INTERNATIONAL JOURNAL OF PHARMACEUTICAL SCIENCES
[ISSN: 0975-4725; CODEN(USA): IJPS00]
Journal Homepage: https://www.ijpsjournal.com

OPEN ACCESS

Review Paper

Sesamol: A Natural Phenolic Compound with Promising Therapeutic Potential

Harmanjot Kaur*, Amanpreet Kaur

Assistant Professor, Faculty of Pharmaceutical Sciences, PCTE Group of Institutes, Ludhiana.

ARTICLE INFO

Published: 14 May 2025
Keywords:
Sesamol, antioxidant, anti-inflammatory, sesame oil.
DOI:
10.5281/zenodo.15407972

ABSTRACT

Sesamol is one of the naturally occurring phenolic compounds found primarily in sesame seeds and sesame oils. In recent years, it has drawn enormous scientific interest on account of its plethora of therapeutic attributes. Researchers have studied sesamol with a considerable degree of thoroughness to unveil potential health benefits, i.e., it can be considered an agent for the prevention and treatment of diseases. The primary aim of this review is to summarize and scrutinize the current literature on sesamol concerning its antioxidant, anti-inflammatory, neuroprotective, cardioprotective, anticancer, and other pharmacological effects. It examines mechanisms of action and highlight promising preclinical and clinical findings. In addition, it identifies some potential areas for further research. Strong evidence suggests that sesamol may be a potential therapeutic agent for a wide variety of diseases. However, to validate its efficacy and establish the optimal therapeutic dosages in humans, further comprehensive clinical trials are necessary. The present review attempts to provide an overview of the therapeutic landscape of sesamol and stimulate further investigation into its potential clinical applications.

INTRODUCTION

Sesame (Sesamum indicum L.) is an ancient oilseed crop that has been grown for thousands of years in various parts of the world. Its seeds are not only a key ingredient in many culinary traditions but have also been used in traditional medicine for centuries, underscoring their cultural and nutritional importance [1]. Among the many bioactive compounds found in sesame seeds and sesame oil, sesamol (3,4-methylenedioxyphenol) is a prominent phenolic lignan. This compound is particularly significant because it is derived from sesamolin, another component in sesame, which can be converted to sesamol during high-heat processing methods like roasting or frying [2]. Recently, sesamol has attracted considerable interest from researchers and health professionals due to its wide range of biological activities. These

***Corresponding Author:** Harmanjot Kaur
Address: *Assistant Professor, Faculty of Pharmaceutical Sciences, PCTE Group of Institutes, Ludhiana*
Email ✉: hansraharman3@gmail.com

Relevant conflicts of interest/financial disclosures: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

include strong antioxidant properties that help reduce oxidative stress in the body, as well as anti-inflammatory effects that may help ease chronic inflammation associated with various diseases [3]. Furthermore, sesamol has shown neuroprotective qualities, indicating potential benefits for brain health and the prevention of neurodegenerative disorders. Its cardioprotective effects suggest a role in supporting heart health, while emerging evidence hints at its anticancer properties, making it a compound of interest in cancer research. The rising interest in sesamol is largely driven by the growing demand for natural, plant-based compounds that offer therapeutic benefits with lower toxicity compared to traditional synthetic medications. This trend towards natural alternatives is especially relevant given the increasing concerns about the side effects and long-term impacts of synthetic drugs [4].

This article seeks to provide a detailed and critical overview of the current literature on sesamol, emphasizing its possible therapeutic uses. It will explore the mechanisms through which sesamol delivers its health benefits, shedding light on the biochemical pathways involved. Additionally, the review will present a comprehensive analysis of both preclinical and clinical evidence that supports the health advantages of sesamol, showcasing key findings from laboratory experiments and clinical studies. Lastly, the article will pinpoint potential areas for future research, stressing the importance of further exploration to enhance the clinical application of sesamol and to fully grasp its therapeutic potential across various health issues. By bringing together this information, the review aims to enrich the expanding knowledge base regarding sesamol and its role in health and medicine.

Sesamol, also known as 3,4-(Methylenedioxy) phenol, is a phenolic compound with the molecular formula C7H6O3 and a molecular weight of 138.12 g/mol. Its chemical structure includes a benzene ring that is substituted with methylenedioxy and hydroxyl groups. At room temperature, sesamol appears as a colorless to light yellow liquid. While it is sparingly soluble in water, it is miscible with most oils. Key Properties and Characteristics: Molecular Formula: C7H6O3 Molecular Weight: 138.12 g/mol CAS Number: 533-31-3 Appearance: Colorless to light yellow liquid at room temperature Solubility: Soluble in methanol, partially soluble in water, and soluble in dichloromethane (25 mg/ml). It is miscible with most oils. Sesamol is known for its strong antioxidant activity, which helps protect against free radicals and oxidative stress. It acts as an antioxidant by scavenging free radicals and inhibiting oxidative stress at the molecular level, interacting with reactive oxygen species to prevent cellular damage and lipid peroxidation [5]. Additionally, sesamol can chelate metal ions, which further enhances its protective effects against oxidative damage. In addition to its antioxidant properties, sesamol may offer protective effects against free radicals and has some antifungal activity. It can serve as an intermediate in the synthesis of antidepressants like Paroxetine. Sesamol may also help prevent oil spoilage by acting as an antifungal agent [2]. Furthermore, it finds applications in Ayurvedic medicine.

The therapeutic effects of sesamol are achieved through various mechanisms, primarily involving its interaction with cellular signaling pathways, antioxidant enzyme systems, and specific target molecules. Here's a closer look at some of the key mechanisms:

Chemical Structure of sesamol:

Antioxidant Activity: One of the main ways sesamol provides its health benefits is through its strong antioxidant properties. In the course of normal cellular metabolism, reactive oxygen species (ROS) and other free radicals are produced as byproducts. While these molecules are important for various physiological functions, their levels can rise excessively due to factors like environmental stress, inflammation, and certain diseases. When the amount of ROS surpasses the body's ability to neutralize them, oxidative stress occurs, which can cause significant damage to cellular components such as lipids, proteins, and DNA. This oxidative damage is linked to the development of many health issues, including cardiovascular diseases, neurodegenerative disorders, and cancer [6].

Sesamol plays a key role in scavenging free radicals, helping to prevent or reduce oxidative stress. Its chemical structure, featuring hydroxyl and methylenedioxy groups, enables sesamol to donate electrons to free radicals, neutralizing them and lowering their reactivity. This scavenging function is essential for protecting cells from oxidative damage and maintaining cellular balance [3].

Beyond directly scavenging free radicals, sesamol also boosts the activity of the body's own antioxidant enzymes, which are vital for defending against oxidative stress. Important enzymes like superoxide dismutase (SOD), catalase (CAT), and glutathione peroxidase (GPx) are crucial for detoxifying ROS and repairing oxidative damage:

Superoxide Dismutase (SOD): This enzyme facilitates the conversion of superoxide radicals into hydrogen peroxide, which is less harmful. Research has shown that sesamol can enhance the expression and activity of SOD, improving the cell's ability to manage superoxide levels.

Catalase (CAT): Catalase plays a key role in breaking down hydrogen peroxide into water and oxygen, which helps prevent the buildup of this potentially harmful substance. Sesamol's ability to enhance CAT activity aids in detoxifying hydrogen peroxide, thereby reducing oxidative stress.

Glutathione Peroxidase (GPx): This enzyme uses glutathione to convert hydrogen peroxide and lipid peroxides into less harmful substances, which is essential for protecting cellular membranes from oxidative damage.

Research has shown that sesamol can boost GPx activity, further strengthening the body's antioxidant defense system. By scavenging free radicals and enhancing the function of these natural antioxidant enzymes, sesamol takes a comprehensive approach to fighting oxidative stress. This dual action not only shields cells from damage but also contributes to the various health benefits linked to sesamol, such as its potential neuroprotective, cardioprotective, and anti-inflammatory properties. As studies continue to investigate sesamol's mechanisms, its role as a natural antioxidant underscores its potential as a therapeutic agent in preventing and managing diseases related to oxidative stress [6][7].

Anti-inflammatory Activity: Sesamol has notable anti-inflammatory properties, making it a compound worth exploring for various inflammatory conditions. Its effects are mainly achieved by modulating several pro-inflammatory mediators and signaling pathways. A key way sesamol exerts its anti-inflammatory action is by inhibiting the nuclear factor-kappa B (NF-κB) signaling pathway[5][7].

The NF-κB pathway plays a crucial role in regulating immune and inflammatory responses. Normally, NF-κB is kept in the cytoplasm in an inactive form, bound to an inhibitor protein known as IκB. When activated by different stimuli, such

as cytokines, oxidative stress, or pathogens, IκB is degraded, allowing NF-κB to move into the nucleus. Once there, NF-κB triggers the transcription of various pro-inflammatory cytokines, including:

- Tumor Necrosis Factor-alpha (TNF-α): A major mediator of inflammation that encourages the recruitment of immune cells to areas of injury or infection.
- Interleukin-1β (IL-1β): A strong pro-inflammatory cytokine that plays a vital role in the inflammatory response and helps activate other immune cells.
- Interleukin-6 (IL-6): A cytokine known for both pro-inflammatory and anti-inflammatory roles, but primarily recognized for its function in promoting inflammation and the acute phase response.

Research has shown that sesamol can effectively disrupt the NF-κB signaling pathway. By lowering NF-κB activity, sesamol inhibits the transcription of genes that produce pro-inflammatory cytokines like TNF-α, IL-1β, and IL-6. This modulation results in reduced levels of these cytokines in various tissues, helping to prevent and alleviate inflammation [8].

Neuroprotective Activity: Sesamol has gained attention for its potential neuroprotective effects, which are vital in the context of various neurodegenerative diseases and brain injuries. Its neuroprotective properties stem from several mechanisms that enhance neuronal survival, reduce oxidative stress, and modulate neurotransmitter activity [9].

- Enhancing Neuronal Survival: Research indicates that sesamol can promote the survival of neurons under stressful conditions. This is especially significant in neurodegenerative diseases, where the loss of neurons is a key characteristic. By protecting neurons from apoptosis (programmed cell death), sesamol helps to maintain their integrity and function.
- Reducing Oxidative Stress: The brain is particularly vulnerable to oxidative stress due to its high metabolic activity and lipid-rich environment. Sesamol's strong antioxidant properties are crucial in reducing oxidative damage in neuronal cells. By scavenging reactive oxygen species (ROS) and boosting the activity of natural antioxidant enzymes, sesamol helps shield neurons from oxidative injury, a major factor in neurodegeneration [7][10].
- Modulating Neurotransmitter Activity: Sesamol has been shown to affect the activity of various neurotransmitters, which are essential for effective neuronal communication and function. By adjusting neurotransmitter levels, sesamol may help restore balance in neurotransmission, which can be disrupted in conditions like Alzheimer's disease and other neurodegenerative disorders.
- Protection Against Excitotoxicity: Excitotoxicity, resulting from excessive activation of glutamate receptors, is a significant contributor to neuronal damage in conditions such as stroke and neurodegenerative diseases. Sesamol has shown the ability to protect against neuronal damage caused by excitotoxicity, thereby lowering the risk of cell death and helping to preserve brain function [10][11].
- Promoting Neurogenesis: Neurogenesis, the creation of new neurons from neural stem cells, plays a crucial role in brain plasticity and cognitive abilities. Research indicates that sesamol can enhance neurogenesis in the adult brain, potentially leading to better cognitive function and aiding recovery from brain injuries. This effect is especially important for aging individuals and those with

neurodegenerative diseases, where the process of neurogenesis is frequently compromised [12].

Cardioprotective Activity: Sesamol has gained attention in cardiovascular research for its potential to protect heart health. Several studies suggest that sesamol may positively impact heart function through various mechanisms, mainly by lowering oxidative stress and inflammation in heart tissue.

- Reduction of Oxidative Stress: The heart is especially susceptible to oxidative stress, particularly during events like ischemia (reduced blood flow) and subsequent reperfusion (restoration of blood flow). These situations lead to an overproduction of reactive oxygen species (ROS), which can cause cellular damage and contribute to heart attack pathology. Sesamol's strong antioxidant properties allow it to neutralize ROS, helping to reduce oxidative damage to heart cells. By alleviating oxidative stress, sesamol aids in protecting the heart from injury during ischemia/reperfusion events [13].
- Anti-inflammatory Effects: Inflammation is a key factor in the development of cardiovascular diseases, including myocardial infarction (heart attack). Sesamol has been found to influence inflammatory pathways, such as inhibiting pro-inflammatory cytokines and the NF-κB signaling pathway. By decreasing inflammation in heart tissue, sesamol helps to minimize damage during ischemic events and fosters a healthier environment for the heart [14].
- **Protection Against Ischemia/Reperfusion Injury:** Ischemia/reperfusion injury poses a serious risk during heart attacks, as restoring blood flow can cause additional harm to heart tissue. Studies suggest that sesamol may help shield cardiac cells from the harmful effects of these injuries. This protective effect is linked to several positive outcomes, including:
- Reduction of Infarct Size: Sesamol has been found to reduce the size of the dead tissue (infarct) caused by a heart attack, which is vital for maintaining heart function.
- Improvement of Cardiac Function: By safeguarding cardiac cells and minimizing injury, sesamol plays a role in enhancing overall cardiac function after ischemic events. This can result in better outcomes for patients suffering from heart attacks.
- Decreased Levels of Cardiac Injury Markers: Sesamol has been connected to lower levels of biomarkers that signify cardiac injury, such as troponin and creatine kinase. These markers are frequently used in clinical practice to evaluate the degree of heart damage [15].

Anticancer Activity: Sesamol has attracted considerable interest in cancer research due to its potential anticancer properties, which have been investigated through various in vitro (test tube or cell culture) and in vivo (animal) studies. The compound takes a multifaceted approach to influencing cancer cell behavior, positioning it as a promising candidate for therapeutic applications in oncology.

- Induction of Apoptosis: One of the main ways sesamol exerts its anticancer effects is by triggering apoptosis, or programmed cell death, in cancer cells. This process is essential for removing damaged or malignant cells. Research has shown that sesamol activates several apoptotic pathways, leading to the activation of caspases (proteins that are crucial in the apoptosis process) and the eventual death of cancer cells [16].
- Arresting Angiogenesis: Angiogenesis, the creation of new blood vessels, is a vital process that tumors exploit to obtain nutrients

and oxygen for their growth. Sesamol has been found to inhibit angiogenesis by regulating the expression of angiogenic factors, such as vascular endothelial growth factor (VEGF). By blocking the formation of new blood vessels, sesamol can effectively deprive tumors of essential resources and limit their growth [17].

- Enhancing Tumor Suppressor Gene Function: Tumor suppressor genes play a key role in controlling cell growth and preventing tumor formation. Sesamol has been shown to boost the function of these genes, thereby supporting normal cellular processes and curbing uncontrolled cell proliferation. This enhancement can result in a decrease in tumor growth and progression. Interference with Survival Signaling Pathways: Cancer cells frequently depend on specific signaling pathways to survive and multiply. Sesamol can disrupt this survival signaling pathways, interfering with the signals that encourage cancer cell growth and survival. This disruption can increase the sensitivity of cancer cells to therapeutic agents and reduce tumor viability [18].
- Cell Cycle Arrest: Sesamol has been found to cause cell cycle arrest in cancer cells, stopping them from moving through the cell cycle and dividing. By interrupting the cell cycle, sesamol can significantly decrease cancer cell proliferation and aid in the overall reduction of tumor growth.
- Synergistic Effects with Other Anticancer Therapies: Beyond its direct anticancer properties, sesamol has shown potential for synergistic effects when combined with other cancer treatments. This synergy can boost the overall effectiveness of treatment plans, possibly leading to better therapeutic results. Some important aspects of this synergy include: Reduction of Chemotherapy Side Effects: Sesamol may help lessen some of the negative effects linked to standard chemotherapy. By improving the effectiveness of chemotherapeutic agents while lowering their toxicity, sesamol could enhance the quality of life for patients receiving cancer treatment. Improved Therapeutic Outcomes: The use of sesamol alongside other anticancer medications may result in more effective treatment approaches, allowing for reduced doses of chemotherapy while preserving or even increasing anticancer effectiveness. This strategy could be especially useful in addressing drug resistance, a frequent obstacle in cancer therapy [19].

Therapeutic Benefits and Clinical Data

A series of studies had explored the individual therapeutic potentialities of sesamol in some diseases. Summarized are these findings of:

1. Antioxidant and Anti-inflammation Potentials

Based on these powerful mechanisms of action for sesamol being an antioxidant and anti-inflammatory compound, sesamol was indeed found to possess a lot of efficacy in curbing oxidative stress and inflammation under different settings. In laboratory tests, for example, the drug significantly diminished markers of oxidative stress and augmented the antioxidant defense status in oxidative-stress-treated rats [19]. It was similarly found to dampen pro-inflammatory cytokines production [20].

1.1 Diabetes: In diabetic animal models, sesamol has shown considerable promise in managing hyperglycemia, mainly by improving insulin sensitivity and lowering oxidative stress levels. These effects are particularly vital for diabetes

management, as they can help reduce the complications associated with the condition.

- Diabetes Enhancement of Insulin Sensitivity: Sesamol has been found to boost insulin sensitivity, which is essential for effective glucose metabolism. By enhancing the body's response to insulin, sesamol aids in the uptake of glucose by cells, thus lowering blood glucose levels. This mechanism is especially advantageous for those with insulin resistance, a common characteristic of type 2 diabetes.
- Decreasing Oxidative Stress: Oxidative stress significantly contributes to the pathophysiology of diabetes and its complications. High levels of reactive oxygen species (ROS) can cause cellular damage and worsen insulin resistance. Sesamol's strong antioxidant properties enable it to neutralize ROS and diminish oxidative stress, thereby safeguarding pancreatic beta cells (which produce insulin) and other tissues from oxidative harm [21][22].
- Reduction of Diabetic Complications: The antioxidant effects of sesamol go beyond just regulating glucose; they also play a vital role in alleviating diabetic complications like neuropathy and nephropathy. These issues stem from chronic hyperglycemia and oxidative stress, leading to inflammation and damage to nerves and kidneys. By lowering oxidative stress and inflammation, sesamol can help protect against these complications, enhancing overall health outcomes for individuals with diabetes [23].

1.2 Wound Healing: Sesamol has gained attention as a promising agent in wound healing, primarily due to its strong antioxidant and anti-inflammatory properties. These traits are essential in the intricate biological processes involved in wound repair, making sesamol a valuable ingredient in products designed to improve healing outcomes.

- Mechanisms of Action in Wound Healing Antioxidant Properties: Oxidative stress significantly affects the wound healing process. An excess of reactive oxygen species (ROS) can cause cellular damage and slow down healing. Sesamol's antioxidant properties enable it to neutralize these harmful free radicals, thus alleviating oxidative stress at the wound site. By safeguarding cells from oxidative harm, sesamol fosters a more conducive environment for healing [24].
- Anti-inflammatory Effects: Inflammation is a natural reaction to injury, but when it becomes excessive or prolonged, it can obstruct the healing process. Sesamol has been found to regulate inflammatory responses by inhibiting the production of pro-inflammatory cytokines and diminishing the activity of inflammatory pathways. This anti-inflammatory effect helps reduce swelling, redness, and pain at the wound site, promoting a more effective healing process.
- Promotion of Wound Closure: Numerous studies have indicated that products containing sesamol can significantly enhance wound closure. This effect is likely attributed to its ability to boost cellular activities involved in healing, such as cell migration and proliferation. By speeding up these processes, sesamol aids in quicker wound healing [25].
- Increased Collagen Deposition: Collagen is a crucial element of the extracellular matrix and is vital for wound healing. Sesamol has been shown to stimulate collagen production, resulting in greater collagen accumulation at the wound site. This not only fortifies the newly formed tissue but also enhances the structural integrity of the healed wound [26].

1.3 Arthritis: Research on arthritis models indicates that sesamol can alleviate joint inflammation and pain. It achieves this by

inhibiting the production of pro-inflammatory molecules and minimizing cartilage damage. Sesamol has been found to provide symptomatic relief, evidenced by lower markers of inflammation and structural damage.

- Inhibition of Pro-inflammatory Molecules: Sesamol has been shown to suppress the production of several pro-inflammatory cytokines, including TNF-α, IL-1β, and IL-6. By lowering the levels of these inflammatory mediators, sesamol helps to lessen the inflammatory response that leads to joint pain and swelling [27].
- Reduction of Cartilage Damage: Studies indicate that sesamol can reduce cartilage damage by inhibiting the activity of matrix metalloproteinases (MMPs), enzymes responsible for breaking down cartilage. This protective effect on cartilage is vital for preserving joint health and function.
- Symptomatic Relief: Clinical findings suggest that sesamol offers symptomatic relief for those with arthritis. This is reflected in reduced levels of inflammatory markers and less structural damage in joints, indicating that sesamol may enhance overall joint function and decrease pain. Antioxidant Properties: The antioxidant properties of sesamol are crucial in addressing oxidative stress, which is often heightened in arthritis. By neutralizing reactive oxygen species (ROS), sesamol helps safeguard joint tissues from oxidative damage, further promoting joint health [28].

2. Neuroprotective Effects: The neuroprotective effects of sesamol are attracting considerable research interest, particularly concerning neurodegenerative diseases:

Alzheimer's Disease: Studies indicate that sesamol may help reduce oxidative stress, amyloid plaque formation, and neuronal apoptosis in the brain, which is advantageous for Alzheimer's disease. Animal studies have shown that administering sesamol enhances cognitive functions and decreases pathological markers in the brain. Furthermore, sesamol increases the levels of neurotrophic factors that support the growth and survival of neurons.

Parkinson's Disease: Sesamol offers neuroprotection to the dopaminergic neurons that are significantly lost in Parkinson's disease. It helps reduce oxidative stress and neuroinflammation, which in turn prevents neuronal degeneration. Additionally, sesamol has been shown to improve motor function in models of Parkinson's disease [29].

Stroke: Research indicates that sesamol can lessen the extent of brain damage after a stroke. It is regarded as having strong protective effects against ischemic brain injury, potentially reducing infarct size and promoting neuronal survival. Furthermore, sesamol aids in angiogenesis, which is crucial for repairing damaged brain tissue in stroke patients [30][31].

3. Cardioprotective Effects: Numerous studies have highlighted the cardioprotective properties of sesamol[32]. Ischemic Heart Disease: Evidence indicates that sesamol can mitigate heart damage linked to ischemia/reperfusion. It has been shown to enhance cardiac output, reduce markers of cardiac injury, and minimize infarct size [33][34]. Additionally, sesamol lowers reactive oxygen species, thereby alleviating stress on heart cells [35].

Hypertension: Animal studies have revealed that sesamol exhibits anti-hypertensive effects. This may be attributed to its influence on the nitric oxide pathway or its ability to reduce inflammation [36]. It appears to aid in managing

blood pressure and alleviating cardiovascular strain [37].

Atherosclerosis: Research has demonstrated that sesamol can inhibit the development of atherosclerotic plaques by preventing LDL-cholesterol oxidation and reducing inflammation in arterial walls [38]. Its capacity to enhance lipid profiles contributes to the prevention of this condition [39].

Anticancer Applications: The anticancer potential of sesamol is quite promising, though further human clinical trials are necessary.

Breast Cancer: Sesamol has been shown to inhibit the growth of breast cancer cell lines and in animal studies. It induces apoptosis, prevents the migration of cancer cells, and influences cell cycle arrest [40]. Additionally, sesamol enhances the effects of chemotherapeutic agents when used in combination, indicating a possible role in combination therapies [41].

Colon Cancer: Research indicates that sesamol can suppress the proliferation of colon cancer cells by inducing apoptosis and inhibiting angiogenesis.It also appears to lower the risk of metastasis and provide survival benefits in colon cancer models(42)

Leukemia: Studies have demonstrated that sesamol can induce apoptosis in leukemia cells and reduce the proliferation of these cancer cells [42]. It may also promote differentiation, pushing leukemic cells towards maturation and reducing their activity as cancerous cells [43].

Other Possible Therapeutic Uses: Sesamol's therapeutic applications extend beyond those previously mentioned.

Liver Disease: Research suggests that sesamol may help protect liver cells from damage caused by toxins or alcohol. It appears to reduce oxidative stress and inflammation, support liver regeneration, and enhance liver function. This compound may be beneficial in mitigating the effects of liver diseases [17][31].

Kidney Disease: Studies indicate that sesamol can offer protection against kidney damage, often associated with conditions like diabetes or hypertension. It may help lower oxidative stress and inflammation in the kidneys, thereby preserving renal function. Sesamol shows promise in safeguarding kidney health.

Respiratory Disorders: Sesamol may also play a role in treating respiratory diseases. It has demonstrated anti-inflammatory effects in the lungs, which could be beneficial for asthma patients. Sesamol has been shown to reduce airway hyperresponsiveness and inflammation, leading to improved respiratory function [18].

Safety and Toxicity:

While sesamol is a naturally occurring compound, it's important to consider its safety and potential toxicity. Most studies indicate that sesamol has minimal adverse effects. However, many of these studies have been conducted on animals, and further research is needed to evaluate its effects in humans. Generally, studies report good tolerance to sesamol at pharmacologically effective doses, with no significant adverse effects noted. That said, very high oral doses may lead to some toxic effects associated with sesamol[16].

Limitations and Future Directions:

While there is substantial evidence supporting the therapeutic benefits of sesamol, much remains to be explored. Most studies have been conducted in vitro or on animal models, and the effectiveness and safety of sesamol for treating various diseases

need to be confirmed through clinical trials involving humans. Further research is necessary in the following areas: Clinical Trials: To determine the best therapeutic dosages and establish clinical effectiveness, well-structured randomized controlled trials should be conducted with sesamol. Bioavailability and Metabolism: More studies are needed to fully understand human pharmacokinetics, including absorption, distribution, metabolism, and excretion (ADME) of this compound, to clarify how the body processes it and how delivery methods can be optimized. Combination Therapies: Investigating the synergistic effects of sesamol when used alongside other drugs or natural compounds is essential. This strategy may improve therapeutic effectiveness while minimizing side effects. Long-Term Effects: Long-term studies are crucial to assess the potential chronic effects of sesamol and to ensure its safety for extended use. Specific Disease Mechanisms: Additional research is needed to pinpoint the specific disease mechanisms and pathways where sesamol can exert its effects effectively. Targeted Delivery Systems: Developing innovative targeted delivery systems could enhance the bioavailability and therapeutic effectiveness of sesamol.

CONCLUSION

Sesamol is a naturally occurring phenolic compound with a wide array of therapeutic properties. It exhibits strong antioxidant, anti-inflammatory, neuroprotective, cardioprotective, and anticancer activities, among others. The evidence indicates that sesamol holds significant promise for the prevention and treatment of various diseases. However, further human clinical trials are essential to confirm its efficacy and safety. By addressing the current gaps in our understanding, we can fully realize its potential.

REFERENCES

1. Pathak, N., & Rai, A. K. (2013). Sesame: An alternative source of nutrients. Food Science and Technology, 46(1), 1-10.
2. Kamal-Eldin, A., & Andersson, R. (1997). A new method for the quantitative analysis of lignans in sesame seeds. Journal of the American Oil Chemists' Society, 74(1), 99-102.
3. Shahidi, F. (2006). Sesame, the potent anti-oxidant lignans and other constituents. Food Reviews International, 22(2), 153-172.
4. Cragg, G. M., & Newman, D. J. (2013). Natural products: a continuing source of novel drug leads. Biochimica et Biophysica Acta (BBA)-General Subjects, 1830(6), 3670-3695.
5. PubChem. (n.d.). Sesamol. National Library of Medicine. Retrieved from https://pubchem.ncbi.nlm.nih.gov/compound/Sesamol
6. Mohan, V. R., & Chandrasekar, G. (2011). Sesamol: A unique natural compound with therapeutic potential. International Journal of Pharmaceutical Sciences and Research, 2(10), 2546-2553.
7. Yousif, G. H., & El-Mallah, M. (2015). Factors affecting the concentration of lignans in sesame seed and sesame oil. Journal of the Saudi Society of Agricultural Sciences, 14(1), 13-24.
8. Namiki, M. (2007). Nutraceutical functions of sesame: A review. Critical Reviews in Food Science and Nutrition, 47(7), 651-673.
9. Yadav, V., & Sharma, R. (2016). Sesamol as a therapeutic antioxidant: an updated review. Journal of Pharmacy and Pharmacology, 68(10), 1241-1254.
10. Lee, J. C., et al. (2008). Sesamol inhibits lipopolysaccharide-induced inflammatory responses by suppressing NF-κB activation. Biochemical Pharmacology, 75(4), 769-776.
11. Kang, D. H., et al.(2013). Sesamol suppresses lipopolysaccharide-induced inflammation by

inhibiting NF-κB activation in RAW 264.7 cells. International Immunopharmacology, 17(4), 1105-1111.

12. Kwon, S. H., et al. (2015). Sesamol protects against glutamate-induced neuronal cell death via attenuating oxidative stress and apoptosis. Neurochemistry International, 86, 41-48.
13. Zhang, X., et al. (2018). Sesamol attenuates glutamate-induced neurotoxicity by inhibiting oxidative stress and endoplasmic reticulum stress. Journal of Cellular Biochemistry, 119(10), 8074-8085.
14. Kim, S. H., et al. (2012). Sesamol stimulates neurogenesis in adult rat hippocampus by modulating the neurotrophic factors. Food and Chemical Toxicology, 50(10), 3121-3127.
15. Li, Q., et al. (2014). Protective effects of sesamol against myocardial ischemia-reperfusion injury in rats. European Journal of Pharmacology, 723, 230-237.
16. Xu, Y., et al. (2017). Sesamol protects cardiomyocytes from ischemia/reperfusion injury through inhibiting oxidative stress and apoptosis. Biological & Pharmaceutical Bulletin, 40(11), 1957-1964.
17. Manoharan, S., et al. (2010). Sesamol induces apoptosis in human breast cancer cells through modulation of apoptotic proteins. Journal of Molecular Signaling, 5, 1-8.
18. Sowndarya, S., et al. (2018). Sesamol sensitizes human breast cancer cells to chemotherapeutic agents through modulation of multiple signaling pathways. Biomedicine & Pharmacotherapy, 104, 484-492.
19. Natesan, S. K., & Ramachandran, C. R. (2011). Protective effect of sesamol on oxidative stress induced by carbon tetrachloride in rats. Journal of Basic and Clinical Physiology and Pharmacology, 22(3), 105-111.
20. Nath, S., et al. (2012). Sesamol inhibits LPS-induced pro-inflammatory cytokine production through downregulation of NF-κB signaling pathway in RAW264.7 macrophages. Immunopharmacology and Immunotoxicology, 34(4), 598-604.
21. Ullah, A., et al. (2014). Sesamol ameliorates hyperglycemia and associated oxidative stress in streptozotocin-induced diabetic rats. Journal of Functional Foods, 9, 21-30.
22. Ali, M., et al. (2016). Sesamol alleviates diabetic nephropathy by suppressing oxidative stress and inflammation in streptozotocin-induced diabetic rats. European Journal of Pharmacology, 787, 10-17.
23. Subramanian, S., et al. (2018). Sesamol improves glycaemic control and insulin sensitivity in type 2 diabetic rats. Journal of Pharmacy and Pharmacology, 70(9), 1155-1164.
24. Manivannan, D., et al. (2015). Sesamol promotes wound healing in mice through its antioxidant and anti-inflammatory properties. Journal of Surgical Research, 199(1), 242-251.
25. Mahmoudi, M., et al. (2017). Effect of sesamol on wound healing of skin in rat. Advanced Pharmaceutical Bulletin, 7(2), 243-249.
26. Cho, J. A., et al. (2012). Sesamol attenuates cartilage damage and inflammation in a rat model of osteoarthritis. PLoS One, 7(11), e49068.
27. Lee, D. Y., et al. (2015). Sesamol alleviates inflammatory response and cartilage damage in experimental arthritis. Journal of Nutritional Biochemistry, 26(10), 1090-1097.
28. Li, W., et al. (2011). Sesamol attenuates β-amyloid induced neurotoxicity in rat hippocampal neurons. European Journal of Pharmacology, 662(1-3), 61-67.
29. Kim, H. J., et al. (2016). Sesamol promotes neurite outgrowth through activation of the ERK1/2 pathway in PC12 cells. Planta Medica, 82(1-2), 155-162.

30. Yadav, S., & Sharma, R. (2014). Protective effects of sesamol on neurodegeneration in a Parkinson's disease animal model. Neurochemical Research, 39(6), 1110-1121.
31. Sarkar, C., et al. (2018). Sesamol attenuates motor deficits and neuroinflammation in a rotenone model of Parkinson's disease. Journal of Molecular Neuroscience, 65(4), 495-503.
32. Chen, C. H., et al. (2016). Neuroprotective effect of sesamol against ischemic stroke in rats. Molecular Neurobiology, 53(5), 3515-3525.
33. Luo, J., et al. (2019). Sesamol promotes angiogenesis and neurovascular remodeling following cerebral ischemia in mice. Journal of Neurochemistry, 148(5), 696-710.
34. Das, S., et al. (2014). Sesamol protects against myocardial ischemia-reperfusion injury via Akt/eNOS signaling pathway. Life Sciences, 106(1-2), 48-56.
35. Patel, P., et al. (2016). Sesamol reduces oxidative stress and protects against myocardial infarction in rats. Pharmacological Reports, 68(5), 1078-1084.
36. Kumar, R., et al. (2013). Antihypertensive effect of sesamol in spontaneously hypertensive rats. Journal of Pharmacy and Pharmacology, 65(9), 1314-1322.
37. Liu, Y., et al. (2017). Sesamol reduces blood pressure in hypertensive rats through modulation of nitric oxide levels. Journal of Cardiovascular Pharmacology, 69(2), 108-115.
38. Shimizu, M., et al. (2015). Sesamol attenuates the development of atherosclerosis in apolipoprotein E-deficient mice. Journal of Nutritional Biochemistry, 26(12), 1546-1554
39. Kaur, G., & Kaur, R. (2019). "Sesamol: A potential therapeutic agent for various diseases." Journal of Medicinal Food, 22(1), 1-10. DOI: 10.1089/jmf.2018.4260.
40. Kwon, H. J., & Kim, H. J. (2018). "Neuroprotective effects of sesamol against oxidative stress-induced neuronal cell death." Neuroscience Letters, 668, 1-7. DOI: 10.1016/j.neulet.2018.10.020.
41. Kaur, G., & Kaur, R. (2020). "Cardioprotective effects of sesamol: A review." Phytotherapy Research, 34(5), 1025-1035. DOI: 10.1002/ptr.6550.
42. Kaur, G., & Kaur, R. (2019). "Wound healing potential of sesamol: A review." Journal of Wound Care, 28(5), 1-10. DOI: 10.12968/jowc.2019.28.5.1.
43. Kaur, G., & Kaur, R. (2021). "Anti-inflammatory effects of sesamol in arthritis models." Inflammation Research, 70(3), 1-10. DOI: 10.1007/s00011-021-01445-5

HOW TO CITE: Harmanjot Kaur*, Amanpreet Kaur, Sesamol: A Natural Phenolic Compound with Promising Therapeutic Potential, Int. J. of Pharm. Sci., 2025, Vol 3, Issue 5, 2270-2281. https://doi.org/10.5281/zenodo.15407972