*Original Research Article*

# Safety and efficacy of aloe vera in the treatment of type 2 diabetes mellitus: A randomized control study

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## Abstract

Diabetes mellitus has been described as the most common endocrine disorder that impairs glucose homeostasis resulting in severe complications. Chronic hyperglycemia in diabetic patients is associated with long term damage, dysfunction and eventually the failure of organs, especially the eyes, kidneys, nerves, heart and blood vessels.

Currently, there is a renewed interest in the plant based medicines. One such herbal drug, *Aloe Vera* used for different clinical purposes claimed for its effect on blood glucose levels.

Total of 240 type 2 diabetes mellitus patients were enrolled and allocated to four groups viz. A, B, C and D. Group A and C will be given conventional anti-diabetic agents, however Group B and D in addition to anti-diabetic agent, *Aloe Vera* will be given as add on therapy.

While assessing the results and comparing the overall degree of glycaemia control between group A & B, a significant ($p<0.004$) difference with mean fasting and mean PP blood glucose ($p<0.001$) were observed. Similarly comparing the overall degree of glycaemia control between group C & D, a significant ($p<0.004$) difference with mean fasting and mean PP blood glucose ($p<0.000$) were observed. A significant difference between mean HbA1c recorded before and after the treatment in the groups were treated with Aloe Vera as add on therapy with conventional antidiabetic drugs.

The study concluded that the subjects who were treated with Aloe Vera as an add on therapy with conventional antidiabetic drugs has comparatively produced better clinical outcome in terms of glycaemia control and lower incidence of complications.

**Keywords:** Diabetes mellitus, FBG, PPG, HbA1C, Aloe vera

## Introduction

Diabetes mellitus (DM) consists of a group of syndromes characterized by hyperglycemia, altered metabolism of lipids, carbohydrates, proteins and an increased risk of complications from vascular and renal diseases [1]. It has already been established that chronic

hyperglycemia in diabetic patients is associated with long term damage, dysfunction and eventually the failure of organs, especially the eyes, kidneys, nerves, heart and blood vessels [2].

Diabetes is rapidly gaining the status of a potential epidemic in India with more than 62 million diabetic individuals currently diagnosed with the disease [3]. According to Indian Heart Association, India is leading the world in 1st place and has earned a dubious distinction of being termed as "Diabetic Capital of the World" [4].

Inspite of the advent of various treatment strategies available for the treatment of diabetes mellitus, are not free from complications like hypoglycaemia, GIT related etc. There has always been a constant search for newer, cheaper and safer natural supplements which can effectively normalize the metabolic derangement underlying the onset of diabetes.

One such herbal drug *Aloe Vera* which is a part of many herbal medicine preparations used for different clinical purposes and has a long history of popular and traditional use [5].

Previous studies showed significantly greater improvements in blood sugar levels among those who given aloe vera over the 2 weeks treatment period [6]. The antidiabetic effects of Aloe vera are thought to be due to the presence of mannans anthraquinones and lectins [7].

There is a paucity of the literature to explore these possibilities of use of Aloe vera in large population of diabetes in India and globally.

The present study aimed to assess the efficacy and safety of *Aloe Vera* as an add on therapy with conventional antidiabetic regimens in terms of glycaemia control and lower incidence of complications in type 2 diabetics.

## Material and Methods

This was a prospective, interventional, single centric, open labelled, controlled study conducted in the OPD of General Medicine in association with Department of Pharmacology, at tertiary care hospital, in Jaipur, on type 2 diabetes mellitus subjects. Total 254 subjects were screened after confirmation of inclusion and exclusion criteria and 240 were eligible and enrolled for the study. Ethical clearance for the study and informed consent from the participants were obtained.

## Inclusion criteria

1. Type 2 Diabetes Mellitus subjects receiving either Glimiperide 2 mg or Metformin 500 mg.
2. Subjects of either sex of age group 18-70 years.
3. Willing to participate in the study and to undergo all study related procedures.
4. Subjects able to give a written informed consent.

## Exclusion criteria

1. Subjects suffering from Type-1 Diabetes.
2. Pregnant and lactating women.
3. Subjects on chronic corticosteroid or any other drug precipitating Diabetes.
4. Subjects suffering from some infection at the time of enrolment in to the study.
5. Clinically relevant hepatic disease or impaired renal function.
6. Subjects having history of diabetic ketoacidosis.
7. Any mental condition rendering the subject unable to give informed consent.
8. Any other condition that in the opinion of the investigator does not justify the patient's participation in the study.

Enrolled subjects were allocated into four groups A, B, C and D illustrated as follows-
**Group A:** Glimepiride 2 mg per day.
**Group B:** Aloe vera (600 mg) and Glimepiride 2 mg per day.
**Group C:** Metformin 500 mg per day.
**Group D:** Aloe vera (600 mg) and Metformin 500 mg per day.

Lifestyle and Diet modifications will also be advised to all groups.

During the Study, subjects were visited 4 times, except the screening visit to the hospital. In the first visit (Screening visit), history, physical examination with an adequate amount of blood sample was collected for routine investigation of FBG, PPG and HbA1C. Next visit (visit 1), which was in 3-4 days later, he/she was assigned a group, either the group A, B, C or Group D. Next visit (visit 2) on day 28 (± 3 days), he/she was asked questions about his/her health, routine physical examination and FBG and PPG was carried out. on day 56 (± 3 days) was the Next visit (visit 3), he/she was asked questions about his/her health, routine physical examination and FBG and PPG was carried out. last visit (visit 4) on day 84 (± 3 days), he/she was asked questions about his/her health, routine physical examination and FBG, PPG and HbA1C was carried out. Subjects of group B & D were receive 300 mg of dry inner gel capsule of Aloe vera twice daily in addition to conventional antidiabetic [8-9].
Data was analysed with descriptive statistics like mean, SD and SEM. The comparison and group difference were analysed by Independent and paired Student 't' test by Statistical Package for the Social Sciences (SPSS) version 21 statistical software. P-value less than 0.05 was considered as statistically significant.

## Results

A total of 254 subjects were screened diagnosed with type 2 diabetes mellitus subjects met inclusion and exclusion criteria out of 240 subjects were enrolled and randomly allocated 60 subjects in each group in to four group vij. A, B, C and D. The subjects of all groups were assessed for glycaemia control and lower incidence of complications.

**Table 1:** Characteristics of the subjects

| Parameter | | Group A | Group B | Group C | Group D |
|---|---|---|---|---|---|
| No. of subjects (n =) | | 60 | 60 | 60 | 60 |
| Age in years (Mean ± SD) | | 46.75 ± 7.86 | 46.36 ± 8.04 | 48.71 ± 8.04 | 47.36 ± 8.60 |
| Sex | Male (n=) | 39 | 40 | 37 | 41 |
| | Female (n=) | 21 | 20 | 23 | 19 |

**Table 2:** Comparison of Blood glucose level achieved by group A vs. group B

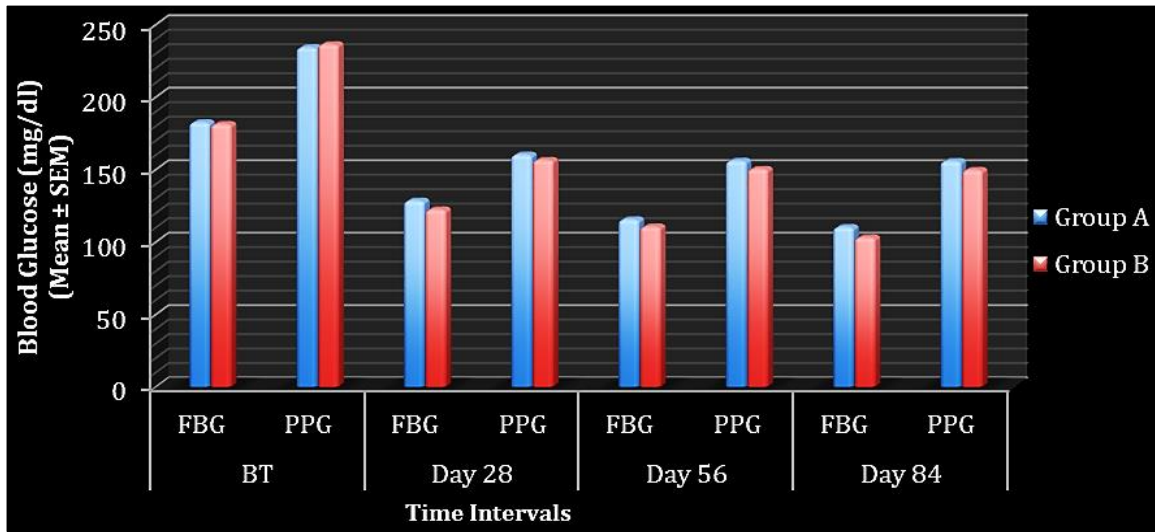| Group | Blood Glucose (Mean ± SEM) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Before Treatment | | After Treatment | | | | | |
| | | | Day 28 | | Day 56 | | Day 84 | |
| | FBG | PPG | FBG | PPG | FBG | PPG | FBG | PPG |
| A | 182.55 ± 2.39 | 234.33 ± 4.15 | 128.48 ± 1.9 | 160.26 ± 1.25 | 115.6 ± 1.59 | 156.05 ± 0.56 | 110.28 ± 1.53 | 155.83 ± 1.14 |
| B | 181.31 ± 2.42 | 236.43 ± 3.93 | 122.43 ± 2.01 | 156.6 ± 1.52 | 110.61 ± 2.28 | 150.36 ± 1.59 | 103.08 ± 1.87 | 149.71 ± 1.4 |

**Fig 1:** Comparison of Blood glucose level achieved by group A vs. group B

While comparing the mean fasting blood glucose of group A (110.28 ± 1.53) and group B (103.08 ± 1.87) after the treatment (Day 84) a significant ($p<0.004$) was observed similarly while comparing the mean Post Prandial Blood glucose of group A (155.83 ± 1.14) and group B (149.71 ± 1.4) a significant ($p<0.001$) was observed.

**Table 3:** Comparison of HbA1C achieved by group A vs. group B

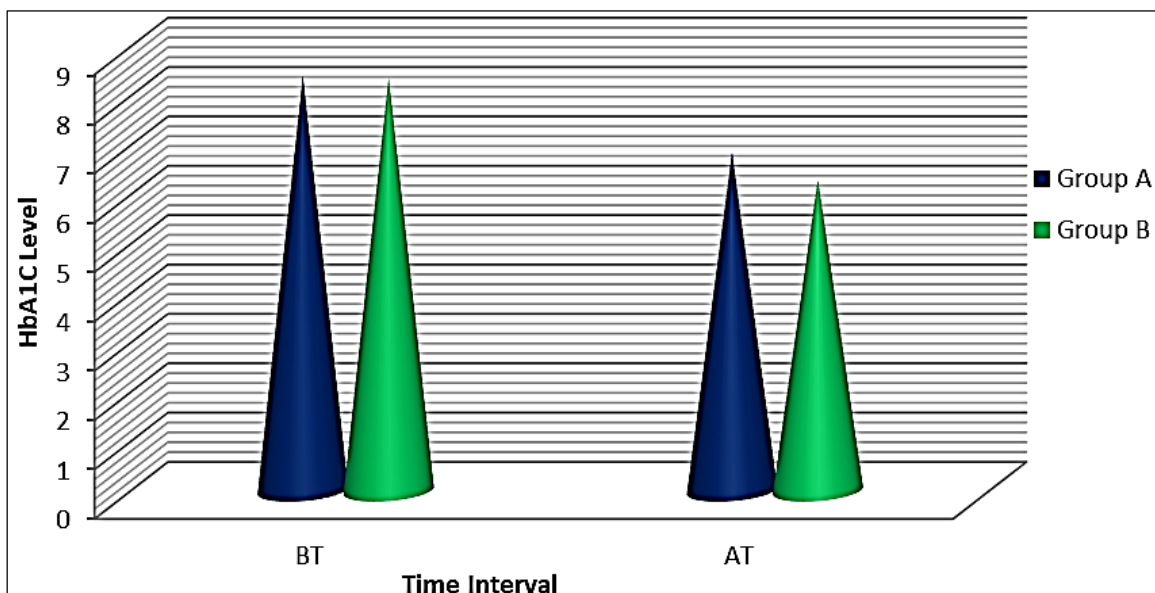| Group | HbA1c (Mean ± SEM) | |
| --- | --- | --- |
| | Before | After |
| A | 8.40 ± 0.04 | 6.84 ± 0.06 |
| B | 8.36 ± 0.04 | 6.29 ± 0.06 |



**Fig 2:** Comparison of HbA1C level achieved by group A vs. group B

While comparing the mean HbA1c recorded after treatment of group A (6.84 ± 0.06) with mean HbA1c of group B (6.29 ± 0.06), a significant ($p<0.000$) difference was observed. Comparatively a lower mean HbA1c value after the treatment with group B who were treated with Aloe Vera as an add on to conventional antidiabetic was observed.

**Table 4:** Comparison of Blood glucose level achieved by group C vs. group D

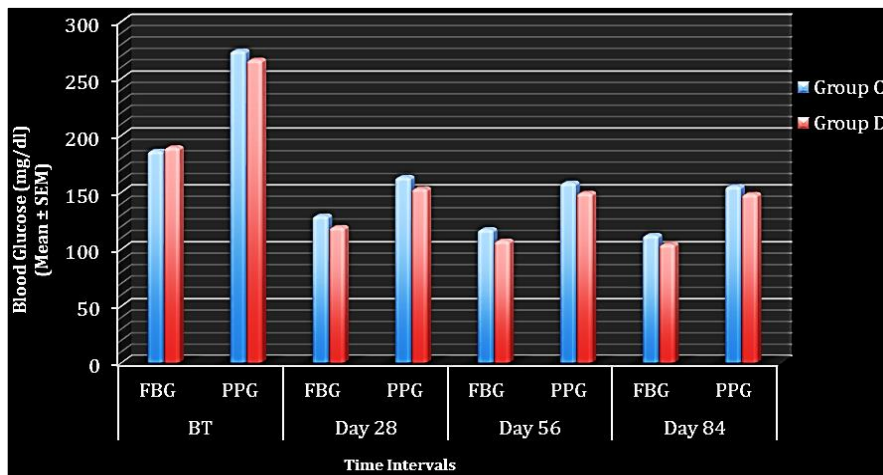| Group | Blood Glucose (Mean ± SEM) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Before Treatment | | After Treatment | | | | | |
| | | | Day 28 | | Day 56 | | Day 84 | |
| | FBG | PPG | FBG | PPG | FBG | PPG | FBG | PPG |
| C | 186.41± 3.09 | 274.76± 5.24 | 129.41± 2.53 | 163.45± 2.08 | 117.88± 2.62 | 158.16± 2.01 | 112.83± 2.25 | 155.76± 1.68 |
| D | 189.78± 3.36 | 266.83± 4.3 | 119.25± 2.51 | 153.93± 16.77 | 107.32± 2.03 | 149.82± 1.31 | 104.98± 1.65 | 148.07± 1.12 |



**Fig 3:** Comparison of Blood glucose level achieved by group C vs. group D

While comparing the mean fasting blood glucose of group C (112.83 ± 2.25) and group D (104.98 ± 1.65) after the treatment (Day 84) a significant ($p<0.004$) was observed similarly while comparing the mean Post Prandial Blood glucose of group C (155.76 ± 1.68) and group B (148.07 ± 1.12) a significant ($p<0.000$) was observed.

**Table 5:** Comparison of HbA1C achieved by group C vs. group D

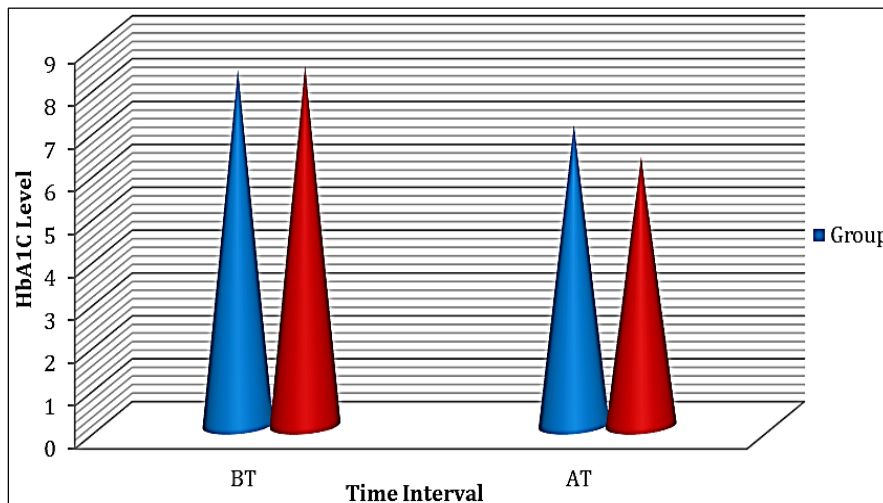| Group | HbA1c (Mean ± SEM) | |
|---|---|---|
| | Before | After |
| A | 8.30 ± 0.03 | 7.01 ± 0.07 |
| B | 8.39 ± 0.04 | 6.26 ± 0.07 |



**Fig 4:** Comparison of HbA1C level achieved by group C vs. group D

While comparing the mean HbA1c recorded after treatment of group C (7.01 ± 0.07) with mean HbA1c of group D (6.26 ± 0.07), a significant ($p<0.000$) difference was observed. Comparatively a lower mean HbA1c value after the treatment with group D who were treated with Aloe Vera as add on to conventional antidiabetic was observed.

Safety of treatment regimens is equally important as efficacy of the treatment regimens. Hence both the treatment regimens were also assessed for incidence of complications in terms of hypoglycaemic episodes, GIT and other complications. Comparatively lower incidence of complications was recorded who were treated with Aloe Vera as add on to conventional anti-diabetics.

**Discussion**

Diabetes mellitus is still a disease which needs to be injured by use of current antidiabetic regimens, as no complete cure till date is available for the treatment of both disorders. More than 400 plants species having hypoglycemic activity have been available in the literature; herbal medicines are often used as therapeutic remedies in combination with allopathic drugs. Usually Ayurvedic or herbal drugs are being used due to their minimum toxicity and low cost. However, searching for new anti-diabetic drugs from natural plant sources is still attractive because they contain substances which have alternative and safe effect on diabetes mellitus.

Many traditional medicines have been evaluated for their role in controlling diabetes mellitus from time to time and one such traditional medicinal herbal preparation of *Aloe vera* is claimed for its effect on blood glucose levels [7, 10, 11].

While comparing the overall degree of glycaemia achieved in subjects who were treated with a combination of Glimiperide and Aloe vera and the subjects who were treated with Glimiperide, a comparatively lower mean fasting (103.08 ± 1.87) and mean PP blood glucose (149.71 ± 1.4) were observed. (Table-2, Fig.-1). Simultaneously subjects who were treated with a combination of Metformin and Aloe vera and the subjects who were treated with Metformin alone, a comparatively lower mean fasting (104.98 ± 1.65) and mean PP blood glucose (148.07 ± 1.12) were observed. (Table-4, Fig.-3). These results are in support of a study stating that the *Aloe vera* produced a significant decrease in blood glucose levels significantly (p=0.041) in type 2 diabetes mellitus patients [12].

Present study result showed agreement which reported that diabetic mice group treated by AV extract at the dose of 300 and 500 mg/kg body weight, orally. It significantly ($p<0.05$) reduced the blood glucose and normalized biochemical parameters compared with alloxan induced diabetic group. The results suggested that the extract of aloe vera leaves possess protective effect against alloxan induced diabetic mice [13].

These differences in degree of glycaemia could possibly be due to Aloe vera's detoxifying properties. As an adjuvant and nutritional supplement, Aloe vera has high fiber content and the polysaccharides and glycoproteins in it are believed to help the body to use glucose effectively and remove excess from the blood [14].

The results of the present study also similar with previous study on pre diabetic subjects, results showed the 300 and 500 mg Aloe vera capsules decrease significantly fasting blood glucose levels in four weeks (p=0.006 and p= 0.001) and eight weeks (p=0.002 and $p<0.001$) and suggested the use of Aloe vera extract in pre diabetic patients can significantly regulate levels of fasting blood glucose levels and could be an interesting supplement strategy to alleviate impaired serum glucose levels [15].

Another data also showed similarity that aloe vera might reduce the levels of FBG, HbA1c, triglyceride, TC and LDL-C, and increase the levels of HDL-C in prediabetes and early non-treated diabetic patients [16, 17].

Furthermore the lower HbA1c (6.29 ± 0.06 and 6.26 ± 0.07) values were also noted in

patients who received Aloe vera as add on therapy. (Table- 3 & 5 Fig.-2 & 4)

These results are supported by the results of a study mentioning that a significant mean 6.6 (1.1) p=0.036 reduction in HbA1C reported with the use of Aloe vera in type 2 diabetics [16, 18]. Huseini HF *et al*. also indicate that the Aloe vera lowered the HbA1C level significantly (p=0.023) [12].

The common complications of aloe vera are abdominal pain, cramping and muscle weakness [19, 20]. However, only one study briefly described the adverse effects of the aloe vera [21].

**Conclusion**

The conclusion of the currently available data showed that the rationale for using Aloe vera as add on therapy for diabetes mellitus and has comparatively produced better clinical outcome in terms of glycaemia control and lower incidence of complications in the treatment of T2DM. Large-scale, multi-center and placebo-controlled trials should be designed to substantiate the current findings and to investigate the long-term effects of aloe vera supplementation on managing T2DM.

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