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ANTI-DIABETIC PROPERTIES AND PHYTOCHEMICAL STUDIES OF ETHANOLIC EXTRACTS OF MOMORDICA CHARANTIA AND ALOE VERA ON ALLOXAN INDUCED DIABETIC ALBINO RATS

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ABSTRACT

Diabetes mellitus is a chronic metabolic disorder characterized by high blood sugar levels, which result from defects in insulin production, insulin action, or both. This condition leads to serious complications if not managed properly. A number of folk medicines are used by diabetic patients to control their condition. This experiment aimed to compare the antidiabetic effects of alcoholic extracts of *Momordica Charantia* (MC), Aloe vera (AV), and their combination (MC + AV) against Metformin (150 mg/kg body weight) in alloxan-induced diabetic male albino rats. The study also measured biochemical parameters such as serum creatinine, albumin, urea, serum glutamate oxaloacetate transaminase (SGOT), and serum pyruvate transaminase (SGPT), as well as changes in body weight after administering these extracts. After 28 days during the treatment with these extracts following observations were made. *Momordica Charantia* when administered orally 300 mg/kg body weight significantly ($p>0.05$) decreased blood glucose level (115.8 ± 5.42), *Aloe vera* when administered orally 300 mg/kg body weight significantly ($p>0.05$) decreased blood glucose level (121.8 ± 4.07) and combination of these two when administered orally 300 mg/kg body weight significantly ($P>0.05$) decreased blood glucose level (102.6 ± 3.72) which showed synergistic effect compared to reference drug Metformin when administered orally 150 mg/kg body weight significantly ($p>0.05$) decreased blood glucose level (86.6 ± 4.27). The results concluded that MC and AV are potent antidiabetic agents, with their combination showing a synergistic effect comparable to Metformin in lowering blood glucose levels. After 28 days, the plant extracts notably reduced blood glucose levels to values close to those of the control group (88.8 ± 3.76 mg/dL). Additionally, the alcoholic extracts of MC, AV, and their combination effectively reduced the severity of diabetes, as indicated by improved biochemical parameters.

Keywords: Folk medicine, Diabetes Mellitus Momordica *Charantia*, *Aloe vera*, combination, Synergistic effect, 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] 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[2]. 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 up to 8.5 crore by 2030. India has now been declared by WHO as the 'Diabetes capital of the world'[3].

Extensive research into diabetes has led to the development of numerous synthetic oral antidiabetic agents, such as thiazolidinediones, biguanides, and sulfonylureas, which are employed to manage and control diabetes mellitus. However, the long-term use of these synthetic drugs often comes with significant side effects. In stark contrast, traditional herbal plants, revered by communities for centuries, have proven to be effective in regulating high blood glucose levels. These plants contain various bioactive compounds, including polysaccharides, glycosides, alkaloids, saponins, terpenoids, and flavonoids, all of which exhibit potent antidiabetic properties. Herbal medicines are not only effective but also come with minimal side effects and are cost-effective, making them a preferred choice for many. Since ancient times, these natural remedies have played a crucial role in diabetes management, with their active compounds offering a safe and holistic approach to maintaining health and managing this chronic condition.

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 [4]. *Aloe vera* is a member of the Liliaceae family, which has about 360 species. *Aloe vera* is a cactus-like plant that grows in hot, dry climate[5] *Aloe vera* has been used for medicinal purposes in several cultures like Greece, Egypt, India, Mexico, Japan, and China since ancient time.[6] The pharmacological actions of *Aloe vera*, as evidenced by *in-vitro* and animal studies, include anti-inflammatory and anti-arthritic activity, and antibacterial

and hypoglycemic effects. The therapeutic claims made for *Aloe vera* range over a broad list, as do the pharmacological activities associated with it [7].

The primary objective of this study is to meticulously examine the anti-hyperglycemic effects of alcoholic extracts from *Momordica Charantia* (Karla fruits) and aloe vera (leaves), both as individual treatments and in combination. Furthermore, the study seeks to compare these effects with those of Metformin, a widely recognized anti-diabetic medication, in rats induced with alloxan diabetes. In addition to monitoring blood glucose levels, the research will also evaluate the impact of these treatments on liver function, as indicated by SGOT and SGPT levels, as well as renal function, assessed through creatinine, serum albumin, and urea levels. Changes in body weight will also be carefully tracked to provide a comprehensive understanding of the overall health effects of these treatments.

MATERIAL AND METHODS

The study was conducted at the Institute of Pharmacy, Bundelkhand University, Jhansi, to investigate the comparative efficacy of alcoholic extracts from *Momordica Charantia* (Karla fruits), aloe vera (leaves), and their combination, with Metformin serving as the standard drug. The research was performed on alloxan-induced diabetic male albino rats to evaluate anti-hyperglycemic activity and the effects on liver and renal functions, as well as body weight changes. The following procedure was 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 authentification of plant materials

The fresh *fruits of karela and* leaves of *Aloe vera* were collected from local region of Bundelkhand, Jhansi Uttar Pradesh, India, and authenticated (Accession no. **28697, and 28699)** 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 dried and powdered karela fruits material (100 g) were soaked in 500 ml of 90% ethanol for about 15 days at room temperature with occasional stirring. After 15 days, the solution was filtered using filter cloth and Whatman's filter paper. The filtrates (ethanolic extract) obtained were evaporated to dryness. It rendered a gummy concentrate and was designated as crude extracts of ethanol [8].

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. Alcoholic extract was made by dissolving it in 95% ethanol. The dose was initially made to 300 mg/kg body weight for oral administration [9].

Preparation of Metformin

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 [10].

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 ± 2^0C) 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, Flavonoids, tannins and carbohydrate [11-13] .

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 [14-16].

EXPERIMENTAL WORK

Animals will be maintained in clean polypropylene cages with 12 hr light & 12 hr dark cycle at temp of 27-29 ^{0}C & 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.

Grouping

30 male albino Wistar rats were randomly divided into six groups (n=5 per group)

Group I (Normal Control) (NC): Rats without any treatment.

Group II (Diabetic Control) (DC): Alloxan-induced diabetic rats without any treatment.

Group III (Metformin Treatment) (Reference): Diabetic rats treated with Metformin 150 mg/kg.

Group IV (Momordica Charrantia Treatment) (MC): Diabetic rats treated with alcoholic extract of *Momordica Charantia* 300 mg/kg.

Group V (Aloe vera Treatment) (AV): Diabetic rats treated with alcoholic extract of *Aloe vera* 300 mg/kg.

Group VI (MK + AV): Diabetic rats treated with a combination of *Momordica Charantia* and *Aloe vera* alcoholic extract 300 mg/kg.

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 [17-18] and determination of SGOT and SGPT as biochemical markers of liver functioning [19-20].

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 meticulously designed to evaluate the comparative efficacy of herbal drug preparations—specifically, the alcoholic extracts of *Momordica charantia* (karela fruit) and *Aloe vera* leaves, both individually and in combination—against the standard pharmaceutical agent Metformin, as blood glucose-lowering agents in male albino rats. In addition to assessing their hypoglycemic potential, the study aimed to investigate the impact of these treatments on kidney function by measuring biochemical markers such as creatinine, albumin, and urea, as well as liver function markers, including SGOT (Serum Glutamic-Oxaloacetic Transaminase) and SGPT (Serum Glutamic-Pyruvic Transaminase). Furthermore, the effects on the rats' body weights were closely monitored.

To conduct this comprehensive study, 30 male albino Wistar rats were randomly assigned to six distinct groups. Group I served as the normal control, receiving no treatment. Group II acted as the diabetic control. Group III was treated with Metformin, the standard

drug. Group IV received the alcoholic extract of *Momordica charantia*. Group V was administered the alcoholic extract of *Aloe vera*. Group VI was treated with a combination of both *Momordica charantia* and *Aloe vera* extracts. All groups were meticulously observed throughout the 28-day treatment period to ensure accurate and reliable results.

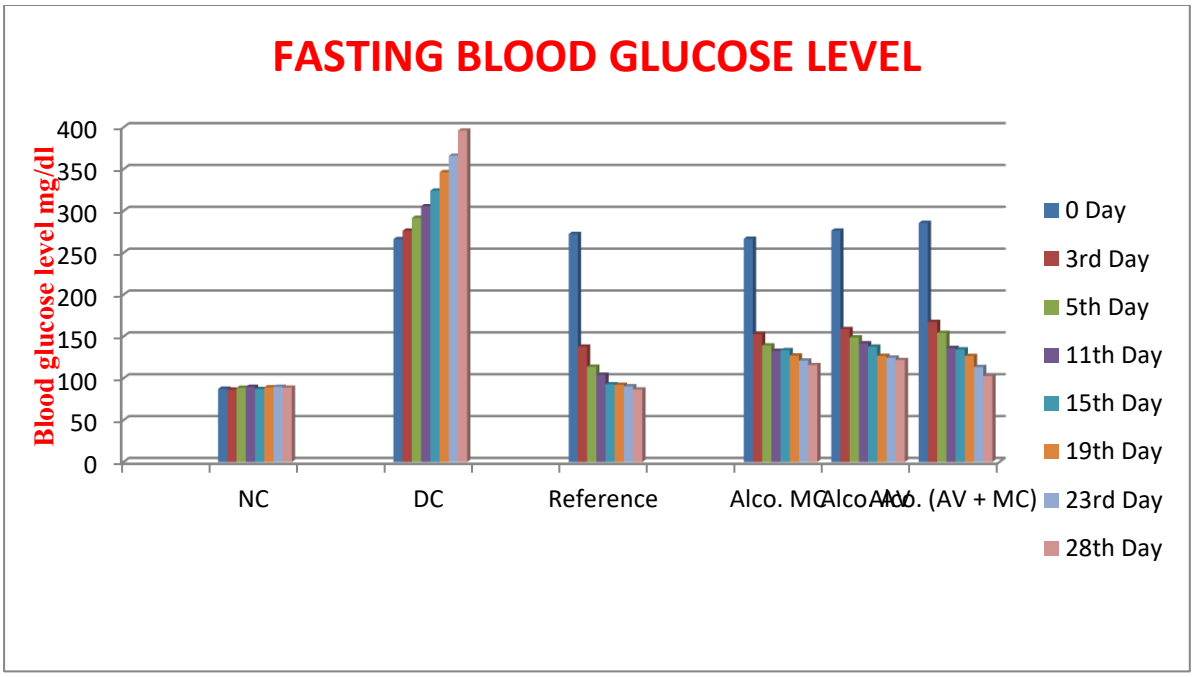
Effect on blood glucose level

The alcoholic extracts of MC, AV and combination of MC+AV 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 MC+AV > MC > AV. The results are shown in table 1.

Table 1: Effect of Metformin, *Karela fruit* alcoholic extract, *Aloe vera* alcoholic Extract and combination of (MC + AV) 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	**Alco. MC**	266.6	152.8	139.2	132.8	133.6	127.2	121.2	115.8
	Alco. AV	276.4 ± 16.72	158.8 ± 11.02	148.8 ± 9.89	141.8 ±	137.8 ± 8.25	126.8 ±6.79	124.6 ±4.59	121.8 ±4.07
VI	**Alco. (AV + MC)**	285.6 ± 17.36	167.4 ±11.62	154.2 ±4.99	136.2 ±6.58	134.4 ± 9.56	126.6 ± 8.04	113.4 ±4.96	102.6 ±3.72

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



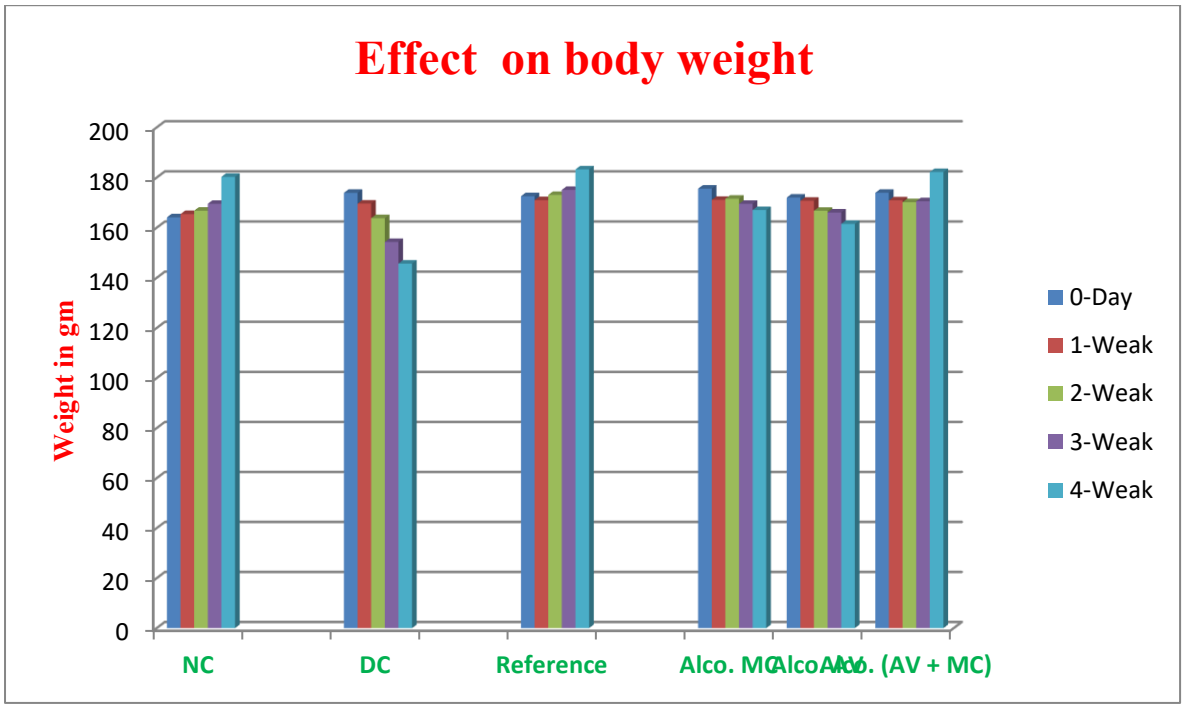
Effect on body weight

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* alcoholic extract, *Aloe vera* alcoholic Extract and combination of (MC + AV) 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	170.96 ± 8.53	173.04 ± 8.05	175.06 ± 7.60	183.24 ± 8.01
VI	Alco. MC	175.6 ±9.10	171.08 ±9.05	171.54 ±10.50	169.5 ±11.87	167.02 ±13.35
V	Alco. AV	172.0 ±10.4	170.7 ±11.10	166.7 ±8.40	166.0 ±5.70	161.5 ±6.20
VI	Alco. (AV + MC)	173.9 ±11.20	170.9 ±11.10	170.2 ±11.10	170.5 ±12.20	182.2 ± 13.70

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



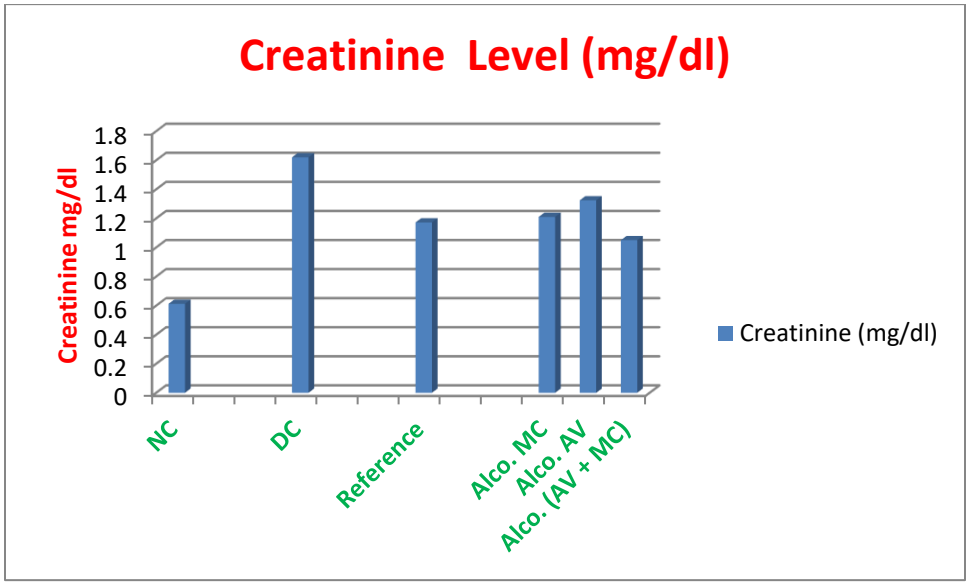
Effect on Biochemical parameters in Alloxan induced diabetic rats

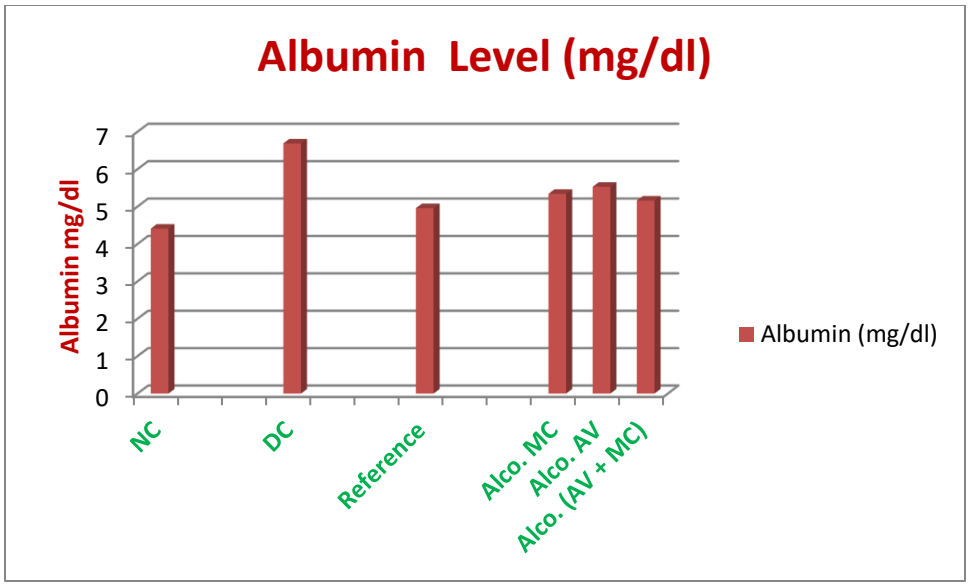
At the end of the experimental study estimation of serum biochemical parameters a varying effect were observed. In this study serum creatinine level was greatly reduced by the combination of MC and AV. The most effective extract to reduce serum creatinine was found to be in order of MC+AV > MC > AV. Serum albumin level was most significantly reduced and the order of effectiveness was found to be MC+AV > MC > AV. The order of extracts to reduce serum urea was MC+AV > MC > AV. Combination of MC and AV significantly reduced serum SGOT and the order was found to be MC+AV > MC > AV. The most significant extract to reduce serum SGPT, order was found MC+AV > MC > AV. Combination of MC and AV extract maintain near about all the biochemical parameters similar to standard drug Metformin. The results are shown in table 3 & 4.

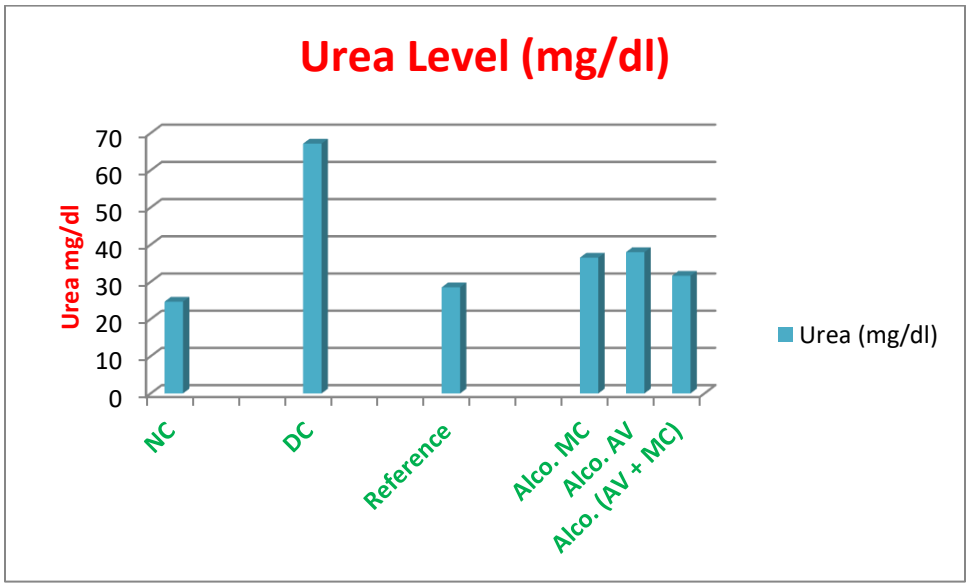
Effects of Plant extracts on Renal functioning

Table 3. Effect of *Karela fruit* alcoholic extract, *Aloe vera* alcoholic Extract and combination of (MC + AV) on serum creatinine, albumin and urea (Kidney function tests)

Groups	Treatment with dose	Creatinine (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	**Reference**	1.172 ± 0.106	4.956 ± 0.242	28.528 ± 3.716
IV	**Alco. MC**	1.21 ±0.032	5.34 ±0.20	36.5 ±0.72
V	**Alco. AV**	1.324 ±0.038	5.53 ±0.05	37.97 ±0.91
VI	**Alco. (AV + MC)**	1.05 ±0.034	5.16 ±0.05	31.628 ±0.68





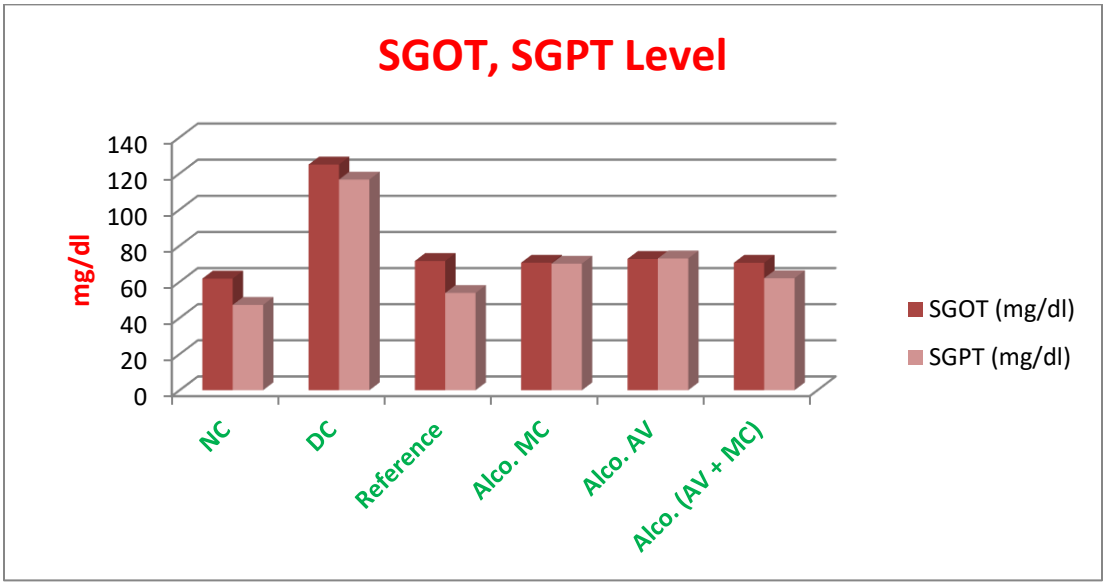


Effects of Plant extracts on Liver functioning

Table 4. Effect of *Karela fruit* alcoholic extract, *Aloe vera* alcoholic Extract and combination of (MC + AV) 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
VI	Alco. MC	70.59 ±1.38	70.05 ±2.05
V	Aq. MK	76.1 ±1.33	71.84 ±0.97
VI	Alco. Mk	76.25 ±0.56	71.7 ±1.65



DISCUSSION

Folk medicinal plants have long been a crucial source of medicine, with many current drugs derived directly or indirectly from them. This study aimed to evaluate and compare the effects of alcoholic extracts of *Momordica Charantia* (Karela fruits), *Aloe vera*, and a combination of these two on blood glucose levels in alloxan-induced diabetic male albino rats. Additionally, the study assessed the impact on other related markers, including liver function tests (SGOT and SGPT), creatinine, serum albumin, and urea as indicators of renal function, as well as changes in body weight. A comparison with Metformin, a commonly used synthetic antidiabetic drug, was also conducted.

The plant extracts exhibited significant antidiabetic activity, notably lowering blood glucose levels compared to the control group. Alloxan-induced diabetic hyperglycemia elevates plasma

levels of urea, albumin, and creatinine, indicating renal dysfunction, as well as SGOT and SGPT levels, which signify liver dysfunction. The results from Table 3 demonstrate a substantial decrease in plasma levels of urea, albumin, and creatinine, while Table 4 shows a notable reduction in serum SGOT and SGPT levels in diabetic rats treated with alcoholic extracts and their combinations.

CONCLUSION

The study concludes that the alcoholic extracts of **Momordica Charantia** and **Aloe vera**, either individually or in combination, have potent antidiabetic effects, comparable to Metformin. These extracts not only help in controlling blood glucose levels but also improve markers of liver and renal functions, thereby presenting a promising alternative for diabetes management.

Our study demonstrates that the alcoholic extracts of Momordica Charantia and Aloe vera and their combination have a beneficial modulatory effect in the treatment of diabetes mellitus and may be utilized as part of diabetes management. Since these folk medicines have been traditionally used as stable foods in daily life, they may be safe for use as dietary supplements and medications. However, long-term research is necessary, as herbal plant compounds often act more slowly than synthetic medications, and higher dosages might lead to a plateau effect.

Conflict of Interest:

The authors declare that they don’t have any
Conflict of interest.

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