

Antidiabetic Activity of Essential Oil of *Hedychium spicatum*

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ABSTRACT

A Himalayan plant *Hedychium spicatum* is medicinally very important as its rhizomes are quite aromatic in nature. In our study the antidiabetic activity of the oil was studied after extracting the oil from rhizomes using Clevenger apparatus. The antidiabetic activity was studied *in vivo* in diabetic male Wistar rats. The reference drug used was glibenclamide. After administering the rats with plant oil at 0.3ml per rat for 14 days, the blood sample was taken on the last day to check blood glucose level and various renal function parameters. The histopathological study of pancreas was done for each group. Gas chromatography-Mass spectrometry (GC-MS) results revealed that the main component in the oil was 1,8 cineole. The results on animal model showed that the oral dose of *Hedychium spicatum* Essential Oil (HEO) reduced the blood glucose and urea level of the rats of group 3 and were statistically significant when compared with normal control. The islets of langerhans of rat pancreas provided with HEO regained normal shape when compared with diabetic control group, emphasizing the antidiabetic potential of the plant essential oil.

Keywords: HEO, GC-MS, Antidiabetic, Wistar rats.

INTRODUCTION

Hedychium spicatum Buch.-Ham. a member of family Zingiberaceae is a plant of Himalayan region. The family constitutes important medicinal and aromatic plants characterized by the presence of essential oils and oleoresins¹. The plant is a perennial rhizomatous herb and is commonly known as shati in Ayurveda and kapur kachari in local markets. It flowers in the month of October and has large orange and white flowers which are borne in terminal spikes. Therefore, the plant is also known as spiked ginger lily. Aromatic rhizomes are 15-20cm long and externally yellowish brown. Oil contains 1,8 cineole, terpinene, limonene, p-cymene as major component¹. The plant is reported to possess anti-inflammatory, antihyperglycemic and vasodilator activity etc². The present paper deals with the antidiabetic activity of *Hedychium spicatum* essential oil to cure type 1 diabetes.

About 217 million individuals all over the world suffer from diabetes mellitus³. In Type 1 diabetes (insulin dependent diabetes mellitus) there is destruction of the β cells of the pancreas. As a result, the body can't make its own insulin. Diabetic patients suffer from many complications such as retinopathy, neuropathy and nephropathy etc⁴. Many synthetic drugs are present in the market for the treatment of diabetes mellitus but still its complications are not controllable. There are various side effects of synthetic drugs such as weight gain, dropsy etc.⁵ For the treatment of diabetes various essential oils are available as therapeutic agents for years without occurrence of any adverse side effects. This shows that the essential oils possess a great therapeutic potential

which if properly utilized can do wonders by treating various diseases related to mankind.

MATERIALS AND METHODS

The plant material was collected from Chail region of Himachal Pradesh in the month of September and identified in the PAN herbarium of Panjab University, Chandigarh.

Extraction of essential oil

The rhizomes were separated from the plant. 500g of washed rhizomes were put into Clevenger apparatus for steam distillation. The apparatus ran for 3hours. After this the essential oil was obtained and stored in vials and dried over anhydrous sodium sulphate.

Analysis of essential oil

The essential oil was analysed using GC-MS technique⁶.

Experiment on Animal model

The experiment was done on Wistar male albino rats weighing 180g-200g which were procured from The Central Animal House of Panjab University, Chandigarh after getting the ethical clearance. Before starting the experiment the rats were acclimatised for 7 days. They were maintained at room temperature with 12h/12h light and dark cycle kept in polypropylene cages and provided with rat diet and water.

Experimental design

Total 4 groups were made as follows:

Group 1- Normal Control(provided with lab feed pellet and drinking water).

Group 2- Diabetic control (Ip dose of alloxan 150mg/Kg body weight).

Group 3- Plant dose (Ip dose of alloxan as given in group 2+ 0.3 ml of HEO/rat given orally).

Table 1: GC-MS of essential oil of rhizomes of *Hedychium spicatum*.

Chemical compound	%age	KI(Kovats Index)
1. α -pinene	1.25	933
2. Camphene	4.11	952
3. Thujene	1.50	923
4. 1,8 cineole	40.0	1039
5. Linalool	1.05	1098
6. Camphor	8.13	1143
7. endo- borneol	3.0	1165
8. Terpinen-4-ol	.29	1178
9. Terpineol	.36	1185
10. Caryophyllene	1.2	1428
11. β - elemene	.4	1393
12. Humulene	.93	1440
13. cis-farnesene	.52	1085
14. γ - selinene	.24	1484
15. Murrolene	.23	908
16. α - copaene	.66	1376
17. Longifolene	1.00	1402
18. Curzerene	4.25	1573
19. Spathulenol	1.05	1576

Group 4- Standard drug (Ip dose of alloxan as in group 2+ 5mg/Kg of glibenclamide(GC)

Induction of diabetes

Before inducing diabetes the blood glucose level of the rats was checked by taking blood from their tail vein. This was done using blood glucometer and the rats were fasted overnight. Next morning, diabetes was induced by giving intraperitoneal (Ip) injection of a solution of alloxan monohydrate (150mg/kg) in 0.9% saline NaCl solution. After 2 days the blood glucose levels of the rats were checked to confirm diabetes. The rats whose blood glucose level was more than 180mg/dl were considered diabetic.

Dose of essential oil

0.3 ml(per rat) of essential oil was mixed with 2% suspension of tween-80 and given orally to each rat of group3 for 14 days.

Dose of Standard drug

5mg/Kg of glibenclamide was solubilised in distilled water and given orally to each rat of group 4 for 14 days.

Collection of blood sample(for blood glucose and renal function parameters) and pancreas for histopathological studies:

On 7 and 14 day the blood was collected from the tail of rats to check the improvement in their blood glucose level. The blood collected on last day of experiment was utilised for the study of renal function parameters. The animals were sacrificed after completion of experiment and their pancreas were taken and stored in 10% formalin solution for histopathological studies.

RESULTS AND DISCUSSION

The GC-MS results showed the presence of 19 chemical compounds which accounts for approx. 70% of the plant essential oil.

The major compound in the plant essential oil was monoterpeneoid 1,8 cineole, followed by camphor, camphene, thujene, α - pinene, linalool etc.

Blood glucose level(mg/dl) – The blood glucose level of the rats was checked with the help of glucometer. The results showed that the oral dose of HEO significantly reduced the blood glucose level of the rats after 14 days of treatment as compared with the normal control.

Renal function parameters (mg%) – The results of renal function parameters like blood urea, serum creatinine and uric acid showed that the HEO significantly reduced the blood urea level in group3 rats as compared to normal control but serum creatinine and uric acid were marginally reduced.

Histopathology of Pancreas -

In normal control(NC) the islets of langerhans are normal as the rats are non – diabetic,

in diabetic control (DC) the islets are reduced to scar type as the rats are diabetic but not provided with any treatment.

The diabetic rats provided with the dose of HEO (*Hedychium spicatum* Essential Oil) and GC (glibenclamide) has islets which regained their normal shape after 14 days of treatment.

Zingiberaceae family comprises a group of rhizomatous medicinal and aromatic plants. The genus *Hedychium* is commonly used in the preparation of traditional medicines. According to ethnobotanical studies there are more than 1200 species all around the world with hypoglycaemic potential⁷. Widely used traditional plant for diabetes are from families Cucurbitaceae, Apocynaceae, Anacardiaceae, Myrtaceae, Liliaceae, Asteraceae, Euphorbiaceae and Myrtaceae⁷ etc. Essential oils reported in the literature having antidiabetic potential are of *Syzygium aromaticum*, *Cuminum cyminum*⁸, *Coriandrum sativum*⁹, *indigenous Cinnamomum osmophloeum*¹⁰, *Artemisia sieberi*¹¹, *Foeniculum vulgare*¹², and *Citrus reticulata*¹³ etc. The hypoglycaemic activity of the rhizomes extract is already reported. The extract of rhizomes of *Hedychium spicatum* possess labdane diterpenoids (α -glucosidase inhibitors) that can be used to cure diabetes, cancer and viral infections¹⁴. In the present article, we examined the antidiabetic activity of the essential oil of rhizomes of *Hedychium spicatum*. Alloxan monohydrate was used to induce type 1 diabetes in all the groups except normal control. When administered with oral dose of 0.3 ml of HEO, for 14 days the blood glucose level of the diabetic rats of group 3 was significantly reduced as compared to control. Various renal parameters such as blood urea, serum creatinine and uric acid were also studied as kidney related complications arise in diabetes. The results showed that the blood urea level of diabetic rats provided with HEO was significantly reduced when compared to control. Blood urea is formed as a result of oxidative deamination of amino acids through urea cycle¹⁵. When there is an elevated level of blood urea the condition is known as uremia which is a result of kidney malfunction. The effectiveness of the HEO may be due to the presence of volatile components such as 1,8 cineole, α - pinene,

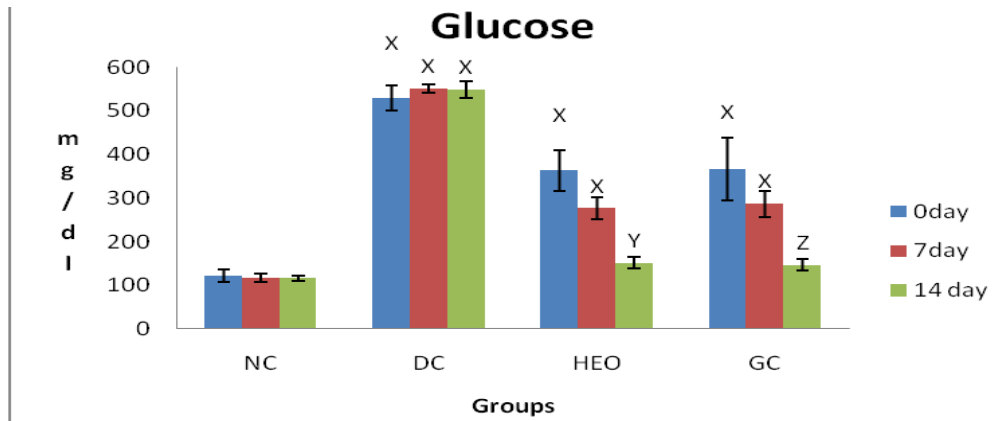


Figure 1: Blood glucose level All values are expressed as mean \pm standard deviation, n=5 (number of rats in each group).

X = $p \leq .001$, Y = $p \leq .01$, Z = $p \leq .05$

(by post hoc analysis when values were compared with control)

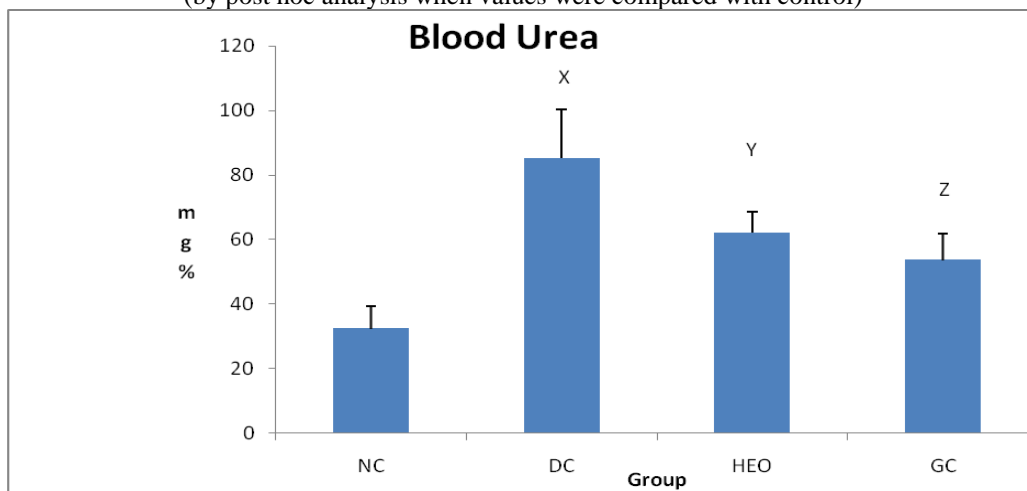


Figure 2: Blood urea level.

All values are expressed as mean \pm standard deviation, n=5 (number of rats in each group)

X = $p \leq .001$, Y = $p \leq .01$, Z = $p \leq .05$ (by post hoc analysis when values are compared with normal control)

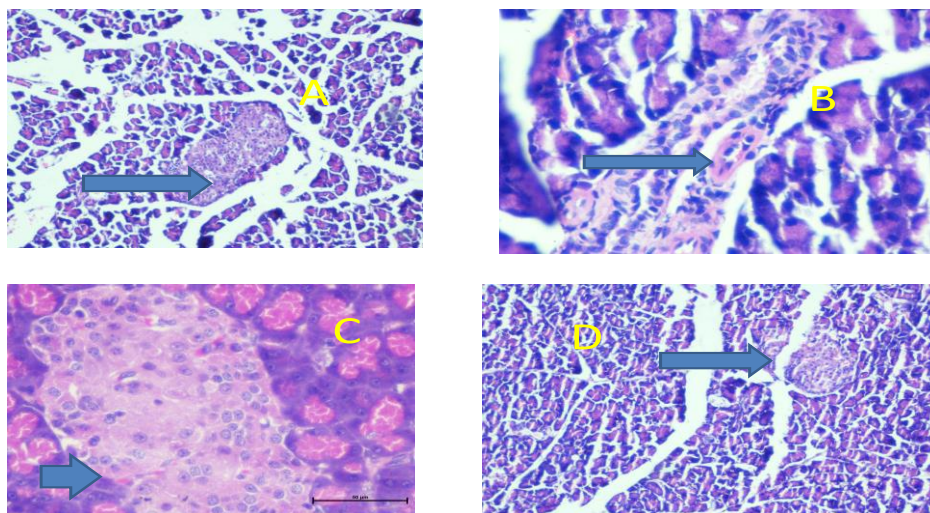


Figure 3: Histopathology of pancreas showing islets of langerhan A) Normal Control (NC) , B) Diabetic Control (DC), C) HEO, D) GC.

linalool etc. Linalool , a monoterpene has antihyperglycemic effect as it reduces the plasma glucose

level and increase the insulin levels¹⁶. It also helps in glucose utilization by cells. In essential oil of *Citrus*

Table 2: Blood glucose (mg/dl).

Groups	0 day	7 day	14 day
Normal Control(NC)	121.3 ± 14.2	117.3 ± 10.0	116.6 ± 6.1
DiabeticControl (DC)	528.6 ± 28.0 X	550.0 ± 10.0 X	548.3 ± 20.2 X
HEO(Essential oil)	363.6 ± 46.6 X	276.6 ± 25.1 X	151.6 ± 12.5 Y
GC(glibenclamide)	366.0 ± 72.3 X	286.6 ± 30.5 X	146.6 ± 12.5 Z

Table 3: Renal function parameters(mg%)-.

Groups	Urea(mg%)	Serum creatinine(mg%)	Uric acid(mg%)
NC(normal control)	32.3 ± 6.3	.80 ± .04	.92 ± .04
DC(Diabetic control)	85.2 ± 15.0 X	.91 ± .03 Y	1.5 ± .39 Y
HEO(Essential oil)	62.1 ± 6.3 Y	.91 ± .02 Y	1.3 ± .11 Z
GC(glibenclamide)	53.5 ± 8.2 Z	.88 ± .02 Z	1.4 ± .14 Y

reticulata there is presence of biflavonoids, sterols, D-limonene and linalool which contribute towards its antidiabetic potential¹³. Hence linalool being secondary metabolite plays an important role in prevention of diabetes. The histopathological study of pancreas was also done for each group shows that in diabetic control, the islets of langerhans was abnormal as the rats of this group were not given any treatment. The rats of group 3 provided with HEO had islets of langerhans which regained its normal shape. As per literature, both 1,8 cineole and α - pinene protects the pancreas from damage^{17,18}. This shows that the pancreatic protective effect of HEO on diabetic rats may be due to α - pinene and 1,8 cineole.

CONCLUSION

On the basis of our results, we conclude that the diabetic rats when provided with oral dose of 0.3ml of HEO their blood glucose level was lowered. The blood urea level also decreased upon ingestion of HEO for 14 days. Besides this, the dose was also effective in protecting the pancreas from abnormalities. Thus, the essential oil of *Hedychium spicatum* possess a great antidiabetic potential which could be used in future to cure type 1 diabetes and might prove as one of the potent herbal medicine.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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