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Investigation of comparative antidiabetic effect of aqueous extract of *Momordica charantia*, *Murraya koenigii* and *Aloe vera* in alloxan induced male albino rats

Mittal Gaurav*, Niranjan Pankaj Singh

Institute of Pharmacy, Bundelkhand University, Jhansi (U.P.)

CorrespondingAuthor:Mittal Gaurav

Abstract

Diabetes, a prevalent metabolic disorder, poses significant challenges to health and quality of life globally. This study focuses on evaluating the Antidiabetic properties of aqueous extracts from three plants, *Momordica charantia* (bitter melon), *Murraya koenigii* (curry leaf), and *Aloe vera*, in comparison to Metformin, a widely used Antidiabetic drug. The research was conducted using alloxan-induced diabetic male albino rats, a common model for studying diabetes. The primary objective of this study was to assess how effectively the aqueous extracts of M. charantia, M. koenigii, and Aloe vera can lower blood glucose levels compared to Metformin. The secondary objective was to evaluate their impact on various biochemical parameters including serum creatinine, albumin, urea, serum glutamate oxaloacetate transaminase (SGOT), and serum pyruvate transaminase (SGPT), as well as their influence on body weight over a treatment period of 28 days. The extracts produced the following results, *M. charantia* at 300 mg/kg body weight significantly ($p<0.05$) decreased blood glucose levels to 109.8 ± 5.45 mg/dL; *M. koenigii* at 300 mg/kg significantly ($p<0.05$) decreased blood glucose levels to 109.2 ± 6.14 mg/dL; Aloe vera at 300 mg/kg significantly ($p<0.05$) decreased blood glucose levels to 112.2 ± 7.83 mg/dL; and Metformin at 150 mg/kg significantly ($p<0.05$) decreased blood glucose levels to 86.6 ± 4.27 mg/dL. For comparison, the blood glucose levels in the untreated control group were 88.8 ± 3.76 mg/dL. Each treatment group showed a statistically significant ($p<0.05$) reduction in blood glucose levels, indicating that the extracts effectively approached normal values. The study also evaluated changes in various biochemical parameters that are indicative of the body's metabolic state and organ functions. These improvements in biochemical parameters across all treatment groups suggest that the plant extracts not only helped in lowering blood glucose level but also had a beneficial effect on overall metabolic health.

Keywords: *Murraya Koenegii*, *Momordica charantia*, *Aloe vera*, antidiabetic, activity, comparative study, Metformin

Introduction

Diabetes mellitus is a group of metabolic diseases characterized by chronic hyperglycemia resulting from defects in insulin secretion, insulin action, or both . The classical classification of diabetes as proposed by the American Diabetes Association (ADA) in 1997 as type 1, type 2, other types, and gestational diabetes mellitus (GDM) is still the most accepted classification and adopted by ADA [1]. Diabetes has become a serious worldwide health problem rising concern among nations around the world and research to address the problem [2]. It is associated with symptoms such as hyperlipidemia, diabetic nephropathy and cardiovascular illnesses. Recent Studies on Type-I and Type-II diabetes indicates alarming situations in posing a serious health hazard across the worldwide population[3, 4].

The number of diabetic patients in the world had been estimated as 150 million. This number is predicted to double of its number by 2025 [5]. The picture in India is much more alarming. The current estimation shows that there are 6.2 crore people with diabetes and this number is likely to raise upto 8.5 crore by 2030 [6]. India has now been declared by WHO as the 'Diabetes capital of the world'.

There are various classes of drugs likeBiguanides, glibenclamide, and Dipeptidyl peptidase-4 (DPP-4) inhibitors Provide an excellent therapeutic results for diabetes mellitus and are expensive and associated with adverse effects in long and short run [7- 8]. Although insulin and various types of synthetic oral hypoglycemic drugs are available in the market for the treatment of diabetes mellitus, synthetic drugs may have significant side effects the main of which is an increased risk of hypoglycemia and toxicity. Hence many studies were carried out to investigate the hypoglycemic effect of some herbal plants used traditionally to treat diabetes beside identification of active ingredients, mode of action and safety. Many herbal extracts have been confirmed for its hypoglycemic effect in human and animals for type II diabetes [9].

Momordica charantia, Murraya koenegii and Aloe vera are the old important plants that are referenced in Ayurveda for their therapeutic benefits. M. charantia, popularly known as bitter melon, belongs to the Cucurbitaceae family of cucumbers. It may be used as an alternate treatment for diabetic people who need to reduce their blood glucose levels [10]. The results of Several investigations on diabetic animal models have shown that curry leaves have anti-diabetic properties [11-12]. Aloe Vera has a very long history of use because of its medical application dating back to the 4th century BC [13-14]. *Aloe vera* has been used in folk medicine as a remedy for various diseases[15].

The primary aim of this study was to assess the impact of these plant extracts on blood glucose levels in diabetic rats. Additionally, the study also examined their effects on various biochemical markers, including:

- **Liver Function Tests**: SGOT (Serum Glutamate Oxaloacetate Transaminase) and SGPT (Serum Pyruvate Transaminase) levels as key indicators.

- **Renal Function Tests**: Serum creatinine, serum albumin, and urea levels.
- **Body Weight**: Changes in body weight were monitored as an overall indicator of health.

The results from the plant extracts were compared with those of Metformin, a standard synthetic antidiabetic drug, to gauge their relative efficacy.

Material and Methods

The study was performed in the Institute of Pharmacy, Bundelkhand University, Jhansi. The experiment was conducted to investigate the comparative efficacy of aqueous extract of *Momordica charantia*, *Murraya koenigii* and *Aloe vera* with reference to Metformin as a standard drug in alloxan induced male albino rats. The following procedure were adopted for conducting this study.

Drug, Chemicals and Reagents

Alloxan monohydrate (Chemdyes Corporation, Rajkot, Gujrat) Metformin, Accu check active Glucometer and strips (Suman Medicals, Jhansi) All other chemicals were provided by the central store, Institute of pharmacy, Bundelkhand University Jhansi.

Collection and authentication of Plant Materials

The fresh leaves of *Aloe vera*, fruits of karela and fresh leaves of Curry neem were collected from local region of Bundelkhand, Jhansi, Uttar Pradesh, India, and authenticated at Botanical department, Ayurvedic College Jhansi, Uttar Pradesh, India. The voucher specimen was deposited in the departmental herbarium for future reference.

Preparation of plant extracts

The fresh leaves of aloe vera were collected, washed with distilled water and shadow dried. The shadow dried leaves of aloe vera were subjected to pulverization to get coarse powder. Aqueous extract was made by dissolving it in distilled water using by mortar and pestle. The dose was initially made to 300 mg/kg body weight for oral administration [16].

Murraya koenigii leaves aqueous extract was prepared by maceration method. About 200 g of leaf powder was subjected to cold maceration with chloroform: water in a conical flask for 7 days at room temperature. The flask was plugged with absorbent cotton at the mouth of flask and shaken periodically. It was filtered through a muslin cloth and the collected filtrate was refiltered through Whatmann filter paper to get the clear filtrate. The filtrate was concentrated to dry residue by shade drying it for 30 days. This extract was labeled as MKAE and the selected dose was 300 mg/kg body weight for oral administration [17].

Bitter melon fruits (BM) or *Momordica charantia* were washed thoroughly dried under shade, then cut into pieces, and seeds were removed from the pulps, then ground to homogeneous powder (40– 60 mesh) and stored at a dry place for further use [18].

Preparation of Metformin solution

Metformin solution was prepared by dissolving 150 mg of Metformin pure powder in 10 ml of distilled water to attain a concentration of 15 mg/ml, labeled as MET and its dose was selected as 150 mg/kg body weight [19].

Animals

Adult healthy male albino rats (Wistar Strain) weighing 100 – 200g were selected. They were kept at departmental animal house in standard polypropylene cages and maintained under controlled room temperature (22±2^{0}C) and humidity (55±5%). All the animals were provided with commercially available rat normal pallet diet and water ad libitum. Approval for the study protocol was granted by the Institutional Animal Ethical Committee of Institute of pharmacy, Bundelkhand University, Jhansi, Uttar Pradesh, India (Reg No. 716/GO/Re/S/02/CPCSEA).

Phytochemical Screening

The individual extract was subjected to qualitative phytochemical screening for the presence of some chemical constituents such as steroids, phenolics, fixed oil, alkaloid, glycoside, saponin, flavonoid, tannins and carbohydrate.

Induction of Diabetes

Overnight fasted albino rats will be made diabetic by injecting alloxan monohydrate (in ice cold normal saline) intraperitoneally at a dose of 120 mg/kg weight. After that the rats will be keep a side for 4 hrs and then 10% glucose solution will be placed in the cages for 24 hrs. Measure the FBS concentration after 72 hr of alloxanization. Animals with blood glucose level above 250 mg/dl will be considered to be diabetic and were used in the study [20,21,22].

Experimental Work

Animals will be maintained in clean polypropylene cages with 12 hr light & 12 hr dark cycle at temp of 27-29ºC & relative humidity of 60± 5. They will be given standard pellet diet and water ad-libitum throughout the course of the study. The study will be carried out in accordance with the guidance by committee constituted for the purpose of experiment animals.

Group I: Normal untreated animals given only vehicle **(Normal Control)**

Group II: Diseased animals treated with single dose alloxan monohydrate 120 mg/kg in ice cold normal saline intraperitoneally **(Diabetic Control)**

Group III: Alloxan treated diabetic animals treated with reference drug (Metformin 150 mg/kg)

Group IV: Alloxan treated diabetic animals treated with 300 mg/kg body weight aqueous extract of *Momordica charantia*.

Group V: Alloxan treated diabetic animals treated with 300 mg/kg body weight aqueous extract of *Murraya koenigii*.

Group VI: Alloxon treated diabetic animals treated with 300 mg/kg body weight aqueous extract of *Aloe vera*.

The blood glucose concentration of the animals will be measured at the beginning of the study and measurements will be repeated on 3rd ,7th,11th, 15th, 19th, 23th and 28th day of experiment. Change in body weight will be observed by measuring weekly changes in body weight. At the end of the experimental period, the animals were fasted overnight and then sacrificed by cervical decapitation. Blood was collected in tubes containing EDTA for the estimation of creatinine, albumin and urea as biochemical markers of kidney functioning [23-24] and determination of SGOT and SGPT as biochemical markers of liver functioning [25-26].

Statistical Analysis

All the data are expressed as Mean ± SD. The anti-diabetic potential was analyzed by one-way analysis of variance (ANOVA). A P value of < 0.05 was considered as statistically significant.

RESULTS

The experiment was carried out for the study of comparative efficacy of herbal drug preparation of Karela Frut Juice (KFJ), curry neem leaves extract and aloe vera juice with a standard drug metformin as blood glucose lowering agent in rats. Attempts were also made to investigate the effects of those herbal preparation and reference drug on creatinine, albumin and urea as biochemical markers of kidney functioning, determination of SGOT and SGPT as biochemical markers of liver functioning and effect on body weights in rats.

To perform the experiment, 30 Rats (albino wistar male rats) were randomly dividing into six groups. Group I was kept as normal control without giving any treatment Group II as a diabetic control, Group III were treated with Metformin, Group IV were treated with *Karela* Fruit Juice, Group V were treated with aqueous extract of *Murraya koenigii* and Group VI were treated with aqueous extract of *Aloe vera*. All the control and treated were closely observed during 28 days of treatment.

Effect on blood glucose level

All the aq. Extracts of KFJ, MKAE and AVJ showed significant Antidiabetic activity in lowering blood glucose level. After 28 days of treatment the effectiveness of extracts was found to be in order of MAKE > BMJ > AVJ. The results are shown in table 1.

Table 1: Effect of Metformin, karela fruit juice, Curry neem aq. extract and Aloe vera aq. extract on blood glucose level (mg/dl) in rats (n=5)

Groups	Treatment with dose	Day 0	Day 3	Day 7	Day 11	Day 15	Day 19	Day 23	Day 28
I	NC	87.4±5.98	86.4±3.97	88.6±5.46	89.8±3.31	87.2±3.54	89.2±4.06	89.8±5.03	88.8±3.76
II	DC	266.2±8.58	276.4±9.47	291.6±7.76	305.6±7.86	324.2±10.28	346.2±8.20	365.8±15.54	396.0±15.33
III	with metformin	272.4±12.04	137.8±11.21	113.8±4.66	104.2±5.77	92.8±6.33	92.2±3.37	90.4±3.00	86.6±4.27
IV	BMJ	282.4±13.92	175.8±7.54	154.4±10.36	140.8±14.10	135.4±6.97	129.8±7.13	120.2±8.70	109.8±5.45
V	MKAE	271.6±7.28	158.6±8.59	152.0±9.59	142.4±11.94	134.4±8.30	132.0±3.74	118.6±10.55	109.2±6.14
VI	AVJ	268.2±11.28	170.2±8.70	152.8±9.82	143.4±9.97	141.2±10.79	135.2±8.32	121.6±6.74	112.2±7.83

n= 5, values express as Mean ± SD, significance $P<0.05$

Effect on body weight

Body weight of all the rats in all groups were carried out before the treatment (0 day) and post the treatment on 7th, 14th, 21st and 28th day of study with the help of electronic balance. The results are shown in table 2.

Table 2: Effect of Metformin, karela fruit juice, curry neem aq. extract and aloe vera aq. extract on body weight (gm) in rats (n=5)

Groups	Treatment with dose	0-Day	1-Weak	2-Weak	3-Weak	4-Weak
I	NC	164.12 ± 6.14	165.42 ± 5.96	166.76 ± 5.97	169.50 ± 5.73	180.26 ± 6.51
II	DC	173.88 ± 7.04	169.60 ± 7.21	163.78 ± 7.60	154.30 ± 7.79	145.66 ± 9.43
III	with metformin	172.54 ± 8.89	170.9 ± 8.53	173.04 ± 8.05	175.06 ± 7.60	183.24 ± 8.01
IV	BMJ	173.70 ± 6.02	171.42 ± 4.52	169.24± 6.29	167.40 ± 6.93	161.04± 7.42
V	MKAE	171.21± 6.90	168.78 ± 7.85	166.96± 7.25	167.04 ± 9.26	162.66± 9.53
VI	AVJ	168.64 ± 8.93	167.12 ± 9.48	164.18± 9.53	162.38± 8.34	159.26± 8.58

n= 5, values express as Mean ± SD, significance P<0.05

Effect on Biochemical parameters in Alloxan induced diabetic rats

At the end of the experimental study estimation of serum biochemical parameters a varying effect were observed. In this study, serum creatinine level was greatly reduced by the karela fruit juice. The most effective extract to reduce serum creatinine was found to be in order to BMJ > MKAE > AVJ. Serum albumin level was most significantly reduced by BMJ. The order of effectiveness was found to be BMJ > AVJ > MKAE. The significant extract to reduce serum urea was Curry leaves aq. Extract and the order of effectiveness was MKAE > BMJ >AVJ. Karela juice most significantly reduced serum SGOT and the order was found to be BMJ > AVJ > MKAE. The most significant extract to reduce serum SGPT was curry leaves extract and the order was found MKAE > BMJ > AVJ. Karela extract maintain near about all the biochemical parameters similar to standard drug Metformin. The results are shown in tables 3 and 4.

Effects of Plant extracts on Renal functioning

Table 3. Effect of BMJ, MKAE and AV aq. extract on serum createnine, albumin and urea (Kidney function tests)

Groups	Treatment with dose	Createnine (mg/dl)	Albumin (mg/dl)	Urea (mg/dl)
I	**NC**	0.612 ± 0.020	4.408± 0.183	24.670± 1.010
II	**DC**	1.620± 0.043	6.688 ± 0.155	67.172± 4.414
III	**with metformin**	1.172 ± 0.106	4.956 ± 0.242	28.528 ± 3.716
IV	**BMJ**	1.022 ± 0.121	4.726 ± 0.240	33.814± 4.170
V	**MKAE**	1.052 ± 0.128	5.144± 0.369	33.522± 4.056
VI	**AVJ**	1.094 ± 0.152	5.040± 0.435	36.260± 3.159

n= 5, values express as Mean ± SD, significance P<0.05

Effects of Plant extracts on Liver functioning

Table 4. Effect of BMJ, MKAE and AV aq. extract on serum glutamate oxaloacetate and pyruvate transaminase (SGOT and SGPT) (Liver function tests)

Groups	Treatment with dose	SGOT (mg/dl)	SGPT (mg/dl)
I	NC	61.788 ± 1.780	47.240 ± 5.032
II	DC	124.948 ± 5.961	116.604 ± 8.436
III	with Metformin	71.544 ± 7.474	53.844 ± 6.782
IV	BMJ	77.330 ± 7.845	70.138 ± 6.487
V	MAKE	82.104 ± 6.896	69.036. ± 9.314
VI	AVJ	80.824 ± 6.810	72.554 ± 7.608

n= 5, values express as Mean ± SD, significance $P<0.05$

DISCUSSION

Folk medicinal plants have been a crucial source of medicine, with many current drugs derived from them. This study evaluated and compared the effects of aqueous extracts of *M. charantia* (karela), *Murraya koenigii* (curry leaves), and Aloe vera on blood glucose levels in alloxan-induced diabetic male albino rats. Additionally, the study assessed liver function (SGOT and SGPT), renal function (creatinine, serum albumin, and urea), and changes in body weight. The plant treatments were also compared with metformin, a common antidiabetic drug.

Effective blood glucose control is key to preventing or reversing diabetic complications and improving quality of life. The plant extracts showed significant antidiabetic activity, effectively lowering blood glucose levels compared to the control group. Diabetic hyperglycemia induced by alloxan increased plasma levels of urea, albumin, and creatinine, markers of renal dysfunction, and elevated SGOT and SGPT levels, markers of liver dysfunction. The results indicated a significant decrease in plasma levels of urea, albumin, and creatinine (Table 3) and a significant decrease in serum levels of SGOT and SGPT (Table 4) in treated diabetic rats compared to the diabetic group. Our study demonstrates that aqueous extracts of *M. charantia, M. koenigii*, and Aloe vera have beneficial effects in treating diabetes mellitus and could be part of diabetes management.

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