

Effect of Coriander Seed (*Coriandrum sativum* L.) Ethanol Extract on Insulin Release from Pancreatic Beta Cells in Streptozotocin-induced Diabetic Rats

Maryam Eidi^{1*}, Akram Eidi², Ali Saeidi², Saadat Molanaei³, Alireza Sadeghipour⁴, Massih Bahar⁵ and Kamal Bahar⁶

¹Department of Biology, Varamin Branch, Islamic Azad University, Varamin, Iran

²Department of Biology, Science and Research Branch, Islamic Azad University, Tehran, Iran

³Pathology Laboratory, Milad Nour Hospital, Tehran, Iran

⁴Pathology Laboratory, Rasoul Akram Hospital, Tehran, Iran

⁵Clinical Biochemistry Department, Medicine School, Tehran University, Tehran, Iran

⁶Bahar Medical Laboratory, Tehran, Iran

Coriander (*Coriandrum sativum* L.) is grown as a spice crop all over the world. The seeds have been used to treat indigestion, diabetes, rheumatism and pain in the joints. In the present study, an ethanol extract of the seeds was investigated for effects on insulin release from the pancreatic beta cells in streptozotocin-induced diabetic rats. Blood samples were drawn from the retro-orbital sinus before and 1.5, 3 and 5 h after administration of the seed extract. Serum glucose levels were determined by the glucose oxidase method. To determine the insulin releasing activity, after extract treatment the animals were anaesthetized by diethyl ether, the pancreas was excised, fixed in 10% formaldehyde and embedded in paraffin for sectioning. Pancreatic sections of 5 µm were processed for examination of insulin-releasing activity using an immunocytochemistry kit. The results showed that administration of the ethanol extract (200 and 250 mg/kg, i.p.) exhibited a significant reduction in serum glucose. Administration of streptozotocin decreased the number of beta cells with insulin secretory activity in comparison with intact rats, but treatment with the coriander seed extract (200 mg/kg) increased significantly the activity of the beta cells in comparison with the diabetic control rats. The extract decreased serum glucose in streptozotocin-induced diabetic rats and increased insulin release from the beta cells of the pancreas. Copyright © 2008 John Wiley & Sons, Ltd.

Keywords: *Coriandrum sativum* L.; coriander; immunohistochemistry; hypoglycaemia; rats.

INTRODUCTION

Many spices are used as a source of vitamins and minerals and to treat human disorders (Chopra *et al.*, 1956; Nadkarni and Nadkarni, 1976). Coriander (*Coriandrum sativum* L.), an annual herb belonging to the carrot family, is grown primarily as a spice crop for use in various cuisines all over the world (Gupta *et al.*, 1986). Extracts and preparations from spices such as coriander have been reported to improve glucose tolerance (Pruthi, 1993). Recent studies have also demonstrated a hypoglycaemic effect of coriander on carbohydrate metabolism (Chithra and Leelamma, 2000; Gray and Flatt, 1999). Apart from these, no demonstration of the effect of this spice on the insulin releasing effects of pancreatic beta cell has been carried out. The present study evaluated the insulin releasing activity of coriander seeds in streptozotocin-induced diabetic rats.

MATERIALS AND METHODS

Plant material. Coriander seeds were collected from Varamin area in summer 2005 and scientifically approved in the Department of Botany of Teacher Training University (Voucher number: 037424, deposited in the Farabi Herbarium). The seeds were cleaned, dried at 25 °C, ground with a blender and stored frozen until required.

Extraction of ethanol plant material. 60 g of dried and ground seeds was extracted with 300 mL ethanol (80%) in a soxhlet apparatus for 72 h. After extraction, the mixture was filtered and evaporated to give a final weight of extract of 5 g.

Animals. Male Wistar rats weighing 200–250 g were housed in cages at 22–24 °C, with a 12 h light/12 h dark cycle and relative air humidity of 40–60%. Rats had continuous access to food and to tap water. Six animals were used in each group.

Induction of diabetes. Rats were injected (i.p.) with streptozotocin 70 mg/kg. Five days after injection, rats with fasting blood glucose levels of more than 180 mg/dL were used for experiments.

* Correspondence to: Dr Maryam Eidi, Varamin Branch, Islamic Azad University, P.O. Box: 16535-617, Tehran, Iran.
E-mail: maryameidi@gmail.com
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Picture 1. Immunoreaction of insulin in pancreatic β -cells after staining with the anti-insulin antibody.

Blood sampling. Before administration and 1.5, 3 and 5 h after administrations of the ethanol seed extract, blood samples were drawn from retro-orbital sinus of the streptozotocin-induced diabetic rats. Blood glucose levels were determined by a Trinder's glucose oxidase method. Serum glucose was shown to have decreased significantly in the fasted diabetic animals 3 h after administration.

Determination of insulin releasing activity. To determine the insulin releasing activity of the extract, 3 h after extract treatment, the animals were anaesthetized with diethyl ether. The pancreases were excised, fixed in 10% formaldehyde for 24 h, and embedded in paraffin for sectioning. Sections of 5 μ m were processed for insulin-releasing activity using an immunocytochemistry kit. Briefly, endogenous peroxidase activity was blocked with methanol- H_2O_2 (30% H_2O_2 ; diluted 1:30 in methanol), and to reduce non-specific binding to cellular immunoglobulin (Fc)-receptors, the specimens were treated with buffered rat serum (dilution 1:10 in PBS buffer). For insulin detection, a rat polyclonal insulin-antibody (DAKO-company) was used as primary antibody (dilution 1:200 in PBS-buffer). Biotinylated anti-rat-F (ab') 2-fragment (dilution 1:200 in PBS-buffer) served as the secondary antibody. The detection of the specific antibody bonding was accomplished using the avidin-biotin-peroxidase-complex method (DAKO-company) with 3,3'-diaminobenzidine. Finally, the background was stained with haematoxylin (Picture 1). For the morphometric semi-quantitative analysis of stained β -cells in pancreas of rats, the stained Langerhan's islets in 13 ocular fields per specimen were measured at 10 \times magnification (Wehner *et al.*, 1999).

Statistical analysis. All data were expressed as mean \pm SD. Differences between groups were considered to be significant at $p < 0.05$ using one-way ANOVA.

RESULTS

Administration of coriander ethanol extract at doses of 200 and 250 mg/kg, i.p. produced a significant hypogly-

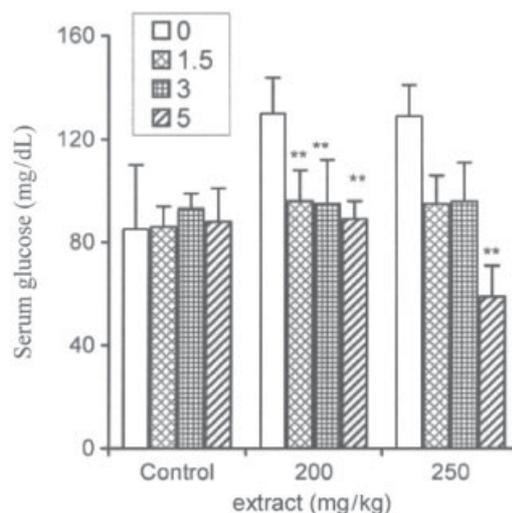


Figure 1. Effect of intraperitoneally administration of coriander seeds ethanol extract at doses of 200 and 250 mg/kg body weight on serum glucose in healthy fasted rats for 1.5, 3 and 5 h after administration. Each column represents mean \pm SD for six rats. Serum glucose levels at zero time or before administrations were considered as control values. The control group was administered with water as a vehicle. ** $p < 0.01$ different from before administration.

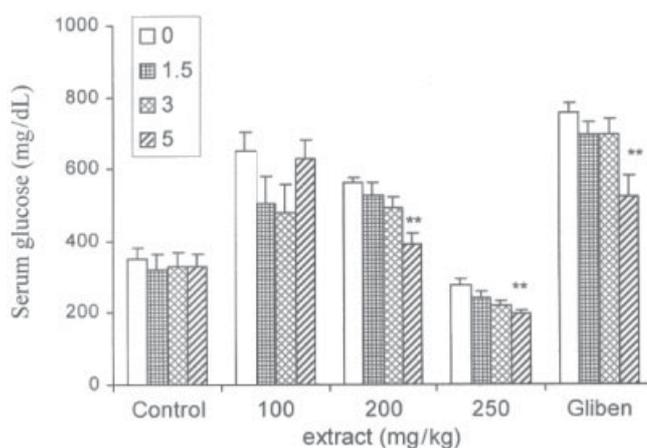


Figure 2. Effect of intraperitoneally administration of coriander seeds ethanol extract at doses of 100, 200 and 250 mg/kg and glibenclamide (Gliben) at a dose of 600 μ g/kg body weight on serum glucose in streptozotocin-induced diabetic fasted rats for 1.5, 3 and 5 h after administration. Each column represents mean \pm SD for six rats. Serum glucose levels at zero time or before administrations were considered as control values. The control group was administered with water as a vehicle. ** $p < 0.01$ different from before administration.

caemic effect in healthy fasted animals lasting for 1–5 h (Fig. 1).

The administration of coriander seed ethanol extract at doses of 100, 200 and 250 mg/kg, i.p. significantly decreased serum glucose in streptozotocin-induced diabetic fasted animals (Fig. 2). Administration of glibenclamide, a standard hypoglycaemic agent (600 μ g/kg, i.p.), also decreased serum glucose in streptozotocin-induced diabetic fasted animals (Fig. 2).

Administration of streptozotocin decreased the number of beta cells with insulin releasing activity in comparison with intact rats. However, treatment with coriander seed extract (200 mg/kg) significantly increased active beta cells in comparison with diabetic control rats (Fig. 3).

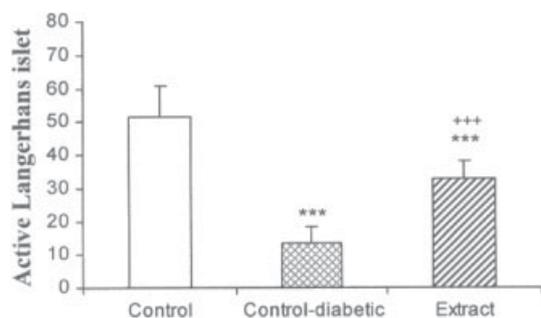


Figure 3. Effect of intraperitoneally administration of coriander seeds ethanol extract at a dose of 250 mg/kg body weight on the number of active beta cells in streptozotocin-induced diabetic fasted rats 3 h after administration. Each column represents mean \pm SD for six rats. The control group was administered with water as a vehicle. *** $p < 0.01$ different from control intact rats. +++ $p < 0.001$ different from control diabetic rats.

DISCUSSION

It is evident from the results that the i.p. administration of coriander ethanol extract at doses of 200 and 250 mg/kg body produced a marked hypoglycaemic effect on healthy fasted animals lasting for 1.5–5 h. Administra-

tion of coriander extract at doses of 200 and 250 mg/kg significantly decreased serum glucose in streptozotocin-induced diabetic fasted animals and also increased the activity of beta cells in comparison with the diabetic control rats.

Chitra and Leelamma (1999) reported previously that the hypoglycaemic action of coriander seeds may be due to the increased utilization of glucose in liver glycogen synthesis and the decreased degradation of glycogen. It may also be due to an increased rate of glycolysis and decreased rate of gluconeogenesis. The present results indicate that coriander may also decrease serum glucose by increasing insulin release from the pancreas.

In conclusion, the results have shown that an ethanol extract of coriander seeds possesses a hypoglycaemic effect on streptozotocin-induced hyperglycaemic rats and thus validates to some extent the folk use of this plant.

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