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Protective Effects of *Nigella sativa* on Metabolic Syndrome in Menopausal Women

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ABSTRACT

***Purpose*:** This study was conducted in menopausal women to determine the metabolic impact of *Nigella sativa.*

***Methods*:** Thirty subjects who were menopausal women within the age limit of 45-60 were participated in this study and randomly allotted into two experimental groups. The treatment group was orally administered with *N. sativa* seeds powder in the form of capsules at a dose of 1g per day after breakfast for period of two months and compared to control group given placebo. Anthropometric and biochemical parameters were measured at baseline, 1st month, 2nd month and a month after treatment completed to determine their body weight, serum lipid profile and fasting blood glucose (FBG).

Results: The treatment group showed slight reduction with no significant difference in body weight changes of the respondents. However, significant (p<0.05) improvement was observed in total cholesterol (TC), triglycerides (TG), low density lipoprotein cholesterol (LDL-C), high density lipoprotein cholesterol (HDL-C), and blood glucose (p<0.05).

Conclusion: These results suggested that treatment with *N. sativa* exert a protective effect by improving lipid profile and blood glucose which are in higher risk to be elevated during menopausal period.

Introduction

Menopause is an important physiological event, with the cessation of menstruation indicating the end of a woman's reproductive lifespan.[1] Menopause is associated with a fall in estrogen levels which accompanied with many health changes. Changes in the hormone levels at menopause, in particular estrogen deficiency are associated with an increase in body fat.[2] Additionally, it sounds an alarm for women's health since it leads to elevated blood pressure, insulin resistance and dyslipidemia.[3] These changes may contribute to increased risks of metabolic syndrome (MetS) in menopause women. The features of the metabolic syndrome include the accumulation of visceral (abdominal) adiposity, insulin resistance, hypertension, and dyslipidemia (hypertriglyceridemia, reduced high density lipoprotein (HDL), and small dense LDL particles based on a set of diagnostic criteria suggested by National Cholesterol Education Program Adult Treatment Panel III (NCEP-ATP III).[4] To date, several previous studies found significant difference in prevalence of MetS among pre- and postmenopausal women.[5-8] The prevalence of MetS in menopausal women was found to be 36.7% in one of the states, Kelantan in Malaysia.[9]

Nowadays there is an increased demand for using plants in therapy instead of using synthetic drugs which may have adverse effects. Traditional medicinal plants are often cheaper, locally available, and easily consumable (raw or as simple medicinal preparations). The seeds of Nigella sativa (*N. sativa*) plant have been used to promote health and fight disease for centuries especially in the Middle East and Southeast Asia.[10]

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Locally, it is called Habattus Sauda and referred as Black cumin in English. This plant has been a great focus of research and has several traditional uses and consequently has been extensively studied for its chemical constituents and biological activities. A lot of studies have been done to determine the various activities of *N. sativa* on different components of the metabolic syndrome for example blood sugar, lipid profile, hypertension and etc.[11,12] In spite of large number of pharmacological studies carried out worldwide on *N. sativa* seeds, only few experimental studies have been done in menopausal women especially in Malaysia. Moreover, many Malaysian women were consuming *N. sativa* in the form of coffee mix, oil products as a source of supplement which they believe can help to boost energy level. However, not many aware neither the actual benefits nor toxicity effect of those *N. sativa* products. Previous studies on the various effect of *N. sativa* in individuals have been performed on a heterogeneous population and only limited data are available for the effect of *N. sativa* on metabolic syndrome in menopausal women. Thus, this study was undertaken with the aim to know the adjuvant effect of *N. sativa* on clinical and biochemical parameters of the metabolic syndrome in menopausal women in Klang Valley, Malaysia.

Materials and Methods

Plant materials

N. sativa seeds samples imported from three different countries like Iran, India and Yemen were purchased through a local company named Sari Tani Desa SDN. BHD located in Shah Alam, Malaysia which has health accreditation from Ministry of Health, Malaysia. The seeds were identified and authenticated by Professor Dr. Maznah Ismail, Head of the Laboratory of Molecular Biomedicine, Institute of Bioscience, Universiti Putra Malaysia and the voucher specimens of the seeds were kept there. The identified seeds were analyzed for its thymoquinone (active compound) content and among the seeds that contained high thymoquinone were sent back to the company for cleaning and capsulation process according to Good Manufacturing Practices (GMP). The *N. sativa* seeds were crushed into fine powder and capsulated at a dose of 500mg per capsule and further bottled with an amount of 60 capsules per bottle. The bottles then were sealed and kept under room temperature until further use.

Study Subjects

Ethical clearance for this study was reviewed and approved by the Faculty of Medicine and Health Sciences Medical Research Ethics Committee, Universiti Putra Malaysia. Respondents for the study were selected based on the inclusion and exclusion criteria to ensure the accurately associated factors of metabolic syndrome. The inclusion criteria were women aged 45-60, menopause for a period≥12 months since the last regular menstruation, presenting one or more features of the MetS based on the NCEP-ATP III definition. The exclusion criteria were women having endocrine or other chronic diseases, taking medication for chronic diseases, herbal or supplementation.

Experimental design

The respondents were randomly allotted into two experimental groups. A co-investigator was selected to create subject identification numbers to assign respondents into the groups. A total of 18 respondents were assigned to *N. sativa* group and 17 respondents to placebo group. After a 2-two week's washout period, the respondents received the alternative treatment for 2 months. Capsules of *N. sativa* powder were orally administered at a dose of 1g after breakfast every day for period of two months. A follow- up assessment a month later has been done after the subjects completed the two months treatment. The physical and pathological histories of these subjects were recorded. All subjects requested to maintain their regular lifestyles including their dietary intake and physical activity during the intervention period. Venous blood was drawn from the subjects before and after treatment for further analysis on the effects of *N. sativa*.

Biochemical analysis

Whole blood was collected in plain tube and further centrifuged at 2500rpm for 15min under 25 °C. Serum was collected in order to run the analysis of TC, TG, HDL-C and LDL-C levels, and FBG using commercial diagnostic kits (Randox Laboratories Limited, UK) on *Selectra XL* chemical analyzer (Vital Scientific, Netherlands)

Statistical analysis

All experimental values are presented as means ± standard deviation (SD). Statistical analysis was performed using SPSS windows program version 18 (SPSS Institute, Inc., Chicago, IL, USA). The One-way Analysis of Variance (ANOVA) with Bonferroni correction was used for analysis of data. Difference was considered to be significant if the probability value was less than 0.05 ($p<0.05$).

Results

Body weight

Over the period of treatment, the body weight of *N. sativa* group reduced slightly 0.32% compare to baseline (Figure 1). The body weight of placebo group had no changes. Supplementation with *N. sativa* for eight weeks tended to reduce the body weight of *N. sativa* groups as compared to control group, however no significant reduction was noticed, ($p>0.05$). To be noted, a month after treatment ends body weight of *N. sativa* group showed significant increase ($p<0.05$).

Fasting blood glucose

Supplementation of *N. sativa* for eight weeks was able to reduce fasting blood glucose significantly ($p<0.05$)

by 9.271% at the end of treatment. In contrast, placebo groups showed an elevation in blood glucose, where it increased significantly by 3.796% (p<0.05) over the period of treatment (Figure 2).

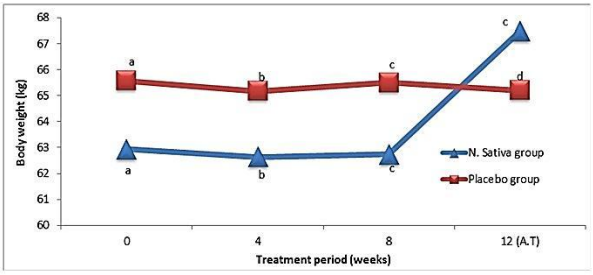

Figure 1. Treatment effect of *N. sativa* and placebo on body weight (kg). Values are expressed as mean ± SD. Same and different lower case letters indicates significant and no significant difference within group, respectively. A.T= one month after treatment ends

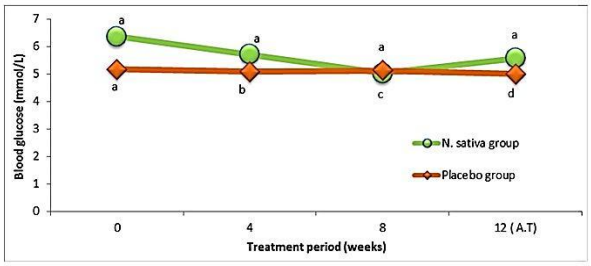

Figure 2. Treatment effect of *N. sativa* and placebo on FBG level (mmol/L). Values are expressed as mean ± SD. Same and different lower case letters indicates significant and no significant difference within group, respectively. A.T= one month after treatment ends

Lipid profile

The sequential changes in serum TC, TG, LDL-C and HDL-C are summarized in Table 1. *N. sativa* supplementations for eight weeks in menopausal women significantly improved TC, TG and LDL-C which was reduced significantly by 9.52%, 35.10% and 26.60%, respectively. HDL-C levels were increased by 8.13% at the end of treatments; however no significant effect was observed (p > 0.05). Whereas, in placebo groups, serum TC and LDL-C were found to decreased significantly (p<0.05) by 4.36% and 10.02%, respectively. HDL-C was reduced by 2.25% at the end of treatment with no significant difference (p<0.05). In contrast, TG was increased by 9.15% at the end of treatment without significant difference (p<0.05).

Discussion

The present study was designed to investigate the effect of *N. sativa* on some of the MetS parameters such as body weight, lipid profile and blood glucose level. It is well documented menopause often contribute to increase in body weight due to hormonal changes. Fat substitution in different tissues (fat accumulation in visceral tissues) with menopausal transition due to decrease in estrogen secretion is one of the theories about the high prevalence of MetS in menopause women.[13] In this study, body weight of the respondents in *N. sativa* group showed slight reduction compared to placebo group throughout the two months of treatment however, not significant reduction was noticed (p>0.05). In the same way from another study, body weight was observed to reduce more in *N. sativa* group as compared to the standard group but the difference was not significant.[14] The metabolic pathway of the effect of *N. sativa* on weight reduction is yet to be explored and further studies are needed.

Table 1. Treatment effect of *N. sativa* and placebo on lipid profile changes. Values are expressed as mean ± SD. Same and different lower case letters (abcd) indicates significant and no significant difference within group, respectively. Same and different uppercase letters (AB) indicate significant difference between the groups by weeks, p<0.05.

Parameters	Weeks	*Nigella sativa*	Placebo
TC	0	6.027 ± 1.045aA	1.053 ± 6.057aB
	4	5.613 ± 0.971aA	0.796 ± 5.880bA
	8	5.453 ± 1.014aA	0.702 ± 5.793cA
	12	5.973 ± 0.830aA	0.498 ± 5.873dB
TG	0	0.357 ± 1.510aA	0.483 ± 1.497aB
	4	0.320 ± 1.000aA	0.369 ± 1.207bB
	8	0.370 ± 0.980aA	0.398 ± 1.360cA
	12	0.577 ± 1.187bA	0.568 ± 1.393dA
LDL-C	0	0.925 ± 4.647aA	0.597 ± 4.827aB
	4	0.863 ± 3.890bA	0.655 ± 4.553bA
	8	0.784 ± 3.413bA	0.606 ± 4.343bA
	12	0.836 ± 4.037bA	0.284 ± 4.393cB
HDL-C	0	0.258 ± 1.575aA	0.281 ±1.357aA
	4	0.355 ± 1.620bA	0.207 ± 1.347bA
	8	0.330 ± 1.703bA	0.255 ± 1.327cA
	12	0.253 ± 1.487bA	0.275 ± 1.353dB

The results showed significant decrease in the development of hyperlipidemia among menopausal women in *N. sativa* treatment group compared to placebo group. This result was comparable with a study on oral administration of *N. sativa* seeds powder at a dose of 500 mg/ daily along with statin for 180 days had improved lipid profile in patients who's having stable coronary artery disease in Multan, Pakistan. That study demonstrated the TC, LDL-C and triglycerides decreased by 14.58%, 23.0% and 15.16% respectively whereas HDL-C increased 3.18% significantly when compared with control group taking statin only.[15] Another study showed positive impact (p<0.05) of 2 g powdered *N. sativa* seeds intake daily for 4 weeks on lipid profile of hypercholesterolemic patients in Isfahan city, Iran. The study reported a significant decrease in the concentration of TC (4.78%), LDL-C (7.6%) and

TG (16.65%) compared to control group receiving wheat powder.[16]

The possible mechanisms of hypolipidemic action of *N. sativa* as suggested from previous study were most probably due to an up-regulation of LDL-C molecules through receptor mediated endocytosis. The endocytosed membrane vesicles fused with lysosomes and in which the apoproteins were degraded and the cholesterol esters were hydrolyzed to yield free cholesterol. The cholesterol was then incorporated into plasma as necessary and excreted from the body.[17] Indeed, lipid lowering activity of *N. sativa* through decreased dietary cholesterol absorption, stimulation of primary bile acid synthesis and its fecal losses were probably contributed from its dietary soluble fibers[18] and sterols.[19] Another mechanism involved probably through non-enzymatic lipid peroxidation by antioxidant properties of *N. sativa* making liver cells more efficient to remove LDL-C from blood by increasing LDL-C receptor densities in liver and binding to apolipoprotein, apo B.[20]

The changes on FBG observed in the present study were similar with a number of clinical studies in patients with diabetes type II. Incorporation of *N. sativa* as add on therapy at a dose of 2 g/day for 12 weeks improves significantly (p<0.001) the blood parameters of glycemia and diabetes control in patients with DM type II.[21] Moreover, fasting blood glucose and HbA1c levels were found to decrease significantly (p = 0.006) from 102.4 + 20.8 to 91.5 + n 12.5 mg/dL in *N. sativa* treated subjects as compared to control group at the end of two months treatment in a randomized control trial conducted in 70 healthy subjects attending general health check up at Bagiatallah Hospital, Iran.[22]

The hypoglycemic effect of *N. sativa* was mediated through multiple pharmacological actions. Study by Al-saif, 2008 and El- Dakhakkhny et al., 2002 reported that glucose lowering effects of *N. sativa* was due to improved insulin insensitivity and extra pancreatic actions of insulin in diabetic rats, respectively.[23,24] Fararh et al., 2005 demonstrated that hepatic glucose production from gluconeogenic precursors (alanine, glycerol and lactate) was significantly lowered in *N. sativa* treated hamsters indicating the hypoglycemic effect of *N. sativa* somehow partly mediated through decreased liver gluconeogenesis in menopausal women.[25] Kaleem et al., 2006 confirmed this anti-diabetic activity of *N. sativa* linking to its antioxidant effects. Thymoquinone, the active constituent of *N. sativa* has been demonstrated to attenuate oxidative stress in streptozotocin-induced diabetic rats through preserving pancreatic β- cell integrity leading to increased insulin levels.[26] *Nigella sativa* was also able to reduce glucose absorption from intestine as evidenced by aqueous extract of *N. sativa* (0.1 pg/ml to 100 ng/ ml) which exerted dose-dependent inhibition of sodium dependent glucose transport across isolated rat jejunum and controlled the activity of SGLT1, a major transporter of glucose in intestine.[27]

As suggested in the previous studies, the effect of *N. sativa* powder on metabolic parameters seem to be on multiple components and the synergistic action of its different constituents including thymoquinone and nigellamine, soluble fiber, sterols, flavanoids and high content of poly-unsaturated fatty acids.[28,29] A study evident the presence of phyto-sterols in amounts of 0.33 to 0.36% which further strengthens the protective effect of *N. sativa* interact with several metabolic pathways of human body.[30]

Conclusion

Nigella sativa has beneficial effects on fasting blood sugar and lipid profile in menopause women suggesting it as one such remedy that may prove beneficial in the future for the prevention and treatment of Mets. Even though there is positive correlation with the intakes of *N. sativa* on MetS but this finding is not enough to consider *N. sativa* as an alternative to drugs. However, it can be taken as complementary supplement in patients having mild or elevated risk of MetS which eventually leads to reduce dependency towards drugs.

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Conflict of Interest

The authors report no conflicts of interest.

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