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COMPARATIVE EFFECT OF FENUGREEK (TRIGONELLA FOENUM GRACEUM) AND GINGER (ZINGIBER OFFICINALE ROSCOE) ON DIABETIC ADULT MALE ALBINO RATS

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ABSTRACT

Background: Diabetes mellitus (DM) is a chronic disease and it is one of the major health problems due to its high prevalence, chronic nature and high risk of chronic complications. Currently available therapeutic options for DM have little or no effect on lipid profile, have various adverse effects and are far from satisfactory as far as long-term complications are concerned.

Objectives: The present study was designed to evaluate and compare the efficacy of fenugreek and ginger on lipid profile, blood sugar and glycated hemoglobin (HbA1c) levels in diabetic adult male albino rats.

Materials and Methods: Thirty two adult male albino rats of local strain were used and divided into four equal groups: group I (control group) was given distilled water orally, group II (diabetic group), group III (diabetic treated with fenugreek extract 1g/kg body weight, single oral daily dose for 12 weeks), and group IV (diabetic treated with ginger extract (0.5g/kg body weight in a single dose orally daily for 12 weeks). Diabetes induced by a single intraperitoneal injection of alloxan (150 mg/kg body weight) in freshly prepared physiological saline.

Results: Diabetic animals showed marked significant elevations in TG, TC and LDL, accompanied with marked decline in HDL relative to the corresponding controls. Treatment of diabetic rats with fenugreek and ginger improved the sera lipids profile as shown by the significant reduction in the values of TC, TC and LDL associated with marked elevation of HDL without significant differences between both treated groups. A significant decrease in the levels of serum insulin accompanied with marked significant elevation in the levels of blood glucose and HbA1c were recorded in diabetic rats when compared to the control rats .Marked recovery in insulin, glucose and HbA1c levels was recorded in diabetic animals post treated with fenugreek and ginger without significant differences between each other.

Conclusion: Fenugreek and ginger showed significant hypolipidemic and hypoglycemic effects in diabetic rats.

Key words: Fenugreek, Ginger, Diabetes, Lipid Profile.

INTRODUCTION

Diabetes mellitus is a chronic disease and it is one of the major health problems due to its high prevalence, chronic nature and high risk of chronic complications. It is commonly associated with dyslipidemia, which is one of the major risk factors of coronary heart disease (CHD) in diabetic patients *(Amandeep et al., 2016)*.

Fenugreek (Trigonella foenum graceum) is one of the oldest herb used for

medicinal purposes and its history dates back to Egyptian civilization *(Ansari and Ansari, 2011)*. Fenugreek seeds contain alkaloids, including trigonelline, gentianine and carpaine compounds.

Ginger has a long history of use as herbal medicine to treat a variety of diseases since it can scavenge superoxide anion and hydroxyl radicals *(Elshater et al., 2009)*.

The present study was designed to evaluate and emphasize the efficacy of fenugreek seed and ginger on lipid profile, blood sugar and glycated hemoglobin (HbA1c) levels in diabetic adult male albino rats.

MATERIALS AND METHODS

Thirty two adult male albino rats of a local strain weighing approximately 140-160 g, were purchased from Animal House Centre, Al-Azhar University, Cairo, Egypt, were housed in clear plastic cages (40x 30x 35 cmm, 4 animals /cage) with wood chips as bedding and given a standard pellet rodent diet, in addition to water ad libitum. The rats were maintained under standard laboratory conditions at 25±2^{o}C and normal light/dark cycle, and kept for ten days before experiment for adaptation.

Induction of diabetes: The animals were rendered diabetics by a single intraperitoneal injection of alloxan (150 mg/kg body weight) in a freshly prepared physiological saline. Diabetic state of animals was monitored for its stability for seven successive days after alloxan treatment. On day eight of alloxan injection, only animals with fasting blood glucose levels >200 mg/dl were selected as diabetic rats for the current experiment *(Szkudelski, 2001)*.

Plant Materials and Preparation: The seeds of Fenugreek (Trigonella foenum graecum), and raw dry ginger rhizomes (Zingiber officinale Roscoe) were obtained from a local herbal commercial market. The fenugreek seeds were dried then homogenized to fine powder. The extract of fenugreek was prepared by boiling of 30 g of fenugreek with 150 ml water for 5 minutes, left cool to room temperature, then filtered and stored at -20?C till used. The Fenugreek aqueous extract solution was given by gastric gavage (single oral daily dose 1g/kg body weight) *(Marzouk et al., 2013)*. Also, ginger was grinded to fine powder and extracted with aqueous solution by boiling of 15 g of ginger with 150 ml water for 5 minutes, left cool to room temperature, then filtered and stored at -20?C till used and given by gastric gavage (single oral daily dose 0.5 g/kg body weight) *(Akhani et al., 2005)* .

Experimental Design: rats were divided into four equal groups: group I (control group) given distilled water orally, group II (diabetic group), group III (diabetic treated with fenugreek 1g/kg body weight, single oral daily dose for 12 weeks), and group IV (diabetic treated with ginger 0.5g/kg body weight, single oral daily dose for 12 weeks).

Collection of blood and estimation of biochemical parameters: At the end of experiment, blood samples were collected after overnight fasting rats in centrifuge tubes by retro-orbital puncture under isofluren anesthesia. Blood samples were used in separation of sera by centrifugation at 4000 rpm for 10 min at

4°C, and immediately stored at -20°C for further analysis of biochemical parameters.

Serum total cholesterol *(Henry et al., 1997)*, triglycerides *(Fossati and Principe, 1982)*, and HDL *(Burstein and Scholnick, 1972)* were estimated colorimetrically, while LDL was calculated by applying the Friedwald's equation *(Friedewald et al., 1972)*.

Serum glucose was estimated according to the method of *(Trinder, 1969)*. Serum insulin level was measured by an enzyme immunoassay kit (SPI-Bio société de pharmacologieetd'lmmunoloie-Bio, France), while values of HbA1c level were determined by ion exchange resin method *(Bunn, 1981)*.

Statistical analysis:

The results were expressed as mean ± SE, and the statistical significance was evaluated by one way analysis of variance (ANOVA) followed by Duncan post Hoc test using the SPSS/17.0 software. Values were considered statistically significant at $P \leq 0.05$.

RESULTS

Diabetic animals showed marked significant elevations in TG, TC and LDL accompanied with marked decline in HDL relative to the corresponding controls. Treatment of diabetic rats with fenugreek and ginger improved the sera lipids profile as shown by the significant reduction in the values of TG, TC and LDL associated with marked elevation of HDL without significant differences between both treated groups (Table 1).

Table (1): Effect of Fenugreek and Ginger on serum lipid profiles in diabetic rats (mean ± SE)

Parameters / Groups	Triglyceride (mg/dl)	Cholesterol (mg/dl)	LDL-C (mg/dl)	HDL-C (mg/dl)
GI	113.32 ± 4.02	86.51 ± 1.55	17.76 ±0.89	45.80 ±1.11
GII	203.24[a] ± 0.11	144.22[a] ± 3.56	51.16 [a] ± 1.77	30.76[a] ±0.57
GIII	164.15[bc] ± 3.19	94.67[bc] ± 2.14	22.96[bc] ± 1.29	40.60[bc] ±1.06
GIV	173.33[bc] ± 0.72	98.35[bc] ± 4.66	32.88[bc] ± 4.03	39.97[bc] ±1.01

GI: control group

GII: diabetic group

GIII: diabetic group treated with fenugreek

GIV: diabetic group treated with ginger

a: Significant as compared with normal control (I)

b: Significant as compared with the diabetic control (II)

c: insignificant GIII and GIV compared with each other

Significant decrease in the levels of serum insulin accompanied with marked significant elevation in the levels of blood glucose and HbA1c were recorded in diabetic rats when compared to the control rats. Marked recovery in insulin, glucose and HbA1c levels was recorded in diabetic animals post treated with fenugreek and ginger without significant differences between each other (Table 2).

Table (2): Effect of Fenugreek and Ginger on serum glucose, insulin and HbA1c in diabetic rats (mean ± SE)

Parameters / Groups	Glucose (mg/dl)	Insulin (mg/ml)	HbA1c %
GI	76.10 ± 1.31	26.47 ± 1.31	5.37±1.83
GII	210.31^{a} ±5.13	20.11^{a} ± 0.93	7.19^{a} ± 1.30
GIII	98.44^{bc} ± 4.81	23.23^{bc} ± 0.17	5.40^{bc} ± 1.16
GIV	94.82^{bc} ± 2.16	25.89^{bc} ± 0.14	5.39^{bc} ± 1.76

GI: control group
GII: diabetic group
GIII: diabetic group treated with fenugreek
GIV: diabetic group treated with ginger
a: Significant as compared with normal control (I)
b: Significant as compared with the diabetic control (II)
c: insignificant GIII and GIV compared with each other

DISCUSSION

The current study revealed high prevalence of hypercholesterolemia, hypertriglyceridemia, high LDL and low HDL levels in diabetic rats compared to control group which are risk factors in patients with diabetes *(Amandeep et al., 2016).*

Fenugreek-treated group showed significant decrease in total cholesterol and triglycerides levels in comparison to the diabetic group. These results agreed with *Reddy and Srinivasan. (2011)* who showed that fenugreek leads to delayed onset of cholesterol crystallization.

Abedinzade et al. (2013) stated that the hypolipidemic action of fenugreek extract caused by delaying lipids and carbohydrates absorption as a result of bioactive fibers existing in fenugreek seeds. Also, fenugreek seeds decrease ApoB and lecithin catalase enzyme as well as phospholipids level which play an important role in cholesterol synthesis *(Marzouk et al., 2013).*

On the other hand, ginger-treated group showed also a significant decrease in total cholesterol and triglycerides levels compared to diabetic group, but insignificant with fenugreek-treated group. These results agreed with *Lebda et al.(2012)* and *Kalaiselvi et al. (2015)* who attributed the hypolipidemic effect of ginger to stimulating the conversion of cholesterol to bile acids and inhibition

pancreatic lipase enzyme, as well as inhibition of cellular cholesterol biosynthesis.

Fenugreek-treated and ginger-treated groups showed a significant decrease in LDL level, while HDL level increased compared to diabetic group without significant differences between each others. The present results agreed with *Shrivastava et al. (2009)* and *Abedinzade et al. (2013)* that fenugreek decreases cholesterol content of the bile by increasing bile secretion. Results agreed with *Lebda et al. (2012)* and *(Kalaiselvi et al., 2015)* that ginger decreases level of LDL-receptor and inhibition of hepatic fatty acid synthesis.

Ginger and fenugreek treated groups showed significant decrease in serum glucose level and HbA1c in comparison to diabetic group without significant differences between each others. Results of fenugreek treated group agreed with *Manmeet et al. (2016)*. The cause of reduction was attributed to slow release of carbohydrate and increase the soluble fiber, which helped lower blood sugar by slowing down digestion and absorption of carbohydrates. Fenugreek seeds contain galactose and mannose which are associated with reduced hyperglycemia and hypercholesterolemia, the seeds also has an insulinotropic effect.

Abedinzade et al. (2013) indicated that fenugreek extract causes control of intestinal absorption of glucose under lab conditions.

Ginger group results agreed with *Kazeem et al. (2015)* who stated that ginger might be exerting insulin-like effect on peripheral tissues by promoting glucose uptake, inhibiting hepatic gluconeogenesis or increased entrance of glucose into the muscle and adipose tissues through the stimulation of glucose transporter gene expression "Glut-4", and stimulation of a regeneration process of the remaining β-cells in addition to gingerols inhibit α–glucosidase and α–amylase enzymes. *Jafri et al. (2011)* also showed that oral administration of ginger extract with daily dose of 500 mg/Kg for 6 weeks in alloxan-diabetic rats causes decrease in blood glucose level.

In parallel, serum insulin level significantly decreased in the diabetic rats compared with normal control, and significantly increased in fenugreek-treated and ginger-treated groups compared with diabetic group. Insulin deficiency ultimately results in increased production of glucose by the liver, and decreased utilization of glucose in peripheral tissues *(Giugliano et al., 2008)*. This indicated that changes in insulin may bring about changes in hepatic glycogen content and lead to the regulatory effect of fenugreek and ginger on glucose metabolism. *Pandit et al.(2010)* indicated that soluble dietary fiber of fenugreek foenum graecum seed exerts antidiabetic effects mediated through inhibition of carbohydrate digestion and absorption, and enhancement of peripheral insulin action.

CONCLUSION

Fenugreek and ginger showed significant hypolipidemic and hypoglycemic effects in diabetic rats, but without significant differences between each other. So, administration of medicinal plants such as fenugreek and ginger could ameliorate the disturbances caused by diabetes without the

disadvantages of chemically synthetic drugs.

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مقارنة تأثير نباتي الحلبة والزنجبيل على ذكور الجرذان البيضاء البالغة المصابة بمرض البوال السكري

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خلفية البحث : مرض البوال السكري هو أحد المشاكل الصحية الرئيسية فى العالم بسبب كثرة شيوعه وطبيعته المزمنة وكثرة مخاطره. والعلاج العشبي يكتسب شعبية وإنتشاراً في علاج مرض البوال السكري ومضاعفاته.

الهدف من البحث: تقييم ومقارنة تأثير نباتي الحلبة والزنجبيل على مستوي دلائل الدهون والجلوكوز والهيموجلوبين السكري فى الدم في ذكور الجرذان البيضاء البالغة المصابة بمرض البوال السكري.

مواد وطرق البحث: تم تقسيم إثنين وثلاثين جرذاً إلي أربعة مجموعات متساوية [المجموعة الضابطة - مجموعة البوال السكري - مجموعة البوال السكري المعالجة بالحلبة - مجموعة البوال السكري المعالجة بالزنجبيل] .

وقد تم إحداث البوال السكري باستخدام جرعة واحدة من الألوكسان بالغشاء البروتينى [١٥٠ مجم / كجم] ، كما تم إعطاء مستخلص نبات الحلبة بالفم مرة واحدة يومياً لمدة ١٢ أسبوع بواقع ١جم / كجم من وزن الجسم، وإعطاء مستخلص نبات الزنجبيل بالفم مرة واحدة يومياً لمدة ١٢ أسبوع بواقع ٠,٥ جم / كجم من وزن الجسم . وفي نهاية التجربة تم سحب عينات الدم لقياس الإنسولين والجلوكوز والهيموجلوبين السكري، وأيضا دلائل الدهون والكولستيرول.

النتائج: أظهرت النتائج في مجموعة البوال السكري إنخفاضاً ملحوظاً في الإنسولين بالدم وارتفاع في نسبة السكر والهيموجلوبين السكري، ووجود خلل في دلائل الدهون بارتفاع مستوى الدهون الثلاثية والكولستيرول والكوليسترول ذو الكثافة المنخفضة، وإنخفاض بمستوي الكولستيرول ذو الكثافة المرتفعة مقارنة بالمجموعة الضابطة. وباستخدام المعالجة بنباتي الحلبة والزنجبيل لوحظ تحسناً كبيراً ذو دلالة إحصائية في معظم هذه الدلالات والقياسات البيوكيميائية ورجوعها إلى المعدلات الطبيعية دون حدوث فارقاً ذوأهمية إحصائية بين المجموعتين المعالجتين.

الاستنتاج: إستخدام نباتي الحلبة والزنجبيل يثبط إرتفاع السكر بالدم والهيموجلوبين السكري وتخفيض حالات الشذوذ الأيضي فى حالات مرض البوال السكري.