WWW.IJRPR.COM

International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

The Effectiveness of Sesame Seeds in Treating Dyslipidemia

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A B S T R A C T

Dyslipidemia is a key risk factor for cardiovascular disease, driven by imbalances in cholesterol and triglyceride levels. While conventional treatments exist, interest in dietary strategies is growing. Sesame seeds (Sesamum indicum L.) are rich in lignans, unsaturated fatty acids, and antioxidants that may beneficially modulate lipid metabolism. Compounds like sesamin and sesamol have been shown to lower LDL-C and triglycerides, increase HDL-C, and protect against oxidative damage. Evidence from both experimental and clinical studies suggests that sesame seed consumption can support healthier lipid profiles. Although generally safe, individual sensitivities and interactions with medications should be considered. These findings highlight sesame seeds as a promising natural aid in dyslipidemia management.

Keywords: Dyslipidemia, Sesame seeds, Sesamin, Sesamol, Cholesterol

1. INTRODUCTION

Dyslipidemia is a metabolic disorder characterized by an imbalance in blood lipid levels, including elevated total cholesterol, low-density lipoprotein cholesterol (LDL-C), triglycerides (TG), and decreased high-density lipoprotein cholesterol (HDL-C). This condition has been identified as one of the major risk factors for cardiovascular disease, which remains the leading cause of death globally to this day.(Pappan et al., 2025; Pirillo et al., 2021) Epidemiologically, dyslipidemia presents a significant burden and a high prevalence worldwide, with variations across regions and population groups. Studies show that its prevalence ranges from 20% to more than 50% among adult populations in various countries.(Pirillo et al., 2021) Developing countries tend to report higher prevalence, likely related to the adoption of diets high in saturated fats, low in fiber, and increasingly sedentary lifestyles. If left untreated, dyslipidemia increases the risk of serious cardiovascular events, including atherosclerosis, myocardial infarction, and stroke.(Mohamed-Yassin et al., 2021) Current strategies for managing dyslipidemia primarily include lifestyle modifications and pharmacological therapy. Statins are the most commonly prescribed drugs due to their effectiveness in lowering LDL-C levels and preventing cardiovascular events. Other therapies, such as fibrates, cholesterol absorption inhibitors, bile acid sequestrants, and PCSK9 inhibitors, are also used. However, limitations still exist, both in terms of side effects, such as myopathy, increased risk of diabetes, and hepatotoxicity, and in terms of long-term patient adherence to medication. As concerns grow regarding the long-term side effects of conventional therapies, alternative approaches and natural supplements are gaining interest as potential adjunct treatments. One widely studied candidate is sesame seeds (Sesamum indicum), a food ingredient long used in traditional medicine and rich in bioactive compounds that support metabolic health.(Houston, 2012) Sesame seeds contain lignans (such as sesamin and sesamolin), phytosterols, polyunsaturated fatty acids (PUFAs), and antioxidants like vitamin E. These components exhibit biological activities relevant to lipid metabolism regulation, oxidative stress reduction, and the suppression of inflammatory processes. Several studies indicate that sesamin may inhibit HMG-CoA reductase, a key enzyme in cholesterol biosynthesis, through a mechanism similar to that of statins. Additionally, PUFA content contributes to increasing the HDL-C to LDL-C ratio and lowering triglycerides, all of which support protection against atherosclerosis.(Houston, 2012; Ma et al., 2022) This literature review aims to evaluate the effectiveness of sesame seeds in the management of dyslipidemia by reviewing current scientific evidence. The discussion will include the mechanisms of action of active compounds in sesame seeds on lipid metabolism, relevant clinical study findings, and aspects of safety and potential use as an adjunct therapy to conventional approaches. It is hoped that a deeper understanding of the role of sesame seeds may serve as a foundation for the development of safe and effective nutraceutical therapies for individuals at risk of cardiovascular disease.

2. METHODS

This study conducted a structured review of existing scientific literature to explore the potential of sesame seeds (Sesamum indicum L.) and their active compounds in managing dyslipidemia. Research articles were retrieved using online databases such as PubMed, Scopus, Web of Science, and Google Scholar. The search utilized keywords including “sesame,” “sesamin,” “sesamol,” “lipid levels,” “cholesterol,” and “cardiovascular health.” Studies were included if they investigated the lipid-modifying effects of sesame products through clinical trials, laboratory experiments, or animal models. Extracted data focused on the form of sesame used (such as oil, seeds, or isolated compounds), intervention dose and duration, and effects on lipid markers like

total cholesterol, LDL-C, HDL-C, and triglycerides. Additional findings on oxidative stress, inflammation, and relevant metabolic enzymes were also reviewed. Each study was assessed for its reliability, design strength, and practical relevance to therapeutic use.

3. RESULTS AND DISCUSSION

3.1 Pathophysiology of Dyslipidemia

Dyslipidemia is a metabolic disorder characterized by elevated levels of low-density lipoprotein cholesterol (LDL-C), increased triglycerides (TG), and/or decreased high-density lipoprotein cholesterol (HDL-C). This lipid imbalance plays a significant role in the pathogenesis of atherosclerotic cardiovascular disease, making it one of the major modifiable risk factors.(Berberich and Hegele, 2022; Freitas Corradi et al., 2016) Lipoproteins are macromolecular complexes composed of cholesterol, triglycerides, phospholipids, and apolipoproteins. The types include chylomicrons, very low-density lipoprotein (VLDL), intermediate-density lipoprotein (IDL), LDL, and HDL, each with a specific role in lipid transport. LDL, which delivers cholesterol to peripheral tissues, is atherogenic, whereas HDL functions in reverse cholesterol transport, carrying cholesterol from tissues back to the liver for elimination.(Berberich and Hegele, 2022)

Cholesterol and triglycerides play important roles in cellular function and energy storage. However, when their quantity or distribution is unregulated, pathological effects can occur. Triglyceride-rich lipoproteins such as VLDL and chylomicron remnants, especially those containing cholesterol esters (CE), contribute to atherosclerotic plaque formation and arterial inflammation.(Berberich and Hegele, 2022; Freitas Corradi et al., 2016) LDL-C levels are primarily regulated by LDL receptors in the liver. Disruption of receptor regulation, whether due to mutations, polygenic variations, or increased activity of proprotein convertase subtilisin/kexin type 9 (PCSK9), which accelerates receptor degradation can elevate circulating LDL levels. In familial hypercholesterolemia (FH), rare monogenic mutations in genes such as LDLR, APOB, or PCSK9 cause elevated LDL-C levels from a young age.(Berberich and Hegele, 2022) Triglyceride metabolism is regulated by the enzyme lipoprotein lipase (LpL), which breaks down triglycerides into free fatty acids for tissue uptake. LpL activity is influenced by various apolipoproteins and regulatory proteins, such as apo C-II (activator), apo C-III (inhibitor), and angiopoietin-like proteins such as ANGPTL3 and ANGPTL4, which inhibit LpL activity.(Freitas Corradi et al., 2016)

Elevated LDL-C leads to cholesterol accumulation in arterial walls. Oxidized LDL particles are phagocytosed by macrophages to form foam cells, which are the initial component of atherosclerotic plaques. This chronic inflammatory process can progress until plaques rupture, resulting in thrombotic events such as myocardial infarction, stroke, or peripheral ischemia.(Berberich and Hegele, 2022) Meanwhile, very high triglyceride levels (>10 mmol/L) may increase the risk of acute pancreatitis. Although the mechanism is not fully understood, it is believed to be related to the toxic effects of accumulated free fatty acids in the bloodstream.(Berberich and Hegele, 2022; Freitas Corradi et al., 2016) Additionally, insulin resistance in conditions such as obesity and type 2 diabetes mellitus disrupts lipid metabolism by increasing hepatic VLDL production and decreasing HDL-C levels. This results in a characteristic atherogenic dyslipidemia profile commonly seen in metabolic syndrome.(Freitas Corradi et al., 2016)

3.2 Bioactive Compounds in Sesame Seeds

Sesame seeds (Sesamum indicum L.) are a rich source of bioactive compounds that have long been recognized for their health benefits, particularly in managing dyslipidemia. Their main components include lignans (sesamin, sesamol, sesamolin), tocopherols (especially γ-tocopherol), phytosterols (such as β-sitosterol), and polyunsaturated fatty acids (PUFAs), including oleic acid and linoleic acid. These compounds work synergistically to regulate lipid metabolism, reduce oxidative stress, and improve cardiovascular function.(Dalibalta et al., 2020; Jafari et al., 2025; Ma et al., 2022)

Lignans are phenolic compounds that are characteristic of sesame seeds. Sesamin and sesamolin, the primary lignans, have demonstrated hypolipidemic effects in various preclinical and clinical studies. Sesamin acts by suppressing lipogenesis through the inhibition of lipogenic gene expression such as SREBP-1c, and by enhancing fatty acid oxidation via activation of the peroxisome proliferator-activated receptor alpha (PPARα) and AMP-activated protein kinase (AMPK) pathways. In addition to lowering total cholesterol, LDL-C, and triglycerides, sesamin has also been reported to increase HDL-C levels.(Ma et al., 2022; Oboulbiga et al., 2023) Sesamol, a minor yet highly potent lignan, possesses strong antioxidant activity. This compound protects lipoproteins, especially LDL, from oxidation, thereby inhibiting one of the early steps in the atherogenesis process. Moreover, sesamol exerts anti-inflammatory effects that help maintain vascular integrity.(Jafari et al., 2025; Oboulbiga et al., 2023)

Sesame oil is a significant source of tocopherols, particularly γ-tocopherol, which functions as a lipophilic antioxidant. Tocopherols protect cell membranes and lipoprotein particles from oxidative damage and reduce inflammation that contributes to atherosclerosis progression. The combination of tocopherols and lignans enhances the overall antioxidant capacity of sesame seeds, making them protective against oxidative stress associated with dyslipidemia and cardiovascular diseases.(Oboulbiga et al., 2023) Phytosterols, including β-sitosterol and stigmasterol, have structures similar to cholesterol and can inhibit its absorption in the intestine, thereby lowering LDL-C levels. In addition to their hypocholesterolemic effects, phytosterols also exhibit anti-inflammatory properties and contribute to maintaining endothelial function and systemic lipid balance.(Oboulbiga et al., 2023)

The fatty acid composition of sesame is dominated by unsaturated fatty acids (>80%), particularly oleic acid (a monounsaturated fatty acid, MUFA) and linoleic acid (an omega-6 PUFA). Numerous studies have shown that this composition can lower TG and LDL-C levels while increasing HDL-C. Furthermore, sesame oil has a favorable PUFA:SFA ratio (0.79) and a hypocholesterolemic to hypercholesterolemic ratio (HH = 4.82), indicating a lipid profile supportive of cardiovascular disease prevention.(Oboulbiga et al., 2023)

Sesame oil is also known to enhance the bioavailability of nitric oxide (NO), promoting vasodilation and reducing vascular inflammation. This activity is achieved through the reduction of oxidative stress, the enhancement of endogenous antioxidant activity, and modulation of vascular inflammation. These effects support the role of sesame seeds as a nutraceutical agent in slowing the progression of atherosclerosis and reducing the risk of cardiovascular complications.(Jafari et al., 2025; Oboulbiga et al., 2023)

3.3 The effectiveness of Sesame Seeds in Treating Dyslipidemia

Sesame seeds (Sesamum indicum L.) have long been used in traditional medicine and are now attracting scientific attention as a potential agent in the management of dyslipidemia. The hypolipidemic effects of sesame seeds and their bioactive compounds, such as sesamin and sesamol, have been demonstrated through various preclinical and clinical studies. Their high content of polyunsaturated fatty acids (PUFAs), lignans (particularly sesamin), tocopherols, and other antioxidants is known to contribute to improving lipid profiles and reducing cardiovascular risk.(Khatun et al., 2021; Mostashari and Mousavi Khaneghah, 2024; Parsa et al., 2024)

In animal models, sesame oil has been shown to reduce total cholesterol (TC), low-density lipoprotein cholesterol (LDL-C), and triglycerides (TG), while increasing high-density lipoprotein cholesterol (HDL-C). Zhang et al. reported that sesamin increased the activity of antioxidant enzymes such as superoxide dismutase (SOD) and reduced malondialdehyde (MDA) levels in hyperlipidemic rats. This effect was accompanied by reduced lipogenesis through inhibition of the Δ5 desaturase and fatty acid synthase enzymes, and enhanced fatty acid oxidation via activation of the PPARα and AMPK signaling pathways.(Parsa et al., 2024) A study by Khatun et al. also found that sesame oil reduced total cholesterol, LDL-C, and triglycerides while increasing HDL-C in hyperlipidemic rats, similar to the effect of atorvastatin in the positive control group.(Khatun et al., 2021)

Clinical studies in humans support these preclinical findings. One trial by Alipoor et al. showed that consuming 40 grams of white sesame seeds daily for two months in patients with hyperlipidemia significantly reduced TC, LDL-C, and the TC/HDL ratio. In addition, there was an increase in antioxidant enzyme activity (SOD and GPx) and a decrease in TBARS levels, a marker of oxidative stress. However, another study using roasted sesame seeds with similar doses and duration showed no significant results, possibly due to the impact of roasting on the bioavailability of active compounds.(Suwimol et al., 2012)

A meta-analysis by Sun et al., which included seven randomized clinical trials (RCTs), found that sesamin supplementation significantly reduced TC (WMD: -10.89 mg/dL) and LDL-C (WMD: -8.42 mg/dL), particularly in individuals with metabolic disorders. However, effects on HDL-C and TG were less consistent, suggesting that responses to sesamin may vary depending on individual metabolic conditions and intervention duration.(Sun et al., 2022)

A systematic review by Cardoso et al. also highlighted the potential of sesame seeds in improving lipid profiles. Two out of seven studies reviewed, conducted in dyslipidemic patients, consistently showed reductions in TC and LDL-C, and some also showed increased HDL-C and decreased TG. Nonetheless, the authors noted methodological weaknesses such as lack of blinding, inadequate randomization, and variability in formulation, dose, and duration of sesame use, which hinder result consistency.(Cardoso et al., 2018)

Mechanistically, sesamin works by suppressing the expression of lipogenic genes such as SREBP-1 and HMG-CoA reductase (the main target enzyme of statins), and by enhancing mitochondrial β-oxidation and lipolysis. This supports the lipid-lowering effects observed in clinical studies.(Parsa et al., 2024) Additionally, sesame seeds are considered a promising nutraceutical, with the potential to reduce LDL-C and TG, increase LDL receptor expression, and reduce inflammation and oxidative stress, two key factors in the pathogenesis of atherosclerosis.(Houston, 2012)

Overall, scientific evidence supports that sesame seeds and their active compounds, particularly sesamin, have significant potential in improving lipid profiles, especially in lowering TC and LDL-C levels. Nevertheless, differences in formulation (whole seeds, oil, roasted, or supplements), dosage, and intervention duration remain challenges in therapy standardization. Therefore, large-scale clinical trials with robust methodological design and more diverse populations are needed to confirm the efficacy and safety of sesame seeds as a dietary intervention for managing dyslipidemia.

3.4 Safety and Side Effects of Sesame Seeds in the Treatment of Dyslipidemia

Dyslipidemia, characterized by elevated LDL cholesterol, triglycerides, and decreased HDL, is one of the major contributors to cardiovascular disease. As scientific evidence continues to grow, dietary approaches involving functional foods such as sesame seeds (Sesamum indicum L.) have become a focus in dyslipidemia management strategies. Sesame seeds are rich in lignans (such as sesamin and sesamol), unsaturated fatty acids, and antioxidants that support improvements in lipid metabolism and reduce cardiovascular risk. Several clinical studies have shown that regular consumption of sesame seeds or their derivatives (such as oil, flour, or sesamin supplements) can reduce blood lipid levels. A meta-analysis by Sun et al. reported that sesamin supplementation lowered total cholesterol by 10.89 mg/dL and LDL-C by 8.42 mg/dL.(Sun et al., 2022) A systematic review by Jafari et al. reinforced these findings, noting more pronounced cholesterol and triglyceride-lowering effects at doses ⩽10 grams per day, particularly in individuals with chronic metabolic diseases.(Jafari et al., 2025) Cardoso et al. also reported significant improvements in lipid profiles among dyslipidemic patients who consistently consumed sesame derivatives.(Cardoso et al., 2018)

Beyond their hypolipidemic effects, the bioactive compounds in sesame seeds also offer antioxidant and anti-inflammatory benefits. Consumption of sesame seeds has been associated with reduced levels of C-reactive protein (CRP), interleukin-6 (IL-6), and malondialdehyde (MDA), markers of oxidative stress and inflammation that contribute to atherogenesis. These effects are especially evident in elderly populations and patients with chronic

inflammatory conditions.(Jafari et al., 2025) Mechanistically, sesamin influences various signaling pathways involved in lipid metabolism and inflammation, such as PI3K/AKT, NF-κB, and p38 MAPK. It also inhibits the enzyme Δ5-desaturase and suppresses the expression of HMG-CoA reductase, making it a potential agent with mechanisms similar to statins.(Parsa et al., 2024)

Although generally considered safe, sesame seeds may cause mild side effects. Some individuals have reported digestive complaints such as bloating or abdominal discomfort, which are typically temporary. Additionally, sesame seeds are classified as potential allergens; in sensitive individuals, consumption may trigger allergic reactions ranging from urticaria to anaphylaxis. Therefore, allergy screening is important, especially for patients with a history of atopic conditions. Drug interactions should also be considered. Although data are limited, there is potential for interactions between sesame seed bioactives and medications such as statins, anticoagulants, and antihypertensives, mainly through hepatic enzyme mechanisms or additive effects on lipid metabolism and blood pressure.(Jafari et al., 2025)

Overall, sesame seeds and their active compounds, particularly sesamin, demonstrate a favorable safety profile and therapeutic potential in managing dyslipidemia. However, variability in individual responses, the possibility of allergic reactions, and potential drug interactions must still be considered. Further research, particularly long-term clinical trials involving large populations and strict monitoring of side effects, is needed to confirm their safety and efficacy as an adjunct therapy in clinical practice.

Equations and formulae should be typed in Mathtype, and numbered consecutively with Arabic numerals in parentheses on the right hand side of the page (if referred to explicitly in the text). They should also be separated from the surrounding text by one space.

4. CONCLUSION

Sesame seeds (Sesamum indicum L.) have been proven to hold potential in the management of dyslipidemia through their effects in lowering total cholesterol, LDL-C, and triglycerides, as well as increasing HDL-C, as shown in several studies. Active compounds such as sesamin and sesamol work through the modulation of lipid metabolic pathways, antioxidant activity, and anti-inflammatory effects. Although study results vary depending on the form of preparation, dosage, and individual conditions, most show consistent benefits. In general, sesame seeds are safe for consumption, although they may cause mild side effects or allergic reactions in certain individuals. Potential interactions with medications also need to be considered. Based on existing evidence, sesame seeds have the potential to serve as an effective complementary dietary therapy, but further studies are needed to determine the optimal dosage and broader safety profile.

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