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# Efficacy of guar gum (*Cyamopsis tetragonolobus*) on alloxan induced diabetic rats

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**Abstract**
Sixty rats were divided into five groups comprising of twelve rats of either sex in each group. The group II, III, IV and V rats were administered alloxan @ 150 mg/Kg body weight intra-peritoneal and Group I served as a control group. No any sign any apparent behavioral changes were in the control group of rats, however, group II rats showed symptoms of dullness, depression polydipsia and polyuria.
The group III, IV and V rats treated orally with metformin @ 100 mg/kg body weight, Guar gum @ 10 gm/100 gm and combination of Guar gum @ 10 gm/100 gm of feed and metformin @ 100 mg/Kg body weight respectively. There was significant increase in the blood glucose level, serum triglyceride, serum cholesterol, serum LDL, serum AST and serum ALT level values in the treatment groups on 0$^{th}$ day and were significantly reduced from 14 days onward and on 28$^{th}$ day it was come down to normal level in the group treatment with Guar gum @ 10 gm/100 gm of feed. Grossly liver and pancreas did not showed any noticeable visual change in any of the experimental rats. No significant change in weights of liver and pancreas in treatment groups. The histopathological changes were predominantly noted in liver and pancreas suggesting induction of diabetes in group II animals. However, restoration of histoarchitecture of these organs was observed after the treatment in these groups.

**Keywords:** Guar gum (*Cyamopsis tetragonolobus*), antidiabetic activity, alloxan induced diabetic in rats and metformin

## Introduction
The World Health Organization (WHO) estimates that more than 180 million people worldwide have diabetes. This number is likely to more than double by 2030 (Najaf *et al.* 2010) [7].
Though many chemical drugs are available for the treatment of diabetes, the complicity, side effects and costly treatments have caused both health care practitioners and majority of population towards alternative therapies more likely towards herbal medicines. Since these systems are believed to be free from side effects and are affordable (Rao *et al.* 2009) [8]. Mostly attention has been focused on the improved control of diabetes which can be achieved by the use of high-carbohydrate, high-fibre diets (Simpson *et al.* 1981) [11]. Although the benefit is partially derived from the high carbohydrate component (Jones *et al.* 1985) [6], the major benefit appears to result from the high fibre content (Jenkins *et al.* 1976) [5].
Guar or cluster bean (*Cyamopsis tetragonolobus*) is an annual legume plant that grows in semiarid regions. India is the major producer of Guar. India produces approximately 80% of world's total production. Guar is drought tolerant and can be eaten green like snap beans, fed to cattle or used as a green manure. It bears many beans like pods, each of which contains six to nine small, rounded seeds. The guar seed is typically made up of 40% to 46% germ, 38% to 45% endosperm, and 14% to 16% husk. Food grade guar gum contains 80% guaran (a galactomannan composed of D-mannose and D-galactose units) with an average molecular weight of 220 kDa. However, guar gum is not a uniform product and its viscosity may vary in proportion to the degree of galactomannan cross-linking.
Guar gum has been used for centuries as a thickening agent for foods and pharmaceuticals. It is used in dairy products like ice cream and as a stabilizer in cheese and cold-meat processing. It continues to find extensive use for these applications as well as the paper, textile, and oil

drilling industries.

Guar Gum is water soluble dietary fiber non-ionic polysaccharides obtained from the endosperm of the seeds of *Cyamopsis tetragonolobus*. Many investigators have reported that soluble dietary fibre has the ability to lower plasma cholesterol concentration in experimental animals and in humans. Guar gum has been shown to be a potent hypo-cholesterolaemic agent in both normal and hyper-cholesterolaemic animals. Ingestion of guar gum decreases postprandial glycaemia and insulinaemia and improves sensitivity to insulin in diabetes patients and several animal models of diabetes. Intake of hydrolyzed guar gum reduces the postprandial blood glucose absorption in small intestine of rats (Takahashi *et al.* 2009) [12].

**Materials and Methods**

Total 60 wistar rats of either sex were used for the study, of which 48 rats were fasted overnight and administered alloxan @ 150 mg/kg body weight (Rathnakar *et al.* 2011) [9]. After one week of administration, the diabetic status of rats was confirmed by estimating serum glucose level. The confirmed diabetic rats were then divided in group II to V comprising of 12 rats in each group. Group I serve as control and group II as diabetic control group respectively. Group III, treated with Metformin @ 100 mg/kg body weight orally and group IV treated with @ 10 percent Guar gum (*Cyamopsis tetragonolobus*) powder mixed with normal rat feed and group V treated with combination of Metformin (@ 100 mg/kg body weight) and Guar gum @ 10 percent in feed for 28 days.

**Parameter studied**

Blood samples were collected on 0 day i. e. after confirmation of diabetes induction followed by 14th day and on 28th day of experiment. The serum was separated and Glucose (GOD/POD method), Total Cholesterol (CHOD/POD method), Triglyceride (GPO/POD method), Aspartate Aminotransferase (AST) (UV Kinetic method) and Alanine Aminotransferase (ALT) (UV Kinetic method) parameters were estimated by using serum biochemistry semi-auto analyzer (Model- Chem.7).

**Histopathological Parameter**

Liver and pancreatic tissues were collected in 10% formalin and were dehydrated in ascending grade of alcohol, cleared in xylene and embedded in paraffin wax. Four to five micron thick sections were stained with routine Haematoxylin and eosin-staining (Culling; 1998) [2] method also the pancreatic tissues were stained with the special staining method i.e. Gomari's method for pancreatic islet cells as described by Gomori (1941) [4] and were examined.

**Results and Discussion**

The present study did not revealed any observed behavioral changes in III to V groups of rats, however, in group II (diabetic control) there was polydipsia, polyuria and dullness was observed in the rats.

**Blood Glucose Level**

The blood glucose level in group I (healthy control) animals on day 0, 14th and 28th observed were 115.33±4.37, 138.33±6.67 and 125.50±4.90 mg/dl respectively (table 1). However in diabetic groups (II to V) the glucose levels were $419.67^{ax}$±72.64, $419.83^{ax}$±83.51, $410.50^{ax}$±74.70 and $408.83^{ax}$±84.98 on 0th day (after induction of diabetic) of experiment.

Statistically significant reduction in blood sugar level of III, IV and V groups was observed on day 28th when compared with their respective day 0 and day 14th values and the values were $127.67^{bz}$±8.59, $187.50^{az}$±32.99 and $139.33^{bz}$±9.45 respectively on 28th day of treatment. Similar observations are also reported by Saeed *et al.* (2012) [10] where they have reported the reduction in the blood sugar level and an increase in the body weight and food intake with the 5, 10 and 20 percent of guar gum level in the diet. Butt *et al.* (2007) [1] also reported the reduction in the blood sugar level but it was with 3 percent level of guar gum in diet. However the findings in the present investigation are in contrast to the findings reported by Dario and Sgarbieri (1998) [3]. They have reported the initial decrease in the blood sugar level on day 30th but further elevation was also reported on 60th day.

The Blood glucose levels in groups II, III, IV and V rats respectively were significantly higher as compared to control on day 0 of experiment, suggestive of induction of diabetes. There is significant decrease in level of glucose on progressive days of experiment as treatments were started in different groups as per protocol. In group III there was significant reduction in glucose level and it was most effective treatment when compare with other groups.

**Serum Cholesterol**

Serum cholesterol level of rats in present experiment on day 0, 14th and 28th of the experiment in healthy control group animals observed were 66.50±3.87, 66.50±4.19 and 64.83±4.58 mg/dl (table 1) respectively where it ranged between 52.03 to 87.3 mg/dl indicating the normal cholesterol level. However, increased in serum cholesterol level was observed in diabetes groups (II to V) and the values were 154.17±9.22, 157.50±7.01 and 158.50±8.10 mg/dl on 0th day of experiment.

There was significant reduction in serum cholesterol level was observed in III, IV and V groups from 14th day onwards and on 28th day the values were $125.67^{by}$±3.30, $125.67^{bz}$±6.92 and $108.67^{cy}$±8.59 compared with their respective day 0 and day 14th values. The difference was observed to be highly significant when compared with the group II values on day 28th. Similar observations are also recorded by Dario and Sgarbieri (1998) [3] where they have reported the significant lower level in the serum cholesterol with the 10 and 20 percent of guar gum level in the diet from day 30 to 60 days. Butt *et al.* (2007) [1] also reported the lowest plasma cholesterol level with 3 percent level of guar gum in diet. Saeed *et al.* (2012) [10] also reported reduction in the serum cholesterol level in rats fed with guar gum (5, 10, and 20%) diet.

The serum cholesterol level was observed to be increased in diabetic animals. In group V there was significant reduction in serum cholesterol level and it was most effective treatment when compare with other groups.

**Serum Triglyceride**

Serum triglyceride level of rats in present experiment on day 0, 14th and 28th of the experiment in healthy control group animals observed were 128.33±28.53, 122.00±16.55 and 120.67±14.70 mg/dl (table 2) where it ranges between 55.3 to 130.8 mg/dl indicating the normal triglyceride level. The serum triglyceride values were increased in diabetic group on 0 day however in response to the treatment on 28th day of experiment the serum triglyceride values significant get

reduced on III, IV and V groups and the values were $223.33^{by}$±42.94, $188.17^{cy}$±4.79 and $180.00^{cy}$±6.29 respectively. The difference was observed to be highly significant when compared with the group II values on day 28th.

Similar observations are also recorded by Butt *et al.* (2012) [1] where they have reported maximum reduction in serum triglyceride level in rats fed with 3 percent guar gum diet as compare to diet containing 3 percent pectin and combination of 2 percent guar gum and 2 percent pectin. Dario and Sgarbieri (1998) [3] also reported significant reduction in serum triglyceride level in the rats fed with 10 percent and 20 percent guar gum diet. Saeed *et al.* (2012) [10] also reported reduction in the serum triglyceride level in rats fed with guar gum (5, 10, and 20%) diet.

**Serum Aspartate Aminotransferase (AST)**

The AST values of control group animals on day 0, 14 and 28 were 71.32±5.55, 70.95±6.26 and 70.56±6.42 U/L respectively (table 2). Though alterations were observed on different days of the experiment all the values were observed to be within normal physiological limit (45.7-80.8 U/L). However, in diabetic induced groups (II to V) the AST values were increased beyond the normal physiological limit indicating disturbance due to use of alloxan for the induction of diabetes. But the Aspartate Aminotransferase (AST) levels were significant get reduced in III, IV and V groups after the respective treatment from 14th day onwards. The Aspartate Aminotransferase (AST) levels on day 28th of treatment was $124.44^{by}$±8.03, $123.65^{by}$±4.70 and $112.42^{bz}$±6.41 compared with their respective day 0 and day 14th values. The difference was observed to be highly significant when compared with the group II values on 28th day of experiment.

**Alanine Aminotransferase (ALT)**

The ALT values of control group animals on day 0, 14 and 28 were observed to be 68.34±4.11, 62.18±4.16 and 66.28±3.88 U/L respectively (table 2). Though alterations were observed on different days of the experiment all the values were observed to be within normal physiological limit (35-80 U/L). Alanine Aminotransferase (ALT) level in diabetes groups (II to V) on day 0 were $123.77^{cy}$±2.61, $133.09^{bx}$±2.01, $133.06^{bx}$±1.3 and $136.17^{ax}$±1.27U/L where it increased beyond the normal physiological limit indicating disturbance due to induction of diabetes.

However, statistically significant reduction in Alanine Aminotransferase (ALT) level of III, IV and V groups was observed on day 28th when compared with their respective day 14th values. The values on 28th day were observed $110.14^{bz}$±0.82, $102.21^{cz}$±1.88 and $96.79^{dz}$±1.72. The highly significant difference was observed when compared with the group II values on 28th day of experiment.

There is significant reduction in increased level of triglyceride in group IV and V after treatment revealed that these treatments were best for triglyceride level. In similar way there is significant reduction in increased level of serum AST level in group V after treatment revealing this treatment was best for serum AST level.

**Gross and Histopathological investigations**

The gross pathological observations of liver, pancreas did not revealed any noticeable change in any of the rat from experimental group. There was no significant effect on organ weights of liver and pancreas in treatment groups.

The histopathological observations of liver in diabetic control group showed, mononuclear cell infiltration along with mild focal fatty changes and degenerative changes in hepatic parenchyma. Minimal focal fatty, degenerative changes and mononuclear cell infiltration observed in treatment groups. Histopathological, pancreas showed vacuolation and degeneration in islets cells of diabetic control group, whereas in treatment groups vacuolation and degenerative changes were minimal in cells of islets.

**Table 1:** Hematological values: Blood glucose level (mg/dl) and serum Cholesterol level (mg/dl)

| Group | Blood glucose level(mg/dl) | | | Serum Cholesterol level (mg/dl) | | |
|---|---|---|---|---|---|---|
| Days | 0 day | 14 day | 28 day | 0 day | 14 day | 28 day |
| Group I | $115.33^{bx}$±4.36 | $138.33^{cx}$±6.69 | $125.50^{bx}$±4.90 | $66.50^{cx}$±3.87 | $66.50^{dx}$±4.19 | $64.83^{dx}$±4.58 |
| Group II | $419.67^{ax}$±72.64 | $333.67^{ay}$±81.89 | $256.50^{az}$±9.70 | $154.17^{ax}$±9.22 | $157.50^{ax}$±7.01 | $158.50^{ax}$±8.10 |
| Group III | $419.83^{ax}$±83.51 | $294.17^{ay}$±95.48 | $127.67^{bz}$±8.59 | $155.17^{ax}$±9.19 | $132.50^{by}$±6.77 | $125.67^{by}$±3.30 |
| Group IV | $410.50^{ax}$±74.70 | $291.33^{ay}$±56.92 | $187.50^{az}$±32.99 | $155.33^{ax}$±17.13 | $139.50^{by}$±12.67 | $125.67^{bz}$±6.92 |
| Group V | $408.83^{ax}$±84.98 | $233.00^{by}$±51.93 | $139.33^{bz}$±9.45 | $118.67^{bx}$±12.32 | $112.67^{cx}$±7.61 | $108.67^{cy}$±8.59 |

Blood Glucose: Different superscripts with denotation of x, y, z indicates significant
Difference within the day (between columns)
Different superscripts with denotation of a, b, c, d indicates significant
Difference within the groups (between rows)
CD: At 5% =66.48 At 1%=85.83.
Serum Cholesterol level (mg/dl):
Different superscripts with denotation of x, y, z indicates significant
Difference within the day (between columns)
Different superscripts with denotation of a, b, c, d indicates significant
Difference within the groups (between rows)
CD: At 5% =10.46 At 1%=13.50.

**Table 2:** Biochemical values: Serum Triglyceride; AST and ALT

| Group | Serum Triglyceride (mg/dl) | | | AST Mean + SE, IU/L | | | ALT Mean + SE, IU/L | | |
|---|---|---|---|---|---|---|---|---|---|
| Days | 0 day | 14 day | 28 day | 0 day | 14 day | 28 day | 0 day | 14 day | 28 day |
| Group I | $128.33^{cx}$±28.53 | $122.00^{cx}$±16.55 | $120.67^{dx}$±14.70 | $71.32^{bx}$±5.55 | $70.95^{bx}$±6.26 | $70.56^{cx}$±6.42 | $60.59^{dx}$±3.22 | $60.77^{dx}$±1.79 | $60.08^{ex}$±2.75 |
| Group II | $287.33^{ax}$±37.93 | $266.67^{ax}$±27.39 | $274.00^{ax}$±28.51 | $143.79^{ax}$±13.86 | $143.87^{ax}$±10.42 | $144.81^{ax}$±8.39 | $123.77^{cy}$±2.61 | $123.86^{ay}$±2.55 | $129.20^{ax}$±2.36 |
| Group III | $265.33^{ax}$±51.61 | $242.50^{ax}$±47.96 | $223.33^{by}$±42.94 | $141.82^{ax}$±10.93 | $136.07^{ax}$±11.60 | $124.44^{by}$±8.03 | $133.09^{bx}$±2.01 | $116.2^{cy}$±1.05 | $110.14^{bz}$±0.82 |
| Group IV | $252.67^{ax}$±12.98 | $218.33^{by}$±8.57 | $188.17^{cy}$±4.79 | $149.86^{ax}$±8.49 | $142.30^{ax}$±7.04 | $123.65^{by}$±4.70 | $133.06^{bx}$±1.3 | $119.59^{by}$±1.35 | $102.21^{cz}$±1.88 |
| Group V | $232.17^{bx}$±5.87 | $214.33^{bx}$±6.24 | $180.00^{cy}$±6.29 | $148.15^{ax}$±10.17 | $130.84^{ay}$±8.12 | $112.42^{bz}$±6.41 | $136.17^{ax}$±1.27 | $118.88^{by}$±1.03 | $96.79^{dz}$±1.72 |

Serum Triglyceride: Different superscripts with denotation of x, y, z indicates significant
Difference within the day (between columns)
Different superscripts with denotation of a, b, c, d indicates significant
Difference within the groups (between rows)
CD: At 5% =34.39; at 1% 44.40
AST: Different superscripts with denotation of x, y, z indicates significant
Difference within the day (between columns)
Different superscripts with denotation of a, b, c, d indicates significant
Difference within the groups (between rows)
CD: At 5% = 11.0; At 1% = 14.20
ALT: Different superscripts with denotation of x, y, z indicates significant
Difference within the day (between columns)
Different superscripts with denotation of a, b, c, d indicates significant
Difference within the groups (between rows)
CD: At 5% = 2.18; At 1% = 2.82

## Conclusion

In conclusion, the study demonstrated significant improvements in various physiological parameters following treatment interventions in diabetic rats. While no notable behavioral changes were observed across most groups, the diabetic control group exhibited classical symptoms of diabetes. Significant reductions in blood glucose, serum cholesterol, serum triglyceride, serum AST, and ALT levels were noted in treatment groups compared to the diabetic control, indicating the efficacy of the interventions. These findings align with previous research on the benefits of dietary interventions, particularly with guar gum supplementation. Additionally, gross and histopathological examinations revealed minimal adverse effects on liver and pancreas, further supporting the safety profile of the treatments. Overall, the study underscores the potential therapeutic value of the interventions in managing diabetes-associated metabolic disturbances, warranting further exploration in clinical settings.

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