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Research Article

Proposed effect of curcumin in type I diabetes mellitus

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Abstract
People of all ages may develop diabetes mellitus (DM), a chronic condition caused by insufficient insulin production and activity. Damage to the eyes, kidneys, heart, and blood vessels may result from diabetes because of the disease's high glycemic effect and ketosis. Type I diabetes mellitus (T1DM) is an endocrine illness in which pancreas cells cease generating insulin as a consequence of autoimmune destruction, making diabetes a severe disease with numerous probable causes. Hyperglycemia and ketoacidosis are difficult to manage without insulin replacement. **Purpose of the study;** Therefor, the current study aimed to assess the protective effects of curcumin (Cur) against type I diabetes in rats. **Basic procedures;** rats were allocated in 4 groups. group1: control (C) received normal saline, group2: diabetic (D) injected intra-peritoneal (IP) with single dose of streptozotocin (STZ) (40 mg/kg), group3: diabetic treated with low dose curcumin (DC) received curcumin 100 mg/kg/day by gavage for 28 days, group4: diabetic treated with high dose curcumin (DC) received curcumin 200 mg/kg/day by gavage for 28 days. Rats were sacrificed after 28 days of treatment. **Main findings:** The damaging effect of STZ on the pancreatic beta cells resulted in T1DM and protective effect of Cur on beta cells that was evaluated by assessment of glucose and insulin, in the diabetic rats 'serum.
Principle conclusion: The results suggested the protective effects of curcumin on TIDM.

Keywords: Antidiabetic drugs, Curcumin, Insulin resistance, DM.

Introduction
Diabetes mellitus (DM) is a condition caused by insufficient insulin action and secretion and may affect individuals of any age. Damage to the eyes, kidneys, heart, and blood vessels may result from diabetes because of the disease's high glycemic effect and ketosis. Insulin insufficiency results from the immune system's attack on the body's own beta cells in the pancreas, making diabetes a potentially fatal illness [1]. Insulin, which plays a crucial role in the control of glucose homeostasis, is synthesized and secreted by cells in the islets of Langerhans, which are located in the endocrine pancreatic tissue [2].

The autoimmune death of pancreatic cells causes type I diabetes mellitus (T1DM), an endocrine condition. This leads to high blood sugar and ketoacidosis, making insulin control crucial. The peak ages for onset are puberty and early adulthood [3], although it may happen at any age. Body's response to free radicals and oxidative stress among the factors contributing to the decline in insulin production by the pancreatic cells [4]. As a result, the significance of antioxidant therapy in diabetic treatment remains unclear [5]. Due to its high therapeutic properties, curcumin can play a crucial role in the cure of diabetes by preventing the deterioration of -cell functions; Curcumin achieves this through the up regulation of defense proteins like reduced glutathione and the inhibition of pro-inflammatory and pro-apoptotic cytokines [6].

The purpose of this research was to determine how effective curcumin is in blocking the effects of streptozotocin on hyperglycemia in rats with TIDM.

Material & Methods

Animals

35 adult male Wister rats were obtained from the National Institute for Research, Cairo, Egypt. At the start of the experiment the average body weight was 160 ± 20 gram. Prior to the experiment they were given a week to acclimatize in a controlled environment with consistent temperature and humidity and allowed standard rat chow and water. The protocol of work was approved by the Animal Care and Use Committee of Faculty of Medicine, Minia University, Egypt. No.293/3:2022. Date 27 March 2022.

Chemicals

Streptozotocin (STZ) was purchased from Sigma-chemical Company, Egypt. In the powdered form. It was used for type 1 diabetes mellitus induction by dissolving it in citrate buffer and given by single intraperitoneal injection [7]. Curcumin was purchased as powder from Sigma-chemical Company, Egypt. It was dissolved in 100 mmol/L DMSO and administrated orally every day for 28 days [8].

Experimental design

Rats were categorized into the following four groups:

***1- Control group (C)*:** rats received only DMSO daily.

***2- Type 1 Diabetic group not treated (D)*:** 10 rats injected with STZ (40mg/kg) Single intraperitoneal (I.P) injection were given to induce T1DM. The animals developed T1DM in within 24 to 72 h after STZ injection.

***3- Diabetic Curcumin treated group (D/Cur low)*:** 10 diabetic rats were received Cur orally (100 mg/kg) after 72h of STZ injection [9].

***4- Diabetic Curcumin treated group (D/Cur high)*:** 10 diabetic rats were received Cur orally (200 mg/kg) after 72h of STZ injection.

Needle gavage was used to administer curcumin orally to rats once daily for 28 days at different doses [10].

Sample collection

At the end of the 28-day treatment period, all participants fasted overnight before being decapitated and scarified. After drawing blood from the jugular vein and letting it clot at room temperature, the samples were spun at 3000 rpm for 15 minutes in a cooled centrifuge to separate the serum. The serum layer was separated and stored at -80°C in designated Eppendorf tubes until the time of the experiment [11].

The following parameters were analyzed:

Glucose level (Fasting blood glucose level of rats was analyzed by glucometer device from sigma-chemical Company).

Insulin level (Serum levels of insulin (Bioassay Technology Lab, China) was measured using rat-specific ELISA kit (Catalog No: E-EL-R246696T) using an ELISA reader (Stat Fax 2100, USA).

Statistical analysis of data

Means and standard deviations (S.D.) were calculated to summarise the data, and one-way analysis of variance was used to draw comparisons across several groups (one-way ANOVA). Statistical significance was assumed for P values less than 0.05. IBM's SPSS 28.0 statistical analysis software was used to examine the data (IBM; Armonk, New York, USA).

Results

1- Effect of STZ induction on serum glucose and insulin level

The induction of T1DM using single low dose STZ resulted in increased fasting blood glucose level with decreased serum insulin level.

“One week after injection, blood sugar is measured. Rats with fasting glucose >250 mg/dL were considered diabetic and used for the study”.

2- Effect of Curcumin on serum fasting glucose and insulin level

Administration of curcumin to diabetic rats significantly lowered the serum glucose level. And also, it showed a significant increase in the serum insulin level

Table (1): One way ANOVA test of fasting blood glucose level among different studied groups

Characteristic	Control (n=5)	Diabetes (n=9)	Curcumin low dose (n=9)	Curcumin high dose (n=9)	p-value
	86.40 ± 8.62	368.33 ± 153.67	133.00 ± 46.36	214.78 ± 127.65	<0.0001*

Table (2): one way ANOVA test of serum insulin level ng/ml by ELISA method among different studied groups

Characteristic	Control (n=5)	Diabetes (n=9)	Curcumin law dose (n=9)	Curcumin high dose (n=9)	p-value
Serum Insulin (ng/ml) Mean ± SD	2.67±0.0045	0.307±0.0518	1.15 ± 0.1611	1.92 ± 0.1213	<0.0001*

Data are expressed as M±SD. The mean difference between groups was considered statistically significant when P value < 0.05. C: Control group. D: Diabetic non treated group. D/Cur: Diabetic + Curcumin low dose treated group. D/Cur: Diabetic + Curcumin high dose treated group.
* Significant p value.

Discussion

The prevalence of diabetes makes it a worldwide health concern. It's a group of metabolic disorders characterized by high blood sugar due to insulin synthesis or function issues. In 2021, 27 million persons aged 20-79 were estimated to have diabetes based on data from the International Diabetes Federation (IDF) Atlas. By 2030 [12], this figure is projected to rise to 653 million. Insulin-producing pancreatic cells are destroyed by the immune system in type I diabetes, disrupting glucose homeostasis and causing the disease. Long-lasting physiological and psychological effects are felt when it first manifests in childhood. TIDM may cut life expectancy by around 10 years [13], due to comorbidities such neuropathy, nephropathy, and retinopathy.

The quality of life is severely diminished by the need of regular injections. Autoantibody screening may uncover instances in pre-symptomatic individuals, and the incidence is rising at a rate of roughly 4% year [14].

New therapeutic methods, including preventive measures, are required. The use of medicines derived from plants has expanded from a small subset of the medical community to the mainstream. New therapeutic methods, including preventive measures, are required. Medications derived from plants have gone from a fringe practice to a mainstream one. Curcumin, a compound isolated from the spice turmeric, is being studied for its potential use in treating a wide range of medical conditions, including diabetes-related problems [15]. Research on curcumin suggests it may control a wide variety of genes and pathways, including those involved in inflammation, cell growth and proliferation, adhesion, apoptosis, and cell cycle regulation. As a result, it has both preventative and therapeutic effects in conditions as diverse as diabetes.

The current study found that diabetic rats given CUR had significantly lower blood glucose levels compared to diabetic rats not given CUR, and significantly higher serum insulin levels compared to diabetic rats not treated with CUR. This was likely due to CUR's ability to stimulate pancreatic insulin production from cells of the islets of Langerhans [16].

Conclusion

The present study concluded that curcumin treatment in a dose of 200 mg/kg/day for 28 days could partially reverse the diabetic changes but not to the control healthy level.

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