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Flaxseed Oil and Diabetes: A Systemic Review

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Preventing the occurrence of diabetes with nutritional interventions is a therapeutic strategy that may warrant greater research attention. Recent studies suggest that for the vegetarians other than the fish oil adding flaxseed oil to the diet may decrease insulin resistance in diabetics and pre-diabetics and help in reducing the risk of developing type 2 as well as type 1 diabetes. Omega-3 and omega-6 fatty acids are an essential source of energy found in animal and vegetable fats and oils. The general consensus is that eating the right proportion of omega-3 and omega-6 reduces inflammation in the body, the association between omega-3 Fatty Acids (FAs), type 1 and type 2 diabetes is not fully understood yet. Studies in the past suggest that omega-3 and omega-6 FA may affect the development of diabetes by modulation of insulin sensitivity in phospholipids membranes. Evidence suggests omega-6 FAs are generally protective for diabetes risk, whereas the evidence for omega-3 FAs is mixed. Based on the results of clinical trials, epidemiological investigations and experimental studies, ingestion of flaxseed oil has been suggested to have a positive impact on diabetics as well as pre diabetics. The purpose of the present review is to identify the protective effects of flaxseed oil and Alpha Linolenic Acid (ALA) on diabetes.

Key words: Omega-3, diabetes, flaxseed oil, ALA

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INTRODUCTION

According to the researchers, India is home to nearly 62 million diabetics and by 2030 nearly 9% of the total population of India is likely to be affected by the disease, with many of them classed as overweight or obese. This puts them at three time's higher risk for developing type 2 diabetes than normal weight people (Jeppesen *et al*., 2013). There is some evidence that flaxseed can lower blood sugar levels and might increase the blood sugar-lowering effects of some medicines used for diabetes. There is a concern that blood sugar could drop too low. If you have diabetes and use flaxseed, monitor your blood sugar levels closely (Taylor *et al*., 2010). These days, sources of omega-3 fatty acids are hard to find, while the consumption of omega-6 fatty acids has increased. This imbalance is thought to contribute to the inflammation that increases the risk of developing diseases like type 2 diabetes and heart disease. It's not that omega-6 fatty acids are bad and omega-3 is good. It's the balance of both that keeps us healthy. Finding healthier sources of omega-6 is as important as adding more omega-3 to our diets. Omega-3 supplementation is unaffected on hypertension, diabetes and microvascular complications. Most studies involved mainly patients with type 2 diabetes and future research needs to focus on the type 1 diabetic patient. Also, the mechanism and role of omega 3, omega-6 fatty acids on diabetes is remain largely unknown. A low dose of flaxseed (13 g day^{-1}) for 12 weeks was associated with a significant reduction in insulin resistance, assessed using the homeostasis model (HOMA-IR), in overweight or obese men and postmenopausal women (Hutchins *et al*., 2013). However, no such benefits were observed for the high dose group (26 g day^{-1}), report researchers from the University of Colorado Springs, the University of Montana and the University of Sherbrook (Canada).

It is known that omega-3 and omega-6 FAs may affect the development of diabetes by modulation of insulin sensitivity in phospholipids membranes (Borkman *et al*., 1993). Evidence suggests omega-6 FAs are generally protective for diabetes risk (Salmeron *et al*., 2001; Hu *et al*., 2001; Lichtenstein and Schwab, 2000; Vessby *et al*., 1994). whereas, the evidence for omega-3 FAs is mixed. Animal studies have provided a biological model of decreased insulin resistance with increased intake (Storlien *et al*., 1987, 1991), whereas there are mixed results in prospective population-based studies (Feskens *et al*., 1995; Kaushik *et al*., 2009; Wang *et al*., 2003; Van Dam *et al*., 2002; Van Woudenbergh *et al*., 2009; Egert *et al*., 2008; Djousse *et al*., 2011) and similar mixed or null findings in clinical trials (Fasching *et al*., 1991; Giacco *et al*., 2007; Toft *et al*., 1995).

FLAXSEED OIL FOR PRE-DIABETICS

Adding flaxseed to the diet may decrease insulin resistance in pre-diabetics and help reduce the risk of developing type-2 diabetes, suggests new data from the US and Canada. The researchers noted that flaxseed contains soluble fiber and lignans, both of which have reported benefits for pre- and type-2 diabetics. The seeds also contain the omega-3 ALA (alpha-linolenic acid). No changes were observed in inflammatory markers for any of the study participants, however, which led the researchers to reject the notion that ALA was responsible for the benefits.

In a study conducted by Hutchins *et al*. (2013), the researchers recruited 25 overweight or obese men and postmenopausal women with pre-diabetes to participate in their randomized, cross-over study. The participants consumed 0, 13, or 26 g ground flaxseed for 12 weeks. Interventions were followed by two week washout periods before crossing to a different intervention. Results showed that the low dose (13 g day^{-1}) flaxseed group experienced decreases in glucose, insulin and HOMA-IR measures, but such decreases were not observed in the other two groups. There was no significant changes were observed in any of the groups for fructosamine, high sensitivity C-reactive protein, adiponectin and high-sensitivity interleukin-6 (Hutchins *et al*., 2013). Research workers could not explain why only the low dose group experienced improvements, while the high dose group did not. Which is investigated further by research publish at journal of oleo science by Barre *et al*. (2008). Flaxseed oil had no impact on fasting blood serum glucose, insulin or HbA1c levels. It is concluded that high doses of flaxseed oil have no effect on glycemic control in type 2 diabetics (Brostow *et al*., 2011).

FLAXSEED OIL FOR TYPE 2 DIABETICS

Flaxseed oil is of particular interest in the nutritional therapy for diabetes, given their potential role in several pathophysiological processes related to cardiovascular disease (Jeppesen *et al*., 2013). Both omega-3 and omega-6 fatty acids are beneficial for improving lipid profiles in healthy individuals and among type 2 diabetic patients: Supplementation with omega-3 fatty acids lowers triglycerides and VLDL-cholesterol. Type-2 diabetes mellitus (T2DM) is known for disruption in fatty acid metabolism leading to dyslipidemia (Barre *et al*., 2008). In a study published in Journal of American College of Nutrition in Feb 2010. Dietary milled flaxseed and flaxseed oil improve N-3 fatty acid status but do not affect glycemic control in individuals with well-controlled type 2 diabetes (Taylor *et al*., 2010). The flaxseed cake and flaxseed oil groups had increases in plasma phospholipid n-3 fatty acids (ALA), eicosapentaenoic acid (EPA), or docosapentaenoic acid (DPA), but not docosahexaenoic acid and the flaxseed oil group had more EPA and DPA in plasma phospholipids compared to the group having flaxseed cake. In 2007 "Public Library of Science One" found that type 2 diabetics who consumed flax seed-derived lignin supplements for 12 weeks had lower average blood sugar levels as determined by the A1C test, a measurement of blood glucose control based on the percentage of hemoglobin

in the blood that contains glucose molecules. A low score on the Hb A1C test indicates good blood glucose control over the past two to three months, while a high score indicates poor blood glucose control (Pan *et al*., 2007).

In the Singapore, Chinese Health Study conducted by Brostow *et al*. (2011) examined the association between total omega-3 FAs, marine omega-3 (EPA, DHA), nonmarine omega-3 (ALA) and omega-6 (n-6) FAs and omega-6: omega-3 ratio on risk of type 2 diabetes in a Chinese population of Singapore. The analysis included 43,176 Chinese men and women free of chronic disease, aged 45-74 year. Baseline data collection occurred between 1993 and 1998, with follow-up interviews between 1999 and 2004. Cox regression models were used to examine the associations between FA intakes at baseline and risk of developing diabetes. Increased intakes of total omega-3 FAs were inversely associated with diabetes incidence (Hazard Ratio (HR) for the fifth compared with the first quintile: 0.78; 95% CI: 0.65, 0.94; p for trend = 0.02). Omega-3 FAs from marine sources were not associated with diabetes risk, whereas nonmarine omega-3 FA intake was strongly associated (HR for the fifth compared with the first quintile: 0.79; 95% CI: 0.67, 0.93; p for trend = 0.004). Omega-6 and omega-6: omega-3 ratio was not associated with incidence of type 2 diabetes. Consumption of nonmarine sources (ALA) of omega-3 FAs is associated with a decreased risk of type 2 diabetes in Chinese Singaporeans (Brostow *et al*., 2011). Flaxseed oil supplementation may also be useful in the treatment of brain dysfunction in diabetes (Badawy *et al*., 2015).

In other study conducted by Taylor *et al*. (2010) and coworkers determine that milled the flaxseed (FXS) and flaxseed oil (FXO) intake does not affect glycemic control in adults with well-controlled type 2 diabetes.

They find the effects of dietary consumption of milled flaxseed or flaxseed oil on glycemic control, n-3 fatty acid status, anthropometrics and adipokines in individuals with type 2 diabetes. The flaxseed (FXS) and flaxseed oil (FXO) groups had increases in plasma phospholipids n-3 fatty acids (ALA, eicosapentaenoic acid (EPA), or docosapentaenoic acid (DPA), but not docosahexaenoic acid) and the FXO group had more EPA and DPA in plasma phospholipids compared to the FXS group. All groups had similar caloric intakes; however, the CTL group experienced a 4% weight gain compared to baseline ($p<0.05$), while both flax groups had constant body weights during the study period. All other parameters, including glycemic control, were unchanged by dietary treatment.

FLAXSEED OIL FOR TYPE 1 DIABETES

As know that there are numerous solutions for type 2 diabetes, such as alteration diet and exercising, but what about type 1 diabetes? In the latest of the studies on type 1 diabetes solutions, researchers found that a compound in flax seed has a wide range of benefits in animals with type 1 diabetes. Among those benefits an improved utilization of glucose in the liver, normalized glucose forming activity in the liver and muscle tissues and "reduced pancreatic and intestinal glycosidase inhibitory activity, which translates into lower post-meal blood sugar elevations". The key in these natural solutions seems to be beta cell regeneration. In a healthy pancreas, beta cells produce insulin. In someone with type 1 diabetes, these cells are either destroyed or impaired to the point of failure. The research was published in the Canadian Journal of Physiology and Pharmacology. In addition to the flax seed study, numerous other bodies of research have found natural compounds that show significant promise in the regeneration of healthy beta cells. These include studies on: type 1 is often referred to as juvenile diabetes because it is most diagnosed in children. It is a lifelong disease characterized by the body's inability to produce insulin, whereas type 2 diabetes is where the body becomes resistant to its own insulin. It is not caused by a child's diet or lifestyle choices. In other words, it can't be solved by reducing carbohydrate or sugar intake. Most people with type 1 diabetes are insulin-dependent. They must take injections to make up for the fact that the beta cells of their pancreas are not producing the hormone so crucial to the metabolism of glucose.

While, millions of dollars have been funneled into researching for a cure to type 1 diabetes, no such solution has been revealed (Renter, 2013; Dusane and Joshi, 2013).

CONCLUSION

The role of omega-6 fatty acids remains largely unknown. While, some studies have shown promise for the use of flax seeds as a treatment for diabetes and cardiovascular disease, others have yielded mixed results. More studies are needed to definitively state that flax seed is effective for this use and to determine the precise dose needed. To date, no studies have reported flaxseed's affect on controlling blood glucose in people with pre-diabetes. Therefore, more research is needed to determine if flaxseed is an effective means of controlling glucose levels in people with pre-diabetes. Clinicians are recognizing that glucose control, through diet, exercise and if necessary, medications, is as important for people with pre-diabetes as it is for people with type 2 diabetes. Standard treatments for pre-diabetes are glucose control through diet, exercise and drugs. A possible treatment that could be added to the standard treatments is intake of flaxseed. Few studies have looked at the effect of flaxseed intake on glucose control and those that have enrolled people with type 2 diabetes.

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