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**Review Article**

# Therapeutic Comparison of Flaxseed and Black Seed Supplementation for Treatment of Type II Diabetic Patients

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## ABSTRACT

Diabetes is one of the most prevailing global health issues. Genetic factors, obesity, environmental factors, poor dietary habits and sedentary lifestyle are the main causes of its occurrence that leads to hyperglycemia and insulin resistance. In recent years therapeutic effects of dietary flaxseed and blackseeds in the management of diabetes have been studied. Both possess anti-oxidant, anti-hyperglycemic and anti-inflammatory properties. Secoisolariciresinol diglucoside (SDG) is a lignan present in flaxseed that lower the blood glucose level and fiber control insulin secretion and its mechanism of action. Thymoquinone (TQ) is a bioactive component present in flaxseed that controls blood glucose level, and insulin secretion and maintains glucose hemostasis. Both seeds are considered as highly acceptable with a great safety profile in management of type II diabetes. Therefore, this article highlights the therapeutic effects of flaxseed and blackseed supplementation in the management of type II diabetes.

## INTRODUCTION

Around the Globe, Type II Diabetes is the most prevalent metabolic disorder. The two main causes of its occurrence are defects in insulin secretion by pancreatic β-cells or insulin-sensitive tissues that are unable to react to insulin [1]. Non-insulin-dependent diabetes occurs due to the combination of resistance to insulin action or inadequate insulin secretion [2]. Diminished or absence of insulin causes prolonged glucose intolerance and high blood sugar. It is the most ancient disease in human history. From the 14th century it is known as black-death [3]. Diabetes is one of the biggest worldwide general wellbeing concerns, forcing a worldwide weight on general wellbeing as well as financial turn of events. The prevalence of diabetes has expanded in ongoing a very long time in most evolved and emerging nations. In developing and developed countries, the prevalence of diabetes has expanded in last few decades [4]. Prevalence of Diabetes in Pakistan is over 19 million and 17/1% adult population of Pakistan is currently living with Diabetes. On the global scale, 463 million adult population is Diabetic. 90% of which aggregate Type II Diabetes [5].

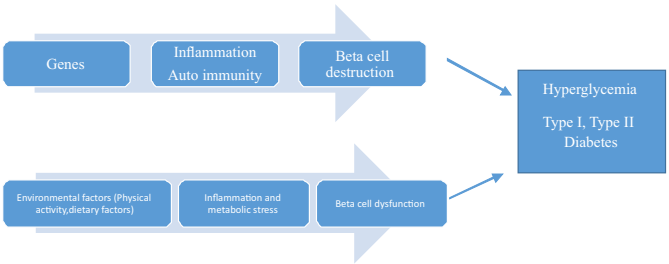


**Figure 1:** Pathophysiology of Diabetes [6]

Flaxseed also named linseed or Linum usitassimum Flaxseed is a part of Lineaceae family that produce blue flowers. Tiny flat seeds are produced by their plants that give reddish brown or golden yellow color. Flaxseed have a nutty taste and crispy texture. When human consume flaxseed, they are known as flax on other hand for industrial purpose linseed term is being used [7]. In functional food

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area, flaxseed is an important source of phytochemicals. A huge amount of α-linolenic acid oil and lignans are present in flaxseed. It also has high biological value of protein and fibers. It is a greatest source of phenolic compounds [8]. Flaxseed hold in 40% lipid, 30% fiber and 20% protein. Due to different environmental factors chemical composition of flaxseed also differs. 75% lipid, 16% protein is present in cotyledon of seed. That's the reason it is richest source of omega 3 fatty acid particularly alpha linolenic acid that makes up to 52% of the total fatty acids [9]. Fiber and ALA (alpha linolenic acid) are the bioactive components of flaxseed. Flaxseed can be consumed in different form flaxseed oil, grounded or in powder form, whole flaxseed and defatted flaxseed meal [10]. Flaxseed possess anti-oxidative, anti-atherogenic, anti-hyperglycemic, anti-inflammatory and anti-hypertensive properties. They also improve glycemic control [11]. Insulin secretion and its mechanism of action is affected by bioactive components and soluble fiber present in flaxseed. Flaxseed also maintains glucose homeostasis. Flaxseeds also have lignans they act as anti-oxidant by killing reactive oxygen species and help in anti-cancer mechanism [12]. Secoisolariciresinol diglucoside (SDG) is a bioactive component in flax lignan that lowers the blood glucose levels and acts as anti-oxidant [13]. Nigella Sativa (NS), is a nonwoody plant of family Ranunculaceae. Other names for NS are "blackseed" and "Kalonji". It is used in food for spices and enhancing the taste of food. It is used in different forms NS oil and powder. It has been known for centuries for treatment of various diseases like GIT disorders, cough, fever, diarrhea and bronchitis [14]. Blackseeds are rich in unsaturated fatty acids eicosenoic acid, linoleic, oleic acid and linolenic acid. 80-84% of fats present in blackseeds lower the lipid level in blood [15]. A phytochemical study of blackseed revealed that it has 36-28% proteins, fixed oil. Alkaloids saponins and essential oils are 0.4-2.5%. The fixed oil of blackseeds consists of palmitic acid stearic acid and myristic acid [16]. Blackseeds contain amino acid, proteins, carbohydrates, fibers, minerals. Alkaloids. Flavonoids, saponins, volatile oil (thymoquinone) and essential fatty acids (polyunsaturated acids) [17]. Thymoquinone (TQ) is the main bioactive ingredient of blackseeds. Some other bioactive components are carvone, limonine, nigellicine, nigellidine, nigellicimine and dithymoquinone [18]. TQ possesses anti-diabetic activity. It has potential therapeutic effects in management of diabetes by reducing appetite, and intestinal absorption of glucose, maintaining blood glucose levels, improving glucose tolerance, preserving beta cell integrity and inducing insulin secretion form beta cells with low toxicity [19]. Recent studies showed that blackseeds have free radical killing properties so it lowers oxidative stress. It also prevents complications of diabetes by maintaining blood glucose levels. Blackseed is also beneficial for a cancer patient as it enhances apoptosis [20]. A Randomized controlled trial study was conducted by Andrea M. Hutchins et al, to evaluate daily flaxseed consumption in overweight or obese individuals with pre-diabetes. Total of 25 overweight, obese men and postmenopausal women with pre-diabetes were included in the study. For 12 weeks they consumed 0, 13, or 26 g of ground flaxseed powder. Results showed that glucose decreased on the 13 g intervention compared to the 0 g period (P=0.036). Insulin decreased during the 13 g intervention but not the 26 g and 0 g periods (P=0.021). Results showed that flaxseed supplementation causes an increase in insulin sensitivity and decrease glucose and insulin when incorporated in the diet on daily basis in overweight and obese people with pre-diabetes [21]. A randomized, double-blind, placebo-controlled, cross-over trial was conducted by An Paul et al., to evaluate the effects of a flaxseed-derived lignan supplement in type II diabetic patients. Total 72 type II diabetic patients with a history of mild hypercholesterolemia were included in the study patients were advised to take 360mg flaxseed lignan derived capsule per day during washout period of 8 week. The duration of study was 12 weeks. HBA1C, insulin resistance and inflammatory markers were evaluated. HBA1C was improved in the experimental group as compared to control group (P=0.01). This study concluded that taking lignan supplementation on daily basis is beneficial for glycemic control in type II diabetic patients [22]. A study was conducted by Seham Tharwat et al., to determine the effect of supplemented bakery with flaxseed or flaxseed oil on type II diabetic patients. Total 92 type II diabetic patients were included in the study. Patients were divided in 3 groups. 30 patients were included in each group. Group 1 received 1350kcal diet. Group 2 received diet just like group 1 and also a dose of flaxseed oil bakery diet. Group 3 received diet plus flaxseed supplemented bakery products. The duration of study was 12 weeks. Fasting blood sugar, postprandial blood glucose, LDL, HDL and leptin were measured at the beginning and end of study. Fasting blood sugar ($p<0.001$), HBA1c (p 0.02, 0.01) postprandial glucose (0.03, 0.02, 0.001) and leptin (<0.001) was improved in group 2 and 3 as compared to control group. This study concluded that supplementing diet with flaxseed oil and flaxseed products decreases blood glucose, HBA1c and lipid profile in type II diabetic patients [23]. A study conducted was conducted by Lilli Zhu et al, to assess the efficacy of dietary flaxseed oil rich in omega-3 that suppresses severity of type 2 diabetes mellitus via anti-inflammation and modulating gut microbiota in rats. Sprague-Dawley rats were divided into 4 groups. Pair fed with corn oil (PF/CO), DM with CO group

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(DM/CO), PF with FO group (PF/FO), DM with FO group (DM/FO). Streptozocin nicotinamide were injected to develop diabetes in rats. The duration of the study was 5 weeks. In intervention group Fasting blood glucose, HBA1c was decreased as compared to control group. But insulin remains the same in both groups. By concluding that flaxseed oil showed improvement by suppressing inflammation and modifying gut microbiota which in turn control diabetes [24]. A study was conducted by Elshal MF, to assess the effects of dietary flaxseed on vascular permeability and endothelial function in type II diabetic rats. Sprague-Dawley male rats 35mg/kg body weight were included in the study and Streptozocin was induced intraperitoneally. Fructose rich diet was given for short period of time. 3 groups were made, first group received standard diet, the second group received standard diet with the addition of flaxseed powder and third group received metformin. The study duration was 8 weeks. Fasting blood sugar, insulin, vascular endothelial growth factors were measured. Fasting glucose. Insulin, and vascular endothelial growth factors was reduced in flaxseed supplementation group as compared to diabetic group without flaxseed supplementation. Insulin resistance and vascular permeability index also showed improvement. By concluding that flaxseed supplementation is beneficial for treatment of diabetic complications [25]. A study conducted by Haliga R, to explore dietary effects of flaxseed supplementation on blood lidips levels. In this study 24 male, Golden Syrian hamsters were included. Intraperitoneal injections were induced in 12 rats and divide them in experimental and control group. Study duration was 20 weeks. In diabetic group standard diet and flaxseed supplementation (15%) were given and control group was only on standard diet. Serum cholesterol, HDL, LDL and TG were measured. Reduction in TC and increase in HDL was observed. But serum TG showed no difference in both groups. Hepatic cholesterol was reduced in experimental group (-39.5%). These results showed that diabetic microvascular complications and lipid profile could be improved by consuming flaxseed [26]. Parfait Kezimana, studied the efficacy of flaxseed lignan secoisolariciresinol diglucoside (SDG) on glucose hemostasis in obese mice. Male rats were fed high-fat diet (60% kcal) and divided into 4 groups. The study duration was of 15 weeks. In control group, low fat diet was given. SDG causes a reduction in fatty acid levels, insulin and blood glucose levels. Oral glucose tolerance and insulin response showed improvement in high-fat diet group. This study suggests that flaxseed SDG is beneficial for glycemic control and it also improved insulin signaling and sensitivity [27]. This study was conducted to analyze how dietary flaxseed meal reduces proteinuria and ameliorates nephropathy in rat model of type II diabetes mellitus. Male hypertensive and type II diabetic rat models were included in this study. 20% casein, 20% soy protein and 20% flaxseed meal were given to models randomly. The study duration was 6 months.24hr urine and blood samples were measured. Plasma glucose was same in all groups and plasma insulin was reduced in flaxseed group as compared to other groups. Urine protein excretion was reduced ($P<0.01$) in flaxseed group. By concluding that substitution of flaxseed meal reduces proteinuria and plasma glucose [28].

| Study Subjects | Dietary intervention | Duration of study | Treatment effect |
|---|---|---|---|
| 57 type II diabetic patients [29] | 200g 2.5 % fat yogurt containing 30g flaxseed | 8 weeks | ↓ HBA1c |
| 60 type II diabetic patients [30] | 5g flaxseed gum | 3 months | ↓Fasting blood sugar |
| 29 type II diabetic patients [31] | 10g flaxseed powder | 1 month | ↓Fasting blood glucose<br>↓HBA1c |
| 46 type II diabetic patients [32] | 0.7g blackseed oil | 40 days | ↓Fasting blood sugar |
| 70 type II diabetic patients [33] | 2.5ml blackseed oil | 3 months | ↓HBA1c<br>↓Fasting blood sugar<br>↓2hr post prandial glucose |
| 114 type II diabetic patients [34] | 2g blackseed powder | 1 year | ↓HBA1c<br>↓Fasting blood sugar<br>↓Insulin resistance |

**Table 1:** Studies regarding flaxseed and blackseed supplementation for management of type II diabetic patients

## CONCLUSIONS

Flaxseed and black seed have nutritional and functional properties. They both possess anti-oxidant, anti-hyperglycemic, and anti-inflammatory properties. Their bioactive components maintain glucose homeostasis, control blood glucose level and improve insulin secretion. Besides that, they have essential fatty acids, dietary fibers, and essential amino acids that are important for health maintenance. Literature studies showed that flaxseed and black seed have potential therapeutic effects in the management of type II diabetes and we can prevent further complications if we made them a habitual part of our diet on daily basis.

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