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Original article

Hypoglycemic and hypolipidemic effects of aqueous extract of phaseolus vulgaris pods in streptozotocin-diabetic rats

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ABSTRACT

The present investigation was carried out to evaluate the reduction potential of aqueous extract of casing of pods of phaseolus vulgaris in blood glucose and lipids levels among hyperglycemic streptozotocin (STZ)-induced rats. Oral administration of 150 mg/kg of aqueous oral administration of aqueous pod extract of phaseolus vulgaris to diabetic rats for 40 days resulted in a significant decrease in blood glucose ($p < 001$), cholesterol ($P < 0.01$) and triglycerides ($P < 0.01$). In addition, glibenclamide reduced blood glucose, cholesterol and triglycerides. It is concluded that both aqueous extract of casing of pods of phaseolus vulgaris and glibenclamide reduced the blood levels of glucose and lipids. In addition, aqueous extract of phaseolus vulgaris pods was more effective than glibenclamide in reducing blood glucose.

1. Introduction

Diabetes mellitus (DM) is a group of endocrine metabolic disorders characterized by fasting hyperglycemia atherosclerotic and microangiopathic vascular disease, and neuropathy [1]. These metabolic disorders include alterations in the carbohydrate, fat and protein metabolisms associated with absolute or relative deficiencies in insulin secretion and/or insulin action [2]. The disease is rapidly increasing worldwide and affecting all parts of the world [3]. Due to deficiency of the insulin, people suffering from diabetes have high blood glucose level [4]. Furthermore, DM is often accompanied by lipid abnormalities, which contribute significantly to cardiovascular (CV) morbidity and mortality in diabetic patient [5]. Ideal treatment of diabetes should, in addition to glycemic control, have a favorable effect on lipid profile [6].

There are two main types of DM: type 1, which is known as insulin-dependent diabetes mellitus (IDDM) [7], and type 2 which is known as non- insulin dependent diabetes mellitus (NIDDM) [8].

The current therapy of IDDM type 1 DM presently is based on synthetic insulin, such as rapid-acting insulin, long-acting insulin, and Intermediate that very often have side effects [9]. The treatment with insulin has side effect, which may reduce Hypoglycemia which is the most common side effect [10], blurry vision [11], general weight gain [12]. For this reason, there is a continuous need to develop new, safe and better pharmaceuticals as alternatives for the management and treatment of DM. Furthermore, many people believe that plants are less toxic and safe to use, more natural, more accessible and less expensive than the synthetic drugs. Their huge advantage is that they can be ingested in everyday diet. Several medicinal plants are used to improve diabetes mellitus in many countries [13–15]. Some of the plants used by the population, as antidiabetic remedies are edible plants [16].

To our knowledge, there is no data about the hypoglycemic and hypolipidepic effects PPVEt of casing of pods of phaseolus vulgaris are limited in literature, and one of the reseaches which talk about the PPVEt in lowring the blood glucouse has been caudated at 2015 and the result shows that there is a significant decrease in blood glucose level with P less than 0.05 compared to untreated diabetic

Abbreviations: DM, diabetes mellitus; CV, cardiovascular; IDDM, insulin-dependent diabetes mellitus; NIDDM, non- insulin dependent diabetes mellitus; STZ, streptozotocin; P. vulgaris, phaseolus vulgaris; PPVEt, pods of phaseolus vulgaris extract; ANOVA, analysis of variance; DMRT, Duncans Multiple Range Test; CHOL, cholesterol; TG, triglycerides; PV, phaseolus vulgaris.

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rats [17]. There are many researches discussed the effect of P. vulgaris one of these researches was conducted in Mexico at 2015 and its results shows that there is an hypocholesterolemic effect in using of P.vulgaris associated with their dietary fiber and resistant starch content. The mechanism of action includes inhibition of intestinal lipid absorption, binding of bile acids, increase of fecal cholesterol excretion and a putative effect on hepatic low-density lipoproteins receptor for improved lipoproteins clearance [18]. Another research was discussed the effect of P.vulgaris in glucose, triglyceride, cholesterol, HDL, LDL, and VLDL nimals in control group and animals which were administered with dry bean powder at dose of 4 g (group R1), 6 g (group R2) and 8 g (group R3) for 30 days, and the result was as the following: (a) The cholesterol levels were found to be decreased significantly ($p = <0.05$) while comparing the animals in control group with the animals in group R1 and R2, While comparing the animals of control group with those of group R3, the levels of cholesterol dropped in highly significant ($p = <0.001$) manner. (b) The levels of triglyceride dropped significantly ($p = <0.05$) when animals of group R1 and R3 were compared. (c) The levels of HDL increased significantly ($p = <0.05$) when animals in control group were compared to animals in group R3. (d) The levels of LDL dropped in highly significant ($p = <0.001$) manner when animals of control group were compared with those of group R1, R2 and R3. (e) The levels of VLDL dropped in highly significant ($p = <0.001$) manner when animals of control group were compared with those of group R1, R2 and R3 [19].

The present study is aimed at evaluating the hypoglycemic and hypolipidemic (reduction in plasma CHL and TG levels) activities of aqueous extract of phaseolus vulgaris in streptozotocin-induced diabetic rats. The effects of Phaseolus vulgaris pods are compared with the hypoglycemic glibenclamide (600 mg/kg body weight) as reference compounds

2. Materials and methods

2.1. Materials

Streptozotocin (STZ), analar grade chemicals and ion standards were obtained from BDH (Poole, UK). The drug called "glibenclamide" was purchased a local pharmacy called Al-Dawa, Al-Ahssa City, Eastern province, Saudi Arabia. The biochemical kits were purchased from Sigma Chemical Company Inc., St Louis, Mo, USA. The chemicals were of analytical grade.

2.2. Methods

2.2.1. Experimental animals

The present study used adult albino Wistar rats (150–250 g) to investigate the hypoglycemic and hypolipidemic actions of the aqueous extract of dried Phasolus volgaris pods. These rats bred in the Animal House, College of Medicine, King Faisal University, Saudi Arabia. The animals were fed with normal laboratory pellet diet and water ad libitum. The ethical committee in King Faisal University approved the use of animals in the present study.

2.2.2. Preparation of plant extracts

Phaseolus vulgaris (P. vulgaris) pods were purchased from local market in Al-Ahssa City, Eastern Province, Saudi Arabia. 150 g of dried casing of pods of Phaseolus vulgaris extract (PPVEt) were extracted with 1000 ml of distilled water by the method of continuous hot extraction and evaporated to dryness in a rotavapor at 40–50 °C. A semisolid material was obtained (20–25 g). It was stored at 0–4 °C until used. When needed, the residual extract was suspended in distilled water and used in the study.

2.2.3. Induction of experimental diabetes

A freshly prepared solution of streptozotocin (45 mg/kg) in 0.1 M citrate buffer, pH 4.5 was injected intraperitoneally in a volume of 1 ml/kg [20]. After 48 h of streptozotocin administration, rats with moderate diabetes having glycosuria and hyperglycemia (i.e. with blood glucose of 200–300 mg/dl) were taken for the experiment

2.2.4. Experimental design

In the experiment, 20 rats were used which were divided into 4 groups of 5 rats each. **Group 1** represents normal control rats. **Group 2** represents Diabetic control rats without treatment. **Group 3** represents diabetic rats that are administrated orally aqueous solution of casing of pods of (200 mg/kg body weight) two times daily; (i) in the morning after an overnight fast, and 16:00 PM using an intragastric tube for 40 days. **Group 4** represents the diabetic rats given glibenclamide (600 mg/kg body weight) also two times daily and at the same time as of phaseolus vulgaris extract using an intragastric tube [21].

After 40 days, the animals were deprived of food overnight and anesthetization, their abdomen is cut off, and the blood was collected from the heart in a tube containing potassium oxalate and sodium fluoride for the estimation of blood glucose, cholesterol (CHL) and triglycerides (TG).

2.2.5. Analytical methods

Fasting blood glucose cholesterol, triglycerides were estimated by specific kits by using Reflotron Plus Clinical Chemistry Analyzer [22].

2.2.6. Statistical analysis

The research performed the statistical analysis using the Statistical Package for Social Sciences 22.0 software (SPSS/IBM, Chicago, IL). Statistical analysis was done by analysis of variance (ANOVA) followed by Duncans Multiple Range Test (DMRT). Values were considered statistically significant when $p < 0.05$.

Values are presented as means ± S.E.M. Statistical differences between the treatments and the controls were tested by one-way analysis of variance (ANOVA) followed by the Student–Newman–Keuls test using the "Instat" statistic computer program. A difference in the mean values of $p < 0.05$ was considered to be statistically significant.

3. Results

Table 1 demonstrates the levels of blood glucose in normal and experimental animals with or without PPVEt daily for 40 days. The level of blood glucose was significantly increased in diabetic rats compared with that in normal control rats. The administration of PPVEt at the dose of 200 mg/kg body weight showed a highly significant lowering effect compared to 50 mg and 100 mg/kg body weight. The dose of PPVEt more than 200 mg/kg body weight has

Table 1
Blood glucose levels in normal, diabetic and diabetic- PPVEt treated rats.

Group	Glucose (mg/dl)
Normal group	119.50 ± 12.90
Diabetic Control	487.9 ± 40.67
Diabetic + PPVEt (50 mg/kg)	448.30 ± 32.93
Diabetic + PPVEt (100 mg/kg)	361.30 ± 29.17
Diabetic + PPVEt (200 mg/kg)	240.30 ± 22.59
Diabetic + PPVEt (250 mg/kg)	2214.30 ± 19.59
Diabetic + glibenclamide (600 μg/kg body weight)	312.30 ± 20.59