Research Article

Effect of *Aloe vera* and metformin on diabetic albino rats

Tanveer Ali Fazlani¹, Mujeeb-ur-Rehman Memon^{1*}, Jehan Ara Baloch², Saeed Ahmed Soomro³, Jamila Soomro³, Aimal Khan Kasi⁴, Panah Munir Shahwani⁴, Saqib Ali Fazilani⁵, Muhammad Mohsen Rahimoon⁶ and Tahir Hussain Dahri¹

1. Department of Veterinary Medicine, Sindh Agriculture University Tandojam-Pakistan

2. Pathology Section, Central Veterinary Diagnostic Laboratory, Tandojam-Pakistan

3. Department of Veterinary Physiology and Biochemistry, Sindh Agriculture University Tandojam-Pakistan

4. Livestock and Dairy Development Department Balochistan-Pakistan

5. Department of Veterinary Pharmacology and Toxicology, Shaheed Benazir Bhutto University of Veterinary & Animal Sciences, Sakrand-Pakistan

6. Department of Animal Reproduction, Shaheed Benazir Bhutto University of Veterinary & Animal Sciences, Sakrand-Pakistan

*Corresponding author's email: drmujebsau@gmail.com

Citation

Tanveer Ali Fazlani, Mujeeb-ur-Rehman Memon, Jehan Ara Baloch, Saeed Ahmed Soomro, Jamila Soomro, Aimal Khan Kasi, Panah Munir Shahwani, Saqib Ali Fazilani, Muhammad Mohsen Rahimoon, and Tahir Hussain Dahri. Effect of *Aloe vera* and metformin on diabetic albino rats. Pure and Applied Biology. Vol. 9, Issue 3, pp2122-2127. <http://dx.doi.org/10.19045/bspab.2020.90226>

Received: 16/03/2020

Revised: 30/05/2020

Accepted: 16/06/2020

Online First: 18/06/2020

Abstract

Diabetes mellitus refers to a predominant concern characterized by excessive glycemia, glycosuria, as well as hyperlipemia; resulting from deficiency of insulin. Plants have always been paid attention as suitable substitutes for chemical drugs due to easy accessibility, fewer side effects, low-toxicity, and cost-effectiveness exhibiting reportedly helpful effects. In the present study, Alloxan monohydrate 150mg/kg body weight was administered intraperitoneally to induce diabetes in rats, the effect of *Aloe vera* leaf gel and Metformin on blood glucose and body weight were compared. *Aloe vera* gel in a concentration of 1000mg/kg body weight and metformin at concentration 150mg/kg body weight was orally administered in induced diabetic in rats. There was a significant difference of ($p < 0.05$) recorded in blood glucose level and body weight in the control and treated groups. The glucose level in blood was decreased in all treated groups (*aloe vera* treated group and metformin-treated group) except control diabetic group: whereas after induction of diabetes bodyweight of all diabetic groups were decreased. After treatment with *aloe vera* and metformin, there was a significant increase in body weight of treated groups as compared with the diabetic control group.

Keywords: *Aloe vera*; Blood glucose; Metformin

Introduction

Diabetes mellitus is a predominant concern characterized by hyperglycemia, glycosuria, hyperlipaemia, resulting from deficiency of insulin [1, 2]. The diabetes mellitus is classified as, insulin-dependent and non-insulin-dependent diabetes

mellitus, commonly known as type-I and type-II [3]. Type-I refers to an autoimmune disorder results when insulin-producing (β) beta cells are destroyed, resulting in a reduction of insulin production causing hyperglycemia. The type-II diabetes mellitus is a more usually

occurring form of the disease in which 90% of the patients are suffering from this form that leads to hyperglycemia. In the type-II diabetes mellitus, resistance developed against insulin secretion so the biological system fails to maintain insulin concentration [4].

Almost 400 medicinal plant species are marketed in Pakistan drug markets used by homoeopathic doctors [5]. These plants have always been paid attention as suitable substitutes for chemical drugs due to easy accessibility, fewer side effects, low-toxicity, and cost-effectiveness exhibiting reportedly helpful effects. Medicinal plants have great beneficial effects with fewer side effects for curing diabetes [6].

Among medicinal plant species; Aloe vera is the most beneficial species of aloe, a desert plant looking like the cactus in the Liliaceae family including 360 species [7, 8]. It is succulent plant originated from the temperate climate of North Africa and can grow in other temperate climates [9, 10, 11]. Aloe vera gel has an effective result to cure diabetes because of its hypoglycemic properties. Aloe vera is a natural herb, having no side-effects in diabetic treatment [12].

Metformin, an oral anti-diabetic drug which falls to the group of agents (biguanide) used to decline the blood glucose level in the animal body and usually used as a prophylactic regime for decreasing blood glucose level in the patient suffering from type-II diabetes mellitus [13]. Metformin used for the treatment of type -II diabetes mellitus, and it has been suggested as an effective therapy for the patient suffered from type - I diabetes mellitus, as it facilitates the releasing of insulin from (β) beta cells of the pancreas and including weight reduction, enhanced lipid profiles and improved endothelial function [14, 15].

Materials and methods

Study area

This study was carried out in the Animal House, Department of Veterinary Parasitology and Department of Veterinary

Medicine, Faculty of Animal Husbandry and Veterinary Sciences, Sindh Agriculture University Tandojam.

Experimental animals

The therapeutic effect of Aloe vera and Metformin on glucose level and body were studied. Male albino rats weighing 150-200 grams were selected as a model. To adopt the environment, rats were tagged and kept in cages one week before study at the animal house.

Feeding of experimental animals

The rats of all groups were allowed for free access to feed and drink clean water throughout the experiment. Nestle ® NIDO (whole Milk powder), chicken peas and wheat flour were fed to experimental animals throughout the study period. Milk powder was mixed with wheat flour @ 100 grams/kg.

Induction of diabetes

Alloxan monohydrate (Sigma – Aldrich) was freshly dissolved in cold normal saline. 150 mg/ kg BW, of Alloxan monohydrate, was injected intraperitoneally to overnight fasted rats on alternate days. After one hour of induction dose, 10% glucose solution was provided in drinkers for 24 hours to prevent the hypoglycemic condition. The rats become diabetic after 72 hours of induction dose and show clinical signs (Frequent urination, Excessive thirst, Unexplained weight loss, Extreme hunger, Sudden vision changes, Tingling or numbness in the hands or feet, Feeling very tired much of the time, Very dry skin and with hyperglycemia).

Experimental design

Twenty four rats were randomly placed into four groups (n=6). Group B, C and D have induced diabetes whereas group A considers as the control group. Group B served as the diabetic control group (without further treatment). Group C received aloe vera gel at a dosage of 1000 mg/kg BW, orally for three weeks. Group D received metformin solution at a dosage of 150 mg/kg BW, orally for three weeks. The dose in treated groups was divided

into two parts and administered at the time interval of 12 hours.

Herbal preparations

Aloe vera: Fresh leaves of Aloe vera (*Aloe barbadensis miller*) was plucked and washed. Aloe vera gel was obtained by removing rind and latex. Aloe vera gel was blended and packed according to the calculated dose. Then it was UV sterilized and stored in a refrigerator at 4°C until use. Aloe vera gel was administered orally at the dose of 1000mg/kg BW, for three weeks.

Oral administration of Tablet Metformin: Metformin mixed with water and administered orally at the dosage of 150 mg/kg BW, per day [16].

Sample collection

The drop of the blood was collected from the tail vein as a sample. The Blood glucose determined through Glucometer (On Call®Ez II) throughout the experimental period. The normal rats had

fasting blood glucose 70-110 mg/dl while rats with fasting blood glucose > 200 mg/dl were considered diabetic.

Statistical analysis

The researcher analyzed data by using t-test, one-way analysis of variance (ANOVA) and Least Significant Difference (LSD) test. The values of ($p < 0.05$) were considered significant, by using SPSS V.20 statistical software.

Results

Table 1 represents the anti-diabetic response of aloe vera and metformin to a glucose level of diabetic rats. There was a statistically significant rise in glucose level in the blood of diabetic control group compared to the control non-diabetic group ($p < 0.05$), whereas blood glucose level was reduced in the groups treated with aloe vera and metformin as compared to a diabetic control group from 0 days to 1st week, 2nd week and 3rd week ($p < 0.05$).

Table 1. Antidiabetic effect of aloe vera and metformin on glucose level in blood of induced diabetic rats (mg/dl)

Variable	Number	0 week	1 st week	2 nd week	3 rd week
Control	6	81.53±1.15 ^b	81.39±1.21 ^e	81.212±0.72 ^e	81.50±0.61 ^e
Control + Diabetic	6	254.64±1.50 ^a	258.64±1.36 ^a	267.48±1.21 ^a	274.12±2.82 ^a
Diabetic + Aloevera	6	254.64±1.50 ^a	156.73±0.68 ^d	109.13±1.22 ^d	93.80±0.60 ^d
Diabetic + Metformin	6	254.64±1.50 ^a	205.22±0.68 ^b	173.57±1.93 ^b	133.69±0.74 ^b

Similar superscript letters shows non-significant difference in the means of variables ($P < 0.05$)

Table 2 shows the effect of aloe vera and metformin on the bodyweight of induced diabetic rats with a significant decrease ($p < 0.05$) in the bodyweight of all groups except the control group. Bodyweight in

control group significantly increased ($p < 0.05$) as compared to all other groups whereas bodyweight of groups treated with *Aloe vera* and metformin elevated when compared to the diabetic control group.

Table 2. Effect of Aloe vera and metformin on body weight (g) of control and treated groups

Variables	Initial-Body weight (g per rat)	Final-Body weight (g per rat)	t-value
Control	182.84±0.43	228.22±0.75	-127.34
Control + Diabetic	178.86±0.61	118.88±0.60	169.42
Diabetic + <i>Aloe vera</i>	188.34±0.75	161.10±0.74	62.73
Diabetic + Metformin	185.75±1.13	135.93±1.26	4.86

t-values show significant difference between the means of variables ($P < 0.05$)

Discussion

The proposed study was designed to evaluate the effect of aloe vera and metformin in blood glucose and body weight of induced diabetic rats. Diabetes in rats has been induced by administration of alloxan monohydrate a cytotoxin intraperitoneally, as this toxin is responsible for the destruction of (β) beta cells of the pancreas which leads towards the insulin deficiency [17].

Induced diabetic rats were provided with aloe vera to reduce their blood glucose level a dose of 1000 mg/kg orally according to bodyweight for 21 days and fasting blood glucose level has been recorded on daily basis, aloe vera caused the reduction of blood glucose level from 254.64mg/dl to 93.80mg/dl of blood. Similarly; [8] also experimentally observed the decrease in blood glucose level by the administration of *Aloe vera* gel extract in induced diabetic rats from 274.17mg/dl to 94.18mg/dl of blood. Furthermore; [18] also reported the decrease in blood sugar level of diabetic rats by administration of *Aloe vera* from 314.25mg/dl to 152mg/dl of blood. Apart from this; [19] also stated that aloe vera is having a soothing effect on (β) beta cells of the pancreas to secrete insulin to maintain the normal blood glucose level so the administration of aloe vera cause proliferation of (β) beta cells and thus causing the lowering level of serum glucose in diabetic rats. Likewise; [20] also observed the reduction in the level of serum glucose in diabetic albino rats by using *Aloe vera* gel.

Induced diabetic rats were experimentally treated by administration of metformin in order to decrease the blood glucose level in diabetic rats; metformin has been administered at dose rate of 150mg/kg body weight daily for continuously 21 days. Metformin causes reduction of blood glucose level from 254.64mg/dl to 133.69mg/dl of blood. Similarly; [21] has experimentally proved that administration of metformin causes reduction of blood

glucose level from 220mg/dl to 155mg/dl of blood in induced diabetic rats. Furthermore; [22] has also reported the anti diabetic effect of metformin in induced diabetic Wistar rats, causing decrease in blood glucose level. Apart from this; [23] also described that metformin enhance the metabolism of glucose in order to maintain the normal glucose level in blood. Likewise; [24] also recommended that the antidiabetic effect of metformin in diabetic rats causes decrease in blood glucose level from 380mg/dl of blood to 150mg/dl of blood in induced diabetic rats.

Bodyweight of control and diabetic control groups of rats were observed before and after experimental trial, the bodyweight of control was observed increase from 182.84 ± 0.43 gram to 228.22 ± 0.75 gram during whole experimental trial and bodyweight of diabetic control groups of rats were observed decrease from 178.86 ± 0.61 gram to 118.88 ± 60 gram. Bodyweight of alloxan-induced diabetic rats observed before and after administration of aloe vera and metformin as a therapeutic agent. At the time of administration of these therapeutic agents, the bodyweight of aloe vera treated group was 188.34 ± 0.75 gram and the metformin-treated group was observed 185.75 ± 1.13 grams. Post-treatment significantly decrease in body weight of diabetic rats were observed aloe vera was 161.10 ± 0.74 grams and metformin was 135.93 ± 1.26 grams. Similarly; [16] has also been explained the significant reduction in body weight of induced diabetic rats before and after treatment with aloe vera and metformin. Furthermore; [23] also experimentally proved that the in diabetes significantly loss in body weight occurs due to the disturbance in the metabolism of glucose and protein in diabetic rats.

Conclusion and recommendations

It was concluded through this study that aloe vera found more effective as an anti-hyperglycemic agent as compared to

metformin. It can be used as first-line management for diabetes type II in rats followed metformin. Therefore, it is recommended that large scale studies may be conducted to manage diabetes by using aloe vera, fenugreek seeds in pets as well as in humans. It is also suggested to know the adverse effects of long term therapy of diabetes with aloe vera.

Authors' contributions

Conceived and designed the project: MR Memon, Performed the experiment: TA Fazlani, MR Memon & JA Baloch, Analysed the data: MR Memon, SA Fazilani & MM Rahimoon, Contributed in material, tools and field supervision: PM Shahwani, AK Kasi & TH Dahi, Helped in data analysis and proof reading of manuscript: MR Memon, SA Soomro & J Soomro

Acknowledgments

The authors also acknowledge the authorities and staff of Animal House, Faculty of Animal Husbandry and Veterinary Science, Sindh Agriculture University, Tandojam, for their assistance and cooperation.

References

1. Issa I A & Bule MH (2015). A Comparative Study of the Hypoglycemic Effect of Aqueous and Methanolic Extracts of *Myrtus communis* on Alloxan Induced Diabetic Siwis Albino Mice. *Med Aromat Plants* (4): 1000190.
2. Tripathi V & Verma J (2014). Current updates of Indian antidiabetic medicinal plants. *Inter J Res in Phar Chem* 4(1): 114-118.
3. Bastaki S (2005). Review Diabetes mellitus and treatment. *Inter J Diabetes Metabol* 111-134.
4. Akira Y, Hegazy S, Kabbash A & Wahab AB (2009). Possible hypoglycemic effect of aloe vera l. high molecular weight fraction on type ii diabetic patients. *Saudi Pharm J* 17(3): 209-215.
5. Mariam A (2015). Some medicinal plant resources and traditional uses in Pakistan. *J Plant Breed and C Sc.* 7(5): 158-162.
6. Tenpe CR & Yeole PG (2009). Comparative evaluation of antidiabetic activity of some marketed polyherbal formulations in alloxan induced diabetic rats. *Inter J Pharm Tech* 1: 43-49.
7. Yeh GY, David ME, Ted JK & Russell SP (2003). Systematic Review of Herbs and Dietary Supplements for Glycemic Control in Diabetes. *Diabetes Care* 26: 1277-1294.
8. Rajasekaran S, Karuran S & Sorimuthu S (2005). Antioxidant effect of *Aloe vera* gel extract in streptozotocin-induced diabetes in rats. *Pharmacol Reports* 57: 90-96.
9. Akinyele BO & Odiyi A C (2007). Comparative study of the vegetative morphology and the existing taxonomic status of *Aloe vera* L. *J Plant Sci* 2(5): 558-563.
10. Channa AA, Qazi IH, Soomoro SA, Shah AH, Gandhai JA, Korejo RA, Shah IA, Kalhor NA & Khaskeli B A (2014). Effect of oral supplementation of Aloe veraextract on haematology indices and immune cells of blood in rabbit. *Afr J Pharm Pharmacol* 8(19): 497-501.
11. Ekanade B, Oridupa OA & Oyeyemi MO (2015). Assessment of the safety of aqueous extract of *Aloe vera* onhaematology of Wistar rats. *Afr J Biotechnol* 14(30): 2395-2399.
12. Okyar A, Ays EC, Nuriye A, Gul B & Nurhayat S (2001). Effect of Aloe veraLeaves on Blood Glucose Level in Type I and Type II Diabetic Rat Models. *Phytother Res* 15: 157-161.
13. Ferrannini E (2014). The target of metformin in type 2 diabetes. *The New England J Med* 371(16): 1547-1548.
14. Kaul K, Apostolopoulou M & Roden M (2015). Insulin resistance in type 1 diabetes mellitus. *J Metabol* 64(12): 1629-1639.
15. Davies MJ, Tringham JR, Troughton J & Khunti KK (2004). Prevention of

- type 2 diabetes mellitus: a review of the evidence and its application in a UK setting. *Diabet Med* 21: 403-414.
16. Majithiya JB & Balaraman R (2006). Metformin reduces blood pressure and restores endothelial functions in aorta osstreptozotocin-induced diabetic rats. *Life Sci* 78(22): 2615-24.
 17. Chude MA, Orisakawe OE, Afonne OJ, Gamanial KS, Vongtau OH & Obi E (2001).Hypoglycemic effect of the aqueous extract of Boerrhaviadiffusaleaves. *Indian J Pharmacol* 33: 215-216.
 18. Vanitha M, Karpagam T, Varalakshmi B & SujaPandian R (2012). A Comparative Study on the Anti-Diabetic Potential of *Aloe vera* Gel and Fenugreek Seeds on Experimentally induced Diabetic Rats. *Pharmacog Comm* 2: 57-61.
 19. Ayesha NS, Gunasekaran A, Manickam S & Vijayalakshmi MA (2008). Antidiabetic activity of *Aloe vera* and histology of organs in streptozotocin induced diabetic rats. *Curr Sci* 94(8): 1070-1076.
 20. Saghir AJ, Hasan SS, Nadeem A, Kalsoom & Iqbal J (2011). Hypoglycemic effect of aloe vera extract in alloxan-induced diabetic Albino rats. *Med. J. Islamic World Acd of Sci* 19(3):127-130.
 21. Stumvoll M, Nurjahan MD, Perriello MDG, Dailey MDG & MDGE Grerich (1995). Metabolic effects of metformin in non-insulin-dependent diabetes mellitus. *The New England J Med* 9(333): 550-554.
 22. Cheng JT, Huang CC, Liu IM, Tzeng TF & Chang CJ (2006). Novel mechanism for plasma glucose-lowering action of metformin in streptozotocin-induced diabetic rats. *Diabetes* 55: 819-824.
 23. Meng XM, Tian YL, Jiang Q, Wang L, Shi R, Ding L & Pang SG (2017). Metformin improves the glucose and lipid metabolism via influencing the level of serum total bile acids in rats with streptozotocin-induced type 2 diabetes mellitus. *Euro Rev for Med and Pharmacol Sci* 21: 2232-2237.
 24. Akinola O, Gabriel M, Suleiman AA & Olorunsogbon F (2012). Treatment of Alloxan-Induced Diabetic Rats with Metformin or Glitazones is Associated with Amelioration of Hyperglycaemia and Neuroprotection. *The Open Diabetes J* 5: 8-12.