

COMPARISON OF GLYCEMIC CONTROL BY ALOE VERA AND METFORMIN IN STREPTOZOTOCIN INDUCED DIABETIC MALE ALBINO RATS

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ABSTRACT

Aims and Objectives: (1) Comparing the effectiveness of Aloe Vera and Metformin in controlling Diabetes Mellitus (2) Using locally available medicine

Study Design: Experimental

Study Setting: Azra Naheed Medical College, Superior University, Lahore and Post Graduate Medical Institute, Lahore

Duration of Study: February 2025 to July 2025.

Methodology: Intraperitoneally injected Streptozotocin (STZ) was used in Healthy, Male Albino Rats to induce Diabetes Mellitus. Rats weighing 170 to 200 grams, were divided in Normal Control (NC), Disease Control (DC), Metformin Treated (MT) and Aloe Vera Treated (AT) groups having 7 rats each. Fasting Blood glucose level, equal or more than 126 mg/dL, was the criteria used for successful induction of Diabetes Mellitus. Random blood glucose level was recorded and compared for glycemic control during 6 weeks study.

Results: Near normal random blood glucose level was achieved after 300 mg/Kg daily oral dose of Aloe Vera extract as compared to glycemic control achieved by 150 mg/Kg Metformin per day.

Discussion: Aloe Vera is locally available, cheap, safe and effective medicine. Aloe Vera treatment helps to control Diabetes Mellitus in much better way and reduces hyperglycemia to almost normal levels.

Conclusion: Aloe Vera has better glycemic control as compared to Metformin in managing Diabetes Mellitus. This locally available and cheap medicine should be investigated to evaluate its different effects on other diseases as well.

Key Words

Diabetes Mellitus, Streptozotocin, Aloe vera, Metformin

INTRODUCTION

Diabetes Mellitus is a global pandemic⁽¹⁾ which can easily be labelled as having maximum duration in Human history. Inadequate Insulin secretion, poor

action or their combination leads to continuous hyperglycemia in Diabetic patients⁽²⁾. Most common is Type 2 Diabetes Mellitus and caused by

peripheral resistance to Insulin. Sedentary life style is as important as genetic predisposition for Diabetes Mellitus⁽³⁾. Diabetes Mellitus is managed by regular exercise, healthy diet and life style modification⁽⁴⁾. Insulin is the best treatment option⁽⁵⁾ but needs proper storage, well calculated dose and being injectable. Oral hypoglycemic agents are first choice medicines and Metformin tops this list^(6,7). Metformin leads to less absorption of glucose from intestine, reduced gluconeogenesis⁽⁸⁾ and approximately 150 million people, all over the world, are using it⁽⁹⁾. More than 21000 plants are used, directly or indirectly, as medicines and nearly 400 for the treatment of Diabetes Mellitus only⁽¹⁰⁾. Insulin like action and proven hypoglycemic effect is described for Cinnamon⁽¹¹⁾ as well. Control of hyperglycemia for short term as well as Glycosylated Hemoglobin (HbA1c) is well documented by the use of Aloe Vera in the form of gel and extract⁽¹²⁾. Aloe Vera lowers lipids, has antibiotic effect and helps in wound healing as well⁽¹³⁾. Streptozotocin is commonly used to induce Type 2 Diabetes Mellitus in experimental animals⁽¹⁴⁾. This study was designed to compare glycemic control by Aloe Vera and Metformin.

MATERIALS AND METHODS

This six week long experimental study comprised of 28 male Albino rats divided into 4 equal numbered groups. Simple random technique was used for rat allocation to each group. Healthy (less than 200mg/dL random blood glucose level) male Albino rats⁽¹⁵⁾ weighing 170-200 grams⁽¹⁵⁾ were included in this study and rats with disease excluded during study. Standard diet and water access was given to all the rats during this study. Rats in Normal Control group were not given any medication and maintained for reference values. Rest of the rats were given STZ intraperitoneally 60 mg/kg to induce Diabetes Mellitus⁽¹⁶⁾. Glucose was added only for initial 3 days to avoid hypoglycemia. On 3rd day after Streptozotocin injection, Fasting blood glucose level was checked. Rats were declared diabetic if ≥ 126 mg/dL was the fasting blood glucose level⁽¹⁷⁾. All the, intraperitoneally injected, rats developed Diabetes Mellitus and then maintained on freely available diet. Disease Control group was not given any treatment for Diabetes Mellitus. Metformin Treated group was given 150 mg/kg Metformin orally. Aloe Vera Treated group had orally 300 mg/kg Aloe Vera extract. Metformin and Aloe Vera was used once

daily. Rats were visited daily for look after and dose delivery.

Fresh leaves of Aloe Vera were used to obtain gel and then concentrated extract prepared by centrifugation. Freeze dried extract was used to prepare powder and stored in fridge. Powder, according to weight of rat, was dissolved in 2 ml of water and given once per day orally⁽¹⁸⁾. Streptozotocin powder 120 mg and 10 ml of normal saline were mixed⁽¹⁹⁾ and 1ml of this solution injected intraperitoneally for induction of Diabetes Mellitus. Metformin was dissolved in water and given orally to rats according to the weight of the rats⁽²⁰⁾. Blood sugar levels, fasting and random, were recorded by tail snip procedure. Random blood glucose level was noted fortnightly for three times⁽¹⁷⁾. Weight of rats was recorded at similar intervals and used to adjust the dose of Metformin and Aloe Vera for control of Diabetes. One Way ANOVA and Tukey Post Hoc was used for data analysis.

Results

At the beginning of study, before injecting Streptozotocin, random blood sugar level was checked in all the rats. The results were similar showing minimum variability indicating healthy status of all the rats in each and every group. One way ANOVA displayed (p-value=0.984) which indicates that difference among groups was non-significant.

Disease Control group, on Day 14, had much elevated random blood sugar level, mean being 333.86 mg/dL, when compared with Normal Control group. This was the result, because Disease Control group was not given any treatment after induction of Diabetes Mellitus. Disease Control group had significantly different random blood glucose level, (p-value<0.001), than all other 3 groups. Metformin Treated and Aloe Vera Treated groups had improved glycemic control but did not differ significantly from each other, (p-value=0.412).

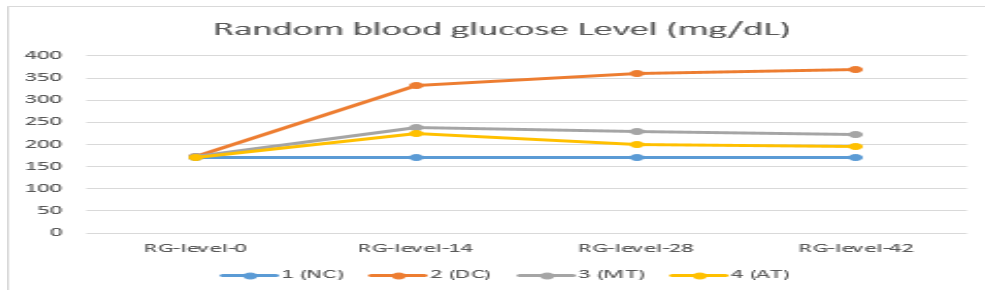
On Day 28, Disease Control group maintained increased hyperglycemia when compared with all other groups. Aloe Vera Treated and Metformin Treated groups had significantly lower level of blood glucose level and Aloe Vera Treated group displayed superior control as indicated by Tukey Post Hoc.

At the end of the study, maximum mean level of random blood glucose was seen in Disease Control

group. Tukey Post Hoc shows that both Metformin and Aloe Vera Treated groups showed lowered mean blood glucose level when compared with the Disease Control group. Aloe Vera Treated group had excellent control of random blood glucose

level which almost reached near Normal Control group.

All the results are displayed in Line diagram1, Figure 1 and Table1.



Line Diagram 1: Showing comparison of Random blood glucose level among 4 groups with the passage of time. RG=Random Glucose.

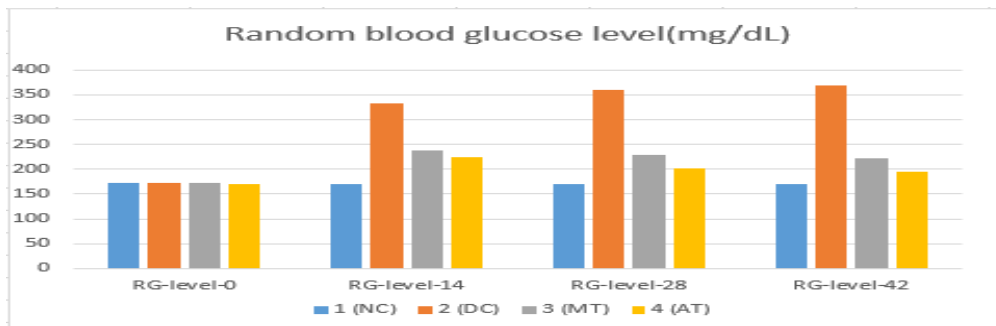


Figure 1: Showing comparison of Random blood glucose level in 4 groups on Day-0, 14, 28 and 42

Groups	RBG-level on Day-0 Mean \pm SD	RBG-level on Day-14 Mean \pm SD	RBG-level on Day-28 Mean \pm SD	RBG-level on Day-42 Mean \pm SD
NC	171.71 \pm 4.5	170.14 \pm 5.55	170.29 \pm 3.73	170.86 \pm 4.3
DC	172.14 \pm 5.98	333.86 \pm 28.1	360.14 \pm 42.29	369.14 \pm 23.16
MT	171.86 \pm 4.14	238.43 \pm 15.1	229.43 \pm 14.48	222.14 \pm 13.12
AT	171.14 \pm 4.81	224.0 \pm 11.37	200.86 \pm 7.54	194.43 \pm 5.16

Table 1: Showing Random Blood Glucose level on Day-0, 14, 28 and 42 (mg/dL) in 4 groups RBG= Random Blood Glucose. SD =Standard Deviation NC= Normal Control, DC= Disease Control, MT= Metformin Treated, AT= Aloe Vera Treated Groups.

Discussion

Healthy, male, Albino rats were included in this study where they had free access to food and water. The environment was safe and temperature regulated with daily visits to take care of any issue at earliest stage.

Streptozotocin and Alloxan are commonly selected drugs for inducing Diabetes Mellitus in rats/animals ⁽²¹⁾. Streptozotocin was very effective and caused severe damage to Pancreas, especially beta cells ⁽¹⁴⁾. Streptozotocin for intraperitoneal injection was prepared by dissolving powder in normal saline ⁽¹⁶⁾. Streptozotocin has led to induction of Diabetes Mellitus as described by Fajarwati et al ⁽²¹⁾. Death of rats at this stage was seen, in multiple studies, due to hypoglycemia instead of hyperglycemia. Glucose was added to diet which may be in the form of 10% solution as described by Kim ⁽²²⁾. This study moved on successfully without death of a single rat just by

covering this single weakness in the management plan.

Fasting blood glucose level was measured on 3rd day after Streptozotocin injection and rats in Disease Control group, Metformin Treated group and Aloe Vera Treated group were labelled Diabetic. The criteria used was fasting glucose level being equal or more than 126 mg/dL⁽¹⁷⁾. Normal Control group had significantly different fasting blood glucose level as compared to rest of the groups (p-value < 0.001) as these rats were not given Streptozotocin. Same standards, for induction of Diabetes Mellitus, have been described by Aba et al⁽¹⁷⁾.

Random blood glucose level was noted at the beginning of the study and then fortnightly. It was same in all the groups at start of study, (p-value = 0.984), indicating healthy rats with blood sugar levels being within normal limits.

Disease Control group had higher level of random blood glucose when compared with all other groups, (p-value < 0.001), after 2 weeks of study. This is quite logical as Normal Control group was non-diabetic while Metformin Treated and Aloe Vera Treated were being helped by medication. Both of these groups, Aloe Vera Treated and Metformin Treated, lowered glycemic level effectively as compared to Disease Control group. Aloe Vera Treated and Metformin Treated groups had random blood glucose levels elevated as compared to Normal Control group but were not significantly different from each other (p value = 0.412). This indicated equal effectiveness of Metformin and Aloe Vera at this stage.

At 4 weeks, Aloe Vera Treated group displayed better glycemic control as compared to Metformin Treated group. Both of these groups were significantly better than Disease Control group.

At the end of study, Aloe Vera Treated and Metformin Treated groups had significantly lower blood glucose level than Disease Control group (p-value < 0.001). Aloe Vera displayed excellent control of blood glucose level and reached maximum close to Normal Control group. Metformin Treatment resulted in controlling hyperglycemia but could not match Aloe Vera Treated group. Similar results have been described by Dede et al⁽²³⁾.

Al-Sarray et al described that normally random blood glucose level remained less than 200mg/dL⁽²⁰⁾. Rats in Normal Control group maintained this level as Streptozotocin was not used for induction

of Diabetes Mellitus in this group. High hyperglycemia was recorded in Disease Control group as no treatment was offered after induction of Diabetes Mellitus. Li et al. had narrated slow and gradual onset and progression of complications seen in Diabetes Mellitus⁽²⁴⁾. None of the rats died due to shorter duration of Diabetes Mellitus during this experimental study.

Dutta et al. declared Metformin as 1st choice oral drug for Diabetes Mellitus⁽⁶⁾. Lesser hyperglycaemia in Metformin Treated group was explained by regular use of this drug. This hypoglycemic effect is achieved by reducing glucose release from liver⁽⁶⁾.

Rats in Aloe Vera treated group got Aloe Vera extract, 300 mg/Kg/day and had far better glycemic control than Metformin Treated group. Dede et al. have reported same results regarding glycemic control⁽²³⁾ at middle as well as end of their study.

Conclusion

Aloe Vera has better glycemic control as compared to Metformin in managing Diabetes Mellitus.

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