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Research Article

Blood glucose-lowering mechanism action of fenugreek and metformin in albino rats

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Abstract

Diabetes mellitus is an endocrine pancreatic common disorder characterized by partial or complete insulin deficiency due to impaired insulin secretion by β-cells. Fenugreek (*Trigonella-foenum-graecum*) is a medicinal plant belongs to Fabaceae family is medicinal plant having pharmacological characteristics. Metformin as an oral hypoglycemic drug has been ordinarily using for Non-Insulin Dependent Diabetes Mellitus and the hypoglycemic activity of metformin happens by virtue of its ability to hinder both gluconeogenesis and glycogenolysis in liver cells. In present study diabetes was induced in rats through the administration of Alloxan monohydrate 150mg/kg body weight intraperitoneal. Hypoglycemic effect of powder of Fenugreek seeds and Metformin was compared. Fenugreek seeds powder at the dose of 3g/kg and metformin at dose of 150mg/kg body weight were administered orally in induced diabetes in rats. A significant difference ($p<0.05$) was observed in blood glucose level. The blood glucose level was decline significantly in treated groups (fenugreek seeds and metformin treated group) as compared with control diabetic group. A significant difference ($p<0.05$) was observed in final body weight in all groups. There was significantly decline in final body weight in diabetic control group as compared to control group whereas final body weight was significantly increased in fenugreek seeds treated group, and metformin treated group as compared to final body weight of diabetic control group.Fenugreek seeds found more anti-hyperglycemic agent as compared to metformin.

Keywords: Fenugreek seeds; Metformin; Diabetes mellitus

Introduction

Diabetes mellitus is an endocrine pancreatic common disorder characterized by partial or complete insulin deficiency due to impaired insulin secretion by β-cells **[1, 2]**. Diabetes mellitus is most commonly occurring in canine and feline. They mostly suffered from either insulin

dependent or non-insulin dependent diabetes mellitus. The insulin dependent diabetes mellitus is said to be Type I and non-insulin dependent diabetes mellitus said to be Type II diabetes mellitus. Type I diabetes mellitus indicate by the completedamage of beta cells of pancreas, which will leads towards the deficiency of insulin causing increase in blood glucose level and type II diabetes mellitus indicate by incomplete destruction of beta cells of pancreas which are not enough for regulating the blood sugar level of animals [3].

Fenugreek (*Trigonellafoenumgraecum*) is a medicinal plant belongs to Fabaceae family is medicinal plant having pharmacological characteristics. Fenugreek develops to normal tallness of two feet. Both leaves and seeds use in the medication of different diseases [4]. These seeds are brilliant yellow in color, little in size, hard and have a four-faced stone like structure [5]**.** Fenugreek seeds contain 50% fiber (30% soluble fiber and 20% insoluble fiber) which slow down glucose absorption rate after feed intake [6].

Metformin belongs to biguanides are utilized worldwide for the treatment of diabetes. Metformin as an oral hypoglycemic drug has been ordinarily using for non-insulin dependent diabetes mellitus and insulin opposition in polycystic ovarian disease, the hypoglycemic activity of metformin happens by virtue of its ability to hinder both gluconeogenesis and glycogenolysis in liver cells [7]. It indirectly down-regulates circulating insulin and insulin development factor-1, by virtue of diminishing serum sugar [8, 9]. It reversibly binds to complex I of the mitochondrial electron transport chain in hepa cells, enhance cell stress [7, 10]. As the liver is the site of activity, metformin diminishes a hepatic glucose generation and enhance muscle glucose take-up and excrete, in this way bringing down hyperglycemia [11, 12].

Due to lack of knowledge regarding to fatality of diabetes mellitus it cure and control in remote areas of Pakistan, an experimental approach was applied on laboratory animals to compare anti-diabetic potential of herbal therapy (fenugreek seeds) with allopathic drug (metformin).

MATERIALS and methods

Study area

This study was conducted in the animal house, Department of Veterinary Parasitology and Veterinary Medicine, Faculty of Animal Husbandry and Veterinary Sciences, Sindh Agriculture University Tandojam.

Experimental animals

The beneficial influence of Fenugreek seeds, and Metformin on glucose level were studied. Male albino rats were designated as a model having weight of body 150-200 grams. Before seven days of experimental study, rats were tagged and assigned in cages for adoption of environment at the animal house.

Feeding of experimental animals

Feed and clean water was provided to rats in all groups throughout experimental period. Skimmed milk and wheat flour was given as feed.

Induction of diabetes

Alloxan monohydrate (Sigma-Aldrich) was freshly dissolved in cold normal saline and administered at the dose of 150 mg/ kg b.wt intra-peritoneal to overnight fasted rats. After one hour of induction dose 10% glucose solution was provided in drinkers for 24 hours to prevent from the hypoglycemic condition. The rats become diabetic after 3 days of induction dose and show clinical signs with hyperglycemia. The Blood glucose determined through Glucometer (On Call®Ez II) throughout the experimental period. Fasting blood glucose > 200 mg/dl in rats under study were considered diabetic.

Experimental design

24 Rats were randomly divided into four groups (n=6). Group B, C and D were induced diabetes whereas group A served

as the control group. Group B served as the diabetic control group (without further treatment). Group C received fenugreek seeds powder at the dosage of 3 g/kg b. wt., orally daily for 21 days. Group D received metformin solution at a dosage of 150 mg/kg b. wt., orally for 21 days. The dose in treated groups was divided into two parts and administered at the time interval of 12 hours.

Herbal preparations

Fenugreek seeds powder: Fenugreek (*Trigonellafoenum-graecum)* seeds were grinded to become powder, using an electric grinder and stored in an airtight container at room temperature. The fenugreek seeds powder mixed with water and administered with the dosage of 3 g/kg body weight, daily for 21 days.

Oral administration of Tablet Metformin

Metformin mixed with water and administered orally at the dosage of 150 mg/kg body weight, per day **[13]**.

Statistical analysis

The collected data was analyzed with Statistix 10.0 version. Significant difference was recorded at p-value ($P<0.05$).

Results

Blood glucose

A statistically significant ($p<0.05$) raise in glycaemia occurred in diabetic control group from 254 mg/dl to 274 mg/dl compared to the control group, whereas blood glucose level decreased in groups treated with fenugreek and metformin as compared to control diabetic group from 254 mg/dl to 116 mg/dl in fenugreek treated group and from 254 mg/dl to 133 mg/dl in metformin treated group from 0 to 3rd week (Fig. 1).

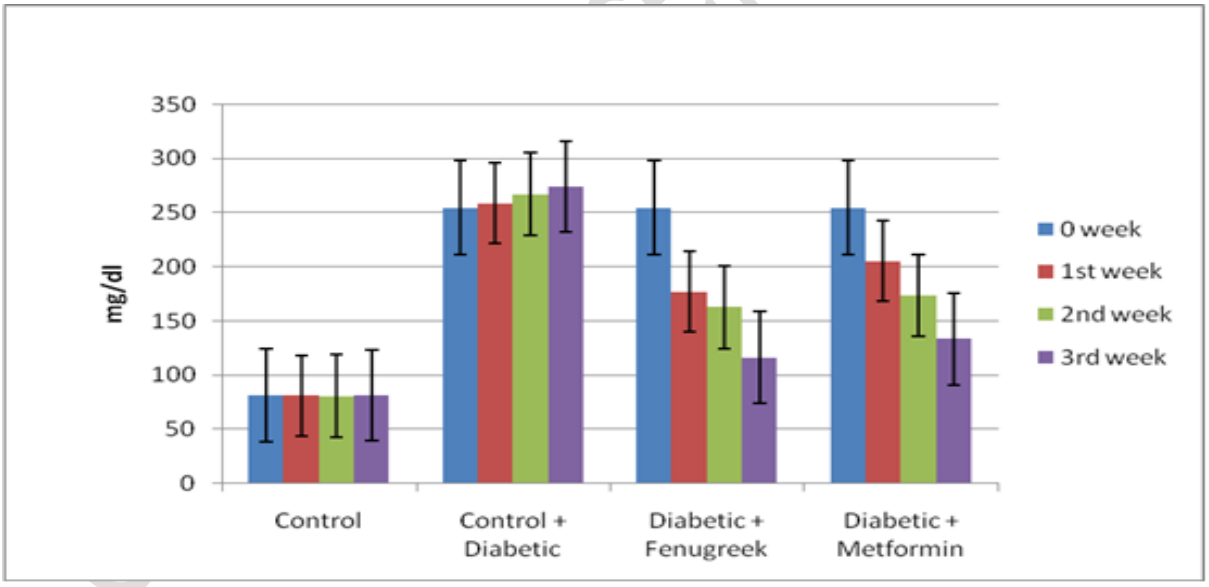

Figure 1. Comparison of blood glucose level in a various groups treated with fenugreek seeds and metformin with control

Body weight

A significant difference *($p<0.05$)* was observed in final body weight among all groups. The final body weight was significant decline *($p<0.05$)* in all groups except control group. Final body weight of diabetic control group significantly decreased as compared to control group and final body weight of fenugreek seeds and metformin treated groups were significantly enhanced as compared with control diabetic group (Fig. 2).

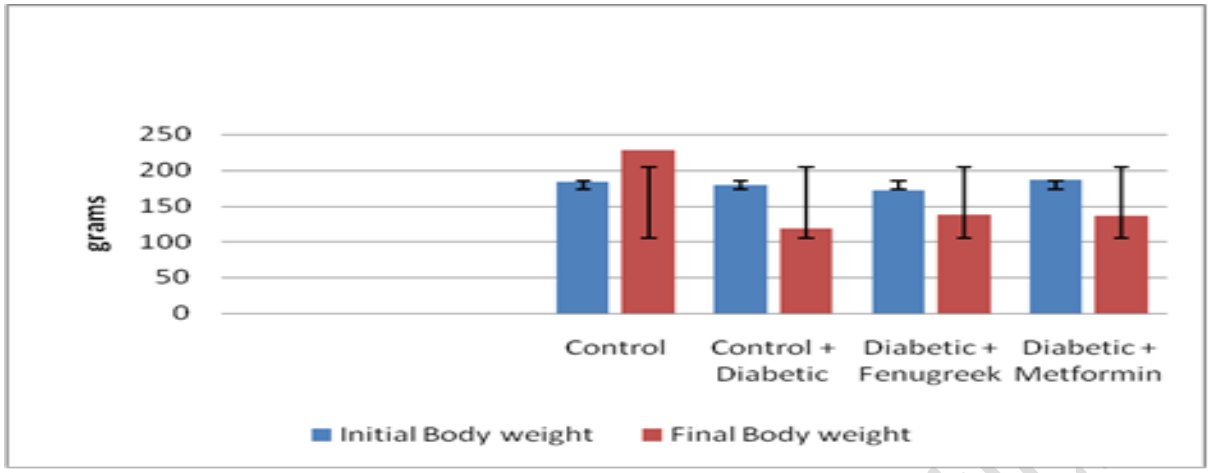

Figure 2. Effect of fenugreek seeds and metformin on body weight (g) of diabetic rats

Discussion

Diabetic induced rats were provided with fenugreek seeds powder for 21 days at the dose of 3 gram/kg body weight in order to decrease the level of serum glucose, administration of fenugreek seeds powder causes reduction of blood glucose level from 254.64 mg/dl to 116.80 mg/dl of blood in induced diabetic rats. Similarly; **[14]** has been stated that the administration ofalkaloid extract of fenugreek seeds is very helpful for taking down the glycemia in the induced diabetic rats from 280.00 mg/dl to 141.83 mg/dl of blood. Furthermore; **[15]** also experimentally observed the anti-hyperglycemic effect of aqueous extract of fenugreek in induced diabetic rats from 314.25 mg/dl to 159.00 mg/dl of blood. Apart from this; **[16]** has explained the anti-diabetic effect of fenugreek extract on blood serum glucose level in induced diabetic rats causing decrease in blood glucose level from 333.20 mg/dl to 71.80 mg/dl of blood in induced diabetic rats. In contrast with result recorded through our studies, **[16, 17]** also stated the improvement was observed in blood glucose level of patients suffering from diabetes mellitus type-II by using fenugreek seeds causes reduction in blood glucose by decrease in absorption of glucose from the micro villi of small intestine. Likewise; **[18]** also reported fenugreek seeds as excellent therapeutic regime as anti-diabetic agent for managing diabetes mellitus type-II and its complication.

Diabetic induced rats has been experimentally treated by administration of metformin in order to decrease the blood glucose level in induced diabetic rats, metformin has been administered in induced diabetic rats at the dose of 150.00 mg/kg body weight per day for continuously 21 days. Metformin causes reduction of blood glucose level from 254.64 mg/dl to 133.69 mg/dl of blood. Similarly; **[19]** has experimentally proved that administration of metformin causes reduction of blood glucose level from 220.00 mg/dl to 155.00 mg/dl of blood in induced diabetic rats. Furthermore; **[20]** has also reported the anti-diabetic action of metformin in induced diabetic Wistar rats, causing decrease in blood glucose level. Apart from this; **[21, 22]** also described that metformin enhance the metabolism of glucose in order to maintain the normal glucose level in blood. Likewise; **[23]** also suggested that the anti-diabetic effect of metformin in induced diabetic rats causes decrease in blood glucose level from 380.00 mg/dl to 150.00mg/dl of blood in induced diabetic rats.

Body weight

Body weight of control and diabetic control groups of rats were observed before and after experimental trial, the

body weight of control were observed increase from 182.84±0.43 gram to 228.22±0.75 gram during whole experimental trial and body weight of diabetic control groups of rats were observed decrease from 178.86±0.61 gram to 118.88±60 gram. Body weight of alloxan induced diabetic rats has been observed before and after administration of fenugreek seeds powder and metformin as a therapeutic agent. At the time of administration of these therapeutic agents the body weight of fenugreek seeds treated group was 172.24±1.44 gram and metformin treated group was observed 185.75±1.13 grams. Post treatment significantly decrease in body weight of diabetic rats were observed fenugreek was 138.10±0.70 gram and metformin was 135.93±1.26 grams. Similarly; **[24]** observed that after treatment with fenugreek body weight of diabetic rats were improved. A part from this; **[19]** explained the metformin improves body weight. **[23]** also experimentally proved that the in diabetes significantly loss in body weight occurs due to disturbance in metabolism of glucose and protein in diabetic rats.

Authors' contribution

Conceived and designed the project: MR Memon, Performed the experiment: TA Fazlani, Analysed the data: MR Memon, R Mangi, MR Memon, MI Memon & JA Baloch, Contributed in material, tools and field supervision: Abdullah G Arijo, J.Soomro, R Mangi, PM Shahwani, AK Kasi & RS Kakar, Helped in data analysis and proof reading of manuscript: MR Memon, J Soomro & MI Memon.

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