

Hypoglycemic effect of *Equisetum myriochaetum* aerial parts on type 2 diabetic patients

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Abstract

The hypoglycemic effect of a water extract from aerial parts (0.33 g/kg) of *Equisetum myriochaetum* Schlecht and Cham (Equisetaceae) was analyzed in 11 recently diagnosed type 2 diabetic patients. A single dose of this extract was orally administered. Glucose and insulin were determined at 0, 30, 60, 90, 120 and 180 min after administration. The same patients served as the control group and received only colored water as placebo. The administration of the extract significantly reduced the blood glucose levels of the type 2 diabetic patients within 90, 120 and 180 min. There were no significant changes in the insulin levels. The results demonstrate that the water extract of the aerial parts of *E. myriochaetum* shows a hypoglycemic effect in type 2 diabetic patients starting 90 min after its administration. © 2002 Elsevier Science Ireland Ltd. All rights reserved.

Keywords: Mexican hypoglycemic plants; *Equisetum myriochaetum*; Type 2 diabetes

1. Introduction

Diabetes mellitus is a multiple group of disorders with different etiologies. It is characterized by derangement of carbohydrate, protein, and fat metabolism caused by a complete or relative insufficiency in insulin secretion and/or insulin action. Type 2 diabetes mellitus results from a combination of tissue resistance (or insensitivity) to insulin action and an inadequate compensation of insulin secretion response. Genetic and environmental factors may influence this type of diabetes but the full etiology is not understood (Islas and Revilla, 1999).

In Mexico, diabetes mellitus is recognized as the fourth highest cause of mortality, and according to the predictions of the World Health Organization by 2025 there will be 11.7 million diabetic patients in Mexico (WHO, King et al., 1998).

Mexico has a great tradition in the use of herbal medicine for disease treatment, and herbal medication is

well accepted by patients. Alternative or complementary medicine is selected by a high percentage of the population to treat many chronic diseases, including diabetes.

About 880 plants worldwide are believed to possess hypoglycemic activity, 343 of which have been reported in the scientific literature (Lamba et al., 2000). Reported ethnopharmacological studies produce an estimated number of 400 plants used in Mexico as treatment for this condition (Andrade-Cetto, 1999).

Equisetum myriochaetum Schlecht. and Cham. ('cola de caballo') is a plant which is used by traditional healers ('curanderos') for the treatment of kidney diseases (Argueta, 1994) and furthermore in the state of Guerrero for diabetes type 2 (Andrade-Cetto, 1999).

Studies in streptozotocin induced diabetic rats showed that water and butanolic extracts of the aerial parts of this plant have a significant hypoglycemic activity, comparable to the synthetic drug glibenclamide. This hypoglycemic effect starts 60 min after administration of the different extracts with a maximum effect 3 h later (Andrade-Cetto et al., 2000). Phytochemically flavonol glycosides were isolated as the main constituents (Wiedenfeld et al. 2000).

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The aim of this study was to investigate the hypoglycemic effect of the water decoction of the aerial parts of *E. myriochaetum* when administered orally in a single dose to type 2 diabetic patients.

2. Materials and methods

2.1. Materials

E. myriochaetum was collected in the Mexican states of Guerrero and Hidalgo. The plant was identified by Monica Palacios-Rios of the Ecological Institute at Jalapa Veracruz. A voucher specimen IMSSM 11266 was deposited at the IMSS Herbarium in Mexico City.

2.2. Preparation of the extract

A quantity of 0.33 g of dried plant (aerial parts) for each kg of patient weight was boiled for 10 min in 250 ml water. The extract was filtrated and orally administered to the overnight fasted type 2 diabetic patients, in less than 3 min.

2.3. Patients

Eleven recently diagnosed type 2 diabetic patients controlled with diet and exercise (seven women and four men with an average age of 46.2 ± 8 years) were invited to participate in the study. The patients were non-smokers and did not take alcohol. After a clear explanation of the study the patients agreed to participate and signed the informed consent.

Blood pressure was taken three times during the 180 min of the study. The length and weight of the patients were measured in order to estimate their body mass index ($BMI = \text{kg}/\text{m}^2$).

Blood samples were obtained before the administration of the water extract and 30, 60, 90, 120 and 180 min thereafter (experimental group). A blood drop was obtained from the fingertip to determine the glycosylated hemoglobin.

Two weeks later the same patients received only colored water (control group). The same procedure was performed and blood samples were taken in identical way.

No hypoglycemic drug was given as a positive control, because, the aim of this study was the testing of the acute effect of *E. myriochaetum* and there is no hypoglycemic drug that can reduce the glucose levels with a single dose. Additionally the included patients were recently diagnosed and the recommended treatment from the American Diabetes Association (ADA) to these kind of patients, is only diet and exercise.

2.4. Methods

Glucose, triglycerides, cholesterol and glycosylated hemoglobin were determined in the basal samples (time 0) of the experimental and control groups. Glucose and insulin were quantified in the 30, 60, 90, 120 and 180 min samples.

The serum samples were processed by the following methods: glucose (mg/dl) was determined by the glucose oxidase technique (Caraway, 1987); triglycerides by separation with lipoproteic carriers hydrolyzed by lipase; ascorbic acid residues (mg/dl) were eliminated with ascorbate oxidase (Tiez, 1987); cholesterol by the dissociation of the lipoprotein carriers. After hydrolysis of the cholesterol esters the free cholesterol was oxidized with cholesterol oxidase (mg/dl) (Kodak Ektachem® DT 60 II). Insulin was measured by radioimmunoassay (Bio-Cis International® U/ml) μ Glycosylated hemoglobin by an inhibition of latex agglutination with mouse monoclonal antibodies (%) (Knowless et al., 1986) (Bayer DCA 2000®).

2.5. Statistical analysis

Data was analyzed by paired *t*-test, comparing each time point with the 0 time value and are expressed as mean \pm standard deviation (S.D.).

3. Results

3.1. Demographic, anthropometric and biochemical parameters

The demographic and anthropometric parameters of the patients (Table 1) showed that the BMI of the women was 29.85 ± 3.27 and 28.21 ± 1.47 for the men. The BMI of the whole group of patients was 29.25 ± 2.97 , value that indicates that these patients were overweight (normal BMI is 20–25).

Table 1
Demographic, anthropometrics and biochemical parameters of type 2 diabetic patients

Demographic, anthropometric and biochemical parameters	Mean	S.D.
Age (years)	46.2	8
Diagnosis of diabetes (years)	2.27	0.90
Body weight (kg)	72.8	12
Size (m)	1.58	0.08
BMI (kg/m^2) (24–28 kg/m^2)	29.25	2.97
Systolic pressure (mmHg) (110–140 mmHg)	125	12.4
Diastolic pressure (mm Hg)(70–90 mmHg)	82	10
HbA1c (%) (3–6%)	9.0	1.94
Cholesterol (mg/dl)(160–200 mg/dl)	196	37.7
Triglycerides (mg/dl) (120–160 mg/dl)	193.5	60.8

Table 2
Effect of the oral administration of the infusion of *E. myriochaetum* (0.33g/kg) on blood glucose levels (mg/dl) of diabetic patients (mean \pm S.D.)

Time (min)	T0	T30	T60	T90	T120	T180
Control	178 \pm 11	185 \pm 10	182 \pm 13	185 \pm 13	171 \pm 11	168 \pm 10
Equisetum	193 \pm 8	179 \pm 10	178 \pm 11	172 \pm 10*	168 \pm 10**	157 \pm 9**

*, $P < 0.01$, compared with the initial level of blood glucose in each group; **, $P < 0.001$, compared with the initial level of blood glucose in each group.

Table 3
Effect of the oral administration of the infusion *E. myriochaetum* (0.33 g/kg) on insulin levels (μ U/ml) of diabetic patients (mean \pm S.D.)

Time (min)	T0	T30	T60	T90	T120	T180
Control	24 \pm 3	16 \pm 1*	18 \pm 2	18 \pm 3	21 \pm 4	18 \pm 3*
Equisetum	22 \pm 2	19 \pm 2	19 \pm 2	20 \pm 2	16 \pm 2*	16 \pm 2*

*, $P < 0.05$ compared with the initial level of blood insulin in each group.

There were no changes in the diastolic and the systolic blood pressure of the different patients during the study (experimental and control phases, data not shown).

The time since diagnosis of type 2 diabetes was 2.27 \pm 0.90 years and after a meticulous medical evaluation none of the characteristic complications of diabetes were detected. The basal levels of glucose were in the range of 178 \pm 11 mg/dl (normal < 110 mg/dl) the day of the control study and 193 \pm 8 mg/dl the day of the experimental study, with no significant difference between the two phases of the study. The basal glucose levels demonstrated that the patients were mild controlled, as was also demonstrated by the glycated hemoglobin value of 9 \pm 1.94% (normal 3–6%). No important hypertriglyceridemia or hypercholesterolemia could be detected.

3.2. Hypoglycemic effect of the water extract

The administration of a single dose of the water extract of *E. myriochaetum* aerial parts induced a significant reduction of the glucose levels 90 ($P < 0.01$), 120 ($P < 0.001$) and 180 ($P < 0.001$) min after administration compared with the basal levels. There was no reduction of the glucose levels in the control group (Table 2).

Insulin levels showed no significant changes in both phases of the study (Table 3).

4. Discussion

This study reports for the first time the hypoglycemic effect of *E. myriochaetum* in type 2 diabetic patients.

The extract was administered exactly as recommended by traditional healers, except that in our study the dose

of the extract was adjusted for the weight of each patient. The traditional healers normally measures the amount of plant with his hand, and uses the same dose, regardless of the patient's weight. We used the same quantity of water as is traditionally used.

The hypoglycemic activity of the water extract of *E. myriochaetum* was evaluated in recently diagnosed type 2 diabetic patients. The results obtained in this study show a significant effect on the reduction of the glucose levels in these patients after the oral administration of the *E. myriochaetum* extract. The hypoglycemic effect started 90 min after the administration of the decoction and was maintained up to 180 min. Insulin levels did not significantly change during the study, implying that the mechanism of action is not glibenclamide-like (not due to stimulation of insulin secretion).

There were no adverse effects due the intake of the extract and no alterations of the blood pressure could be detected. Furthermore, there were no complaints about the taste of the extract and it was well tolerated.

It is important to stress that the patients participating in the study were recently diagnosed, showed no complications, and were controlled only with diet and exercise according to the recommended treatment of the early stages of the illness with moderate high blood glucose levels.

Further studies will follow, involving administration of plant preparations for longer periods. Studies are in progress in our laboratories to elucidate in detail the mechanism of action exhibited by the plant.

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