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ANTIDIABETIC EFFECT OF OKRA SEED: IN STREPTOZOTOCIN-INDUCED DIABETIC RATS.

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ABSTRACT

Objectives

The present study was aimed to study the antidiabetic potential of okra seed in streptozotocin (STZ)-induced diabetic rats.

Materials and Methods

Diabetes was induced in rats by administration of STZ (60 mg/kg, i.p.). After 14 days of blood glucose stabilization, diabetic rats received okra seed pellet up to 42 days. The blood samples were collected on day 28 to estimate the Blood Glucose Level.

Area and duration

The present study the effect of okra seed supplementation on serum blood glucose profile of hyperglycemia induced rat in Varanasi city at Banaras Hindu University Department of Zoology, Uttar Pradesh for a period of 42 days during year 2017.

Results

In the study, okra seed assess the antidiabetic action, two dose of powder were selected. one is high does and other is low dose Administration of 250 mg and 500 mg rats showed significant ($P < 0.001$) reduction in blood glucose level and increase body weight than diabetic control rats.

Conclusion

The present study results,support the antidiabetic potential of okra seed powder in diabetic rats.

Key words: antidiabetic, streptozotocin, okra, antidiabetic, blood Glucose.

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INTRODUCTION

Diabetes mellitus is a general term for heterogeneous disturbances of metabolism for which the main finding is chronic hyperglycemia. The cause is either impaired insulin secretion or impaired insulin action or both.[1] It's become a major health challenge worldwide. [2] The WHO's definition of diabetes states that it occurs from deficiency in the body's use of insulin due to an ineffective pancreas or an ineffective body for using insulin. There are two main type of diabetes; "type 1 called insulin-dependent or juvenile-onset diabetes", which is found only 5–10% of patients with diabetes and "type 2 is known as non-insulin dependent or insulin resistance", which is found 90–95% of patients with diabetes.[3,4].

Plants of the genus *Abelmoschus* belong to the family of flowering plants called *Malvacea*; this genus, also known as *okra* is composed of numerous species of flowering plants in the mallow family and they are native to tropical and sub-tropical areas. [5] In traditional medicine Okra seeds are reported to have ability in managing increased blood glucose concentration. Modern research has correlated this traditional claim with scientific evidences. Okra (*Abelmoschus esculentus*) is an economically important vegetable crop grown in tropical and sub-tropical parts of the world. [6] Okra (*Abelmoschus esculentus*) is the vegetable crop of significance in the Malvaceae family and it's very popular in the India Pakistan subcontinent. In India, it ranks number one in its consumption but its original home is Ethiopia and Sudan, the north-eastern African countries. [7] It is an important vegetable which is widely distributed from Africa to Asia, Southern Europe and America. [8] The plant has a wide range of medicinal value and it has been used to control diseases and disorders. Okra fiber helps to stabilize blood sugar level by regulating sugar absorbed rate from the intestinal tract. It is a helpful vegetable for those feeling weak, exhausted, and suffering from depression and it is also used in ulcers, lung inflammation, sore throat as well as irritable bowel. Okra is good for asthma patients and it also normalizes blood sugar and cholesterol levels. [9, 10] Researches have confirmed that okra's peel and seed powder could elevate total antioxidant status of kidney, pancreas and liver of diabetic rats. Okra's polysaccharides constituents are responsible to maintain blood glucose level in normal range through controlling sugar absorption from the small intestine. [11, 12]

MATERIALS AND METHODS

Animals and experimental design

Animals and Maintenance: Male albino rats (180 – 200gm) were selected for the study. They were of the same age and weight. The rats were housed in polycarbonate clean cages under a 12 /12 h normal light/dark cycle. The animals were fed with standard diet and water ad libitum. After keeping in the laboratory condition for a week for acclimatization the experiment was initiated. The study protocol was approved by Institutional Ethical Committee, Committee for the Purpose of Control and Supervision of Experiments on Animals (CPCSEA) Registration no. 1802/GO/ Re/S/15/CPCSEA of Faculty of Zoology, Banaras Hindu University, Varanasi.

Plant materials

Okra seed used was the genus *Abelomoschusesculentus* okra and was purchased from Local market of Lucknow City. The cleaning of okra seed was performed manually to remove damaged seeds, dust particles, seeds of other grains/crops and other impurities such as metals and weeds washed in tab water. The okra seeds were placed into the dry grinder. It was grinded.

Chemicals

Streptozotocin and all other chemicals used in this study are analytical grade. For the estimation of biochemical parameters, kits were used procured from Reckon Diagnostics enzopak, Varanasi India.

Experimental animals

Male Wistar albino rats (180-200 g) were used to assess antidiabetic activity. Male albino healthy rats were collected from the local supplier from the vicinity of Varanasi. They were maintained in a well ventilated room exposed to ambient condition. Environmental conditions such as humidity, heat, light, and ventilation were kept constantly for 24 hours daily during the period of the study.

Induction of diabetes

Animals were fasted overnight and diabetes was induced by single intraperitoneal injection of streptozotocin (60 mg/kg body weight) prepared in 0.1 M Citrate buffer at pH 4.57. To overcome drug induced hypoglycemia, animals were allowed to drink 5% glucose solution overnight. Citrate buffer alone injected to control rats. In this group total 46 rats were taken and 36 rats were induced with STZ and after induction period of 3 days 6 rats were sacrificed for confirmation of diabetes.

Experimental design for antidiabetic activity

Animals were divided into three groups. The grouping details are follows:

Control Group (Negative Control)-In control group 10 rats were taken. They were only fed with the pellet diet and water throughout the study period. The weights of the rats were checked biweekly.

Stz Control (Positive Control)- In this group 10 rats were taken and, acclimatized for 7 days and reweighed. They were induced with Stz. In between feeding period the weight of the rats were checked biweekly.

Okra seed Group- There were 20 rats taken in this group. They were also induced with Stz. The rats were acclimatized for 7 days and reweighed. In between feeding period the weight of the rats were checked biweekly. The group was further divided into two subgroups (n=10) in each group as low okra seed group (given 250 mg of okra seed) and high okra seed group (given 500 mg of okra seed).

Biochemical parameters estimation

Body weights were recorded biweekly and at the end of the stipulated period, the animals were kept for overnight fasting and sacrificed. The blood was collected from heart. About 2-3 ml of blood sample was collected and centrifuged at 2500 rpm for 25 minutes to separate serum. The serum was stored at - 20°C until the analysis. From the collected blood serum, the biochemical marker such as blood glucose was determined by using ENZOPAK reagent kit [13].

Statistical analysis

The mean value of the quantitative variables was compared in the Diabetic groups and Control group by the Independent-Samples t-test, chi-square test and one way anova test. t is defined as, t = difference in the mean values/ SE (difference in the mean values),where , SE = Standard Error. For all statistical evaluations, a two-tailed probability of value, P <0.05 was considered as the cutoff value or significance.

RESULTS AND DISCUSSION

The present study measures series of biochemical indicators including preprandial glucose and posprandial glucose. Administration of STZ (60 mg kg^{-1} b.wt. I.P.) induced hyperglycemia (**blood glucose** level ≥200 mg dL^{-1}) in almost all treated rats. The **blood glucose** level was monitored for 48 h. Fasting **blood glucose** of untreated **diabetic rats** was significantly higher than those of normal control rats.

Table No. 01: Intergroup comparison of body weight diabetic rat in different groups

Group	N	Mean	SD	SE	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Negative Control	10	190.4	7.7	2.42	184.92	195.88	180	200
Positive control	10	192.6	7.0	2.21	187.58	197.62	180	200
Low dose	10	194.1	5.8	1.84	189.93	198.26	185	200
High dose	10	194.2	5.6	1.77	190.1	198.2	187	200
Total	40	192.82	6.52	2.06	188.13	197.49	180	200

F value = 0.727, P value = 0.543

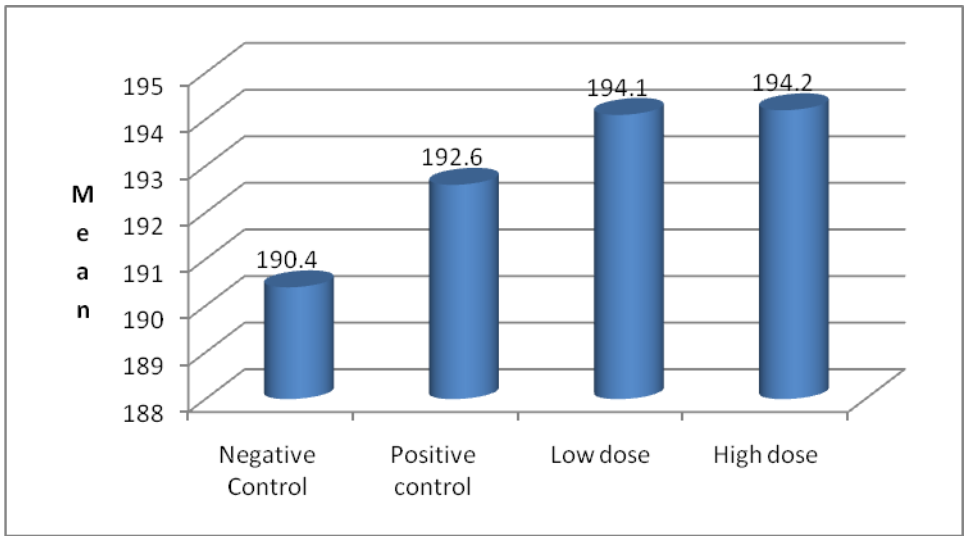

Fig No.01: Showing comparison of body weight diabetic in different groups

Table no 1 revealed that body weight diabetic ranged from 180 to 200 mg/dl in different groups. Mean body weight diabetic minimum in negative control group (190.4±7.7mg/dl) followed by positive control group (192.6±7.0mg/dl), low dose group (194.1±5.8mg/dl) and high dose group (194.2±5.6mg/dl). On evaluating the data statistically, this difference among groups was found to be not significant. (p>0.05)

Table No. 02: Showing mean difference & statistical relation in body weight diabetic in different groups

Comparison	Mean Difference	SE	P value
Control to STZ control	-2.2	2.75	0.445
Control to Low dose	-3.7	2.28	0.139
Control to High dose	-3.8	2.5	0.164
STZ to low dose	-1.5	3.40	0.670
STZ to High dose	-1.6	2.4	0.529
Low dose high dose	-0.10	2.61	0.970

Table no 2 revealed mean differences & statistical relation in body weight diabetic in different group was found to be minimumin Control to High dose followed by Control to Low dose, Control to STZ control, STZ to High dose and STZ to low dose. None of the between group comparisons were found significant statistically. (p>0.05)

Table No. 03: Comparison of body weight diabetic in STZ induced rat groups at different time periods

Time Interval	Negative Control (N=10) (Mean±SD)	Positive Control (N=10) (Mean±SD)	Low dose (N=10) (Mean±SD)	High dose (N=10) (Mean±SD)	ANOVA	
					F value	P value
At 1st day	199.2±8.6	189.1±6.8	185.6±5.8	186.7±5.3	8.47	<0.001
At 14th Day	210.6±8.0	172.1±4.4	179.0±6.1	189.2±6.7	68.1	<0.001
At 28th Day	221.4±8.4	157.5±3.0	187.9±6.3	197.9±6.7	177.9	<0.001
At 42nd Day	232.9±7.7	143.0±3.5	200.2±4.0	206.0±5.7	476.2	<0.001

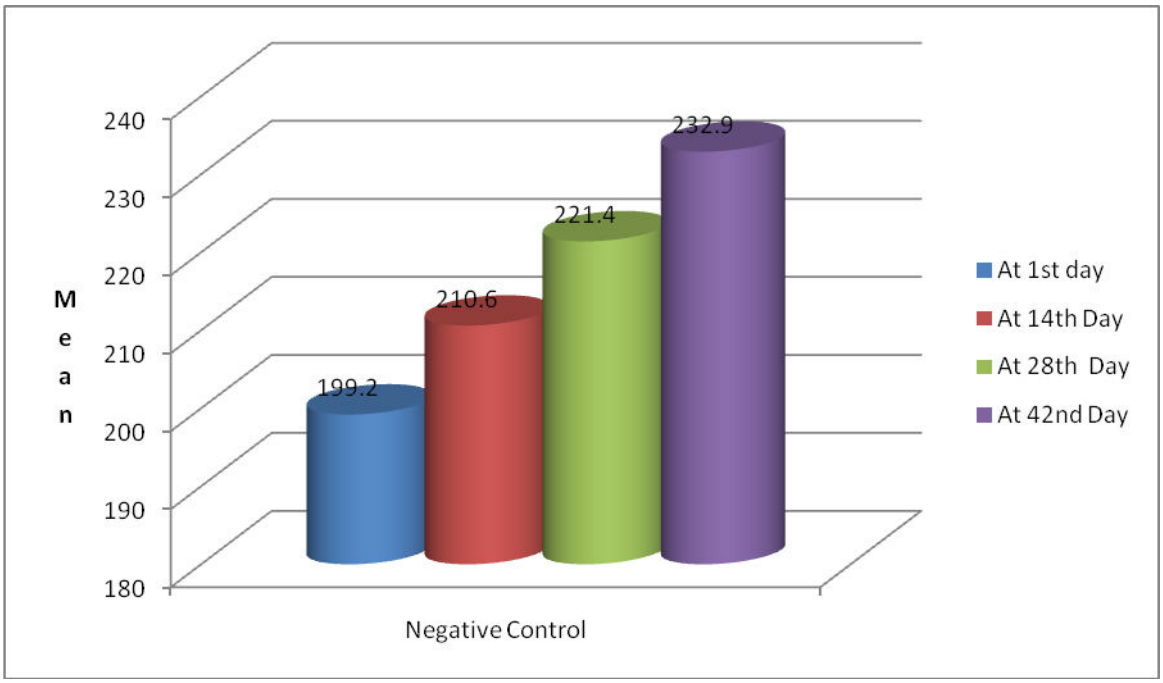

Fig No.02: Showing control group of body weight (gm) diabetic rat

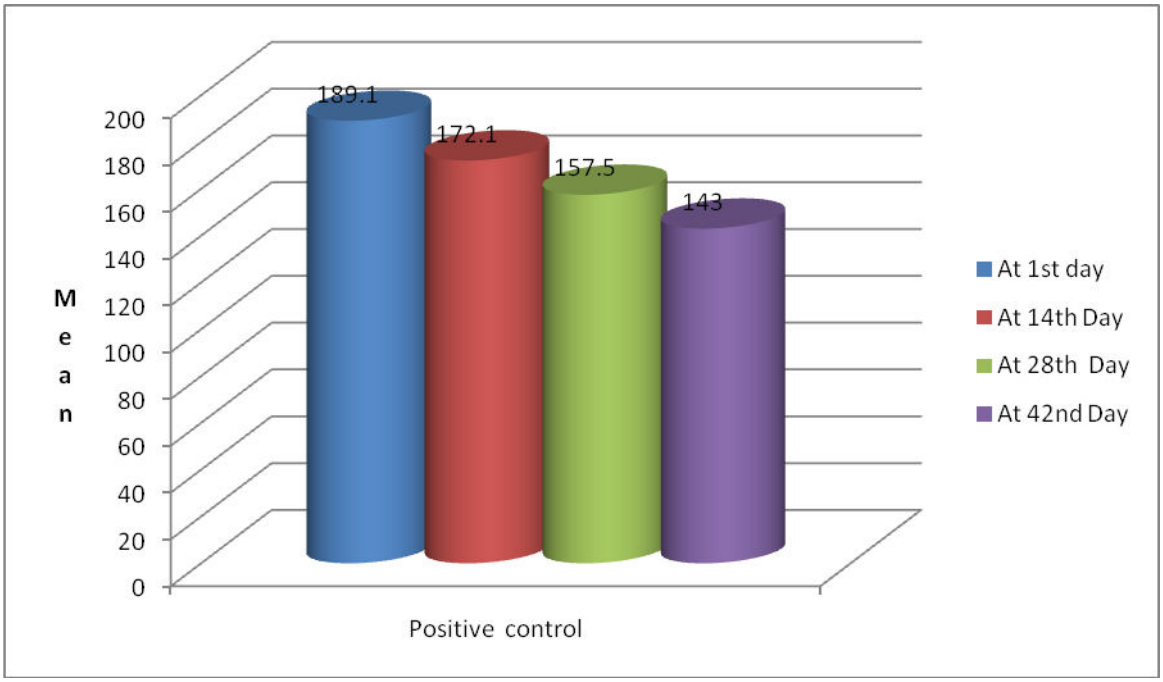

Fig No.03: Showing positive (stz) control group of body weight (gm) diabetic rat

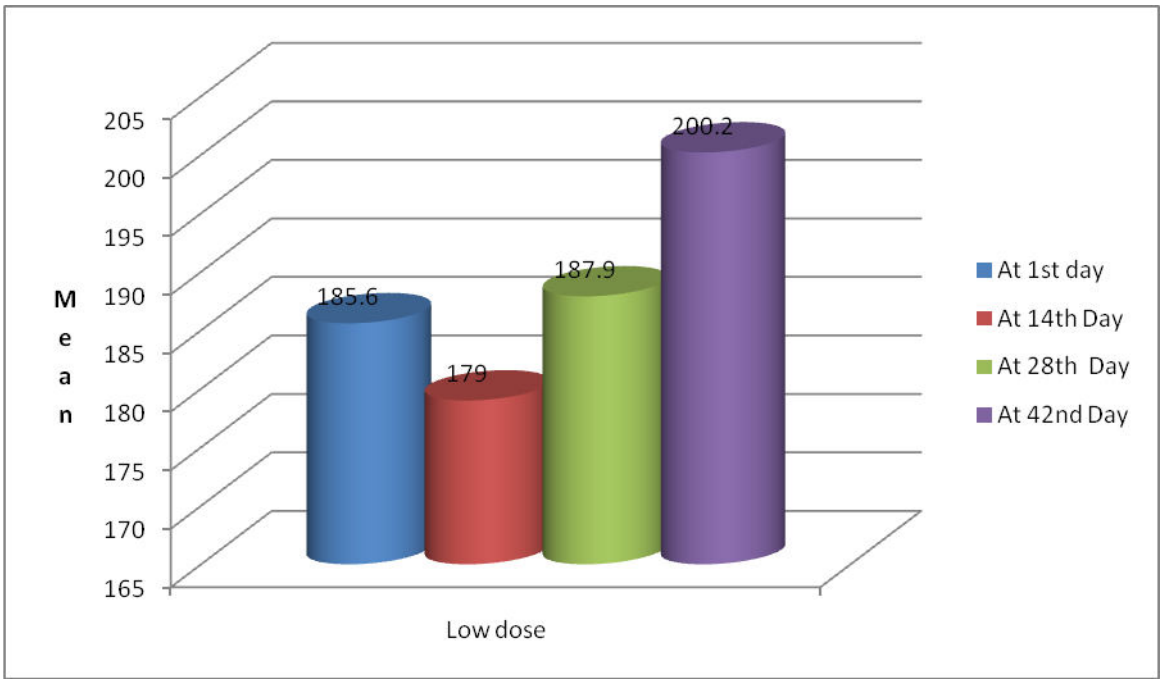

Fig No.04: Showing low dose group of body weight (gm) diabetic rat

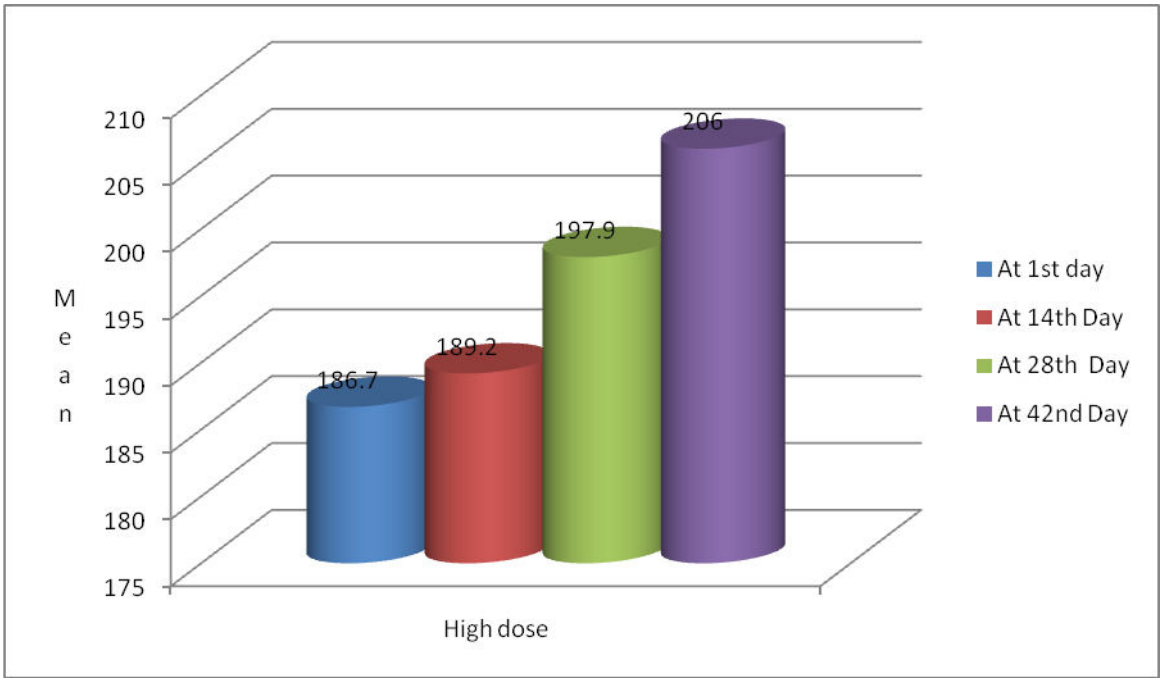

Fig No.05: Showing high dose group of body weight (gm) diabetic rat

Table no 3 is depicted comparison of body weight diabetic in STZ induced rat groups at different time periods, ranged from 185.6±5.8 g (Low dose) to 199.2±8.6g (Negative Control) at 1st day after intervention, however the difference among groups was significant statistically. At 14th day after intervention, mean body weight among different groups ranged from 172.1±4.4g (Positive Control) to 210.6±8.0g (Negative Control). At 28th day after intervention, mean body weight among different groups ranged from 157.5±3.0g (Positive Control) to 221.4±8.4g (Negative Control). The difference among groups was found to be significant. ($p<0.001$).

Table No. 04: Between group comparisons of body weight diabetic in negative control

Comparison		Mean Difference	T value	P value
Control	1st to 14th day	-11.4	3.06	0.006
	1st to 28th day	-22.2	5.8	<0.001
	1st to 42th day	-33.7	9.23	<0.001
	14th to 28th day	-10.8	2.94	0.008
	14th to 42th day	-22.3	6.35	<0.001
	28th to 42th day	-11.5	3.19	0.005

Table no 4 depicted comparisons of body weight diabetic in negative control group. Mean difference minimum was from 1st to 42th day (-33.7±9.23) followed by 14th to 42th(-22.3±6.35) day and maximum mean difference was 14th to 28th day (-10.8±2.94). The difference among groups was found to be significant. (p<0.001)

Table No. 05: Between group comparisons of body weight diabetic in STZ control

Comparison		Mean Difference	T value	P value
STZ control	1st to 14th day	17.0	6.63	<0.001
	1st to 28th day	31.6	5.20	<0.001
	1st to 42th day	46.1	6.33	<0.001
	14th to 28th day	14.6	8.35	<0.001
	14th to 42th day	29.1	5.47	<0.001
	28th to 42th day	14.5	7.22	<0.001

Table no 5 depicted comparisons of body weight diabetic in STZ control group. Mean difference minimum was from 28th to 42th day (14.5±7.22) followed by 14th to 28th day(14.6±8.35), 1st to 14th day (17.0±6.63) and maximum mean difference was in 1st to 42th day (46.1±6.33). The difference among groups was found to be significant. (p<0.001)

Table No. 06: Between group comparisons of body weight diabetic in low dose

Comparison		Mean Difference	T value	P value
Low dose	1st to 14th day	6.6	2.47	0.023
	1st to 28th day	-2.30	0.849	0.406
	1st to 42th day	-14.60	6.23	<0.001
	14th to 28th day	-8.9	4.62	<0.001
	14th to 42th day	-21.2	5.32	<0.001
	28th to 42th day	-12.3	6.42	<0.001

Table no 6 depicted comparisons of body weight diabetic in Low dose group. Mean difference minimum was from 14th to 42th day (-21.2±5.32) followed by1st to 42th day (-14.6±6.23) and maximum mean difference was in 1st to 14th day (6.6±2.47). The difference among groups was found to be significant (p<0.05) except 1st to 28th day groups (p>0.05).

Table No. 7: Between group comparisons of body weight in diabetic high dose

Comparison		Mean Difference	T value	P value
High dose	1st to 14th day	-2.50	0.924	0.367
	1st to 28th day	-11.2	5.41	<0.001
	1st to 42th day	-19.3	3.22	<0.001
	14th to 28th day	-8.7	2.65	<0.001
	14th to 42th day	-16.80	4.70	<0.001
	28th to 42th day	-8.1	5.83	<0.001

Table no 7depicted comparisons of body weight diabetic in High dose group. Mean difference minimum was from 1st to 42th day (-19.3±3.22) followed by 14thto 42th day (-16.80±4.70) and maximum mean difference was in 1st to 14th day (-2.50±0.924). The difference among groups was found to be significant (p<0.001) except 1st to 14th day group (p>0.05).

Table No. 8: Comparison of blood glucose in STZ induced rat groups at different time periods

Time Interval	Negative Control (N=10) (Mean±SD)	Positive Control (N=10) (Mean±SD)	Low dose (N=10) (Mean±SD)	High dose (N=10) (Mean±SD)	ANOVA	
					F value	P value
At 1st day	100.0±4.0	207.7±15.3	189.8±7.1	186.4±5.8	278.6	<0.001
At 14th Day	102.0±4.2	215.7±11.7	187.0±6.2	182.4±7.0	393.5	<0.001
At 28th Day	100.0±4.1	222.6±11.5	183.6±6.2	176.9±7.0	447.6	<0.001
At 42nd Day	99.5±4.4	232.3±12.6	180.3±6.2	168.6±7.0	449.8	<0.001

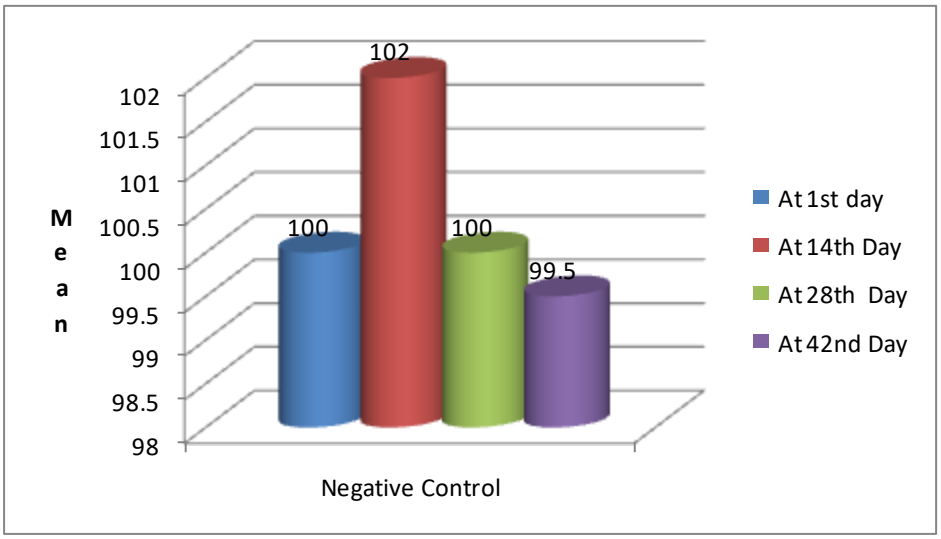

Fig No.06: Showing control group of Blood glucose (mg/dl) in diabetic rat

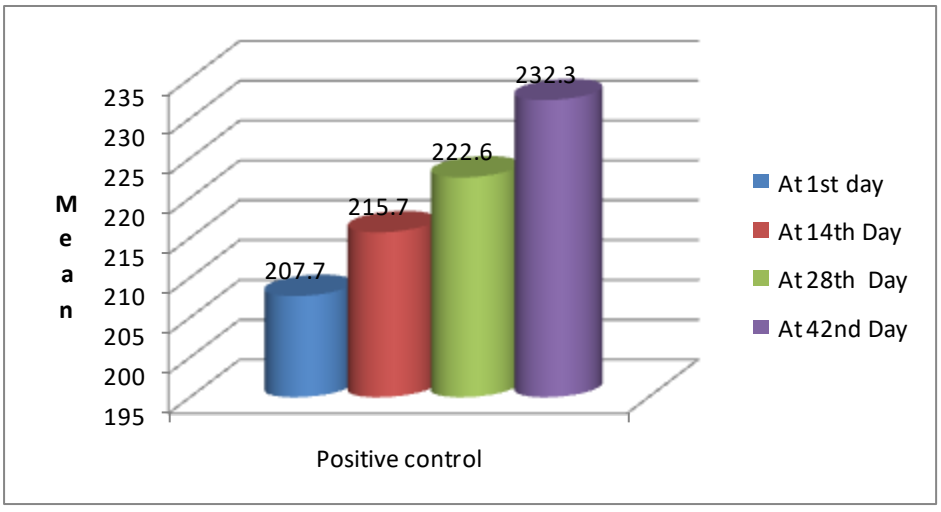

Fig No.07: Showing positive control group of Blood glucose (mg/dl) in diabetic rat

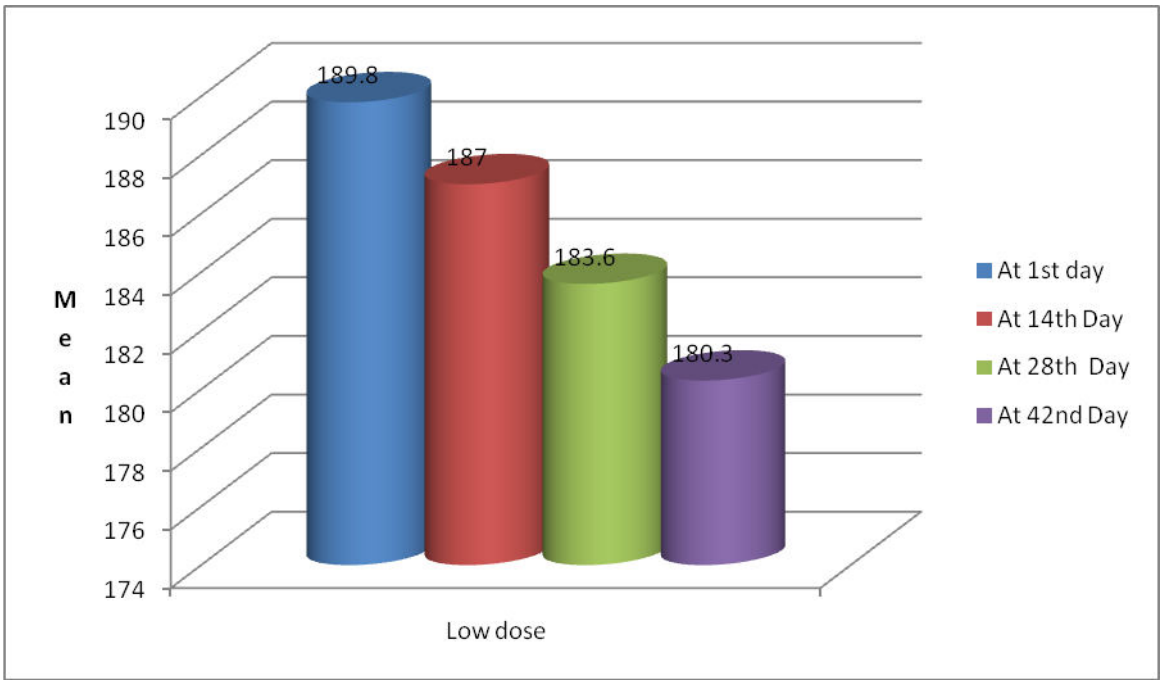

Fig No.8: Showing low dose group of Blood glucose (mg/dl) in diabetic rat

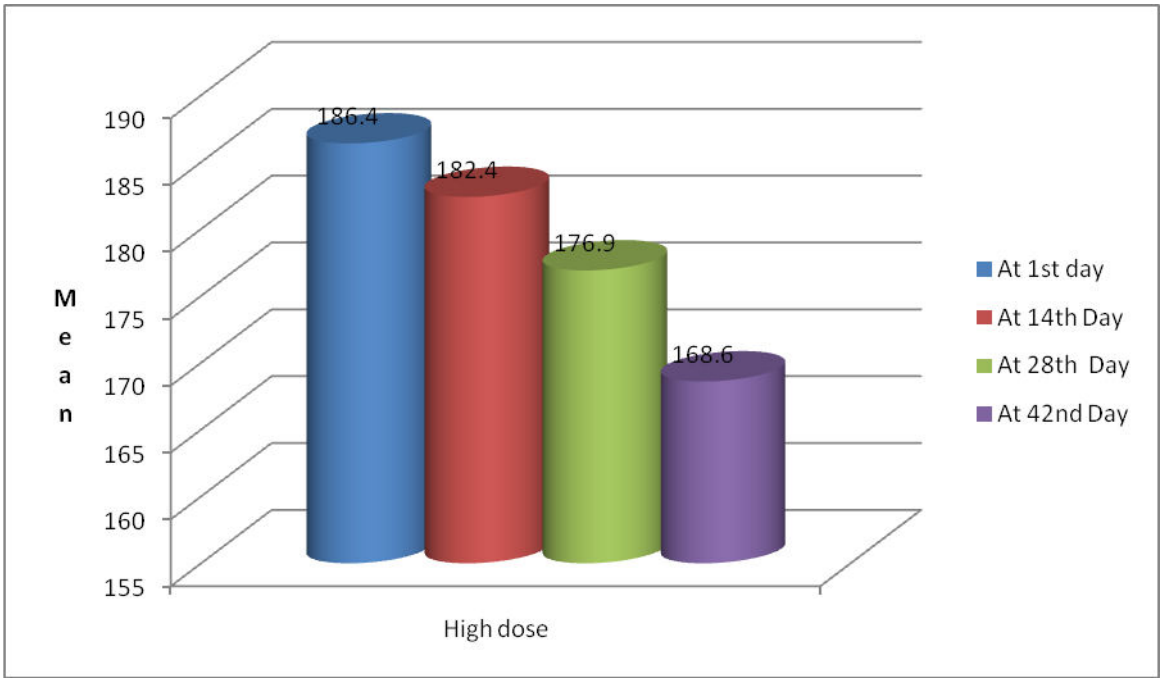

Fig No.9: Showing high dose group of Blood glucose (mg/dl) in diabetic rat

Table no 8 is depicted comparison of blood glucose in STZ induced rat groups at different time periods. At 1st day after intervention mean blood glucose in STZ induced rat ranged from 100.0±4.0g (Negative Control) to 207.7±15.3 (Positive Control), At 14th Day after intervention it ranged 102.0±4.2g (Negative Control) to 215.7±11.7g (Positive Control). At 28th Day after intervention it ranged 100.0±4.1g (Negative Control) to 222.6±11.5g (Positive Control). At 42th Day after intervention it ranged 99.5±4.4g (Negative Control) to 232.3±12.6g (Positive Control), however the difference among groups at difference time period was significant statistically. ($p<0.001$)

Table No. 9: Between group comparisons of blood glucose in control

Comparison		Mean Difference	T value	P value
Control	1st to 14th day	-2.0	1.09	0.289
	1st to 28th day	0.00	0.00	1.00
	1st to 42th day	0.500	0.265	0.793
	14th to 28th day	2.0	1.06	0.301
	14th to 42th day	2.50	1.329	0.203
	28th to 42th day	0.50	0.265	0.793

Table no 9 depicted comparisons of blood glucose in control group. Mean difference minimum was from 1st to 14th day (-2.0±1.09) and maximum mean difference was in 14th to 42th day (2.5±1.329). The difference among groups at different interval of time was found to be not statistically significant. ($p>0.05$)

Table No. 10: Between group comparisons of blood glucose in STZ control

Comparison		Mean Difference	T value	P value
STZ control	1st to 14th day	-8.0	1.31	0.205
	1st to 28th day	-14.9	2.46	0.0241
	1st to 42th day	-24.6	3.92	0.001
	14th to 28th day	-6.9	1.33	0.200
	14th to 42th day	-16.6	3.05	0.006
	28th to 42th day	-9.7	1.78	0.091

Table no 10 depicted comparisons of blood glucose in STZ control group. Mean difference minimum was from 1st to 42th day (-24.6±3.92) and maximum mean difference was in 14th to 28th day (-6.9±1.33). The difference among groups was found to be not significant ($p>0.05$) except 1st to 28th day, 1st to 42th day and 14th to 42th day group.($p<0.05$)

Table No. 11: Between group comparisons of blood glucose in low dose

Comparison		Mean Difference	T value	P value
Low dose	1st to 14th day	2.8	0.934	0.360
	1st to 28th day	6.2	2.08	0.052
	1st to 42th day	9.5	3.18	0.005
	14th to 28th day	3.4	1.22	0.235
	14th to 42th day	6.7	2.41	0.026
	28th to 42th day	3.3	1.90	0.249

Table no 11 depicted comparisons of blood glucose in low dose group. Mean difference minimum was from 1st to 14th day (2.8±0.934) and maximum in 1st to 42th day (9.5±3.18). The difference among groups was found to be not significant at different time interval ($p>0.05$) except 1st to 42th day and 14thto 42th day of time interval respectively. ($p<0.05$)

Table No. 12: Between group comparisons of blood glucose in high dose

Comparison		Mean Difference	T value	P value
High dose	1st to 14th day	4.0	1.39	0.181
	1st to 28th day	9.5	3.30	0.003
	1st to 42th day	17.8	6.19	<0.001
	14th to 28th day	5.5	1.91	0.071
	14th to 42th day	13.8	4.80	<0.001
	28th to 42th day	8.3	2.65	0.016

Table no 12 depicted comparisons of blood glucose in high dose group. Mean difference minimum was from 1st to 14th day (4.0±1.39) and maximum mean difference was in 1st to 42th day (17.8±6.19). The difference among groups was found to be statistically significant (p>0.001) except 1st to 14th day and 14th to 28th day groups. (p>0.05)

DISCUSSION

The present study measures series of biochemical indicators including preprandial glucose and posprandial glucose. Administration of STZ (60 mg kg^{-1} b.wt. I.P.) induced hyperglycemia (**blood glucose** level ≥200 mg dL^{-1}) in almost all treated rats. The **blood glucose** level was monitored for 48 h. Fasting **blood glucose** of untreated **diabetic rats** was significantly higher than those of normal control rats. Diabetes induced by STZ was characterized by apoptosis of cells of pancreas, attenuation of **gene expression** of insulin and reduced synthesis of insulin. Usually, cells of pancreas normally maintain **blood glucose** concentrations within a narrow range by modulating their insulin secretion rate in response to the **blood glucose** concentration apoptosis of pancreatic cells is believed to be the primary factor which ultimately results in hyperglycemia (Patel *et al*., 2006).

In our study, administration of AESP (250 and 500 mg/kg) decreased elevated blood glucose levels significantly ($P < 0.001$) from first to fourth week compared to diabetic control rats. The AESP at a dose 500 mg/kg showed significantly ($P < 0.001$) more blood glucose reduction than its 250 mg/kg dose. There are many reports available to support the multiple mechanisms of antidiabetic plants to exert their blood glucose lowering effect, such as inhibition of carbohydrate metabolizing enzymes, enhancement of insulin sensitivity, regeneration of damaged pancreatic islet β-cells, and enhancement of insulin secretion and release.(Møller N, et al 2008) More studies are on Okra seed efficacy in the reduction of blood sugar level that shows significantly reduction of blood glucose level with okra seed as medication.

CONCLUSION

There is considerable evidence from experimental studies that okra seed has potential hyporglycemic activity in STZ induced diabetic rats. Our results confirm that supplementation of okra seed (*A. esculentus*) significant in body weight reduction. The Supplementation of okra reduce blood glucose level.

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