



## Effect of *Raphanus sativus* on Glucose, Cholesterol and Triglycerides Levels in Glucose Loaded Rats

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### ABSTRACT

**Background:** Diabetes is now a serious health concern, and the import of medications from other countries consumes a significant amount of foreign cash each year. The effects of *Raphanus sativus* (Radish) in the treatment of diabetes mellitus were evaluated scientifically in this study. Thyroid hormone increases metabolic actions in almost every tissue, and the current study was an attempt to evaluate scientifically the effects of *R. sativus* in the treatment of diabetes mellitus.

**Objectives:** The main objective of this study is to evaluate the hypoglycemic effect of *R. sativus* on induced hyperglycemic rats.

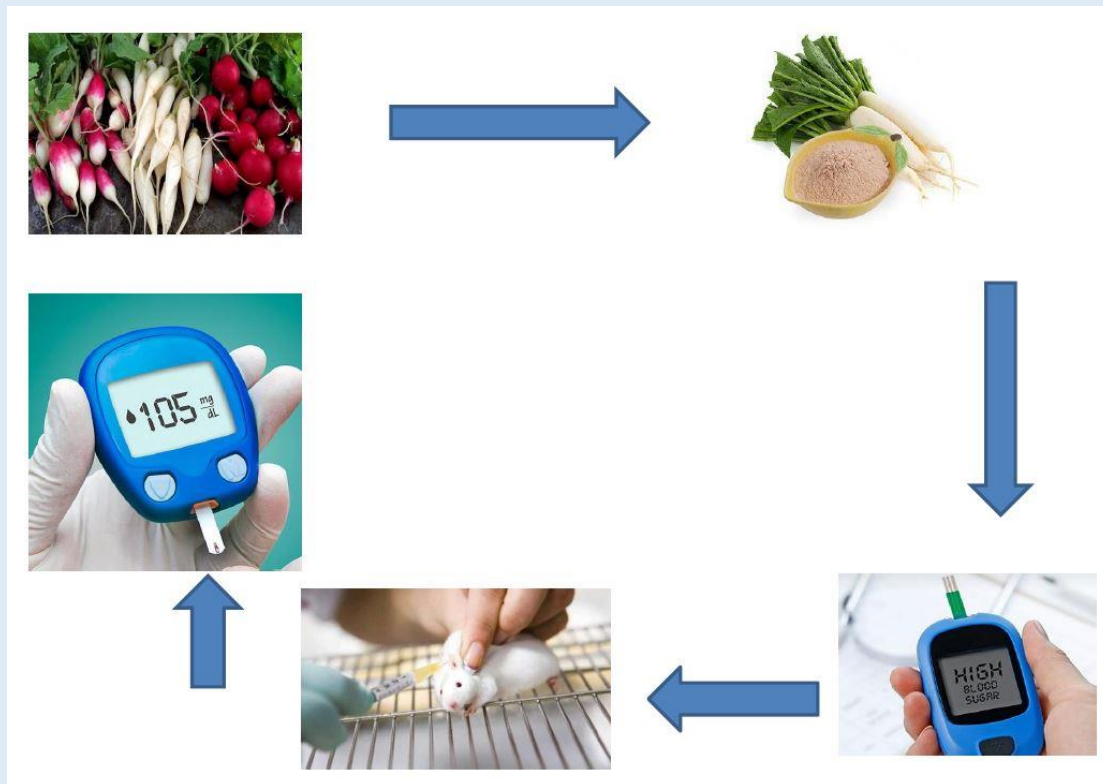
**Methods:** An oral administration of ethanolic extract of *R. sativus* in glucose loaded rats at dose of 250mg/kg body weight, standard group was administered with 10mg/kg of hypoglycemic drug glibenclamide for 2 consecutive weeks. The control group was given distilled water only. After the two weeks' time, the groups were subjected to a glucose tolerance test and measurement of plasma cholesterol and triglyceride levels.

**Results:** Significant reduction of blood glucose was observed ( $P < 0.001$ ), when compared with the control group at 2 hours after glucose load. Radish ethanolic extract did not present any significant difference in cholesterol level after 2 weeks

compared with start point. No significant difference was seen in triglyceride level after 2 weeks of administration of Radish extract compared with start point. Radish extract (250 mg/kg) did not affect kidney function creatinin and urea, also liver function was not affected. In addition, Glutamic-Oxaloacetic Transaminase (GOT), Glutamic-Pyruvate Transaminase (GPT), albumin, and total protein and bilirubin were not affected, meaning that administration of increased doses to hyperglycemic subjects can be considered safe.

**Conclusion:** In this investigation, doses of radish extract (250 mg/kg) had no effect on renal function, creatinin, and urea, as well as liver function. There was also no effect on Glutamic-Oxaloacetic Transaminase (GOT), Glutamic-Pyruvate Transaminase (GPT), albumin, total protein, and bilirubin.

**Keywords:** *Raphanus sativus*, extract, hypoglycemic, glucose, rats



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## INTRODUCTION

Diabetes mellitus is a hyperglycemia resulted from glitch in insulin action, insulin secretion, or together. The chronic hyperglycemia of diabetes is linked with long-term dysfunction, damage, and failure of many organs, especially the kidneys, eyes, nerves, blood vessels, and heart [1]. This contrasts with diabetes mellitus

type 1 diabetes (T1D) which is resulted from breakups of beta cells of the pancreas [2]. Diabetes mellitus is a major health problem, its incidence and associated mortality are increasing. Inadequate regulation of the blood sugar imposes serious consequences for health. Imitative antidiabetic drugs are effective, with serious side effects. But medicinal plants may act as an alternative source of

antidiabetic agents [3].

*R. sativus* is a root vegetable grown and consumed all over the world and is considered part of the human diet. This plant has a hypoglycemic activity in both normal and diabetic rats and partly improve lipid metabolism in the normal rats [4]. Radish may contain goitrogens, [5] which are antithyroid substances, that constitute a protein of regular human diet. The radish is an edible root vegetable of the Brassicaceae family [6]. Radishes have numerous varieties, varying in size, color, and duration of required cultivation time. There are some radishes that are grown for their seeds; oilseed radishes are grown for oil production. Radish can sprout from seed to small plant in as little as 3 days. Radish is round to cylindrical with a color ranging from white to red. A longer root form, ideal for cooking, grows up to 15 cm long, while the smaller, rounder form is typically eaten raw in salads. The flesh initially tastes sweet but becomes bitter if the vegetable is left in the ground for too long [7]. Leaves are arranged in a rosette, with sizes ranging from 10–15 cm in small cultivars, to up to 45 cm in large cultivars. They are divided pinnate with an enlarged terminal lobe and smaller lateral lobes. The white flowers are borne on a racemose inflorescence [8]. Radishes are rich in ascorbic acid, folic acid, and potassium. It is a good source of vitamin B6, riboflavin, magnesium, copper, and calcium. One cup of sliced red radish bulbs provides approximately 20 cal. largely from carbohydrates [9].

Leaves and roots of *R. sativus* have been used in various parts of the world to treat cancer and as antimicrobial and antiviral agents [10]. Lipo poly saccharides (LPS) were isolated from radish having a macrophage activating with ED50 of 0.4–100 mg/ml. These compounds can be used as anti diabetic agents in pharmaceutical or veterinary fields. Also, the LPS showed analgesic activity [11]. Radishes may contain goitrogens, which may cause swelling of thyroid gland and should be avoided in individuals with thyroid dysfunction. However,

they may be used liberally in healthy person [2], extracts of *R. sativus* can retard the risk of complications due to chronic hyperglycemia ameliorates, reduce the metabolic abnormalities formed with diabetes and has beneficial effects in diabetes and this is attributed to the synergistic effects of its bioactive compounds such as saponins, flavonoids and glycosides [12]. Jani and Goswami, (2019) [13] stated that the anti-diabetic activity of *R. sativus* may be due to factors like the enhancement of the antioxidant defense mechanism, decrease of lipid peroxidation and oxidative stress, improvement of hormonal-induced glucose hemostasis, the promotion of glucose uptake and energy metabolism and the reduction of glucose absorption in the intestine.

## MATERIALS

**Plant Materials:** Fresh Radish was purchased from Omdurman market in Khartoum state, Sudan, in October 2021 for the estimation of hyperglycemic effects.

**Animals:** Adult male Wister albino rats weighting 160-280 grams obtained from the Animal House Veterinary Research Center (Soba Khartoum Sudan) and were used in the study. The total number of rats used throughout the study was 28 rats, 10 rats used for the toxicity study and 18 rats used to test hypoglycemic effect. All the rats were fed a standard diet composed of vegetable, meat, oil, and wheat flour.

## METHODS

**Preparation of extract:** Plant extraction was carried out according to method described by [14], 140g of the dry plant sample were extracted by soaking in 200 ml 80% ethanol for about seventy-two hours with daily filtration and evaporation. Solvent was evaporated under reduced pressure to dryness using rotary evaporator apparatus and extract was kept at 4°C for later use.

**The Experimental Procedure:** Eighteen rats allocated

into three groups with six rats each were divided as follows [15]:

Group (1): served as normal control and received distilled water.

Group (2): served as standards group and treated with glibenclamide, (10 mg / kg body weight).

Group (3): treated with ethanolic extract of radish (250mg/kg body weight) daily for two weeks.

250 mg/kg dose has been chosen for this study according to the traditional use of the plant in human. However, scientific calculation was made to convert human dose to rat's dose [16]. The concentration of glucose, cholesterol and triglyceride were determined in rat's plasma but thyroid hormones, liver enzymes and kidney function were determined in serum.

The experiment continued for two consecutive weeks. All groups were subjected to fasting for 18 hours prior to experimentation and the plasma glucose level was determined (zero reading). The three groups were administered intraperitoneally with 2 g/kg body weight of 50 % glucose solution. Plasma glucose level was monitored in the three groups at two and four hours after the glucose load. The cholesterol and Triglyceride levels were also measured, and the levels were compared with those before treatment. The Plasma glucose, cholesterol and triglycerides levels were measured [17, 18, 19].

**Toxicity study of Radish:** Ten experimental rats were used to examine the toxicity and safety of radish. The rats were equally divided into two groups of five rats each as follows:

Group (1): served as normal control was received distilled water.

Group (2): treated with ethanolic extract of radish (250mg/kg body weight).

Liver enzymes and kidney function were determined in serum. After two weeks and after one month

## RESULTS AND DISCUSSION

Table (1) shows that Radish extract did not present any significant difference on Triiodothyronin hormone (T<sub>3</sub>) level after 2weeks of treatment when compared with start point and presents significant difference ( $p < 0.05$ ) in Thyroxin hormone (T<sub>4</sub>) level after 2weeks compared with start level. Radish extract exhibited decrease in Thyroid stimulating hormone (TSH) level after 2 weeks of administration. The decrease of TSH level was found to be at its highest degree in the Radish extract group. In a previous study it was found that Iodine supplementation in the Radish fed rats showed increase in Thyroid stimulating hormone (TSH) serum level from 0.59ng/dl to 2.28ng/dl in case of prolonged feeding while level of Triiodothyronin hormone (T<sub>3</sub>) and T<sub>4</sub> were decreased in percentages 17.3% and 16.45, respectively [20].

**Table 1.** Effect of *Raphanus sativus* (Radish) on Thyroid hormones

Dose	Radish ext. (250mg/ kg)	
	Start	2 weeks
<b>T3 level (nm/l)</b>	0.70 ± 0.07	0.50 ± 0.07
<b>Thyroxin hormone (T4)</b>	36.00 ± 6.00	*110.00 ± 6.00
<b>Thyroid stimulating hormone (TSH).</b>	1.30 ± 1.50	0.00 ± 0.00

\*Data are expressed in means ± standard error of mean = ( $P \leq 0.05$ )

An oral administration of ethanolic extract of Radish in glucose loaded rats at dose of 250mg/k BWT exhibited hypoglycemic effect (Table 2), significant reduction of

blood glucose was observed ( $P < 0.001$ ), when compared with the control group at 2 hours after glucose load. The reduction of glucose level was more observed in Radish

group. Radish ethanolic extract did not present any significant difference in cholesterol level after 2 weeks compared with start point (Table 3). No significant difference was seen in triglyceride level after 2 weeks of administration of Radish extract compared with start point (Table 3). However, the effect of Radish extract in reduction of glucose level was better than that caused by KI alone [21]. It has long been known that thyroid hormones are of vital importance in maintaining the initial level of phospholipids in cell membranes and fatty acids composition of the lipids [22]. T3 plays a critical role in lipid metabolism by regulating genes involved in lipogenesis and lipolysis [23, 24]. Taniguchi *et al.* [25] said that *Rhaphnus sativus* had a hypoglycemic activity in both normal and diabetic rats and partly improve lipid metabolism in normal rats. Radish has the potential to

alleviate hyperglycemia in cases where the diabetes is present and to serve in the primary prevention of diabetes mellitus. Although the hypolipidemic effect of Radish was evaluated by Taniguchi *et al* [24], when normal rats fed on Japanese radish (*Rhaphnus sativus*) show lower plasma level of total cholesterol, triglycerides, and phospholipids while JRS- fed diabetic rats showed lower plasma levels of glucose, insulin without change in plasma lipid parameters. These antidiabetic properties may be due to its ability to enhance the antioxidant defense mechanism and decrease oxidative stress and lipid peroxidation, improve hormonal-induced glucose hemostasis, promote glucose uptake and energy metabolism, and reduce glucose absorption in the intestine [26].

**Table 2.** Effect of *Raphanus sativus* (Radish) on Plasma Glucose level in induced hyperglycemic rats

Groups	Glucose	Glucose	Glucose	Glucose
	Start point (mg/dl)	0 time (mg/dl)	2 hours (mg/dl)	4 hours (mg/dl)
	After 2 weeks of treatment & after Glucose Load			
<b>Standard: glibenclamid (10mg/kg)</b>	86.6 ± 3.18	89.8 ± 4.78	91.4 ± 4.41**	112.6 ± 2.42*
<b>Control: distilled water(10mg/kg)</b>	94.00 ± 1.5	94.60 ± 1.12	204.40 ± 1.9	132.80 ± 3.07
<b>Radish ext (250mg/ kg)</b>	98.60± 2.731	81.20 ± 2.04*	107.40± 4.697**	94.60 ± 4.523*

(\*Data are expressed in mean± standard error of mean) = (P<0.05)\*\* = (P<0.001)

**Table 3.** Effect of *Raphanus sativus* (Radish) on plasma cholesterol and triglyceride levels

Dose	Radish ext. (250mg/ kg)	
	Start	2 weeks
<b>plasma cholesterol level (mg/dl)</b>	69.60 ± 4.29	53.80 ± 7.57
<b>plasma triglyceride level (mg/dl)</b>	65.20 ± 3.39	51.00 ± 5.55

Data are expressed in mean± standard error of mean \*\* = (P≤0.001)

**Toxicity study of Radish:** In the current study, administration doses of Radish extract (250 mg/kg) did not affect kidney function creatinin and urea, also liver function were not affected Glutamic-Oxaloacetic

Transaminase (GOT), Glutamic-Pyruvate Transaminase (GPT), albumin, total protein and bilirubin (Table 4), this means administration of Radish extract to hyperglycemic subjects can be considered safe.

**Table 4.** Effect of *Raphanus sativus* (Radish) on kidney and liver functions

Dose Radish ext. (250mg/ kg)	Control: distilled water (10ml/kg)		CR level	
	2weeks	1month	2weeks	1month
Urea level (mg/dl)	59.67 ± 5.18	55.67 ± 5.78	63.00 ± 9.82	63 ± 5.77
Creatinin level (mg/dl)	0.67 ± 0.186	0.86 ± 0.03	1.00 ± 0.29	1.05 ± 0.02
Total protein level (g/dl)	5.8 ± 1.74	7.53 ± 0.23	5.80 ± 1.40	6.05 ± 1.07
Albumin level (g/dl)	2.6 ± 0.87	3.36 ± 0.19	2.70 ± 0.85	2.95 ± 0.43
Billrubin level (mg/dl)	0.00 ± 0.00	0.05 ± 0.88	0.03 ± 0.03	0.00 ± 0.00
Direct billrubin level (mg/dl)	0.00 ± 0.00	0.13 ± 0.15	0.00 ± 0.00	0.0 ± 0.00
Glutamic Pyruvate Transaminase level(U/L)	27.33± 3.71	36.67 ± 3.28	27.66 ± 6.74	62.50±15.29
Glutamic-Oxaloacetic Transaminase level(U/L)	68.33 ± 17.25	111.33 ± 17.29	138.00 ± 65.82	114.00 ± 4.62

(Data are expressed in mean± standard error of mean)

## CONCLUSION

In fact, diabetes now a days is a major health problem and yearly there is a considerable amount of foreign exchange involved in the import of drugs of foreign origin. Thyroid hormone increases metabolic actions in almost each tissue and the present study was an attempt to evaluate scientifically the effects of *Raphanus satives* (Radish) in the treatment of diabetes mellitus. Radish exhibited a promising hypoglycemic effect on induced hyperglycemic rats. In this study, administration doses of Radish extract (250 mg/kg) did not affect kidney function, creatinin and urea, also liver function were not affecting Glutamic-Oxaloacetic Transaminase (GOT), Glutamic-Pyruvate Transaminase (GPT), albumin, total protein and bilirubin, this means administration of increased doses to hyperglycemic subjects can be considered safe.

**List of Abbreviations:** Glutamic-Pyruvate Transaminase:

GPT; Glutamic-Oxaloacetic Transaminase: GOT; Thyroid Stimulating Hormone: TSHT; Lipo poly saccharides: LPS; Diabetes Mellitus: DM; Type 1 Diabetes: T1D

**Competing Interests:** No financial interests or personal relationships between the authors influence the research.

**Authors' Contributions:** Elnour, conceived of the presented idea. Elnour, and EzzEldin wrote the manuscript draft with support from Ahmed and Elthahir. Mariod revised and submitted the manuscript. All authors discussed the manuscript results and contributed to the final manuscript version.

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