
ORIGINAL ARTICLE

The Hypoglycemic effect of Flaxseed Oil in Alloxan-Induced Diabetic Rats

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ABSTRACT

Hypoglycemic is metabolic disorders of glucose levels in the blood and the major risk factor that precipitate coronary heart and cardiovascular diseases. The present study was conducted to investigate to compare the hypoglycemic effect of Flaxseedoil on rats. Sixty (60) adult male Wister rats used in the current study, weighing (230-250 g). The rats were randomly divided into four groups (n = 15): normal control, diabetic control and diabetic-flaxseed oil group. Hematological parameters were examined by automatic analyzer and the results were statistically analyzed by SPSS.12. In comparison with control, highly significant increases in the values of blood glucose, triglycerides, cholesterol, low density lipoprotein LDL-cholesterol were observed in diabetic rats, while the value of high density lipoprotein HDL-cholesterol was significantly decrease. Flaxseed oil-diabetic were highly significant decreases in the values of blood glucose, triglycerides, cholesterol, low density lipoprotein LDL-cholesterol when compared with diabetic control group after 7 weeks of treatment, while the value of high density lipoprotein HDL-cholesterol was significantly increase. These findings showed that diets containing Flaxseed oil significantly improved the physiological parameters of rats. We suggest that Flaxseed oil efficiency may be caused by the antioxidant properties of its essential oil components thereby preventing hyperglycemia and increase high density lipoprotein cholesterol in rats. We further suggest that Flaxseed oil supplementation is an excellent adjuvant therapy for rats.

Key words: Flaxseed oil, glucose, lipid profile, cholesterol. Hypoglycemia

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INTRODUCTION

Diabetes mellitus is a chronic metabolic disorder characterized by hyperglycemia due to insulin deficiency or insulin resistance or both. Diabetes mellitus is accompanied with metabolic, cardiovascular, nephropathic and neuropathic diseases. [1,2].

Linum usitatissimum or Flaxseed or linseed belonged to family Linaceae. The Genus comprised of about 200 species. Flaxseed contains 35-45 oil, 28% soluble dietary fiber, and 21% protein[9]. Flaxseed comprises nutritional valuable components such as protein (200-240 g/kg), dietary fiber (250-280 g/kg) and flaxoil (350-450 g/kg). The health benefits are related with the ingestion of polyunsaturated fatty acids (PUFA) and dietary fiber. Flaxseed is among unique oil seed crops because of its exceptionally high content of α -linolenic acid (45 to 52% of its oil) (ALA), Each tablespoon of ground flaxseed contains about 1.8 grams of plant omega- (E1). High amounts of ALA were derived from Soybean oil. [3, 10]

Three types of omega-3 fatty acids involved in human physiology are α -linolenic acid (ALA) (found in plant oils), eicosapentaenoic acid (EPA), and docosahexaenoic acid (DHA) (both commonly found in marine oils).[2]

Marine algae and phytoplankton are primary sources of omega-3 fatty acids. Common sources of plant oils containing the omega-3 ALA fatty acid include walnut, edible seeds, clary sage seed oil, algal oil, flaxseed oil, SachaInchi oil, Echium oil, and hemp oil, while sources of animal omega-3 EPA and DHA fatty acids include fish, fish oils, eggs from chickens fed EPA and DHA, squid oils, and krill oil. Dietary supplementation with omega-3 fatty acids does not appear to affect the risk of death, cancer or heart

disease. Furthermore, fish oil supplement studies have failed to support claims of preventing heart attacks or strokes. [4,15]

Omega-3 fatty acid plays an important role in prevention or treatment of cardiovascular disease, hypertension, atherosclerosis, cancer neurological disorders and inflammatory disease. More omega-3 fatty acids intake decreases serum cholesterol which beneficially affects blood pressure, skin diseases, thrombosis atherosclerosis and diabetes, arterial compliance and hyperlipidemia response. Flaxseed - but not flaxseed oil - contains soluble fiber. It might cause diarrhea, cramping, wind, and bloating. Large amounts of flaxseed, especially when not taken with enough water, can cause constipation and even bowel obstruction, flatulence, stomach pains, nausea, constipation. [7]

This study aimed to compare the efficiency of Flaxseedoil to decrease the levels of total cholesterol and proteins in Wister rats.

MATERIALS AND METHODS

FlaxseedOil was obtained by cold pressing the seeds.

Animals

Sixty (60) adult male Wister rats used in the current study, weighing (230-250 g) were obtained from The Animal physiology Lab of Faculty of Science Hail University.

The rats were housed in individual cages and maintained in a temperature-controlled room (24 ± 1 °C) with a 12 h light/12 h dark cycle, 55 ± 10 % humidity. They were fed with normal commercial chow and water ad libitum. Throughout the experiments, animals were processed according to the suggested international ethical guidelines for the care of laboratory animals.

Induction of diabetes

Experimental diabetes was induced by administration of alloxan monohydrate (75 mg/kg of body weight) intraperitoneally two weeks before starting the treatment. After a 2-week experimental period, the blood glucose level of the animals was tested for evidence of a diabetic state, following a 12 h fast. The animals that had a blood glucose level equal to or greater than 250 mg/dl were included in the study. [3].

Experimental design:

A total of sixty rats were used in the experiment. The rats were randomly divided into four groups (n = 20): normal control (non-diabetic control rats given normal saline intraperitoneally daily for 7weeks), diabetic control (untreated diabetic control rats given normal saline intraperitoneally daily for 7weeks to equalize stress induced by injections in all groups) and diabetic-flaxseed oil (diabetic rats given received diet were enriched with 5g/100g diet of flaxseed oil.

Blood collection and determination of physiological parameters

At the end of experimental period, blood samples were collected from retro-orbital eye plexus. [3]

Each sample was collected into both heparinized tubes to obtain the plasma and into a dry clean centrifuge glass tube without any coagulation to prepare serum.

Blood was left for 15 min at room temperature, then the tubes were centrifugation for 15 min at 3000 rpm and the clean supernatant serum was kept frozen at -20 °C until the time of analysis for different biochemical analyses, prior immediate determination of triglycerides, cholesterol, high density lipoprotein HDL-cholesterol (HDL-C), low density lipoprotein LDL-cholesterol (LDL-C). All of these parameters were measured using an automatic analyzer (Architect c8000 Clinical Chemistry System, USA).

Statistical analysis

Statistical analyses were performed using SPSS package for Windows version 13.0. Data are expressed as mean \pm SE. One-way ANOVA and two-way ANOVA were used to analyze differences among groups. Post-hoc analyses of significance were made using least-significant difference (LSD) test. Differences between groups were considered statistically significant at $p < 0.05$.

RESULTS

Fasting Blood Glucose

As shown in Table 1, the mean values of fasting blood glucose of both control and experimental groups. In diabetic rats group there were a very highly significant ($P < 0.001$) increase in fasting blood glucose level as compared with group I (control group) after 7 weeks of treatment. .

Administration of flaxseed oil to diabetic rats showed remarkably reduction in glucose concentration, there were very highly significant ($P < 0.001$) in treated rats when compared with group II (diabetic group) after 7 weeks of treatment.

Blood triglyceride, cholesterol, LDL-C and HDL-C

The changes in the levels of serum lipids in control and experimental groups are illustrated in Table 1.

There was a significant ($p < 0.001$) decrease in the level of HDL- cholesterol and significant ($p < 0.001$) increases in the levels of cholesterol, LDL- cholesterol and triglycerides in Alloxan -induced diabetic rats compared to the control rats group .

The diabetic rats were treated with flaxseed oil resulted in a significant ($p < 0.01$) decrease in the levels of triglycerides, cholesterol and LDL- cholesterol compared to untreated diabetic rats. While HDL- cholesterol level was significantly ($p < 0.01$) increased after 7 weeks of treatment.

Table 1. Effects of flaxseed oil supplementation on blood glucose ,triglyceride, cholesterol, LDL-C and HDL-C after 7 weeks of treatment.

Parameter	Normal control	Diabetic	Diabetic+ Flaxseed oil
Glucose (mg/dl)	97.18±1.5	319.57±2.1###	115.41±3.5***
Triglyceride (mg/dl)	64.10±2.5	88.24±3.5###	68.33±4.2***
Cholesterol (mg/dl)	66.38±3.3	131.58±7.2###	80.22±5.9***
HDL-C (mg/dl)	39.54±2.2	20.35±4.8###	38.01±3.8***
LDL-C (mg/dl)	33.00±1.3	81.9.1±5.1###	37.08±5.2**

The number of animals was 10 for each group

All values are expressed as means ± SE.

Significantly different from untreated STZ-induced diabetic rats (* $p < 0.05$, ** $p < 0.01$ and *** $p < 0.001$).

Significantly different from normal control (# $p < 0.05$, ## $p < 0.01$ and ### $p < 0.001$).

DISCUSSION

The current study was performed to evaluate the hypoglycemic effects of flaxseed oil in alloxan induced diabetic Wister rats. This study shows that oily extract of flaxseed produces a marked decrease in blood glucose levels in alloxan diabetic rats. Several studies showed that a variety of herbal extracts effectively lowered the glucose level in STZ- induced diabetes mellitus rats).In the present study, normal rats fed on diets containing the oil of fish when compared with those rats fed on the control diet after 7 weeks of treatment [2-6].

Present study goes in accordance with the previous studies showed that a variety of plant extracts effectively had hypoglycemic effect on experimental rats [3] reported that *Azadirachta indica* alcoholic Leaf Extract significantly lowered the blood sugar level in glucose-fed and adrenaline induced hyperglycemic rats [3-9].

The effect of diabetes mellitus on lipid metabolism is well established. The association of hyperglycemia with an alteration of lipid parameters presents a major risk for cardiovascular complications in diabetes. Many secondary plant metabolites have been reported to possess lipid-lowering properties [2-6].

The serum cholesterol and triglycerides were significantly decreased in diabetic rats supplemented with of flaxseed oil. The oil supplementation also result the significant attenuation in the levels of HDL-cholesterol and LDL-cholesterol in serum toward the control level which again strengthen the hypolipidaemic influence of these oils. A variety of derangements in metabolic and regulatory mechanisms, due to insulin deficiency, is responsible for the observed accumulation of lipids[10-16].

The impairment of insulin secretion results in enhanced metabolism of lipids from the adipose tissue to the plasma. Further, it has been reported that diabetic rats treated with insulin show normalized lipid levels [3,17.18].

We suggest that the present effects of these oils-treated diabetic rats may be due to its role in normalization of insulin secretion, lowering activity of lipid biosynthesis enzymes, especially cholesterol [19-21]. However, many minor components of foods, such as secondary plant metabolites, have been shown to alter biological processes which may reduce the risk of chronic diseases in humans. *Azadirachta indica* popularly known as flaxseed is an indigenous plant widely available in India and Burma. Different parts of this plant have been reported to have antiseptic, wound healing and skin disease[22-23]. Many workers have shown that water soluble portion of alcoholic extract of leaves of *Azadirachta indica* possesses significant anti-inflammatory, antiserotonin, antifertility and hepatoprotective activity [8,16.24.25].

Significant hypolipidemic activity in rats fed on atherogenic diet and antihyperglycemic as well as hypotensive activity have also been reported by us [9]. Significant blood sugar lowering effect of *A. indica* in alloxan and streptozotocin induced diabetic rats have also been reported by several workers .It

is well documented that cardiovascular disease induced by hyperglycemia is associated with alterations in serum lipid metabolism [12,19].

CONCLUSION

In conclusion, the results denote that diet that using flaxseedoil improve hematological parameters. The responses in blood parameters in these animals are also demonstrated that flaxseed oil supplementation may act as antioxidant agents and hypoglycemic. Flaxseed oil could be an excellent adjuvant support in the therapy of diabetic mellitus and its complications.

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