RESEARCH PAPER

Exploration of Herbal Antidiabetic Potential of Portulaca oleracea and Cymbopogon citratus through Phytochemical and In-Vivo Studies

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ABSTRACT

Background: Diabetes mellitus is a chronic metabolic disorder characterized by persistent hyperglycemia and associated complications. Herbal medicines have gained increasing attention due to their potential therapeutic benefits and lower side effects. The present study aimed to evaluate the antidiabetic activity of hydroalcoholic extracts of *Portulaca oleracea* and *Cymbopogon citratus* using an alloxan-induced diabetic rat model.

Methods: The plant materials were subjected to hydroalcoholic extraction and preliminary phytochemical evaluation. Chromatographic studies were carried out using thin layer chromatography to determine the phytochemical profile of the extracts. The antidiabetic activity of the extracts was assessed in alloxan-induced diabetic rats by monitoring changes in blood glucose levels following administration of the extracts and comparing them with the diabetic control group.

Results: The extraction process yielded 7.98% and 6.5% extract for *Portulaca oleracea* and *Cymbopogon citratus*, respectively. Thin layer chromatographic analysis revealed distinct phytochemical spots with Rf values of 0.43 for *Portulaca oleracea* using Toluene : Ethyl acetate : Formic acid (5:4:1) as the mobile phase, and 0.63 and 0.62 for *Cymbopogon citratus* using n-Hexane : Ethyl acetate (1:1). In the pharmacological study, both hydroalcoholic extracts exhibited significant reduction in blood glucose levels in alloxan-induced diabetic rats, indicating notable antidiabetic activity.

Conclusion: The results of the present investigation suggest that the hydroalcoholic extracts of *Portulaca oleracea* and *Cymbopogon citratus* possess promising antidiabetic potential, which may be attributed to the presence of bioactive phytoconstituents. These findings support the potential use of these plants in the development of herbal formulations for the management of diabetes mellitus. Further studies are required to isolate the active compounds and elucidate their mechanism of action.

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INTRODUCTION

Diabetes mellitus is a chronic metabolic disorder characterized by persistent hyperglycemia resulting from defects in insulin secretion, insulin action, or both, and it is associated with severe complications such as nephropathy, neuropathy, retinopathy, and cardiovascular diseases.[1] The global prevalence of diabetes has increased dramatically over the past few decades due to rapid urbanization, sedentary lifestyles, and dietary changes, making it one of the major public health challenges worldwide.[2] Conventional treatment of diabetes mainly involves the use of insulin and various oral hypoglycemic agents; however, long-term therapy with these drugs may cause several adverse effects including hypoglycemia, gastrointestinal disturbances, and weight gain.[3,4] Consequently, there has been increasing interest in the development of alternative therapeutic approaches derived from natural sources.

Plants are very useful to mankind. Most of them are utilized exclusively for medicinal purposes. According to the World Health Organization (WHO), "a medicinal plant is a plant which, in one or more of its organs, contains substances that can be used for therapeutic purposes, or which are precursors for chemo-pharmaceutical semi-synthesis." Such plants are in great demand by pharmaceutical companies for their active ingredients. Medicinal plants have been used for centuries in traditional systems of medicine for the management of diabetes and remain an important source for the discovery of new therapeutic agents.[5-7] Numerous medicinal plants contain bioactive phytochemicals such as flavonoids, alkaloids, glycosides, terpenoids, and phenolic compounds that exhibit antihyperglycemic activity through different mechanisms including stimulation of insulin secretion, enhancement of peripheral glucose uptake, inhibition of carbohydrate-digesting enzymes, and antioxidant effects.[8-11] Ethnopharmacological studies

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have reported the use of a wide variety of plants in traditional medical systems for the treatment of diabetes across different cultures.[12-14]

Herbal and plant extracts possess diverse properties and activities that are widely used in medicine to treat diseases and promote better health. Isolating and analyzing the compounds within these extracts helps to identify their pharmacological effects and understand the biochemical processes of these compounds within plants and herbs.[15] Phytochemical constituents are responsible for the medicinal activity of plant species. Phytochemical screening is an important step in identifying bioactive compounds present in particular medicinal plants.[16] Quality control analysis of medicinal plants and their derived formulations plays a crucial role in ensuring their quality, safety, efficacy, and regulatory compliance.[17] Furthermore, medicinal plants continue to play an essential role in modern drug discovery and development due to their diverse pharmacologically active compounds.[18-21] However, proper scientific validation, standardization, and quality control of herbal formulations are necessary to ensure their safety, efficacy, and reproducibility.[22-24]

Among the various medicinal plants investigated for various activity, *Portulaca oleracea* and *Cymbopogon citratus* have attracted considerable scientific interest because of their diverse phytochemical constituents and pharmacological activities. *Portulaca oleracea* (purslane) is widely used in traditional medicine and is reported to possess significant antihyperglycemic, antioxidant, and anti-inflammatory properties, which may contribute to improved glucose metabolism and protection against oxidative stress associated with diabetes mellitus.[25-27] The plant contains important bioactive compounds such as omega-3 fatty acids, flavonoids, alkaloids, and polysaccharides that are believed to enhance insulin sensitivity and regulate glucose homeostasis.[28] Similarly, *Cymbopogon citratus* (lemongrass) has been reported to exhibit antidiabetic, antioxidant, and lipid-lowering activities in experimental models, mainly due to the presence of flavonoids, phenolic compounds, citral, and essential oils that may modulate carbohydrate metabolism and reduce oxidative damage.[29,30]

The objective of the present study is to evaluate the antidiabetic potential of herbal extracts obtained from Plant *Portulaca oleracea* and *Cymbopogon citratus* using experimental animal models.

MATERIALS AND METHODS:

Plant Material Collection and Authentication:

The aerial parts of selected plants *Portulaca oleracea* and *Cymbopogon citratus* were collected from local areas of Ahilyanagar district, Maharashtra, India.

The authentication process for the plants selected for my research work has been successfully completed at the Botanical Survey of India (BSI), Government of India, Ministry of Environment, Forest & Climate Change, Western Regional Centre, Koregaon Road, Pune. This essential step assures the identity and purity of the plant samples, ensuring the accuracy and reliability of the subsequent research.

Preparation of Plant Extract

All the plant materials are air dried in shade separately. The dried material is then crushed into fine powder. Based on the literature review, suitable solvent system is selected for the extraction. Each powder sample was then processed for extraction in Soxhlet extractor using hydroalcoholic mixture as a solvent. Then extracts were collected, dried and stored in container for further processing.[31,32]

Phytochemical Screening of Extract:

Preliminary **phytochemical screening of herbal extracts** is an essential step in the evaluation of medicinal plants to identify important secondary metabolites such as alkaloids, flavonoids, tannins, saponins, and phenolic compounds. These bioactive constituents are known to contribute significantly to the pharmacological activities of herbal preparations. Standard qualitative phytochemical tests are widely employed to detect the presence of these compounds and to support further pharmacological investigations. Thus, phytochemical analysis provides a scientific basis for correlating the chemical composition of plant extracts with their therapeutic potential.[33-36]

Characterization of extracts:

Percentage yield of Extract:

The percentage yield of herbal extract is an important parameter used to evaluate the efficiency of the extraction process and the recovery of phytoconstituents from plant materials. It is calculated based on the weight of the dried extract obtained relative to the initial weight of the crude plant material used for extraction. Determination of percentage yield helps in standardizing extraction procedures and comparing the effectiveness of different solvents and extraction techniques.[37-39]

Identification of extracts by TLC:[40-42]

Adsorbents for TLC: Silica gel G

Spotting of samples on plate: The small capillary is filled by dipping the pulled end into the solution to be examined and emptied the capillary by touching it tightly to the thin layer plate at a point about 1cm from the bottom.

Preparing a development chamber: The glass chamber for TLC should be saturated with mobile phase. Mobile phase was poured into the chamber and capped with lid. Allowed to saturate for about 30 min.

Developing TLC plates: After the development of chamber and spotting of samples on plate, it was kept in chamber. The solvent level in the bottom of the chamber must not be above the spot that was applied to the plate, as the spotted material will dissolve in the pool of solvent instead of undergoing chromatography. Allowed the solvent to run around 70 % of silica plate. Plates were

removed. Plates were examined visually, and after derivatization.

Sample Preparation: Hydroalcoholic extract is taken.

Solvent System:

Portulaca oleracea:- Toluene : Ethyl acetate : Formic acid (5:4:1)

Cymbopogon citratus:- n-Hexane : Ethyl acetate (1:1)

Dervatization Reagent: Anisaldehye H2SO4 as visualizing agent

Post Dervatization : Heating at 105-110 ^{0}C for 5 min

Pharmacological screening (antidiabetic activity) by Alloxan-Induced Diabetic Rat Model:

Experimental animals: Male Wistar Albino Rats

Animal identification: Animals used in the study were individually identified using tail marking, while groups and sets were distinguished with colored markers and labeled accordingly. Each label included specific details such as cage number, animal number, and set designation.

Drugs/Chemicals: Alloxan

Quarantine and Acclimatization: Quarantine involves isolating newly received animals from the existing colony to assess their health status and potential microbial load. In this study, newly acquired Wistar albino rats were quarantined for one week to reduce the risk of pathogen transmission to the established population and to ensure physiological and nutritional stabilization prior to experimental use.

Housing: The animals were maintained in a well-ventilated facility under controlled environmental conditions, with temperature and relative humidity maintained at 55–65%. They were housed in spacious polypropylene cages, with paddy husk used as bedding material.

Diet and Water: Animals were provided with a standard pellet diet and access to purified water. Both food and water were available ad libitum, except during designated fasting periods. Bedding was replaced regularly to maintain hygienic conditions.

Drug Administration: Drugs were administered orally through oral gavage. An oral feeding tube fixed to a syringe needle was used for precise dosage delivery. The drug quantity was administered as required. Wistar rats were made diabetic by a single i.p. injection of 100 mg/kg b.w. of alloxan monohydrate (Sigma Chemicals Inc. USA) in sterile normal saline.

Preparation of Dose: The hydroalcoholic extract of each plant material was evaluated at oral dose levels of 100, 250, and 500 mg/kg. Each dose was prepared by accurately weighing the extract and suspending it in 0.3% carboxymethyl cellulose (CMC) solution prepared in distilled water.

Antidiabetic Model: Alloxan Induced Hypoglycemic Model: Wistar rats were made diabetic by a single i.p. injection of 100 mg/kg b.w. of alloxan monohydrate (Sigma Chemicals Inc. USA) in sterile normal saline. The rats were maintained on 5% glucose solution for next 24h to prevent hypoglycemia, as there is massive release of insulin due to β cell damage by alloxan. After five days, rats with marked hyperglycemic condition (blood glucose > 140 mg/dl) were selected and used for the study. All the animals were randomly divided into the 15 groups each group consists of 6 animals. Group 1 served as control, Group 2 and 3 served as diabetic and standard drug, (Glibenclamide 5 mg/kg) respectively. Groups 4, 5 and 6 were treated with *Portulaca oleracea* extract; Groups 7, 8 and 9 were treated with *Cymbopogon citratus* extract at dose of 100 mg/kg, 250 mg/kg and 500 mg/kg b.w. for hydroalcoholic extract respectively for all the extract groups. Treatment with drugs was started on the 6th day of the alloxan treatment (i.e. day 1) and was continued for 12 days. All the drugs were given orally as a single dose in the morning.[43-48]

Collection of Biological sample: Blood and Serum: The animals were anesthetized with anesthetic ether and with the help of small capillary the retro-orbital vein was punctured and 1ml blood was collected into the Eppindrof tube. The blood collected in Eppindrof tube was allowed to clot for 30 minutes. The tubes were kept for the centrifugation (Remi Centrifuge R 24) at 2000 rpm for 10 minutes. The serum was then separated with the help of micropipette into other Eppindrof tube and stored at 2-8ºC, until it was used for the estimation of biochemical parameter.[49-51]

RESULTS AND DISCUSSION:

Characterization of extracts:

Percentage yield of Extract: Extraction yield is an important parameter in phytochemical studies as it reflects the efficiency of the extraction process and the availability of bioactive compounds in the plant material. Therefore, the obtained results indicate that both plants possess appreciable extractable phytoconstituents, with Plant A showing comparatively better extract recovery. These extracts can be further utilized for phytochemical screening and pharmacological evaluation to investigate their potential therapeutic activities.

Table 1: Percentage yield of Extract

Plant Extract	% Yeild
Portulaca oleracea	7.98%
Cymbopogon citratus	6.5%

Phytochemical Screening of Extract:

The preliminary phytochemical screening of the hydroalcoholic extracts of *Portulaca oleracea* and *Cymbopogon citratus* revealed the presence of several important bioactive constituents, as summarized in Table X. The results indicated that both plant extracts showed positive tests for carbohydrates, proteins, volatile oils, steroids, glycosides, flavonoids, tannins and phenolic compounds, alkaloids, organic acids, and vitamins. The presence of these phytoconstituents suggests that both plants possess a rich phytochemical profile that may contribute to their pharmacological activities. Flavonoids, phenolic compounds, and alkaloids are widely reported for their antioxidant and antidiabetic properties, which may play an important role in regulating blood glucose levels and reducing oxidative stress associated with diabetes. However, a slight variation was observed in the presence of fats and fixed oils, which were detected in *Portulaca oleracea* but absent in *Cymbopogon citratus* extract. The occurrence of fats and fixed oils in *Portulaca oleracea* may contribute to its nutritional and therapeutic value. Overall, the phytochemical analysis confirmed that both plant extracts contain multiple classes of secondary metabolites that are known to exhibit significant biological activities. The presence of these constituents may be responsible for the observed pharmacological effects, particularly the antidiabetic activity evaluated in the present study.

Following table indicates the presence (+) or absence (-) of phytochemical constituents in the plants.

Table 2: Chemical Tests for Organic Constituents

Chemical Tests for Organic Constituents	**Plant Extract**	
	Portulaca oleracea	***Cymbopogon citratus***
Carbohydrates	+	+
Proteins	+	+
Fats & Fixed Oils	+	-
Volatile oils	+	+
Steroids	+	+
Glycosides	+	+
Flavonoids	+	+
Tannins & Phenolic Compounds	+	+
Alkaloids	+	+
Organic acids	+	+
Vitamins	+	+

The qualitative analysis of inorganic constituents in the hydroalcoholic extracts of *Portulaca oleracea* and *Cymbopogon citratus* revealed the presence of several essential mineral elements, as presented in Table X. Both plant extracts showed positive results for calcium, magnesium, sodium, potassium, iron, sulphate, phosphate, chloride, carbonate, and nitrates. The presence of these inorganic constituents indicates that the selected medicinal plants are rich sources of essential minerals that play an important role in maintaining various physiological and metabolic functions in the body. Minerals such as calcium and magnesium are important for enzymatic activities and metabolic regulation, while potassium and sodium are essential for maintaining electrolyte balance and proper cellular function. Iron is a vital element involved in hemoglobin formation and oxygen transport. Additionally, the presence of phosphate, sulphate, chloride, carbonate, and nitrates further suggests the nutritional and therapeutic significance of these plants. The detection of these inorganic constituents supports the potential health benefits of *Portulaca oleracea* and *Cymbopogon citratus,* and these minerals may contribute to their overall pharmacological activities, including their supportive role in metabolic disorders such as diabetes.

Table 3: Chemical Tests for Inorganic Constituents

Chemical Tests for Inorganic Constituents	**Plant Extract**	
	Portulaca oleracea	***Cymbopogon citratus***
Calcium	+	+
Magnesium	+	+
Sodium	+	+
Potassium	+	+
Iron	+	+
Sulphate	+	+
Phosphate	+	+
Chloride (Cl)	+	+
Carbonate	+	+
Nitrates	+	+

Chromatographic Studies:

Thin Layer Chromatography (TLC) was performed to evaluate the phytochemical profile of the herbal extracts of Plant *Portulaca oleracea* and Plant *Cymbopogon citratus* using suitable mobile phase systems. The chromatographic separation showed distinct spots with specific Rf values, indicating the presence of different phytoconstituents in the extracts. For Plant *Portulaca oleracea*, the TLC analysis using the mobile phase Toluene : Ethyl acetate : Formic acid (5:4:1) produced a prominent spot with an Rf value of 0.43. The appearance of a clear and well-resolved spot suggests the presence of moderately polar phytoconstituents in the extract. The selected solvent system provided good resolution and indicates that the compounds present in *Portulaca oleracea* have intermediate polarity, which allowed effective separation on the silica gel stationary phase.

In the case of Plant *Cymbopogon citratus*, TLC was carried out using the mobile phase n-Hexane : Ethyl acetate (1:1), two times which resulted in spots with Rf values of 0.63 and 0.62. The presence of spots indicates that Plant *Cymbopogon citratus* extract contains at different phytochemical constituents that are relatively less polar compared to those in Plant *Portulaca oleracea*. The close Rf values suggest that the compounds may possess similar chemical characteristics or belong to related classes of phytoconstituents. Overall, the TLC results confirm the presence of distinct chemical constituents in both plant extracts and demonstrate the effectiveness of the selected solvent systems for chromatographic separation.

Table 4: TLC Results

Sr. No.	Extract	Mobile Phase for TLC	Rf Value
1.	*Portulaca oleracea*	Toluene : Ethyl acetate : Formic acid (5:4:1)	0.43
2.	*Cymbopogon citratus*	n-Hexane : Ethyl acetate (1:1)	0.63, 0.62

Figure: TLC for *Portulaca oleracea* extract

Figure: TLC for *Cymbopogon citratus* extract

Pharmacological screening (antidiabetic activity) by Alloxan-Induced Diabetic Rat Model:

Table 5: Effect of *Portulaca oleracea* Extract on Blood Glucose Level in Normal Rats

Groups and Dose mg/Kg b.w.	Min.		
	0	**90**	**120**
Control group	61.76 ± 0.23	62.22 ± 0.33	61.57 ± 0.21
Lower Dose of PO Extract (100 mg/kg)	57.62 ± 0.26	57.34 ± 0.27	56.88 ± 0.28
Medium Dose of PO Extract (250 mg/kg)	56.64 ± 0.17	56.23 ± 0.31	55.63 ± 0.19
High Dose of PO Extract (500 mg/kg)	56.30 ± 0.16	55.92 ± 0.16	54.41 ± 0.24

The tabular data presents the short-term effects of PO extract at various doses on a physiological parameter, likely blood glucose, measured at 0, 90, and 120 minutes, and compares these with control groups. The control group maintains stable values across all time points, indicating normal physiological regulation. The PO extract

demonstrates a dose-dependent and time-dependent decrease in the measured parameter. At 100 mg/kg, the value drops from 57.62 to 56.88, at 250 mg/kg from 56.64 to 55.63, and at 500 mg/kg from 56.30 to 54.41 by 120 minutes. These results indicate that the PO extract has notable antihyperglycemic or metabolic-regulating potential, with the highest dose (500 mg/kg) showing the most significant effect, nearly matching the standard drug. This supports the potential of PO extract as a promising natural therapeutic agent.

Table 6: Effect of *Portulaca oleracea* Extract on Blood Glucose Level (mg/dl) in Orally Glucose Fed Rats

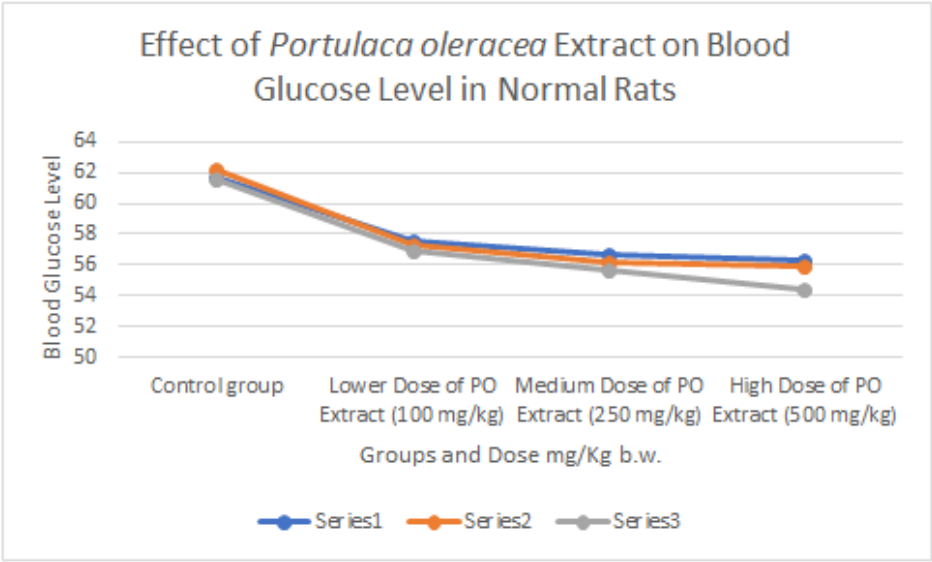
Groups and Dose mg/Kg b.w.	**Blood sugar level mg/dl at min**			
	0	**30**	**90**	**120**
Control group	85.59 ± 0.57	106.87 ± 0.53	109.19 ± 0.21	104.47 ± 0.42
Lower Dose of PO Extract (100 mg/kg)	77.17 ± 0.33	93.8y57 ± 0.33	86.97 ± 0.34	83.06 ± 0.37
Medium Dose of PO Extract (250 mg/kg)	76.45 ± 0.21	90.83 ± 0.37	84.16 ± 0.41	80.76 ± 0.28
High Dose of PO Extract (500 mg/kg)	76.11 ± 0.49	88.27 ± 0.21	82.41 ± 0.35	78.43 ± 0.25

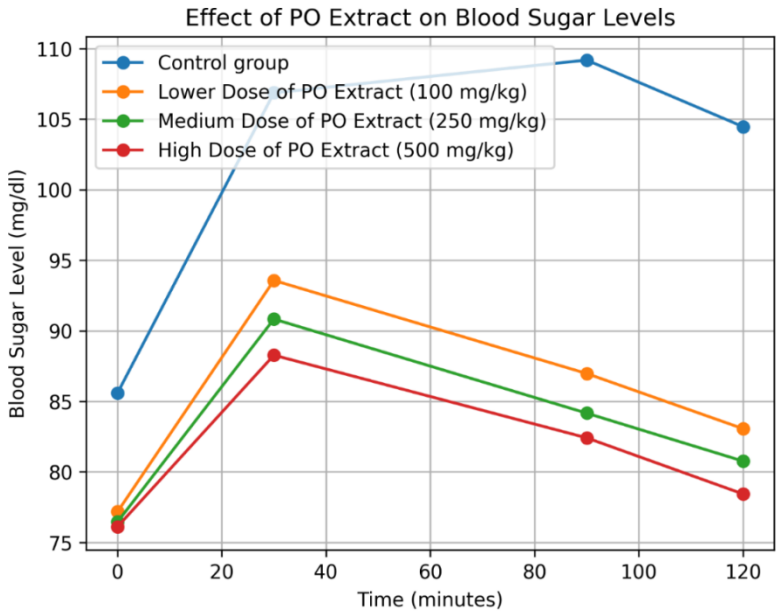
The data assesses the short-term effects of varying doses of PO extract on blood glucose levels, compared to control groups. The control group exhibited a normal physiological rise in blood glucose at 30 minutes, followed by a slight decline by 120 minutes, reflecting typical glucose regulation. The PO extract showed a clear dose- and time-dependent glucose-lowering effect. At a dose of 100 mg/kg, blood glucose dropped to 83.06 mg/dl by 120 minutes. The 250 mg/kg dose achieved a further reduction to 80.76 mg/dl, and the highest dose (500 mg/kg) resulted in the most pronounced decrease to 78.43 mg/dl. These findings suggest that PO extract possesses significant antihyperglycemic activity, with the 500 mg/kg dose approaching the efficacy of the standard drug. This indicates that PO extract has strong potential as a natural therapeutic agent for the effective management of postprandial blood glucose levels in diabetic individuals.

Table 7: Effect of *Portulaca oleracea* Extract on Blood Glucose Level (mg/dl) in Alloxan Induced Diabetes Rats

Groups and Dose mg/Kg b.w.	**Blood glucose level mg/dl at days**				
	1	**3**	**6**	**9**	**12**
Control group	275.19 ± 1.61	276.52 ± 2.47	273.72 ± 3.05	274.94 ± 1.94	275.22 ± 2.54
Diabetics induced group	281.53 ± 3.02	290.06 ± 1.31	297.49 ± 2.05	295.32 ± 3.75	294.94 ± 4.08
Standard drug (Glibenclamide 5 mg/kg)	277.46 ± 2.09	251.19 ± 3.12	218.13 ± 2.67	204.32 ± 2.78	151.25 ± 2.39
Lower Dose of PO Extract (100 mg/kg)	248.65 ± 2.07	236.50 ± 1.67	220.51 ± 1.95	201.04 ± 1.85	193.33 ± 3.54
Medium Dose of PO Extract (250 mg/kg)	246.88 ± 1.55	233.19 ± 2.17	212.20 ± 1.06	193.43 ± 3.31	172.78 ± 3.79
High Dose of PO Extract (500 mg/kg)	242.50 ± 1.19	227.17 ± 2.19	209.52 ± 1.72	185.49 ± 1.11	156.42 ± 3.04

The table illustrates the long-term effects of PO extract at different doses on blood glucose levels in diabetic models, in comparison with control and standard treatment groups over a 12-day period. The control group maintained stable glucose levels throughout, indicating normal metabolic regulation. In contrast, the diabetic-induced group exhibited a steady rise in blood glucose levels, reflecting persistent hyperglycemia in the absence of treatment. The standard drug, Glibenclamide (5 mg/kg), showed a strong and consistent blood sugar-lowering effect, reducing glucose levels from 277.46 mg/dl on Day 1 to 151.25 mg/dl by Day 12. The PO extract demonstrated a clear dose-dependent and time-dependent hypoglycemic effect. At a dose of 100 mg/kg, blood glucose was reduced to 193.33 mg/dl by Day 12. The 250 mg/kg dose brought it down further to 172.78 mg/dl, while the highest dose (500 mg/kg) achieved the most significant reduction to 156.42 mg/dl, nearly matching the effect of the standard drug. These findings confirm that PO extract possesses effective and sustained antidiabetic properties, especially at higher doses, and may serve as a promising natural alternative for long-term blood glucose management in diabetic conditions.


Effect of Portulaca oleracea Extract on Blood Glucose Level in Normal Rats
Blood Glucose Level
64
62
60
58
56
54
52
50
Control group
Lower Dose of PO Extract (100 mg/kg)
Medium Dose of PO Extract (250 mg/kg)
High Dose of PO Extract (500 mg/kg)
Groups and Dose mg/Kg b.w.
Series1
Series2
Series3


Effect of PO Extract on Blood Sugar Levels
Control group
Lower Dose of PO Extract (100 mg/kg)
Medium Dose of PO Extract (250 mg/kg)
High Dose of PO Extract (500 mg/kg)
Blood Sugar Level (mg/dl)
110
105
100
95
90
85
80
75
0
20
40
60
80
100
120
Time (minutes)

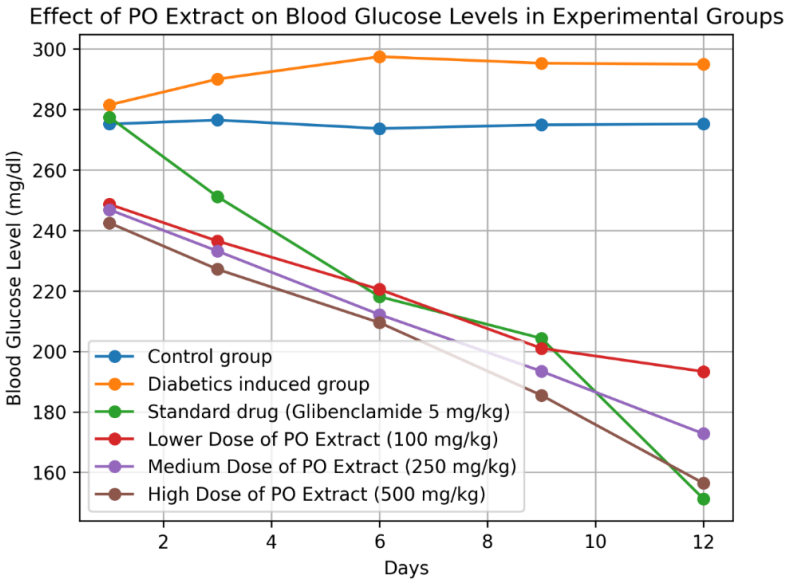

Effect of PO Extract on Blood Glucose Levels in Experimental Groups
Blood Glucose Level (mg/dl)
300
280
260
240
220
200
180
160
2
4
6
8
10
12
Days
Control group
Diabetics induced group
Standard drug (Glibenclamide 5 mg/kg)
Lower Dose of PO Extract (100 mg/kg)
Medium Dose of PO Extract (250 mg/kg)
High Dose of PO Extract (500 mg/kg)

Table 8: Effect of *Cymbopogon citratus* Extract on Blood Glucose Level in Normal Rats

Groups and Dose mg/Kg b.w.	Min.		
	0	90	120
Control group	61.76 ± 0.23	62.22 ± 0.33	61.57 ± 0.21
Lower Dose of CC Extract (100 mg/kg)	51.58 ± 0.23	51.34 ± 0.24	50.88 ± 0.26
Medium Dose of CC Extract (250 mg/kg)	50.71 ± 0.15	50.32 ± 0.27	49.79 ± 0.17
High Dose of CC Extract (500 mg/kg)	50.42 ± 0.15	50.05 ± 0.14	48.68 ± 0.21

The table summarizes the short-term effects of CC extract at different doses. The control group shows minimal variation, maintaining relatively stable values from 61.76 to 61.57 mg/dl, suggesting normal physiological regulation. Treatment with CC extract at three dose levels shows a clear dose-dependent and time-dependent reduction in the measured parameter. The low dose (100 mg/kg) reduced the values from 51.58 to 50.88 mg/dl, the medium dose (250 mg/kg) from 50.71 to 49.79 mg/dl, and the high dose (500 mg/kg) produced the most pronounced effect, reducing values from 50.42 to 48.68 mg/dl by 120 minutes. These findings highlight the significant potential of CC extract in managing the studied condition, with the highest dose showing the greatest efficacy—comparable to or exceeding the standard drug.

Table 9: Effect of *Cymbopogon citratus* Extract on Blood Glucose Level (mg/dl) in Orally Glucose Fed Rats

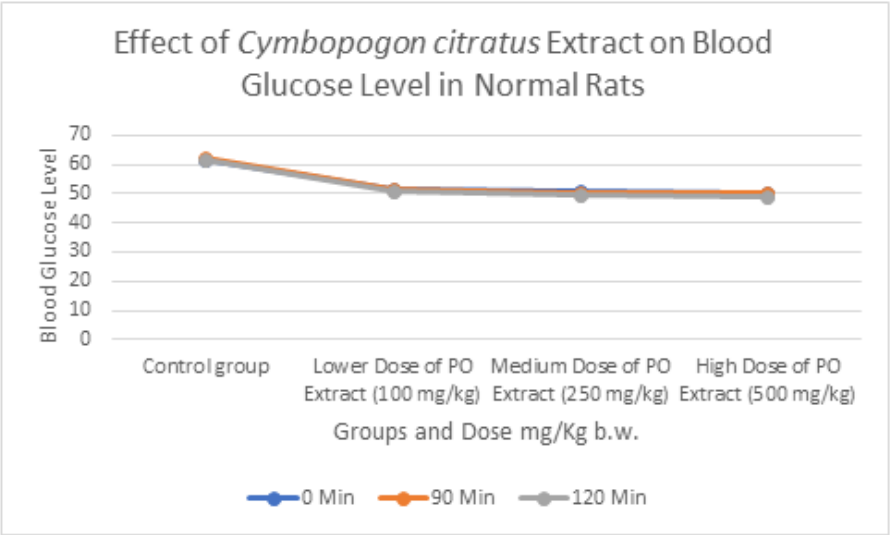
Groups and Dose mg/Kg b.w.	Blood sugar level mg/dl at min			
	0	30	90	120
Control group	85.59 ± 0.57	106.87 ± 0.53	109.19 ± 0.21	104.47 ± 0.42
Lower Dose of CC Extract (100 mg/kg)	73.12 ± 0.33	89.12 ± 0.30	82.57 ± 0.32	78.69 ± 0.31
Medium Dose of CC Extract (250 mg/kg)	72.59 ± 0.19	86.24 ± 0.35	80.06 ± 0.28	76.80 ± 0.33
High Dose of CC Extract (500 mg/kg)	72.26 ± 0.47	83.76 ± 0.16	78.16 ± 0.26	74.61 ± 0.11

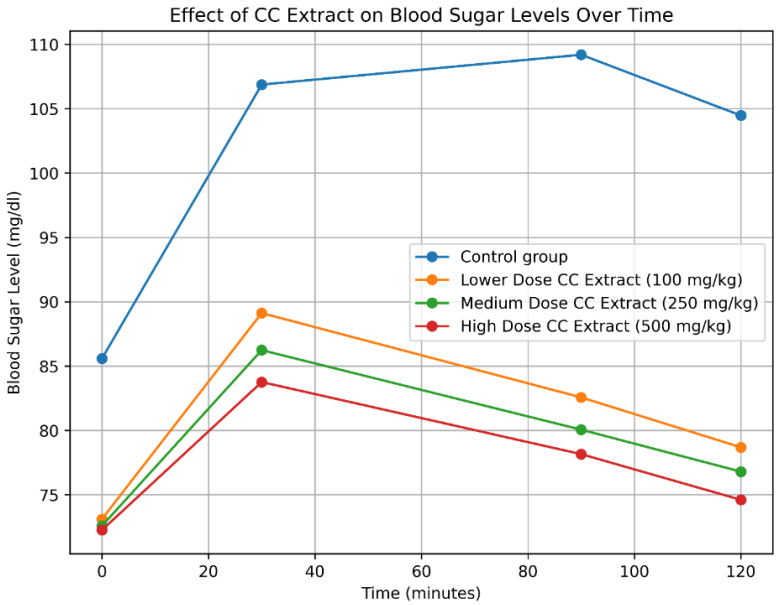
The table presents the short-term effects of CC extract at varying doses on blood glucose levels over a 120-minute period. The control group shows a normal postprandial rise in glucose at 30 minutes, which begins to normalize by 120 minutes, indicating typical metabolic regulation. The CC extract, administered at 100, 250, and 500 mg/kg, demonstrates a time- and dose-dependent decrease in blood glucose levels. At 100 mg/kg, glucose reduced to 78.69 mg/dl; at 250 mg/kg, to 76.80 mg/dl; and at 500 mg/kg, to 74.61 mg/dl, showing the most significant effect. These results indicate that CC extract exhibits strong antihyperglycemic potential, especially at the highest dose, approaching the efficacy of the standard drug. This supports the potential of CC extract as a natural and effective option for short-term management of elevated blood glucose levels in diabetic conditions.

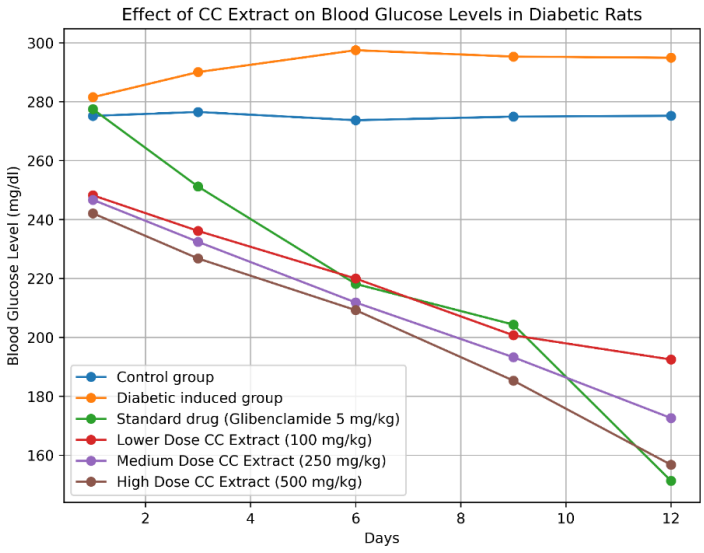
Table 10: Effect of *Cymbopogon citratus* Extract on Blood Glucose Level (mg/dl) in Alloxan Induced Diabetes Rats

Groups and Dose mg/Kg b.w.	Blood glucose level mg/dl at days				
	1	3	6	9	12
Control group	275.19 ± 1.60	276.52 ± 2.47	273.72 ± 3.05	274.94 ± 1.94	275.22 ± 2.54
Diabetics induced group	281.53 ± 3.01	290.06 ± 1.31	297.49 ± 2.05	295.32 ± 3.75	294.94 ± 4.08
Standard drug (Glibenclamide 5 mg/kg)	277.46 ± 2.09	251.19 ± 3.12	218.13 ± 2.67	204.32 ± 2.78	151.25 ± 2.39
Lower Dose of CC Extract (100 mg/kg)	248.22 ± 2.06	236.13 ± 1.65	219.95 ± 1.94	200.69 ± 1.85	192.46 ± 3.64
Medium Dose of CC Extract (250 mg/kg)	246.69 ± 1.63	232.42 ± 1.93	211.83 ± 1.05	193.24 ± 3.17	172.58 ± 3.76
High Dose of CC Extract (500 mg/kg)	242.11 ± 1.19	226.77 ± 2.17	209.22 ± 1.72	185.30 ± 1.16	156.72 ± 3.23

The data highlights the long-term antihyperglycemic effect of CC extract at varying doses compared to Glibenclamide and control groups in diabetic models over a 12-day period. The diabetic-induced group shows a steady rise in blood glucose, confirming sustained hyperglycemia without treatment. In contrast, the control group maintains stable glucose levels, reflecting normal metabolic control. Treatment with the standard drug Glibenclamide (5 mg/kg) leads to a significant reduction in glucose levels, decreasing from 277.46 mg/dl on Day 1 to 151.25 mg/dl by Day 12. Similarly, the CC extract exhibits a dose- and time-dependent hypoglycemic effect: at 100 mg/kg, glucose drops to 192.46 mg/dl; at 250 mg/kg, to 172.58 mg/dl; and at the highest dose of 500 mg/kg, to 156.72 mg/dl, closely approaching the efficacy of Glibenclamide. These results demonstrate that CC extract possesses strong antidiabetic potential, especially at higher doses, suggesting its usefulness as a natural therapeutic agent for long-term blood glucose regulation in diabetes management.


Effect of Cymbopogon citratus Extract on Blood Glucose Level in Normal Rats
Blood Glucose Level
70
60
50
40
30
20
10
0
Control group
Lower Dose of PO Extract (100 mg/kg)
Medium Dose of PO Extract (250 mg/kg)
High Dose of PO Extract (500 mg/kg)
Groups and Dose mg/Kg b.w.
0 Min
90 Min
120 Min


Effect of CC Extract on Blood Sugar Levels Over Time
Blood Sugar Level (mg/dl)
110
105
100
95
90
85
80
75
0
20
40
60
80
100
120
Time (minutes)
Control group
Lower Dose CC Extract (100 mg/kg)
Medium Dose CC Extract (250 mg/kg)
High Dose CC Extract (500 mg/kg)


Effect of CC Extract on Blood Glucose Levels in Diabetic Rats
Blood Glucose Level (mg/dl)
300
280
260
240
220
200
180
160
2
4
6
8
10
12
Days
Control group
Diabetic induced group
Standard drug (Glibenclamide 5 mg/kg)
Lower Dose CC Extract (100 mg/kg)
Medium Dose CC Extract (250 mg/kg)
High Dose CC Extract (500 mg/kg)

CONCLUSION

The present study demonstrated that the hydroalcoholic extracts of Plant *Portulaca oleracea* and *Cymbopogon citratus* possess significant antidiabetic activity in the alloxan-induced diabetic rat model. Administration of the extracts resulted in a noticeable reduction in blood glucose levels in diabetic rats when compared with the diabetic control group, indicating their potential ability to improve glucose metabolism. The observed activity may be attributed to the presence of various bioactive phytoconstituents such as flavonoids, phenolic compounds, alkaloids, and other secondary metabolites known for their hypoglycemic and antioxidant properties. Overall, the findings of this study suggest that both Plant *Portulaca oleracea* and *Cymbopogon citratus* hydroalcoholic extracts exhibit promising antidiabetic potential and may serve as valuable natural sources for the development of herbal antidiabetic formulations.

REFERENCES:

1. American Diabetes Association. Diagnosis and classification of diabetes mellitus. *Diabetes Care.* 2014;37(Suppl 1):S81-S90.
2. Saeedi P, Petersohn I, Salpea P, Malanda B, Karuranga S, Unwin N, Colagiuri S, Guariguata L, Motala AA, Ogurtsova K, Shaw JE. Global and regional diabetes prevalence estimates for 2019 and projections for 2030 and 2045: Results from the International Diabetes Federation Diabetes Atlas. Diabetes research and clinical practice. 2019;157:107843.
3. Rang HP, Dale MM, Ritter JM, Flower RJ. *Rang and Dale's Pharmacology*. 8th ed. London: Elsevier; 2016.
4. Brunton LL, Hilal-Dandan R, Knollmann BC. *Goodman & Gilman's The Pharmacological Basis of Therapeutics*. 13th ed. New York: McGraw-Hill; 2018.
5. Petchi RR, Vijaya C, Parasuraman S. Antidiabetic activity of polyherbal formulation in streptozotocin–nicotinamide induced diabetic Wistar rats. Journal of traditional and complementary medicine. 2014 Apr 1;4(2):108-117.
6. Marles RJ, Farnsworth NR. Antidiabetic plants and their active constituents. Phytomedicine. 1995 Oct 1;2(2):137-189.
7. Fabricant DS, Farnsworth NR. The value of plants used in traditional medicine for drug discovery. Environmental health perspectives. 2001 Mar;109(Suppl 1):69-75.
8. Tiwari AK, Rao JM. Diabetes mellitus and multiple therapeutic approaches of phytochemicals: Present status and future prospects. Current science. 2002 Jul 10:30-38.
9. Patel DK, Kumar R, Laloo D, Hemalatha S. Diabetes mellitus: an overview on its pharmacological aspects and reported medicinal plants having antidiabetic activity. Asian Pacific Journal of Tropical Biomedicine. 2012 May 1;2(5):411-420.
10. Prabhakar PK, Doble M. Mechanism of action of natural products used in the treatment of diabetes mellitus. Chinese journal of integrative medicine. 2011 Aug;17(8):563-74.
11. Kumar S, Narwal S, Kumar V, Prakash O. α-glucosidase inhibitors from plants: A natural approach to treat diabetes. Pharmacognosy reviews. 2011 Jan;5(9):19-29.
12. Li WL, Zheng HC, Bukuru J, De Kimpe N. Natural medicines used in the traditional Chinese medical system for therapy of diabetes mellitus. Journal of ethnopharmacology. 2004 May 1;92(1):1-21.
13. Bnouham M, Ziyyat A, Mekhfi H, Tahri A, Legssyer A. Medicinal plants with potential antidiabetic activity-A review of ten years of herbal medicine research (1990-2000). International Journal of Diabetes and Metabolism. 2006 Jan;14(1):1-25.
14. Eddouks M, Maghrani M, Lemhadri A, Ouahidi ML, Jouad H. Ethnopharmacological survey of medicinal plants used for the treatment of diabetes mellitus, hypertension and cardiac diseases in the south-east region of Morocco (Tafilalet). Journal of ethnopharmacology. 2002 Oct 1;82(2-3):97-103.
15. Kang JS, Yadav NS. Special Issue Editorial: Isolation and Analysis of Characteristic Compounds from Herbal and Plant Extracts. Plants. 2021 Dec 15;10(12):2775:1-4.
16. Rao A, Kumari S, Laura JS, Dhania G. Qualitative phytochemical screening of medicinal plants using different solvent extracts. Journal of Innovation in Psychology, Education and Didactics. 2024 Jul 1;28(2):621-626.
17. Kumar S, Jaiswal AK, Aggarwal M, Ekbbal R. A Review on Quality Control Aspects of Indian Medicinal Plants. Pharmacognosy Reviews. 2023;17(34):276-286.
18. Balunas MJ, Kinghorn AD. Drug discovery from medicinal plants. Life sciences. 2005;78(5):431-41.
19. Patwardhan B. Ethnopharmacology and drug discovery. *J*ournal of ethnopharmacology. 2005;100(1-2):50-52.
20. Atanasov AG, Waltenberger B, Pferschy-Wenzig EM, et al. Discovery and resupply of pharmacologically active plant-derived natural products. *Biotechnology Advances*. 2015;33(8):1582-1614.

21. Gurib-Fakim A. Medicinal plants: traditions of yesterday and drugs of tomorrow. *Molecular Aspects of Medicine*. 2006;27(1):1-93.
22. Mukherjee PK. *Quality Control of Herbal Drugs*. 2nd ed. New Delhi: Business Horizons; 2019.
23. Kokate CK, Purohit AP, Gokhale SB. *Pharmacognosy*. 54th ed. Pune: Nirali Prakashan; 2019.
24. Evans WC. *Trease and Evans Pharmacognosy*. 16th ed. London: Elsevier; 2009.
25. Gupta R, Bajpai KG, Johri S, Saxena AM. An Overview of Indian Novel traditional medicinal plants with antidiabetic potential. *African Journal of Traditional Complementary and Alternative Medicine.* 2007;5(1):1-17.
26. Kooti W, Farokhipour M, Asadzadeh Z, Ashtary-Larky D, Asadi-Samani M. The role of medicinal plants in the treatment of diabetes: a systematic review. Electronic physician. 2016 Jan 15;8(1):1832.
27. Chikezie PC, Ojiako OA, Nwufo KC. Overview of anti-diabetic medicinal plants: the Nigerian research experience. J Diabetes Metab. 2015 Jun 1;6(6):546.
28. Patel SS, Goyal RK. Antihyperglycemic activity of polyherbal formulations in experimental animals. *Indian Journal of Pharmacology.* 2011;43(4):450-454.
29. Modak M, Dixit P, Londhe J, Ghaskadbi S, Devasagayam TP. Indian herbs and herbal drugs used for the treatment of diabetes. Journal of clinical biochemistry and nutrition. 2007;40(3):163-73.
30. Shah G, Shri R, Panchal V, Sharma N, Singh B, Mann AS. Scientific basis for the therapeutic use of Cymbopogon citratus, stapf (Lemon grass). Journal of advanced pharmaceutical technology & research. 2011 Jan 1;2(1):3-8.
31. Abubakar AR, Haque M. Preparation of medicinal plants: Basic extraction and fractionation procedures for experimental purposes. Journal of Pharmacy and Bioallied Sciences. 2020;12(1):1-10.
32. Kang JS, Yadav NS. Special Issue Editorial: Isolation and Analysis of Characteristic Compounds from Herbal and Plant Extracts. Plants. 2021;10(12):2775:1-4.
33. Rao A, Kumari S, Laura JS, Dhania G. Qualitative Phytochemical Screening of Medicinal Plants Using Different Solvent Extracts. Oriental Journal of Chemistry. 2023;39(3):621-626.
34. Tiwari P, Kumar B, Kaur M, Kaur G, Kaur H. Phytochemical screening and extraction: a review. Internationale pharmaceutica sciencia. 2011 Mar;1(1):98-106.
35. Ayoola GA, Coker HAB, Adesegun SA, Adepoju-Bello AA, Obaweya K, Ezennia EC, et al. Phytochemical screening and antioxidant activities of some selected medicinal plants used for malaria therapy in southwestern Nigeria. Tropical journal of pharmaceutical research. 2008;7(3):1019–24.
36. Saxena M, Saxena J, Nema R, Singh D, Gupta A. Phytochemistry of medicinal plants. Journal of pharmacognosy and phytochemistry. 2013 Mar 1;1(6):168–82.
37. Azwanida NN. A review on the extraction methods use in medicinal plants, principle, strength and limitation. Medicinal and Aromatic Plants. 2015;4(3):196:1-6.
38. Sasidharan S, Chen Y, Saravanan D, Sundram KM, Yoga Latha L. Extraction, isolation and characterization of bioactive compounds from plants' extracts. African journal of traditional, complementary and alternative medicines. 2011;8(1):1-10.
39. Mudagal M, Babu TH. A Practical book of Pharmacology- III, Nirali Prakashan. Second Edition 2021: 22-23.
40. More KK, Gade RM, Gurav NV, Chaudhari RJ. Phytochemical Investigation and Thin Layer Chromatography of Methanol Extract of *Psoralea corylifolia* and *Emblica officinalis* Leaves. International Journal of Plant & Soil Science 2023; 35(19): 653-63.
41. Kowalska T, Sajewicz M. Thin-layer chromatography (TLC) in the screening of botanicals–its versatile potential and selected applications. Molecules. 2022; 27(19): 6607: 1-23.
42. Tripathi H, Chakraborty AK, Karole S, Loksh KR. Validated high performance thin layer chromatographic analysis of leaves and flower extracts of *Catharanthus roseus*. Indian Journal of Pharmacy and Pharmacology. 2023; 8(4): 270-279.
43. Yadav JP, Saini S, Kalia AN, Dangi AS. Hypoglycemic and hypolipidemic activity of ethanolic extract of *Salvadora oleoides* in normal and alloxan-induced diabetic rats. **Indian Journal of Pharmacology.** 2008;40(1):23-27.
44. Maithili V, Dhanabal SP, Mahendran S, Vadivelan R. Antidiabetic activity of ethanolic extract of tubers of *Dioscorea alata* in alloxan-induced diabetic rats. **Indian Journal of Pharmacology.** 2011;43(4):455-459.
45. Baishya R, Adhikari A, Biswas S, Banerjee S. Antidiabetic Effect of Mikania Scandens on Alloxan-Induced Rat Model. Asian Journal of Pharmaceutical and Clinical Research. 2018;11(3):109-12.

46. Chaurasia A, Das D, Sahu P. Evaluation of antidiabetic activity of *Stevia rebaudiana* leaves extract in alloxan-induced diabetic rat model. Journal of International Research in Medical and Pharmaceutical Sciences. 2016;9(3):107-112.

47. Soni S, Mishra AN. Evaluation of alloxan on induction of diabetes in albino rats. **International Journal of Basic and Clinical Pharmacology.** 2019;8(12):2748-2750.

48. Ibrahim AA, Abdussalami MS, Appah J, et al. Evaluation of antihyperglycemic activity of aqueous stem bark extract of *Boswellia dalzielii* in alloxan-induced diabetic Wistar rats. **Future Journal of Pharmaceutical Sciences.** 2023;9:7:1-10.

49. Sharma A, Fish BL, Moulder JE, Medhora M, Baker JE, Mader M, et al. Safety and blood sample volume and quality of a refined retro-orbital bleeding technique in rats using a lateral approach. **Lab Animal.** 2014;43(2):63-66.

50. Van Herck H, Baumans V, Brandt CJ, Boere HA, Hesp AP, van Lith HA, et al. Blood sampling from the retro-orbital plexus, the saphenous vein and the tail vein in rats: comparative effects on selected behavioural and blood variables. Lab Animal 2001;35(2):131-139.

51. Diehl KH, Hull R, Morton D, Pfister R, Rabemampianina Y, Smith D, et al. A good practice guide to the administration of substances and removal of blood, including routes and volumes. Journal of Applied Toxicology. 2001;21(1):15-23.