

## THE EFFECT OF *NASTURTIUM OFFICINALE* ON BLOOD GLUCOSE LEVEL IN DIABETIC RATS

Hassan Fallah Hoseini <sup>1</sup>, Ahmad R. Gohari <sup>2</sup>, Soodabeh Saeidnia <sup>2\*</sup>, Naghi Shahabi Majd <sup>3</sup>, Abbass Hadjiakhoondi <sup>2</sup>

1- Department of Pharmacology, Institute of Medicinal Plants ACECR, Tehran , Iran

2- Medicinal Plants Research Center, Tehran University of Medical Sciences, Tehran, Iran, P. O. Box 14155-6451, Tel & Fax: +98-21-64122330, saeidnia\_s@tums.ac.ir

3- Physiology and Pharmacology Department, School of Medicine, Medical Sciences University of Mazandaran, Sari, Iran.

### Summary

In this article, the effect of *Nasturtium officinale* (watercress, belonging to Brassicaceae) extracts on the blood glucose level was evaluated in diabetic rats. After inducing diabetes via streptozotocin injection, the animals were orally received various concentrations of *N. officinale* extracts (ethyl acetate, methanol and aqueous) for short (one week) and long (two months) periods. Only 800 and 1000 mg/kg of the methanol extract of *N. officinale* caused a significant decrease in the blood glucose level after one week treatment. At the end of two months treatment with ethyl acetate extract, the blood glucose level reduced and this reduction was significant statistically in the group, received 100 mg/kg of the extract. The decreasing of blood glucose was comparable with glybenclamide as an anti-diabetic drug. Long period treatment of the animals with methanol and aqueous extracts were not effective.

**Keywords:** *Nasturtium officinale*, Brassicaceae, streptozotocin, blood glucose

### Introduction

*Nasturtium officinale* R. Br. (watercress) is an aquatic herb belonging to Brassicaceae family and frequently found in association with *Veronica anagallis-aquatica*. There is apparently no relation between them except they both prefer the same habitat. *N. officinale*, named Alafe-Cheshmeh in Persian language, has the white flowers (1). *N. officinale* is used to palliate abdominal pain and eaten as a vegetable or salads. This herb is used to treat, bronchitis, and diuresis, as anti-ulcerogenic, in the treatment of scurvy, tuberculosis, influenza, asthma, nutritional supplement and also seems to have antimicrobial and anticarcinogenic (2-5).

*N. officinale*, which contains a glucosinolate named gluconasturtiin, has been traditionally used for treatment of diabetes, an endocrinal chronic disease caused by altered carbohydrate metabolism and characterized by elevated blood glucose levels (6,7). *N. officinale* extracts showed an antioxidant activity via reducing cellular lipid peroxidation, reducing power, free radical and superoxide anion radical scavenging activities (2). Regarding to the potential use of antioxidant treatment in this disease, watercress could be a choice of more investigation for diabetes treatment (8).

The present paper reports the effect of *N. officinale*, which has been used in the Eastern traditional medicine for anti-diabetic activity, on the blood glucose level in streptozotocin diabetic rats.

## Material and methods

### *Plant material*

Aerial parts of *Nasturtium officinale* were collected in April 2008 from southern parts of Qazvin province in Iran during the full flowering stage. A voucher specimen was preserved for further reference at the Herbarium of Institute of Medicinal Plants ACECR, Tehran, Iran.

### *Preparation of the extracts*

Air-dried aerial parts of the plant (3 kg) were cut in to small pieces then powdered and percolated consequently with ethyl acetate, methanol and water. After filtering, the solutions were concentrated under reduced pressure to gain ethyl acetate (63 g), methanol (405 g) and aqueous (930 g) extracts.

### *Animals*

Wistar rats weighting 200-250 g (prepared from Seromsazi-Razi Institute, Iran) were kept in the animal house under standard condition in 12h / 12h light dark cycle ( $23 \pm 3$  °C). The animals received standard pellet diet and water *ad libitum*. Animal handling was performed as per *Good Laboratory Practice*. Research proposal was prepared based on the CPCSEA (Committee for the Purpose of Control and Supervision of Experiments on Animal) and approved by IAEC (Institutional Animal Ethical Committee) of Tehran University of Medical Sciences.

In order to induce the diabetes, the animals were injected by streptozotocin at the dose of 50 mg/kg of the body weight intraperitoneally. Diabetic animals and non-diabetic control group were kept in metabolic cages individually, separately and under feeding and metabolism control. Glucose in the blood of diabetic rats exceeded that of the non-diabetic control ones. Food and water consumption were measured in terms of gram and milliliter respectively. Urine volume was measured in terms of milliliter on a daily basis. Glucose in blood serum was also measured, so that chemical diabetes was verified in rats with fasting blood sugar more than 200 mg/dl (9).

### *Administration of the extracts*

The rats were randomly selected and divided in to several groups of 10-12 in each. The normal group was non diabetic animals. The positive control rats were received glybenclamide 10 mg/kg/day. Other groups were treated orally (via gavage) the different doses of the methanol and aqueous extracts (10, 50, 100, 200, 400, 600, 800 and 1000 mg/kg) and ethyl acetate extract (5, 10, 50, 100 and 200 mg/kg) for short (one week) and long (8 weeks) period study. In all animals, blood glucose was measured.

### *Statistical analysis*

The data were expressed as Mean  $\pm$  SD. One-way ANOVA was used for comparison of the data followed by Duncan's Multiple Range Test and P values less than 0.05 were considered significant.

### Results

In this study, we evaluated the effect of the watercress extracts on the blood glucose of the diabetic rats. The results of short period (one week) consumption of watercress ethyl acetate, methanol and aqueous extracts have been summarized in the tables 1-3. Also, the results of two months study on the ethyl acetate extract have been shown in table 4.

**Table 1.** Blood glucose evaluation of the short period treated rats with ethyl acetate extract of *Nasturtium officinale* compared to control.

Groups	N	Blood glucose (Mean)	Standard Deviation
control	10	275.7000	122.44913
5 mg/kg	10	296.6000	167.31288
10 mg/kg	10	278.3000	86.37650
50 mg/kg	10	254.0000	122.84227
100 mg/kg	10	255.2000	119.63909
200 mg/kg	10	198.0000	69.02978

\* The mean difference is significant at the 0.05 level ( $P < 0.05$ );  
Control: The diabetic rats which received no drug or treatment;  
Treated rats: The diabetic rats which received different doses of the ethyl acetate extract of *N. officinale*.

**Table2.** Blood glucose evaluation of the short period treated rats with methanol extract of *Nasturtium officinale* compared to control.

Groups	N	Blood glucose (Mean)	Standard Deviation
control	12	266.5000	116.76044
10 mg/kg	10	167.3000	36.43884
50 mg/kg	10	179.8000	43.38151
100 mg/kg	6	210.0000	112.05713
200 mg/kg	10	165.8000	49.42289
400 mg/kg	10	144.8000	129.05021
600 mg/kg	10	145.8000	66.59963
800 mg/kg	10	132.5000 *	36.63408
1000 mg/kg	10	125.5000 *	31.08501

\* The mean difference is significant at the 0.05 level ( $P < 0.05$ );  
Control: The diabetic rats which received no drug or treatment;  
Treated rats: The diabetic rats which received different doses of the methanol extract of *N. officinale*.

**Table 3.** Blood glucose evaluation of the short period treated rats with aqueous extract of *Nasturtium officinale* compared to control.

Groups	N	Blood glucose (Mean)	Standard Deviation
control	10	185.4000	75.46773
10 mg/kg	10	176.2000	48.12668
50 mg/kg	10	166.0000	63.51378
100 mg/kg	10	179.5000	41.29366
200 mg/kg	10	175.9000	45.84382
400 mg/kg	10	155.2000	48.51071
600 mg/kg	10	142.9000	28.25853
800 mg/kg	10	179.6000	56.81197
1000 mg/kg	10	173.3000	52.46597

\* The mean difference is significant at the 0.05 level ( $P < 0.05$ ); Control: The diabetic rats which received no drug or treatment; Treated rats: The diabetic rats which received different doses of the aqueous extract of *N. officinale*.

**Table 4.** Blood glucose evaluation of the long period (2 month) treated rats with ethyl acetate extract of *Nasturtium officinale* compared to control.

	Groups	N	Blood glucose (Mean)	Standard Deviation
In the beginning of treatment	Control	12	266.5000	116.76044
	Glybenclamide	10	250.7000	130.46247
	50 mg/kg	9	264.4444	125.49613
	100 mg/kg	10	255.2000	119.63909
	200 mg/kg	10	198.0000	69.02978
After 2 month treatment	Control	12	269.0000	158.80577
	Glybenclamide	10	141.4000 *	57.31783
	50 mg/kg	9	160.5556	80.59174
	100 mg/kg	10	142.5000 *	35.55668
	200 mg/kg	10	183.0000	57.31783

\* The mean difference is significant at the 0.05 level ( $P < 0.05$ ); Control: The diabetic rats which received no drug or treatment; Treated rats: The diabetic rats which received different doses of the *Morus nigra* extract.

### Discussion

Diabetes mellitus is an important chronic disease related to serious complications. Research documents have suggested that enhanced oxidation is responsible for some of the complications of diabetes. The information about the benefit of antioxidants, vitamins and supplementations is conflicting because some trials have demonstrated adverse effects of excessive consumption of vitamin supplements (10).

*Nasturtium officinale*, which has been used in folk medicine by the people of south eastern region of Iran, has a high hypolipidaemic activity and this may be attributed to its antioxidative potential (11). Based on unpublished data, the aqueous extract of this plant could reduce the plasma glucose level. There fore, in this article we examined the effect of several extracts of *N. officinale* on the blood glucose level in the streptozotocin diabetic rats. Streptozotocin or streptozocin is an antibiotic which cause pancreatic  $\beta$ -cell destruction and widely used for inducing insulin-dependent diabetes mellitus in the animal models. (12).

As it can be seen in the table 1 and 3 regarding to short period study, none of the doses of ethyl acetate and aqueous extracts for *N. officinale* caused a significant reduction in the plasma glucose level compare to control. Only 800 and 1000 mg/kg of the methanol extract of *N. officinale* caused a significant decrease in the blood glucose level (see table 2). The data of the long period investigation (2 months) were not significant for methanol and aqueous extracts. When two months treatment of the diabetic rats with ethyl acetate extract was carried out, the blood glucose reduced and this reduction was significant in the group, received 100 mg/kg of the extract. The decreasing of blood glucose is comparable with glybenclamide as a well-known anti-diabetic drug.

In conclusion, it seems that the *N. officinale* (watercress) is a potential source of anti-hyperglycemic compounds and we suggest continuing the phytochemical study to find out its pharmacologically active component(s).

### Acknowledgments

This research has been supported by Tehran University of Medical Sciences and Health Services grant (No.6626).

### References

1. [http://www.wnmu.edu/academic/nspages2/gilaflo/nasturtium\\_officinale.html](http://www.wnmu.edu/academic/nspages2/gilaflo/nasturtium_officinale.html)
2. Ozen T, Investigation of antioxidant properties of *Nasturtium officinale* (watercress) leaf extracts. Acta Polon Pharm- Drug Res 2009; 66: 187-193.
3. Palaniswamy UR, McAvoy RJ, Bible BB, Stuart JD. Ontogenic variations of ascorbic acid and phenathyl isothiocyanate concentration in watercress (*Nasturtium officinale* R. Br) leaves. J Agric Food Chem 2003; 51: 5504-5509.

4. Chen L, Mohr SN, Yang CS. Decrease of plasma and urinary oxidative metabolites of acetaminophen after consumption of watercress by human volunteers. *Clin Pharm Ther* 1996; 60: 651-660.
5. Mozaffarian V. A Dictionary of Iranian Plant Names. Tehran, Farhang Moaser Publication, 1996: 422.
6. Engelen-Eigles G, Holden G, Cohen JD, Gardner G. The effect of temperature, photoperiod, and light quality on gluconasturtiin concentration in watercress (*Nasturtium officinale* R. Br.). *J Agric Food Chem* 2006; 54: 328-334.
7. Zargari A. Medicinal Plants. 4th edn., Vol. 1, Tehran, Tehran University Publication, 1985: 198-201.
8. Schultz Johansen J, Harris A, Rychly DJ, Ergul A. Oxidative stress and the use of antioxidants in diabetes: Linking basic science to clinical practice. *Cardiovasc Diabetol* 2005; 4: 5.
9. Karunanayake EH, Hearse D J, Mellows G. The metabolic fate and elimination of streptozocin. *Biochem Soc Trans* 1975; 3: 410-14.
10. Hasanain B and Mooradian AD. Antioxidant vitamins and their influence in diabetes mellitus. *Curr Diabetes Rep* 2002; 2: 1534-4827.
11. Yazdanparast R, Bahramikia S, Ardestani A. *Nasturtium officinale* reduces oxidative stress and enhances antioxidant capacity in hypercholesterolaemic rats. *Chem Biol Interact* 2008; 172: 176–184.
12. Kenneth KW, Youming H. Streptozotocin Induced Diabetic Models in Mice and Rats. *Current Protocols in Pharmacology* 2008, DOI: 10.1002/0471141755.ph0547s40.