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Review Article

Hypolipidemic effect of Sesame Seed Oil: A Review

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ABSTRACT

Sesame seed *(Sesamum indicum L)* oil is an excellent source of unsaturated fatty acids and secondary metabolites. Most commonly used in Eastern countries, easily available and cheap source of essential nutrients. **Objective**: To identify scientific evidence regarding the hypolipidemic effect of sesame seed oil and its derivatives. Elevated levels of plasma lipids and cholesterol is known as hyperlipidemia, increased lipids levels are directly associated with vascular and metabolic disorders. Hyperlipidemia is the most common risk factor of cardiovascular diseases. Sesame seed oil is loaded in vitamin E, sesamin, sesamolin, sesamol, lignans, and phytoestrogen, these constituents have the potential to reduce hyperlipidemia, hypercholesterolemia, and elevated triglycerides levels. They also act as antioxidants to prevent lipid peroxidation and oxidative stress. The mechanism behind the hypolipidemic effect of sesame seed oil is its ability to increase superoxide dismutase SOD and glutathione peroxidase (antioxidants), reduction in triglycerides, and Malondialdehyde (MDA) concentration. MDA is the end product of lipid peroxidation and triggers lipid accumulation in blood. It has been studied that Sesaminol diglucoside helps to reduce white fat deposition by increasing the conversion of fat into brown fat. **Conclusions:** Results suggest that sesame seed oil is highly effective to manage hyperlipidemia and dyslipidemia due to its lipid ameliorating and anti-oxidative effect.

INTRODUCTION

Dyslipidemia is directly associated with coronary heart diseases (CHD), characterized by low high density lipoproteins (HDL) levels [1], high triglycerides (TG) and cholesterol levels [2]. Its prevalence is increasing throughout the world and major factors behind it are unhealthy dietary and living practices [3]. Globally cardiovascular diseases are the number one cause of deaths. Pakistan ranks at 17 number with high motility rate due to CVDs. Hyperlipidemia and lipids abnormalities are directly associated with increased incidence rate of heart attacks, stroke and myocardial infarction. Excessive accumulation of lipids, fatty acids, cholesterol, steroids and fat-soluble vitamins in blood enhances plaque formation and hardening of arteries [4,5]. Hypolipidemic agents and drugs are used to reduce symptoms and further complications [6]. Common complications of hyperlipidemia are angina, myocardial infarction, and atherosclerosis [7]. Many plant products have the tendency to reduce higher levels of lipids and people also use them to achieve health benefits. Sesamum indicum L (Sesame) is the most basic known oleaginous from the family Pedaliaceae [8] and its main origin is the African continent. Cultivated in small regions where sometimes water supply is very short but it is resistant to drought [9]. Most commonly produces in Asian and African countries and plays a significant role in the food, cosmetic, pharmaceutical, and nutraceutical industries. Sesame seeds contain 34-59% of oil which is used in many applications [10]. Sesame seed is consisted of proteins (20% -25%), fats (45%-50%), carbohydrates (3% -14%), and hull (17%). Also rich in calcium, fiber, potassium, iron, polyphenols [11], and oric acid [12]. Sesame oil has the potential to prevent different metabolic disorders such as hyperlipidemia [13], hypertension, aging, and oxidative

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stress [14]. It contains sesamin, sesaminol lignans, sesamolin [15] and flavonoids [16], these are also known as major antioxidants. The sesame plant is comprised of phenolics, amino acids, alkaloids, cyanogenic [17], polyunsaturated fatty acids [18], vitamin and mineral contents [19].

NUTRIENTS	VALUES
Energy	884kcals
Carbohydrates	0.00g
Fats	100g
Proteins	0.00g
Saturated fats	14.2g
Monounsaturated fatty acids	39.7g [20]
Poly unsaturated fatty acids	41.7g
Vitamin K	1.40mg
Vitamin E	13.6µg [21]

Table 1: Nutritional composition of sesame seed oil per 100g (3.5oz)

Recently it has been evaluated that domestic use of sesame oil improved blood pressure, cholesterol, and glucose levels in diabetic patients with increased blood pressure [22]. The MUFAs and PUFAs in sesame seed oil have antihypertensive and hypoglycemic activity collectively [23]. Sesamin in sesame seeds acts as a vasodilating agent and is directly associated with the prevention of heart diseases [24]. Sesame also contains significant amounts of fiber, vitamin E, and lignans [25], which are thought to be linked with its plasma lipid-lowering properties [26]. Sesame seeds have the potential to lower total triglycerides levels and promote heart health. Triglycerides are a major contributor to increased lipids levels [27]. Globally sesame seeds production was 62 lac tons in 2016 about 576 kg ha-1[28]. The production of this crop is insufficient to meet consumer demands. Production rate is affected by the low yield of the cultivars, high sowing cost, indeterminate growth, and lack of harvesting techniques [29].

Hypolipidemic effect of sesame seed oil

Lipids ameliorating potential: Sesame seed oil combined with rice bran is known as hypolipidemic in nature due to their polyunsaturated fat contents. In a study sesame seed oil (unrefined20%) and rice bran oil (refined80%) mixture was used to determine their hypolipidemic effect. Total 400 individuals were participated, 300 hypertensive and 100 non hypertensive. These individuals were divided into four (4) groups and each group provided different treatments. In first group non hypertensive individuals were provided with sesame oil blend, in second group same treatment was given to hypertensive patients, in third hypertensive patients were provided medicine nifedipine (20 mg/d), and in the last group with the combination of sesame oil mixture and medicine nifedipine. The intervention time period of this prospective study was 60 days, in which resting blood pressure was measured at 0, 15, 30, 45, and 60 days while fasting lipid profile (FLP) was measured at 0 and 60th days. There was a significant reduction in blood pressure from day one to last day in hypertensive individuals treated with sesame oil mixture, calcium blockers, and a combination of mixture and medicine. All these three groups had a direct association with blood pressure (p=0.001). Total cholesterol, triglycerides, and LDL levels were also reduced in these treated groups. So it has been evaluated that sesame oil blend also has potential to lower blood lipid levels similar to nifedipine or hypolipidemic drugs [30]. Another study also supports lipid-lowering effect of sesame seed among hypolipidemic rats. Total of 30 rats were distributed in 5-treatment groups. Control group (regular food+1gram multivitamin), Second treatment-group (3.7ml coconut oil+regular food+1gram multivitamin), Third treatment-group (25mg sesame seed extract/ kg body weight+regular food), Forth treatment-group (50mg sesame seed extract/ kg body weight+regular food) and Fifth treatment-group (75mg sesame seed extract/ kg body weight+regular food). Rats were provided these treatments for 60days. At the end of the study statistical analysis showed that there was a significant reduction in total fat contents and lipids levels whereas the number of antioxidants was increased in rats treated with sesame seed as compared to other groups [31]. A study was conducted to check out the effect of sesame oil combined with N-acetylcysteine (NAC) on the hypothalamic-pituitary-adrenal (HPA) axis, lipid profile and liver architecture among middle-aged mice fed with a diet rich in cholesterol. Thirty-six randomly selected mice were divided into 6-groups: control group, cholic acid/cholesterol diet group, cholic acid/cholesterol diet group with N-acetylcysteine, cholic acid/cholesterol diet group with 10% sesame seed oil, a group with sesame seed oil-enriched diet and last group received a diet enriched with NAC. Diet rich in cholesterol caused hepatic damage and abnormal lipid metabolism. NAC inhibited the onset of hyperlipidemia by reducing lipid peroxidation and alkaline phosphatase levels. Hepatic damage was also reduced in the NAC group as compared to the control group. While there were no significant changes observed in sesame seed oil group [32]. Anti-hypercholesterolemic effect of Black sesame oil was determined by comparing its prophylactic and hypolipidemic effects with evening primrose oil and olive oil. Serum cholesterol, lipid, triglycerides, LDL, and HDL levels were measured and data analysis evaluated that rats fed with sesame oil had lower serum cholesterol, LDL, and triglycerides levels while HDL levels were significantly increased. Sesame seed oil also

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ameliorated serum lipids levels by improving enzymatic activities in the liver [33].

a. Formation of Brown Adipose Tissues: Brown adipose tissues are responsible for thermogenesis in mammals and are also known as non-shivering thermogenesis site. Basically, brown adipose tissues use energy for heat production as compared to energy storage in white adipose tissues. It has been investigated that sesaminol diglucoside (SDG) in black sesame seeds increases the expression of uncoupling protein 1 (UCP 1) at the site of brown adipose tissues and converts energy in heat. It (SDG) is also responsible for reduction in white fat pads and plasma glucose levels. So the active component of sesame seed, sesaminol diglucoside helps to prevent high fat induced weight gain or obesity. Another study revealed that SDG lower the function of beta 3 adrenergic receptors (b3-AR) that is responsible lipolysis and thermo genesis in body as shown in figure 1 [34].

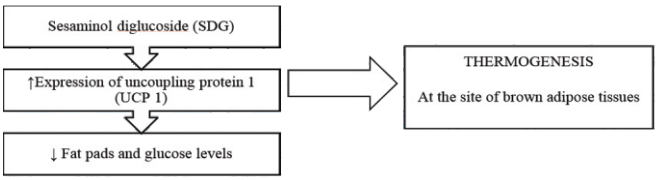

Figure 1: SDG Mechanism of Thermogenesis

b. Antioxidative Potential: Haghighian MK and his colleagues determined the hypolipidemic and antioxidative effect of sesame) in patients with osteoarthritis (OA). Two groups were taken as intervention and control groups (n= 25). The intervention group was treated with 40g of sesame seed daily. After 2 months serum lipid profile, LDL, HDL, cholesterol, triglycerides, and total antioxidant capacity were determined. Biochemical analysis revealed a remarkable reduction in LDL, HDL, cholesterol, triglycerides, and malondialdehyde (MDA) levels with p-value less than 0.05 while all these indicators were not reduced with p-value greater than in 0.05 in control group. Malondialdehyde (MDA) is the intermediate product of lipid peroxidation. It was concluded that sesame seed helps to reduce lipid oxidation by acting as an antioxidant and also improves lipid profile in blood [35]. Diabetes is associated with oxidative-stress-induced diseases. In a study was the antioxidative impact of sesame seed butter and sesame seed oil in diabetic rats. The aim of the study was to measure changes in lipid profile, oxidative stress, and glucose levels. Forty (40) male albino rats were divided into four groups: control group, diabetic group, diabetic rats treated with sesame oil and diabetic rat with sesame butter. Intraperitoneal injection (streptozotocin) about 55mg/kg was used to cause experimental diabetes in rats. 0.5g/kg sesame seed oil was given to one group and other group with 1.25g/kg of sesame butter for 6-months. At the end of study, blood glucose, lipids, malondialdehyde and antioxidants levels were analyzed. Findings showed that rats fed with sesame seed oil and sesame butter had lower levels of glucose and lipid levels whereas high-density lipoproteins levels were increased in interventional groups with p-value less than 0.05 as compared to control group. Group treated with sesame butter had higher levels of TAC and lower levels of malondialdehyde [36]. Vittori Gouveia LD and his colleagues performed a review by using seven databases from September 2013-January 2014. The basic aim of this review was to access the anti-oxidative efficacy of sesame seeds and their by-products. This review used seven clinical trials exploring that sesame seed is responsible for an increase in enzymatic and nonenzymatic antioxidants levels and a reduction in free radicals production [37]. It was also observed that sesame seed oil also has antihypertensive properties as shown in figure 2.

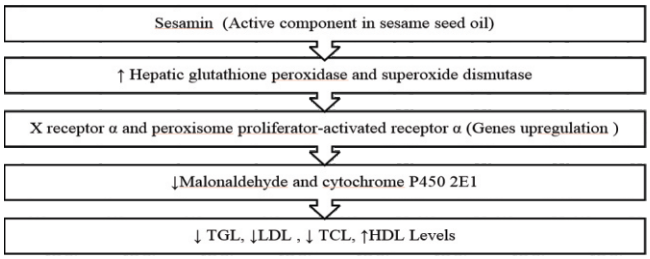

Figure 2: Antioxidant potential [38]

c. Anti-Inflammatory Effect: Atherosclerosis is one of main risk factors of cardiac failure, characterized by chronic inflammation. Recently anti-inflammatory effect of sesame seed oil also has been determined. In a study female rats were fed with sesame oil aqueous extract, atherosclerotic lesions, and blood lipids levels were measured after 12-weeks of intervention. RNA samples from the liver and aorta were extracted and used to analyze genes expression. Intervention group showed a significant reduction in plasma inflammatory cytokines. Gene analysis showed a reduction in the gene expression which is directly linked with inflammation and oxidation. It also improved fat and cholesterol metabolism [39]. Oxidative stress is directly associated with inflammatory diseases such as atherosclerosis and rheumatoid arthritis (RA). Sesame seed has great anti-oxidative potential due to its abundance in sesamin and other lignin contents. A study was conducted to evaluate the antioxidative effect of sesamin, the active component of sesame seeds among RA patients. Total of 44 patients with RA were randomly selected and divided into two major group's intervention and control group. In treatment group, patients were provided 200mg/kg sesamin supplement for six-months and control group was provided placebo supplements. At the start and end of the study, Blood pressure,

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anthropometric measurements and blood tests were collected. Data analysis exposed that sesamin supplement was much more effective to reduce malondialdehyde levels. It also increased total antioxidants capacity. On the other hand, anthropometric measurements (weight, body mass index, and waist-to-hip) and blood pressure were also improved in treatment group. Total cholesterol levels were also reduced in sesamin group. So it has been concluded that sesamin supplements are more effective to control blood pressure, and lipid profile and to improve anthropometric measurements [40]. A study was performed to check the effects of sesame seed oil, rice bran oil, and groundnut oil on blood lipid levels, inflammatory remarkers, and liver functions. Wistar Male rats were fed with AIN-93 diet supplemented with 10% of sesame seed oil, bran and groundnut oil. Findings of the study showed a reduction in lipids levels and cytokines in liver in sesame and rice bran oil group as compared to ground nut oil. Cytokines are proteins produced by the immune system in response to inflammation [41]. A summary of studies search through literature survey is provided in table 1.

Intervention	Population/sample	Sample size	Outcomes
Sesame seed oil, ground nut and rice bran oil about 10% of each with AIN-93 diet	Wistar Male rats	25	Anti-inflammatory effect [41]
200mg/kg of sesamin supplement for 6 weeks	Humans	44	Improved systolic blood pressure Reduction in MAD and LDL levels Antioxidant [40]
sesame oil aqueous extract (SOAE) for 3 months	Female hyperlipidemic wister rats	57	Anti-inflammatory [39]
1.25g/kg sesame butter0.5g/kg sesame seed oil to diabetic rats	male albino rats	40	Sesame butter has more antioxidant potential than oil [36]
Orally fed with 25, 50, 75mg of sesame seed extract	Hyperlipidemic rats	30	Hypolipidemic [31]

Table: Summary of literature review

CONCLUSIONS

Compounds in sesame seed oil have the potential to lower lipids levels by modulating gene expression and preventing oxidative stress. These compounds are also responsible for thermogenesis and lipolysis to prevent fat accumulation in the body.

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