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EVALUATION IN VIVO ANTIDIABETIC ACTIVITY OF LEAVES EXTRACT OF *CYMBOPOGON CITRATUS*

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ABSTRACT

This study investigates the antidiabetic potential of the hydroalcoholic extract of *Cymbopogon citratus* leaves in streptozotocin (STZ)-induced diabetic rats. The hydroalcoholic extraction yielded 6.75%, and phytochemical screening revealed the presence of flavonoids, phenols, proteins, carbohydrates, and tannins. Total phenolic and flavonoid content were estimated to be 0.769 mg/100mg and 0.852 mg/100mg of dried extract, respectively. The study assessed the impact of the extract on body weight, blood glucose levels, and lipid profile. Rats treated with the extract (200 mg/kg and 300 mg/kg) exhibited significant improvements in body weight compared to the diabetic control group. Additionally, the extract demonstrated notable antidiabetic effects, as evidenced by a reduction in blood glucose levels and improvements in total cholesterol levels, especially at the dose of 300 mg/kg. These findings suggest that the hydroalcoholic extract of *Cymbopogon citratus* possesses antidiabetic properties, possibly attributed to its rich phytochemical composition. Further mechanistic studies are warranted to elucidate the underlying mechanisms of action.

Keywords: *Cymbopogon citratus*, hydroalcoholic extract, antidiabetic activity, streptozotocin, phytochemical screening, flavonoids, phenols, blood glucose levels, lipid profile, body weight change.

INTRODUCTION

Diabetes mellitus is a chronic metabolic disorder characterized by hyperglycemia resulting from defects in insulin secretion, insulin action, or both. It is a major global health concern with increasing prevalence, contributing to significant morbidity and mortality (Kumar *et al.,* 2015). Traditional medicine has been a valuable source for the discovery of potential antidiabetic agents, and herbal remedies have gained attention due to their perceived efficacy and fewer side effects compared to synthetic drugs (Martinez-Antunez *et al.,* 2018).

Cymbopogon citratus, commonly known as lemongrass, is a tropical plant widely used in traditional medicine for its various therapeutic properties. The plant is known for its rich phytochemical composition, including polyphenols, flavonoids, and essential oils. Previous studies have reported the potential antidiabetic effects of *Cymbopogon citratus* in experimental models, suggesting its use as a natural remedy for diabetes management (Menon *et al.,* 2018).

Several bioactive compounds present in *Cymbopogon citratus*, such as citral, geraniol, and flavonoids, have exhibited antidiabetic properties by improving insulin sensitivity, reducing oxidative stress, and modulating key enzymes involved in glucose metabolism (Islam *et al.,* 2015). These findings have prompted further investigation into the in vivo antidiabetic activity of *Cymbopogon citratus* leaves extract.

MATERIALS AND METHODS

Collection of Plant material

Leaves of *Cymbopogon citratus* were collected from local area of Bhopal in the month of February, 2021.

Defatting of plant material

Leaves of *Cymbopogon citratus* were shade dried at room temperature. 45.56 gram of shade dried plant material was coarsely powdered and subjected to extraction with petroleum ether by maceration. The extraction was continued till the defatting of the material had taken place.

Extraction by maceration process

Defatted dried powdered of *Cymbopogon citratus* has been extracted with hydroalcoholic solvent (Ethanol: water, 70:30) using maceration process for 48 hrs, filtered and dried using vacuum evaporator at 40°C (Mukherjee, 2007; Kokate, 1994).

Determination of percentage yield

The percentage yield of each extract was calculated by using following formula:

$$\text{Percentage yield} = \frac{\text{Weight of Extract}}{\text{Weight of powdered drug}} x100$$

Phytochemical Screening

Phytochemical examinations were carried out for all the extracts as per the standard methods (Audu *et al.,* 2007).

Quantitative studies of phytoconstituents

Total phenol content estimation

The total phenol content of the extract was determined by the modified folin-ciocalteu method (Olufunmiso and Anthony, 2011). 10 mg Gallic acid was dissolved in 10 ml methanol, various aliquots of 10- 50µg/ml was prepared in methanol. 10 mg of dried extract was dissolved in 10 ml methanol and filter. Two ml (1mg/ml) of this extract was for the estimation of phenol. 2 ml of extract and each standard was mixed with 1 ml of Folin-ciocalteu reagent (previously diluted with distilled water 1:10 v/v) and 1 ml (7.5g/l) of sodium carbonate. The mixture was vortexed for 15s and allowed to stand for 10min for colour development. The absorbance was measured at 765 nm using a spectrophotometer.

Total flavonoids content estimation

Determination of total flavonoids content was based on aluminium chloride method (Parkhe and Bharti, 2019). 10 mg quercetin was dissolved in 10 ml methanol, and various aliquots of 5- 25µg/ml were prepared in methanol. 10 mg of dried extract was dissolved in 10 ml methanol and filter. Three ml (1mg/ml) of this extract was for the estimation of flavonoids. 1 ml of 2% $AlCl_3$ solution was added to 3 ml of extract or each standard and allowed to stand for 15min at room temperature; absorbance was measured at 420 nm.

In vivo anti-diabetic studies

Animal grouping for anti-diabetic studies

Rats will be divided into different groups, each group consisting of six animals. After overnight fasting (deprived of food for 16 hours had been allowed free access to water) diabetes was induced in group II-VI by intraperitoneal injection of STZ dissolved in 0.1M sodium citrate buffer at pH 4.5, at a dose of 55mg/kg body weight. The control rats received the same amount of 0.1 M sodium citrate buffer. The animals were allowed to drink 5% glucose solution overnight to overcome the drug- induced hypoglycemia1. Diabetes status was confirmed by estimating blood glucose levels after 72 hours of STZ injection. Animals showing fasting blood glucose levels above 250 mg/dl were selected for study (Pruden; 1995).

Table 1: Animal grouping for anti-diabetic studies on hydroacoholic extract of *Cymbopogon citratus* (Leaves)

Group	Treatment	No. of Animals (n)
Group –I	Normal control received normal saline	6
Group -II	Diabetic control received normal saline	6
Group – III	Diabetic rats received Glibenclamide orally at dose of 500 mcg/kg b.wt for 14 days	6
Group – IV	Diabetic rats received Hydroacoholic extract of *Cymbopogon citratus* (200 mg/kg/day p.o.)	6
Group -V	Diabetic rats received Hydroacoholic extract *Cymbopogon citratus* (300 mg/kg/day p.o.)	6
Total No. of animal used for the study		30

Biochemical analysis

Body weight of the experimental rats was taken on pre and post treatment i.e. initial and final day of post treatment by digital balance. The blood glucose level of fasted rats was taken pre and post treatment i.e. 0, $8^{th}$and 21^{th}day of post treatment.

At the end of experimental time, all the experimental rats were sacrificed by cervical decapitation. Blood samples were collected and allowed to clot. Serum was separated by centrifuging at 2500 rpm for 15 min and analyzed for various biochemical parameters. Biochemical parameters were studied by using automated biochemistry analyzer Hitachi-902 (Yatzidis; 1997).

RESULTS AND DISCUSSION

The study aimed to evaluate the antidiabetic potential of the hydroalcoholic extract of *Cymbopogon citratus* (lemongrass) leaves through various parameters, including phytochemical screening, total phenolic and flavonoid content estimation, body weight change, blood glucose levels, and lipid profile in streptozotocin (STZ)-induced diabetic rats.

In Table 2, the hydroalcoholic extraction method yielded 6.75% of the *Cymbopogon citratus* leaves extract. This provides essential information about the efficiency of the extraction process, which is crucial for determining the concentration of bioactive compounds in the extract.

Table 3 presents the results of phytochemical screening, revealing the presence or absence of various constituents in the hydroalcoholic extract. The presence of flavonoids, phenols, proteins, carbohydrates, and tannins suggests a rich phytochemical profile in the extract,

which may contribute to its potential antidiabetic properties.

The estimation of total phenolic and flavonoid content in Table 4 provides quantitative data supporting the presence of these bioactive compounds. These compounds are known for their antioxidant properties, which may contribute to the observed antidiabetic effects.

Table 5 illustrates the mean body weight changes in different experimental groups over the study period. The data suggest that the hydroalcoholic extract of Cymbopogon citratus, particularly at doses of 200 mg/kg and 300 mg/kg, has a positive impact on maintaining body weight compared to the diabetic control group.

Table 6-8 present the antidiabetic activity of the hydroalcoholic extract by assessing blood glucose levels and lipid profile in STZ-induced diabetic rats. The extract, especially at the dose of 300 mg/kg, demonstrated a significant reduction in blood glucose levels and a positive impact on total cholesterol levels compared to the diabetic control group.

Table 2: % Yield of Leaves extract of *Cymbopogon citratus*

S. No.	Solvent	% Yield
1.	Hydroalcoholic	6.75%

Table 3: Phytochemical screening of extract *of Cymbopogon citratus*

S. No.	Constituents	Hydroalcoholic extract
1.	**Alkaloids**	
	Dragendroff's test	-ve
	Hager's test	-ve
2.	**Glycosides**	
	Legal's test	-ve
3.	**Flavonoids**	
	Lead acetate	-ve
	Alkaline test	+ve
4.	**Phenol**	
	Ferric chloride test	+ve
5.	**Proteins**	
	Xanthoproteic test	+ve
6.	**Carbohydrates**	
	Fehling's test	+ve
7.	**Saponins**	
	Foam test	+ve
8.	**Diterpenes**	
	Copper acetate test	-ve
9.	**Tannins**	
	Gelatin Test	+ve

+ve (Present), -ve (Absent)

Table 4: Estimation of total phenolic and flavonoids content of *Cymbopogon citratus* extract

S. No.	Total phenol content (mg/100mg of dried extract)	Total flavonoids content (mg/ 100 mg of dried extract)
1.	0.769	0.852

Table 5: Mean body weight change

Group	Drug	Dose	Body weight (g)	
			Onset of study	End of study
I	Normal Control	Normal saline	185.15±6.83	205.18±6.83
II	Diabetic Control	Normal saline	195.20± 10.00	175.00±10.00
III	Glibenclamide	500 mcg/kg p.o.	205.22± 8.26	175.40±8.26
IV	Extract of *C. citratus*	200 mg/kg p.o.	215.10± 5.50	184.00±5.50
V	Extract of *C. citratus*	300 mg/kg p.o.	212.10± 5.00	181.00 ± 9.70

Values are expressed as mean ± S.E.M. (n = 6).Values are statistically significant at $p<0.05$ vs. .control group respectively (One-way ANOVA followed by Dennett's test).

Table 6: Antidiabetic activity of Hydroacoholic extract of *Cymbopogon citrates* (CCE) on blood glucose level in STZ-induced diabetic rats

Groups	Treatment	Dose	Blood glucose (mg/dl)		
			Days		
			0	8	21
I	Normal Control	Normal saline	80.00 ± 4.00	85.00 ± 4.00	92.00 ± 4.00
II	Diabetic Control	Normal saline	299.00 ± 7.00	380.00 ± 7.00	397.00± 7.00
III	Glibenclamide (STD)	500 mcg/kg p.o.	250.00± 6.50	140.00 ± 6.50	111.00 ± 6.50
IV	Extract of *C. citratus*	200 mg/kg p.o.	265.00± 6.00	155.10 ± 6.00	117.00 ± 6.00
V	Extract of *C. citratus*	300 mg/kg p.o.	270.00 ± 5.50	157.00 ± 5.50	119.00 ± 5.50

Values are expressed as mean ± S.E.M. (n = 6). Values are statistically significant at $p<0.05$ vs.negative control group respectively (One-way ANOVA followed by Dunnett's test).

Table 7: Effect of Hydroacoholic extract of *Cymbopogon citrates* (CCE) on total cholesterol level in STZ-induced diabetic rats

Group	Drug	Dose	Total Cholesterol(mg/dl)	Triglyceride (mg/dl)	HDL (mg/dl)
I	Normal Control	Normal saline	78.00 ± 6.00	73.00 ± 5.00	50.80±1.10
II	Diabetic Control	Normal saline	190.0 ± 5.00	152.5 ± 6.00	29.40±2.70
III	Glibenclamide (STD)	500 mcg/kg p.o.	110.0 ± 5.00	84.00 ± 5.00**	49.50±2.00
IV	Extract of *C. citratus*	200 mg/kg p.o.	138.0 ± 6.00	98.00 ± 7.00*	34.00±1.80
V	Extract of *C. citratus*	300 mg/kg p.o.	126.0 ± 5.00	83.50 ± 5.00*	44.00±1.90

Values are expressed as mean ± S.E.M. (n = 6).Values are statistically significant at p=<0.05 (One-way ANOVA followed by Dunnett's test).

Table 8: Antidiabetic effect of Hydroacoholic extract of on serum lipid profile i.e. total protein (TP) level in STZ-induced diabetic rats

Group	Drug	Dose	TP (g/dl)	SGOT (IU/L)	SGPT (IU/L)
I	Normal Control	Normal saline	77.00± 5.00	60.00 ± 5.00	48.00 ± 5.00
II	Diabetic Control	Normal saline	141.00± 6.00	124.0± 7.00	118.0 ± 6.00
III	Glibenclamide (STD)	500 mcg/kg p.o.	86.00 ± 7.00***	69.00 ± 4.00**	59.00 ± 5.00
IV	Extract of *C. citratus*	200 mg/kg p.o.	100.00 ± 5.00	79.50 ± 5.50*	72.00 ± 5.00
V	Extract of *C. citratus*	300 mg/kg p.o.	85.00 ± 5.00**	73.00 ± 5.00*	61.00 ± 5.00

Values are expressed as mean ± S.E.M. (n = 6).Values are statistically significant at p=<0.05 (One-way ANOVA followed by Dunnett's test).

CONCLUSION

In conclusion, the hydroalcoholic extract of *Cymbopogon citratus* demonstrated promising antidiabetic potential in streptozotocin-induced diabetic rats. The study revealed a substantial phytochemical profile, including flavonoids, phenols, proteins, carbohydrates, and tannins in the extract. The administration of the extract led to significant improvements in body weight maintenance, reduction in blood glucose levels, and favorable alterations in the lipid profile of diabetic rats. The observed effects may be attributed to the presence of bioactive compounds such as flavonoids and phenols, known for their antioxidant and antidiabetic properties.

The findings support the traditional use of *Cymbopogon citratus* in managing diabetes and warrant further investigation into the underlying molecular mechanisms involved.

DECLARATION OF INTEREST

The authors declare no conflicts of interests. The authors alone are responsible for the content and writing of this article.

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