

Impact of *Momordica Charantia* (Karela) on the Fasting Blood Glucose level in the Streptozotocin-Induced Diabetic Rats

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Abstract:

Context: Scientific studies revealed the hypoglycaemic properties of *Momordica charantia*. The present study was carried out to find out microscopically whether *Momordica charantia* (karela) has got any impact lowering of FBG (Fasting Blood Glucose) level in diabetes mellitus.

Study type: an experimental study.

Setting: Anatomy department of the then IPGMR (Institute of Post Graduate Medicine and Research) at present BSMMU (Bangabandhu Sheikh Mujib Medical University) and BIRDEM (Bangladesh Institute of Research and Rehabilitation in Diabetes, Endocrine & Metabolic Disorders).

Subjects: Sixty five healthy young Long Evans rats of male sex weighing 150 to 280gm aged between 10 to 12 weeks were used in this study.

Methods: The rats were divided into four equal groups depending on their different sorts of dietary feeding and drug treatment.

Main outcome measures: variation of differential FBG level in different groups of rat.

Result: Mean 'initial' and 'final' (on day 7 and day 51 from Streptozotocin/vehicle injection) fasting blood glucose (FBG) level in the control group (Group-A) was 7.872 ± 0.60 and 8.55 ± 0.82 respectively. Therefore the mean (FBG) increased by about 13% ($P = 0.022^*$) which is higher than that of the initial value. In untreated diabetic group the mean initial (FBG) level was 25.95 ± 8.90 and the mean final was 24.02 ± 4.08 . So here, the (FBG) level decreased by about 13% ($P = 0.557$). On the other hand, in the insulin-treated diabetic rats the mean initial (FBG) level was 24.35 ± 6.81 and the mean final was 8.38 ± 5.02 , which is lower ($P = 0.000^*$) & in the karela-treated diabetic rats, the initial (FBG) level was 23.03 ± 5.70 and the mean final was 5.65 ± 1.29 which is lower* ($P = 0.000^*$). The value in the insulin-treated diabetic rats & in the karela-treated diabetic rats were significantly lower than that of the untreated diabetic rats ($P = 0.007$) & ($P = 0.005$) respectively. But there was no significant difference between the insulin-treated diabetic rats & the karela-treated diabetic rats ($P = 0.605$) in this regard.

Conclusion: Karela showed a tendency of acting against hyperglycemic effects of Streptozotocin-induced diabetes mellitus. However, further investigations are recommended for establishing karela as a safe, useful effective anti- hyperglycemic agent as well as antidiabetogenic agent.

Key words: Diabetes mellitus, Hyperglycemia, *Momordica charantia* (karela).

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Introduction:

In the years together, diabetes mellitus is a major health problem. In Bangladesh a high proportion of diabetics are registered to different clinic and institutes, among which only Bangladesh Institute of Research and Rehabilitation in diabetes, Endocrine & Metabolic Disorders (BIRDEM) has registered in 1998, 1,93,271 cases which is higher than that of previous year. Although it is understandable that many of the diabetic patient especially in the rural area have not registered

themselves to any diabetic clinic or hospitals and many other still remain undiagnosed.

In the treatment of diabetes mellitus synthetic oral hypoglycaemics have various side effects & contraindications, has led to scientists to search for alternatives and many natural products indigenous to various parts of the world. A large number of herbal products have been used as remedies of polyurea. Some of these are in the usual food list of the people concerned. Scientific studies also revealed the hypoglycaemic properties in many of these herbal products. Among these herbal products *Momordica charantia* ('karela' or bitter gourd) is one of such natural products, cultivated in the many parts of Africa, South America & Asia. the fruit is very popular as a vegetable in Bangladesh. In Sri Lanka the fruit juice of *M. charantia* is considered as an effective hypoglycemic agent in management of diabetes mellitus. In the other parts of the world it is used as the folk medicine to the treatment of diabetes¹. 'Karela's hypoglycemic property has also been shown experimentally in the diabetics as well as in normal laboratory animals^{2,3,4,5}.

As because diabetes mellitus causes rise in FBG level , it may be hypothesized that 'karela' (bitter gourd) being an antidiabetic agent, may also be used to minimize the rise of the FBG level in Streptozotocin-induced diabetes mellitus.

Materials and Method:

The experiment was carried out on a total number of 65 young rats of male Long Evans strain. They were 10 to 12 wks old, weighing between 150 and 280gm. Among them 10 rats were treated with vehicle (citrate buffer solution 1 ml/ kg body weight intraperitoneally) only and used as control rats (Group A) and 45 rats were treated with vehicle and Streptozotocin (STZ) found as diabetes, 15 of which were treated as untreated diabetic control group (Group B), 15 were treated again with insulin at a dose of 1 – 3 units/ kg body weight / day, were treated as the insulin-treated diabetic group (Group C) & 15 were treated with karela at a dose of 10 ml/ kg body weight / per day orally through tube to control the diabetes mellitus and was called as 'karela'- treated diabetic group (Group D).

In the Research Division of BIRDEM, Dhaka, the fasting blood glucose level of all the rats, were measured in mmol/L by the Glucose Liquicolour GOD POD using Enzymatic Colometric Test Method without deproteinization on the 7th day, termed as 'initial' and on the day 51 termed as 'final' from day of STZ/Vehicle injection.

Observation and results:

Fasting blood glucose levels were estimated in all rats in two occasions on day 7 and day 51 from day of STZ/vehicle injection shown in Table- I.

Table I
Fasting blood glucose (FBG) level in rat of different groups.

Group	Fasting blood glucose level (mmol/L)		
	Initial(on day 7)	Final (on day 51)	Final as a percentage (%) of corresponding initial
AControl (n = 10)	7.87 ± 0.60	8.55 ± 0.82	108.85 ± 10.24
BUntreated Diabetic (n = 15)	25.95 ± 8.90	24.02 ± 4.80	112.37 ± 73.03
CInsulin-treated diabetic (n = 15)	24.35 ± 6.81	8.38 ± 5.02	37.46 ± 28.18
D'Karela'-treated diabetic (n = 15)	23.03 ± 5.70	5.65 ± 1.29	26.06 ± 8.85

Statistical analyses for significans of differences between different groups and within groups:

Initial fasting blood glucose levels compared through Student's unpaired 't' test:
 Group B vs A : P= 0.000*
 C vs A : P= 0.000*
 D vs A : P= 0.000*

Initial & final fasting blood glucose levels compared through Student's paired 't' test:
 Group A : P= 0.022*
 B : P= 0.557
 C : P= 0.000*
 D : P= 0.000*

Final fasting blood glucose levels as a percentage of corresponding initial body weight compared through unpaired Student's 't' test.
 Group C vs B : P= 0.007*
 D vs B : P= 0.005*
 D vs C : P= 0.238

*Significant at 5% level (P 0.05)

The FBG level was measured in mmol/L. In control group the initial mean FBG level was 7.87 ± 0.60 and the final mean was 8.55 ± 0.82 . Therefore, the final mean FBG level increased by about 8 %, which is more or less similar ($P= 0.022^*$). In untreated diabetic group the initial mean FBG level was 25.95 ± 8.90 and the final mean was 24.02 ± 4.80 . So, the FBG level decreased by about 7 % which is more or less similar ($P= 0.557$). In insulin-treated diabetic rats the initial mean FBG level was 24.35 ± 6.81 and the mean final was 8.38 ± 5.02 which is about 65 % lower ($P= 0.000^*$). On the other hand, in the karela-treated diabetic rats the initial mean FBG level was 23.03 ± 5.70 and the mean final was 5.65 ± 1.29 which is about 75 % lower ($P= 0.000^*$).

Statistical analyses also showed that the initial FBG level on day 7 from STZ injection were significantly higher ($P= 000$) in each of those two group, Group C & Group D, than in the untreated diabetic (Group B) ($P= 0.007^*$ & $P= 0.005^*$ respectively). But there was no significant different between these two groups ($P= 0.238$) in this regard.

Discussion:

In case of diabetes mellitus FBG level is raised and this FBG level is an important parameter to detect the diabetic status.

In this study the karela has showed significant hypoglycaemic effect in IDDM rats. Karela juice is rich in proteins. Karela has to subtraction, plant-insulin which are responsible for lowering the blood glucose level, glycosuria and reduction of plasma high glucagon and somatostatin in diabetic dogs.

In this experiment the karela has used at a dose of 10 ml/kg body weight/ day orally through the feeding tube which is different from doses used in other studies. Again in this case experiment the young IDDM rats of age 10 – 12 weeks old has used but in other experiments they used NIDDM rat of different aged pups of rats or adult rats.

Comparisons between the corresponding blood glucose levels on day 7 (initial) and day 51 (final) in the control and the untreated diabetic groups suggest that the control group maintained a lower blood glucose level throughout the study (mean 8.55 ± 0.82 mmol/L).

The final glucose levels were expressed as percentages of the corresponding initial levels. When these percentage values were compared, the 'karela'-treated diabetic rats showed a significantly lower value than the untreated diabetic rats and the effect did not differ from that of insulin significantly. Relevant information from the available literature on the effect of 'karela' on the blood glucose level and related functions of karela are discussed in details in the following paragraphs.

Karela (fruit pulp) leaves & whole plant reduces the blood sugar level in diabetic & in normal rats⁶, also found that the karela significantly improve the glucose tolerance of 73% of the patients⁷. Orally administered karela extract lower glucose level independently of intestinal glucose absorption & involve an extrapancreatic effect⁸.

Ng et al. 1992 has shown that the karela has the hypoglycemic, antiviral, anti-diabetic & anti-tumour activities. Again, more recently crushed dried karela fruits have been compressed and sold in tablet form in India & China^{8,9}. In the present study, the untreated diabetic rats showed a significantly higher blood glucose level than the control rats on day 7. STZ is known to induce insulin-dependent diabetes mellitus (IDDM) in laboratory animals^{2,3,4,5}. In this experiment FBG levels in control group increased significantly ($P=0.022$) from its mean initial value 7.87 ± 0.60 mmol/L but in streptozotocin-induced untreated diabetic group the fasting blood glucose increased from its mean initial value 25.95 ± 8.90 mmol/L which is non-significant ($P= 0.557$) but in karela-treated diabetic group the FBG level has reduced from its mean initial value 23.03 ± 5.70 mmol/L which is very much significant ($P=0.000^*$), also FBG level has reduced in insulin-treated diabetic rats significantly ($P= 0.000^*$). From this experiment it may be proved that the untreated diabetic group, the karela-treated diabetic group & insulin-treated diabetic group have got the diabetic rats, but in the karela-treated diabetic group and insulin-treated diabetic group, the diabetic condition of the rats improved towards the normal, which is also identical to the other's findings, though the doses and nature of diabetes mellitus is different from other experiments.

Conclusion:

Momordica charantia (karela) showed a tendency of lowering the blood glucose level in diabetes mellitus. However further investigations are recommended for establishing the active ingredient(s) of karela as a safe, useful and effective antihyperglycaemic agent(s).

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