An Experimental Study on the Efficacy of Certain Medicinal Herbs in Lowering Blood Sugar Levels in Diabetic Rats

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Abstract

This research aims to study the effect of cinnamon extract on blood sugar levels in diabetic rats. Rats were used and divided into four different groups according to the nature of the diet provided to them. The first group was given a normal, balanced diet, and the second group was given cinnamon in addition to the balanced diet. Diabetes was induced in the third and fourth groups by providing a diet high in sugars and fats for a certain period of time, and then the fourth group was given cinnamon extract to study its effect on blood sugar levels and lipid profiles. The results confirmed that the third and fourth groups that followed a high-sugar and high-fat diet had already developed diabetes, and when the fourth group was given cinnamon extract, the results recorded a significant decrease in blood sugar levels and fat profiles. From here, we conclude that cinnamon has a very effective role in regulating and normalizing blood sugar levels.

Key Words:

Blood sugar, Diabetes, High-fat diet, Lipid profile.

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1. Introduction: Despite advancements in healthcare and treatment, chronic illnesses remain prevalent today, with diabetes being among the most widespread. It is projected that by 2030, 366 million individuals will be affected by diabetes. Various factors, including inadequate nutrition and genetic predisposition, can lead to diabetes. Nutrition plays a crucial role as it can increase the likelihood of developing the disease, exacerbate its symptoms, or even result in fatality (Schmidt,2016).

Cinnamon has characteristics that are similar to those of insulin, including increasing the synthesis of glycogen, activating insulin receptors, and affecting glycogen storage. The overall goal of this study is to evaluate the impact of cinnamon on diabetic rats that consume foods high in fat and sugar (Kizilaslan & Erdem, 2019).

Diabetes is a chronic illness that affects how blood sugar levels are regulated, which is crucial for giving the body energy. The hormone that carries glucose

into cells is called insulin (American Diabetes Association, 2022).

Either inadequate insulin secretion or cell resistance to insulin is the issue in diabetes. Insulin is no longer functionally effective when blood glucose levels are high, yet do not reach the cells (Mayo Clinic, 2021).

Because of their strong genetic and physiological resemblance to humans, mice are widely used in scientific studies and are therefore useful for experimental studies (Rosenthal & Brown, 2007). They are also ideal for scientific investigations due to their small size, simplicity of handling, and quick reproduction, particularly when researching the impact of medications or natural compounds like cinnamon on long-term conditions like diabetes. Researchers can easily observe the consequences and symptoms by inducing diabetes in mice through genetic alteration or pharmacological treatments that produce similar symptoms (King, 2012).

Because of its therapeutic qualities, cinnamon, a well-known aromatic herb, has been used in traditional medicine for ages. It is made from the tree's bark and contains natural substances, including cinnamon aldehyde and polyphenols that have therapeutic uses. These substances help improve glucose absorption and the body's reaction to insulin (Ranasinghe et al., 2013; Anderson, 2008).

The impact of cinnamon on blood glucose levels has been the subject of several earlier investigations. Most of them have produced favourable findings, suggesting a connection between eating cinnamon and lowering blood sugar levels (Khan et al., 2003; Subash Babu et al., 2007).

Furthermore, several studies have discovered that cinnamon's anti-inflammatory and antioxidant properties not only help to alter blood glucose levels but also lower the risk of complications related to diabetes, including cardiovascular diseases (Ranasinghe et al., 2013).

In this study, we will investigate how herbs, specifically cinnamon, can lower blood sugar levels in diabetic rats. Due to its well-known status, high nutritional content, accessibility, and cost, studies have shown that cinnamon can effectively lower blood sugar levels. Cinnamon helps control the amount of insulin the pancreas secretes.

2. Methods

For this study, twenty-four adult rats were acquired from the Theodor Bilharz Institute in Egypt. Each rat weighed 120 grams and was roughly the same age. They were kept in cages with adequate ventilation, room temperature, and normal humidity. Before the trial started, they were given the proper food and water and given a few days to acclimate.

Dietary Practices:

1. A typical pellet diet.

2. A diet heavy in fat and sugar. According to Al-Qulaly (2021), the diet's ghee has 20.3% protein, 24% carbs, and 46% fat.

3. Cinnamon: After buying cinnamon powder from the neighbourhood grocery, it was combined with water and added to the food.

There were four equal groups of rats. Throughout the trial, the first group, which served as the control group, was given a regular pellet diet and water.

As with the diabetic group, the second group was given a diet heavy in fat and sugar. Throughout the experiment, high-sugar and high-fat foods were fed to the rats to induce diabetes (Ranasinghe, 2013).

Rats in the third group were given a diet heavy in fat and sugar, which caused them to develop

diabetes. They were then given cinnamon for two weeks, each rat received 1.5g of cinnamon three times a day by combining cinnamon powder with water and adding it to their chow (Haghighian, 2011).

The fourth group was made up of healthy rats that had water and cinnamon blended into their diet.

Blood Collection: From each of the earlier groups, blood samples were taken when the rats were killed at the end of the experiment.

Serum was extracted from blood samples by centrifuging them for 15 minutes at 5000 rpm and then aspirating the serum into Eppendorf tubes for examination.

Biochemical analysis: Measurement of cumulative blood sugar, liver function measurement (ALT and AST), and lipid profile measurement (Cholesterol, Triglyceride, HDL, LDL).

Analysis of statistics: All data were analyzed using the t–test to determine the reason for a significant effect. A significant difference from the control was defined as $p<0.05$, and the data were expressed as mean ± standard deviation.

3. Results

The results of serum glucose showed that the high–fat and glucose diet induced diabetes in rats, as observed in the determination of serum glucose in all groups (Table 1). The serum glucose increased significantly ($p<0.01$) in the diabetic group compared with the control group, while the induction of cinnamon into the diet decreased the serum glucose level (Fig.1). The intake of cinnamon into to control group improved the serum glucose level.

Table 1: Presents the mean and standard deviation of the serum glucose of the control and treated groups of male rats

	Control		Diabetic		Diabetic+Cinnamon		Cinnamon	
	Mean	±St. D	Mean	±St. D	Mean	±St. D	Mean	±St. D
Glucose	84.38	±1.52	186.9*	±3.39	126.79*	±3.57	82.53	±1.4

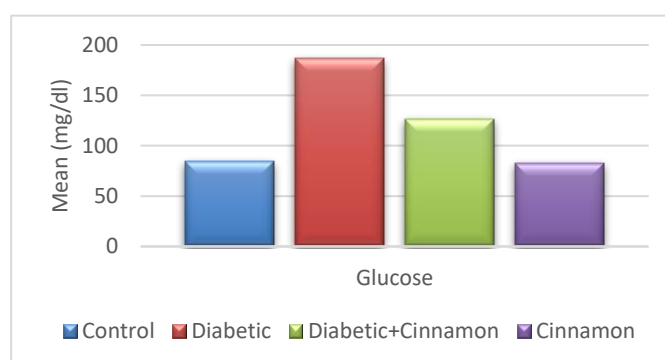*Significant $p<0.05$, St. D: Standard deviation

Figure 1: Histogram presents the mean of the serum glucose in all treated groups.

The effect of diabetes on liver function and the role of cinnamon: Table 2 showing the results on liver function including ALT and AST showing a high significant increased ($p<0.05$) of ALT and AST of diabetic group compared with control group while the induction of cinnamon in diet decreased the values of ALT and AST and the values of ALT and AST in cinnamon group decreased compared with control group (Fig.2).

Table 2: Presents the mean and standard deviation of liver function (ALT and AST) of all groups of male rats.

	Control		Diabetic		Diabetic+Cinnamon		Cinnamon	
	Mean	±St. D	Mean	±St. D	Mean	±St. D	Mean	±St. D
ALT	32.67	±1.09	120.55*	±0.967	64.79*	±0.96	30.63	±0.97
AST	41.497	±0.92	151.55*	±0.84	75.497*	±2.1	39.72	±1.04

*Significant $p<0.05$, St. D: Standard deviation, ALT: alanine transaminase, AST: Aspartame transaminase.
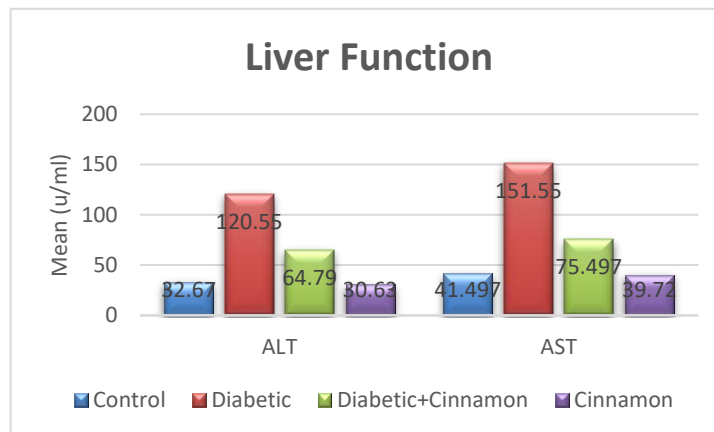

Figure 2: Histogram presents the mean of the serum ALT and AST in all groups.

The effects of diabetes on lipid profile and the role of cinnamon:

A highly significant increase ($p<0.05$) in cholesterol, triglyceride, and LDL of the serum of diabetic rats, while the HDL significantly decreased ($p<0.05$) compared with the control group (Table 3). In contrast, the values of biochemical parameters (cholesterol, triglyceride, and LDL) of the serum of diabetic plus cinnamon rats decreased, and the value of HDL increased compared with diabetic rats (Fig.3), and cinnamon improved the parameter values in control rats.

Table 3: Presents the mean and standard deviation of lipid profiles of all treated groups of male rats

	Control		Diabetic		Diabetic+Cinnamon		Cinnamon	
	Mean	±St. D	Mean	±St. D	Mean	±St. D	Mean	±St. D
Cholestrol	62.56	±0.75	181.58*	±0.85	91.58*	±0.71	60.47	±0.67
Triglyceride	86.55	±0.68	191.56*	±0.845	101.61*	±1.23	83.72	±0.72
HDL	35.51	±1.13	14.62*	±0.98	27.41*	±0.93	34.24	±0.93
LDL	14.49	±1.024	49.56*	±0.814	26.56*	±0.82	12.52	±0.89

*Significant $p<0.05$, St. D: Standard deviation, HDL: High density lipoprotein, LDL: Low density lipoprotein
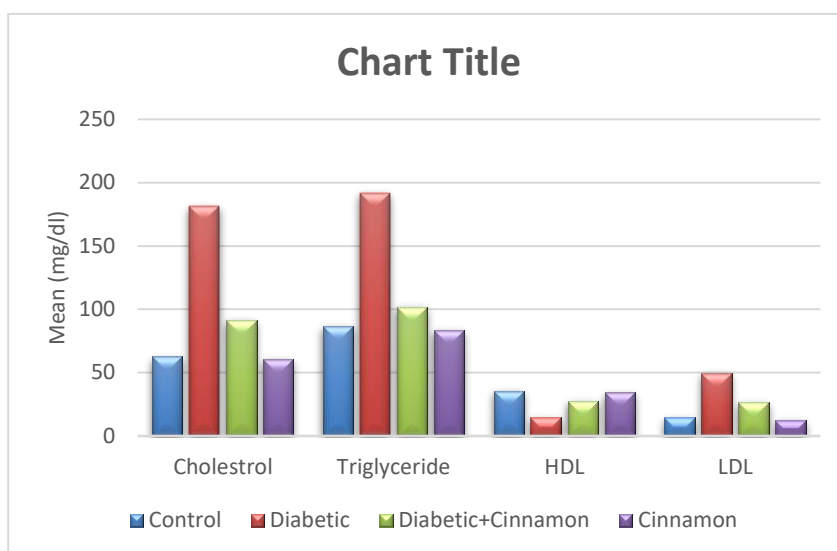
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Figure 3: Histogram presents the mean of the lipid profile of all treated groups

4. **Discussion**

In our research, rats' blood sugar levels showed signs of diabetes brought on by a diet heavy in fat and glucose (Al-Qulaly, 2021).

According to the study, giving diabetic rats 1.5g of cinnamon for two weeks improves their lipid profile, ALT, AST, and blood glucose levels. Consuming cinnamon may help people with type 2 diabetes regulate and lower their fasting blood sugar levels and lipid profiles, according to research by Haghighian et al. (2011). A big mouse study found that adding cinnamon extract to the chow of diabetic mice resulted in a considerable drop in blood glucose levels. This study found that cinnamon effectively regulates blood sugar levels (Viral et al., 2010).

Another study that examined the effects of cinnamon on body fat found that it reduced triglyceride and bad cholesterol levels while increasing good cholesterol (Khan et al., 2003).

According to Broadhurst et al. (2000), a number of plants are hypoglycemic, meaning they help lower blood sugar levels. Glycemic control is influenced by cinnamon data (Anderson et al., 2006). In the Khan et al. study, it was demonstrated that consuming 1, 3, or 6 grams of cinnamon per day for 40 days significantly decreased blood glucose, triglyceride, LDL, and total cholesterol levels. According to this study, even tiny doses of cinnamon significantly decreased blood glucose, triglyceride, LDL, and cholesterol levels. The polyphenolic polymers in cinnamon, which have antioxidant properties, enhance the effects of insulin and may help manage diabetes and glucose intolerance. They may be the cause of the decrease in biochemical markers following consumption of cinnamon (Anderson et al., 2004).

This component was identified by Broadhurst et al. (2000) in cinnamon, which increased insulin activity in rats' glucose metabolism. According to Ziegenfuss et al., taking 3 g of water-soluble cinnamon extract daily for 12 weeks significantly improved blood glucose levels. According to another study, the methylehydroxy chalcone polymers in cinnamon increase the sensitivity of fat cells to insulin by activating the enzyme insulin receptor kinase, which makes insulin attach to cells, and inhibiting the enzyme insulin receptor phosphatase, which stops this progression and results in maximal phosphorylation of the insulin

receptor, which is linked to increased insulin sensitivity (Anderson et al. 2006).

It has become obvious via our scientific study, as well as national and international studies, that cinnamon helps lower and reduce blood glucose levels in patients with diabetes. Numerous studies and research articles have shown how cinnamon affects blood glucose levels in people who are ill. Cinnamon also lowers blood sugar levels in healthy (non-diabetic) people, according to scientific studies. In healthy individuals, cinnamon's influence on blood glucose helps keep levels within the usual range. Based on our investigations, we came to the conclusion that cinnamon significantly altered blood indicators, which were shown across a range of statistical and relative values (Kizilaslan & Erdem, 2019).

5. Conclusion

The present study suggests that the suggested health advantages of cinnamon intake in diabetic rats could improve some biochemical factor levels and shows that cinnamon intake has a favorable effect on lowering blood glucose and modifying the blood lipid profile, ALT, and AST. Using small amounts of cinnamon can be a safe and efficient way to lower the risk factors for diabetes. When diabetics use cinnamon in their cooking, their lipid profiles and blood sugar levels may remain close to normal.

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دراسة تجريبية لفعالية بعض الأعشاب الطبية في خفض مستويات السكر في الدم لدى الجرذان المصابة بالسكري

المستخلص العربي ومقترح البحث:

يهدف هذا البحث إلى دراسة تأثير مستخلص القرفة على مستويات السكر في الدم لدى الفئران المصابة بالسكري. تم استخدام الفئران وتقسيمها إلى أربع مجموعات مختلفة حسب طبيعة النظام الغذائي المقدم لها. وتناولت المجموعة الأولى نظاماً غذائياً عادياً ومتوازناً، والمجموعة الثانية تم تزويدها بالقرفة إلى جانب النظام الغذائي المتوازن. تم تحريض مرض السكري في المجموعتين الثالثة والرابعة عن طريق تقديم نظام غذائي غني بالسكريات والدهون لفترة معينة، ثم أعطيت المجموعة الرابعة مستخلص القرفة لدراسة تأثيره على مستويات السكر في الدم وملامح الدهون. وقد أكدت النتائج أن المجموعتين الثالثة والرابعة اللتين اتبعتا نظاماً غذائياً غنياً بالسكريات والدهون قد أصيبتا بالفعل بمرض السكري، وعندما أعطيت المجموعة الرابعة مستخلص القرفة سجلت النتائج انخفاضاً ملحوظاً في مستويات السكر في الدم وملامح الدهون. من هنا نستنتج أن القرفة لها دور فعال جداً في تنظيم مستويات السكر في الدم لتصبح طبيعية.

وتشير الدراسة الحالية إلى أن المزايا الصحية المقترحة لتناول القرفة في الفئران المصابة بالسكري يمكن أن تحسن بعض مستويات العوامل الكيميائية الحيوية وتظهر أن تناول القرفة له تأثير إيجابي على خفض نسبة الجلوكوز في الدم وتعديل ملف الدهون في الدم. يمكن أن يكون استخدام كميات صغيرة من القرفة طريقة آمنة وفعالة لتقليل عوامل خطر الإصابة بمرض السكري. عندما يستخدم مرضى السكر القرفة في طبخهم، قد تظل ملامح الدهون ومستويات السكر في الدم قريبة من المعدل الطبيعي.