ISSN (Print 0974-2115) (Online 2349-8552)
www.jchps.com Journal of Chemical and Pharmaceutical Sciences

Effects of Nigella sativa and Metformin on HbA1C, Glucose tolerance and Lipid Profile of Diabetic Rats

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ABSTRACT

The purpose of this study was to determine the effects of Nigella sativa and Metformin in normal and streptozotocin-induced diabetic rats. METHOD: 50 male albino rats weighing between 200 and 240 gm were included in this study. They were equally divided into 5 groups as following; Group (1) control normal rats. Group (2) streptozotocin 60 mg/kg body weight -induced diabetic rats. Group (3) diabetic rats treated with Metformin 8.5 mg/kg IP. Group (4) diabetic rats treated with Nigella sativa oil 0.5 ml/kg IP and group (5) diabetic rats treated with aqueous extract of Nigella sativa 3 mL/kg IP. The sugar level, glucose tolerance test, HbA1C and lipid profile were investigated in plasma of normal and streptozotocin-induced diabetic rats before and after administration of Nigella sativa and Metformin. RESULTS: Showed significant hypoglycemic effect after administration of Nigella sativa oil more than aqueous extract of Nigella sativa and Metformin in glucose tolerance test. The administration of Nigella sativa oil for one month showed a decrease by 13% in sugar level, 10% in HbA1C, 20% in total cholesterol, 17% triglycerides, and by 18% in LDL- cholesterol. While diabetic rats treated with aqueous extract of Nigella sativa showed a decrease by 10% in sugar level, 7% in HbA1C, 14% in total cholesterol, 18% in triglycerides, and by 12% in LDL-cholesterol. Also, metformin group showed a decrease by 17% in sugar level, 8% HbA1C, 10% in total cholesterol, 22% triglycerides, and by 8% in LDL-cholesterol. CONCLUSIONS: The findings of this study indicate that the administration of Nigella sativa resulted in a significant hypoglycemic effect and reduce lipid profile in diabetic rats.

KEY WORDS: Nigella sativa, glucose tolerance test, lipid profile, and HbA1C.

1. INTRODUCTION

Diabetes is a common disease in the word and its prevalence rate increase rapidly (Zar, 2016). IDF estimates that in 2015, there is 415 million global population was suffering from Diabetes mellitus and the number of Diabetic patients is going to increase 642 m by 2040 (Jaya, 2017). Nigella sativa, widely known as black seeds contain wide variety of functional chemical substances (Dinagaran, 2016). Dyslipidemia is an important risk factor responsible for cardiovascular disease in patients with diabetes (Qidwai and Ashfaq, 2014). Medical plants are more affordable and have less side effects compared synthetic drugs, and are more effective in treatment of diabetes mellitus (Kooti, 2016). Nigella sativa is a potential protective natural agent against atherosclerosis and cardiovascular complications in patients with type 2 diabetes (Kaatabi, 2012). Long term supplementation with N. sativa improved glucose homeostasis and enhanced antioxidant defense system in type 2 diabetic patients treated with oral hypoglycemic drugs (Zahra, 2016). N. sativa supplementation reduced systolic blood pressure, diastolic blood pressure, mean arterial pressure, and heart rate (Lebda, 2012) and caused significant reductions in fasting blood glucose, blood glucose level 2 hours postprandially and glycosylated hemoglobin in patients with type 2 diabetes without changing their body weight (Bamosa, 2010). Lipid peroxidation in plasma or liver decreased with Nigella suggesting potential in diseases in which free radical damage play a pathogenical role (Hasani-Ranjbar, 2009; Abdul Latiff, 2014) suggested that treatment with N. sativa improved lipid profile and blood glucose of perimenopausal women. Bamosa (2015) suggested that N. sativa supplementation might protect the hearts of type 2 diabetic patients from diastolic dysfunction. A polyherbal mixture containing N. sativa showed beneficial effects on blood glucose and lipid profile in streptozotocin-induced diabetic rats and it had the potential to be used as a dietary supplement for the management of diabetes (Ghorbani, 2013).

2. MATERIAL AND METHODS

Experimental Rats: 50 male albino rats weighing between 200 and 240 gm at the animal house of department of Medical Technology, Alahlia Amman University, Jordan. Animals were weighed and tagged, kept in separate stainless steel cages at normal temperature, 12 hour dark-light cycle and they were fed with normal commercial chow and water ad libitum. Throughout the experiments, animals were processed according to the suggested international ethical guidelines for the care of laboratory animals and all experimental procedures were approved by the Animal Care and Use Committee of University accordance with the Declaration of Helsinki.

The experimental animals were fasted for 12 hours and then diabetes was induced by a single intra peritoneal injection of streptozotocin, dissolved in a freshly prepared physiological saline solution (0.9% NaCl) at a dose of 45 mg/kg body weight. A drop of blood was taken from their tails before and after they have been diabetic. Blood

glucose was measured after three days of streptozotocin injection by using Glucometer. Animals distributed randomly into five groups (10 rats in each group), as following:

Group 1- Normal healthy rats

Group 2- diabetic rats without treatment

Group 3- diabetic rats treated with Metformin 8.5 mg/kg IP once a day

Group 4- Diabetic rats treated with Nigella sativa oil 0.5 ml/kg IP once a day

Group 5- Diabetic rats treated with Aqueous extract of Nigella sativa 3 mL/kg IP once a day

Biochemical analysis: The following analyses were carried out: Glucose, Cholesterol, Triglycerides, Low and high density lipoprotein using kits from Syrbio, France. Oral glucose tolerance test (OGTT) done by recorded FBG as 0min, without delay, glucose solution (2gm/kg body weight) was administered to all groups orally also Nigella sativa oil, Aqueous and metformin. After were administered orally to respective groups. The blood glucose level was measured at zero min, 60 min, 120 min and 180 min by using Glucometer and HbA1c measured by using iqroma kits.

Statistical analysis: Statistical analysis was done utilizing the computer data processing (SPSS, version 18). A probability value (P) of <0.05 was considered statistically significant.

3. RESULTS

A comparison of the effects of Nigella sativa extracts on the mean Glucose tolerance test during the study is shown in Table.1. Statistically significant difference was observed in the group (4) Diabetic rats treated with Nigella sativa oil 0.5 ml/kg IP once a day and other group (5) Diabetic rats treated with Aqueous extract of Nigella sativa 3 mL/kg IP once a day

Table.1. Effect of Nigella sativa and Metformin on blood glucose tolerance test in diabetic rats

Groups	FBG at zero time Mean± SD(mg/dl)	After 1 hour Mean± SD(mg/dl)	After 2 hours Mean± SD(mg/dl)	After 3 hours Mean± SD(mg/dl)
Group 1	112± 7.6	203± 13.5	135.3 ± 11.3	105.2 ± 21.5
Group 2	404 ± 23.1	611.2 ± 12.2	624.4 ± 26.1	644.7 ± 36.4
Group 3	414 ± 43.8	634.1± 24.5	543 ± 15.7	500 ± 13.2
Group 4	419 ± 13.8	587.2 ± 17.7	445 ± 24.5	433 ± 30.8*
Group 5	447 ± 33.6	621.2 ± 13.5	500 ± 19.3	474 ± 20.9*

* Significant at P <0.05

Table.2, shows the effect of Nigella sativa extract and Metformin drugs on HbA1C test after one month treatment in diabetic rats and normal rats there was no significant difference in group 1 and group 2 while there are significant in the other groups.

Table.2. Effect of one month treatment with Nigella sativa and Metformin on HbA1C test in diabetic rats

Groups	1st reading of HbA1C Mean± SD (%)	After 2 months reading of HbA1C Mean± SD (%)
Group 1	5.7±0.3%	5.8±0.7%
Group 2	8.7±1.4%	9.2±1.3%
Group 3	8.5±1.3%	7.1±1.5%*
Group 4	8.3±1.5%	6.5±0.6%*
Group 5	8.1±1.3%	6.9±0.8%*

* Significant at P <0.05

Table.3, shows the effect of Nigella sativa oil, Nigella sativa aqueous extract and Metformin drugs after one month treatment on Lipids profile in diabetic rats. When administration of Nigella sativa oil for one month showed a decrease by 13% in sugar level, 20% in total cholesterol, 17% triglycerides, and by 18% in LDL- cholesterol. While diabetic rats treated with aqueous extract of Nigella sativa showed a decrease by 10% in sugar level, 14% in total cholesterol, 18% in triglycerides, and by 12% in LDL-cholesterol. Also, metformin group showed a decrease by 17% in sugar level, 10% in total cholesterol, 22% triglycerides, and by 8% in LDL-cholesterol.

Table.3. Effect of Nigella sativa Oil, Aqueous and Metformin on Lipid Profile in diabetic rats after one month treatment

Groups		Cholesterol mmol/L	Triglycerides mmol/L	LDL mmol/L
Group 3 Metformin	Before	7.17	3.2±0.29	4.21 ± 0.8
	After	6.45*	2.49*	3.87
Group 4 Nigella sativa oil	Before	6.80	3.91±0.20	4.18 ± 0.6
	After	5.44*	3.23*	3.42*
Group 5 Aqueous N. sativa	Before	6.97	3.08±0.32	3.91 ± 0.1
	After	5.99*	2.52*	3.44*

* Significant at P <0.05

DISCUSSION

The results showed significant hypoglycemic effect after administration of Nigella sativa oil more than aqueous extract of Nigella sativa and Metformin in glucose tolerance test, agree with Meddah (2009), daily consumption of 2 mg/kg N.sativa for 6 weeks improved glucose tolerance, inhibition of intestinal glucose absorption. N.sativa has various pharmacological effects such as reduction of inflammatory, antioxidant reducing glucose and lipid, it also can improve insulin secretion by maintain the beta cells and reduced insulin resistance which results in control of blood glucose and diabetes (Hadi, 2016). Many studies have confirmed the results of my study Ikram F and Hussain 2014 found that two weeks daily consumption of 100 mg/kg N.sativa decrease the glucose levels, LDL, VLDL and TG of alloxan induced diabetic rabbits. Anthor study by Al-Logmani and Zari in 2009 adding 5% N.sativa oil to the diets of diabetic rats resulted a significant reduction in glucose levels, LDL, VLDL and TG. in my study adminstration of N.sativa oil, Aqueous *N. sativa* and Metformin drug for one month significantly reduced the HbA1c these result approved by Heshmatia (2015) founded that 12 weeks daily consumption of 3grams N.sativa oil significantly decreased fasting glucose and HbA1c in type 2 diabetic patients.

Use of Metformin decreased glucose level and prevented kidney damage by improved kidney function significantly which was indicated by decrease in serum creatinine and urea Zhang (2017). Results of treated group of our study regarding reduction in glucose and HbA1c levels are in conformity with the study conducted by (Zhang, 2017).

4. CONCLUSIONS

Hypoglycemic effect after administration of Nigella sativa oil more than aqueous extract of Nigella sativa and Metformin in glucose tolerance test, HbA1C test and hypolipidemic in the diabetic rats.

Conflict Of Interest: The author declare that there is no conflict of interests

5. ACKNOWLEDGMENTS

The author is grateful to the Alquds laboratory for their efforts.

REFERENCES

Abdul Latiff L, Parhizkar S, Dollah MA, Syed Hassan ST, Alternative supplement for enhancement of reproductive health and metabolic profile among perimenopausal women, a novel role of Nigella sativa, Iran J Basic Med Sci, 17, 2014, 980-985.

Al-Logmani AS, Zari TA, Effects of Nigella Sativa L and Cinnamomum Zeylanicum Blume Oils on some Physiological Parameters in Streptozotocininduced Diabetic Rats. Bol Latinoam Caribe Plant Med Aromat, 8, 200, 86-96.

Bamosa A, Kaatabi H, Badar A, Al‐Khadra A, Al Elq A, Abou‐Hozaifa B, Lebda F and Al‐Almaie S, Nigella sativa, A potential natural protective agent against cardiac dysfunction in patients with type 2 diabetes mellitus, Journal of Family and Community Medicine, 22, 2, 2015, 88-95.

Bamosa A.O, Kaatabi H, Lebda F.M, Al Elq A and Al-Sultan A, Effect of Nigella sativa Seeds on the Glycemic Control of Patients with Type 2 Diabetes Mellitus, Indian J PhysiolPharmacol, 54, 4, 2010, 344–354.

Dinagaran S, Sridhar S, Eganathan P, Chemical composition and antioxidant activities of black seed oil (nigella sativa l.). ijpsr, 7 (11), 2016, 4473-4479.

Ghorbani A, Shafiee-Nick R, Rakhshandeh H, Borji A, Antihyperlipidemic Effect of a Polyherbal Mixture in Streptozotocin-Induced Diabetic Rats, Journal of Lipids, 2013, 1-6.

Hadi S, Mirmiran P, Hadi V, Hosseinpour-Niazi S, Emamat S.M. Effects of Nigella Sativa on Cardiovascular Risk Factors. Mazandaran Med Sci Uni J, 134, 2016, 430-42.

Hasani-Ranjbar S, Larijani B, Abdollah M, A Systematic Review of the Potential Herbal Sources of Future Drugs Effective in Oxidant-Related Diseases, Inflammation & Allergy - Drug Targets, 8, 2009, 2-10.

Heshmatia J, Namazib N, Memarzadehc M, Taghizadehc M, Kolahdoozd F, Nigella Sativa Oil Affects Glucose Metabolism and Lipid Concentrations in Patients with Type 2 Diabetes, A Randomized, Double-blind, Placebo-controlled Trial, Food Res Int J, 70, 2015, 87-93.

Ikram F, Hussain F, Antidiabeti Efficacy of Nigella Sativa L in Alloxan- induced Diabetic Rabbits, JMJM, 13, 2014, 12-17.

Jaya Prasad Tripathy J.S, Thakur Email author, Gursimer Jeet, Sohan Chawla, Sanjay Jain, Arnab Pal, Rajendra Prasad and Rajiv Saran, Prevalence and risk factors of diabetes in a large community-based study in North India, results from a STEPS survey in Punjab, Diabetology & Metabolic Syndrome, 9 (8), 2017.

Kaatabi H, Bamosa A.O, Lebda F.M, Al Elq A.H, Al-Sultan A.I, Favorable impact of Nigella sativa seeds on lipid profile in type 2 diabetic patients, Journal of Family and Community Medicine, 19 (3), 2012, 155-161.

Kooti W, Farokhipour M, Asadzadeh Z, Ashtary-Larky D and Asadi-Samani M, The role of medicinal plants in the treatment of diabetes, a systematic review, Electronic Physician, 8 (1), 2016, 1832-1842.

Lebda F.M, Bamosa A.O, Kaatabi H, Al Elq A and Al-Sultan A, Effect of Nigella sativa on hemodynamics, hemoglobin and blood coagulation in patients with type 2 diabetes. Egyptian Journal of Haematology, 37 (2), 2012, 73-80.

Meddah B, Ducroc R, El Abbes Faouzi M, Eto B, Mahraoui L, Benhaddou-Andaloussi A, Nigella Sativa Inhibits Intestinal Glucose Absorption and Improves Glucose Tolerance in Rats, J Ethnopharmacol, 121, 2009, 419-424.

Qidwai W and Ashfaq T, Effect of Dietary Supplementation of Black Seed (N. Sativa L.) on Lipid Profile of Patients Suffering from Diabetes, Anti-Inflammatory & Anti-Allergy Agents in Medicinal Chemistry, 13 (3), 2014, 83- 86.

Zahra Gholamnezhad Shahrzad Havakhah Mohammad Hossein Boskababy, Preclinical and clinical effects of Nigella Sativa and its constituent, thymoquinone, Journal of Ethnopharmacology, 190, 2016, 372-386.

Zar A, Hoseini A, Ahmadi F, Rezaei M, Effects of Ginger with Swimming Training on Blood Fat Profiles in Adult Diabetic Rats with Streptozotocin. Iranian J Nutr Scie Food Tech, 11, 2016, 65-74.

Zhang S, Xu H, Yu X, Wu Y & Sui D, Metformin ameliorates diabetic nephropathy in a rat model of low-dose streptozotocin, induced, diabetes. Experimental and Therapeutic Medicine, 14 (1), 2017, 383–390.