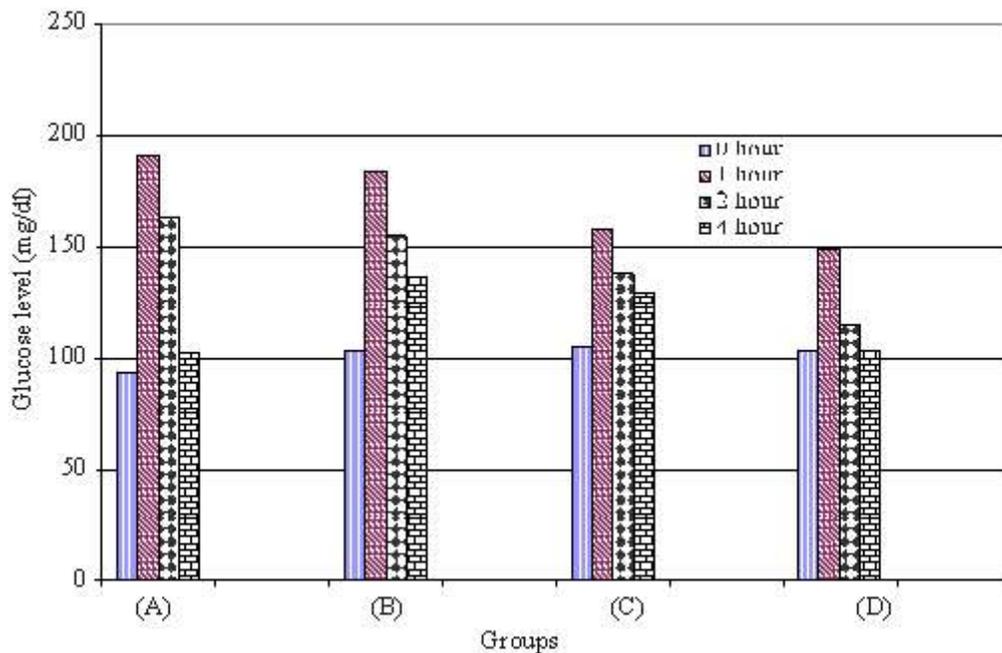
Group	Dose (kg/body weight)	Body weight (g)		Liver weight (%)
		Starting day	Day 6 <sup>th</sup>	
(A)	10 ml distilled water	14.2 ± 4.1	78.6 ± 7.1	2.0 ± 0.4
(B)	100 mg Aloe vera extract	24.0 ± 6.2	65.0 ± 0.5	1.9 ± 0.4
(C)	500 mg Aloe vera extract	75.8 ± 5.9	60.0 ± 0.7**	2.1 ± 0.6

\* Significant at (P< 0.05)

\*\*Significant at (P < 0.01)

**Table 3:** The effect of Aloe vera extract on plasma glucose level (mg/l) in Wistar albino rats.

	Dose	Starting day	Day 6 <sup>th</sup>
		(A)	10 ml distilled water
(B)	100 mg Aloe vera extract	93.4 ± 10.1	86.8 ± 5.2
(C)	500 mg Aloe vera extract	99.8 ± 11.8	87.8 ± 3.8



**Fig. 1:** The effect of the ethanolic extract of Aloe vera and glibenclamid on blood glucose level in an induced hyperglycemic Wistar albino rats.

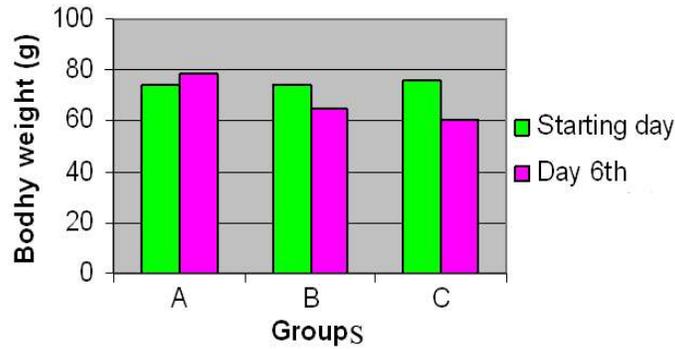


Fig. 2: The effect of *Aloe vera* extract on body weight (g) of Wistar albino rats.

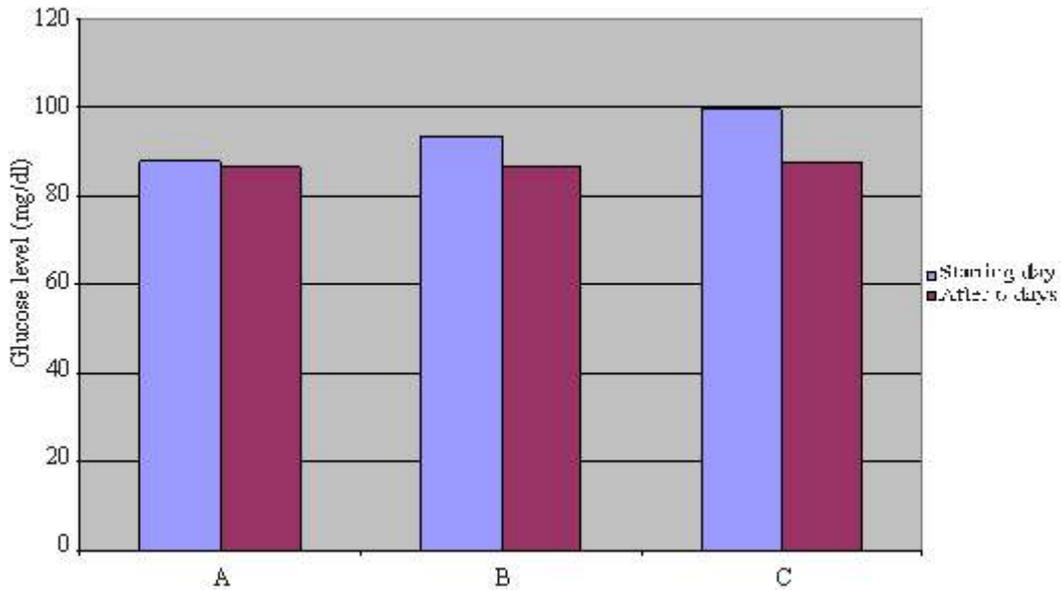


Fig. 3: The effect of *Aloe vera* extract on the plasma glucose level (mg/l) in Wistar albino rats.

Histologically there was an increase of goblet cells in the mucosa of the intestine beside sloughing of epithelium. There were no pathological changes in the tissues examined in the control and treated animals.

**Discussion:** In the present study the effects of ethanolic extract of *Aloe vera* on blood glucose level was performed in an induced hyperglycemic and normal rats to determine whether the extract has hypoglycemic properties.

Administration of *Aloe vera* ethanolic extract to rats loaded with glucose caused significant drop in plasma glucose level. The drop was dose dependant. On the other hand when similar doses administered to normal rats no significant drop in plasma glucose level occurred. These findings suggested that the hypoglycemic effect of *Aloe vera* extract was induced only in hyperglycemic rats but not in normoglycemic animals. This is similar to the

action of biguanid group of hypoglycemic drugs that do not cause hypoglycemia in normal subjects even when taken in excessive dose<sup>[8]</sup>. This groups of drug originally derived from the plant *Galega officinalis*. Its mechanism of action is by inhibition of hepatic glucose production and increase of muscle glucose uptake. However, Blumental *et al.*<sup>[4]</sup> reported that *Aloe vera* contained high calcium level. Abu Amra<sup>[1]</sup> stated that calcium stimulate the beta cells of langerhans that lead to an increase in insulin and liver glycogen levels. Shane and Whorter<sup>[20]</sup> stated that *Aloe vera* gel obtained from the inner portion of the leaves contain glycomannan which may account for its hypoglycemic effect. Ajabnoor<sup>[2]</sup> reported that the hypoglycemic effect of *Aloe vera* was mediated through the stimulation and release of insulin from beta-cells of the pancreas. However, Ghannan *et al.*<sup>[7]</sup> stated that caution should be made when using *Aloe vera* in diabetic patients.

The histological investigation in our study showed no morphological changes in the pancreas of rats treated with *Aloe vera*. This may indicate that the effect of *Aloe vera* ethanolic extract on glucose level may either be due to increased carbohydrate utilization or enhancement of glucose uptake by muscles rather than increased activity of pancreatic B. cells.

The *Aloe vera* extract has an effect on the gastrointestinal tract as evident by diarrhea. This is in agreement with Ishii and Tanizawa<sup>[13]</sup> and Wendle<sup>[24]</sup> who suggested that the *Aloe* gel may be a contaminant with latex during isolation and this could lead to diarrhea. Brusick and Mengs<sup>[5]</sup> reported presence of anthraquinone glycosides in *Aloe* latex, reached the colon mostly undigested, resulted in more frequent stools with softer consistency. The increase in goblet cells in the gastrointestinal tract is in harmony with Kim and Kacew findings who stated that the plant stimulates mucus secretion.

In our findings the body weight gain was reduced in rats treated with *Aloe vera*, this may be attributed to the diarrhea. In contrast to Helal *et al.*<sup>[11]</sup> and Takaka *et al.*<sup>[23]</sup> who reported that treatment of *Aloe vera* on alloxan hyperglycemia improved the reduced on the body weights.

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