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Essential oils in influencing gene expression involved in hypertension: a Scoping Review

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Abstract: Hypertension, one of global health problems, is often treated with antihypertensive drugs that may cause adverse drug reactions, thus increasing interests in alternative therapies such as essential oils which are known to have antioxidant and anti-inflammatory properties. This study aimed to assess the effect of essential oils on gene expression involved in the regulation of blood pressure through a scoping review of available research that explore the potential benefit of essential oils as a natural complementary therapy. This study is reported according to PRISMA protocol for scoping review. We have selected 24 relevant articles that were published from 2019-2024. Thematic analysis was applied to identify important patterns and themes from the published literature to gain in-depth insights into the topic under study. The results showed that essential oils have significant potential benefits in influencing the expression of genes involved in hypertension through antioxidant and anti-inflammatory mechanisms. Compounds such as linalool, eugenol, and allicin play key roles. Analysis of the selected articles showed that essential oils can lower blood pressure by modulating genetic pathways related to oxidative stress and inflammation. This study highlights the potential benefit of essential oils as a natural complementary therapy for hypertension, although the exact mechanisms and effectiveness in larger population still requires further research.

Keywords: Essential Oil, Gene Expression, Hypertension

Introduction

Hypertension or high blood pressure is one of the significant global health problems, affecting millions of people worldwide. According to Ke et al. (2021), treatment of hypertension is generally done through lifestyle modification accompanied by the administration of antihypertensive drugs, but long-term use of these drugs also carries the risk of unwanted drug reactions (ROTDs) or unwanted side effects. Therefore, there is an increasing interest in complementary and alternative therapies, one of which is essential oils.

Essential oils have been known to have antioxidant and anti-inflammatory properties, thus potentially providing a more natural and less side-effect therapeutic solution for various health conditions, including inflammation, skin disorders, and oxidative stress that can trigger chronic diseases (Baptista-Silva et al., 2020).Essential oils, which are extracted from aromatic plants, have long been used in various traditional medicine practices around the world. Some of the active components in essential oils, such as linalool, limonene, and eugenol, are known to have pharmacological properties that can have a relaxing effect on blood vessels and lower blood pressure (Soares et al., 2021). Batiha et al. (2023) showed that the compound linalool in lavender essential oil can induce relaxation in vascular smooth muscle, which has implications for lowering blood pressure. With the increasing interest in herbal therapy, further

research on the mechanism of action of essential oils against hypertension is important to explore.

Hypertension is not only influenced by environmental factors, such as diet and lifestyle, but also by genetic factors. Genes such as angiotensinogen (AGT), angiotensin II receptor (AGTR1), endothelin-1 (ET-1), and nitric oxide synthase (NOS) are known to play important roles in regulating blood pressure balance (Laxmi et al., 2024). Mutations or changes in the expression of these genes can trigger hypertension, so research on genetic regulation in hypertension is growing. According to Shahid et al. (2022), overexpression of the AGT gene correlates with increased blood pressure in individuals with a genetic predisposition to hypertension.

Early research showed that some compounds in essential oils can modulate the expression of genes that play a role in blood pressure regulation. Jesus et al. (2023) showed that the eugenol compound in clove oil can suppress the expression of the AGTR1 gene that plays a role in increasing blood pressure. However, the exact mechanism of this interaction is still not fully understood and requires further study. Systematic studies on the relationship between essential oils and gene expression in hypertension may provide new insights into the potential use of essential oils as molecular therapy in hypertension.

Although several studies have indicated the potential of essential oils in lowering blood pressure, there is still little scientific evidence reporting on how essential oils affect gene expression associated with hypertension. This creates an important research gap to fill in order to deepen the understanding of the molecular mechanisms behind the therapeutic effects of essential oils in hypertension. A scoping review of the existing literature is necessary to map research on the effects of essential oils on the expression of genes involved in blood pressure regulation (Peterfalvi et al., 2019).

This study aims to conduct a scoping review of studies that have explored the effect of essential oils on the expression of hypertension-related genes. Through this approach, a more comprehensive understanding of the potential benefits of essential oils as a complementary therapy in hypertension is expected. The findings of this study are expected to serve as a foundation for the development of herbal-based genetic therapy and enrich the literature on natural-based hypertension treatment.

Method

The methodology used in this research involves several important stages.

1. Establishing inclusion criteria and keywords
2. Screening the titles and abstracts with those keywords
3. Full-text screening of selected articles
4. Extraction of data from selected full-text

The selection criteria used to select the literature involved consideration of the time period of publication, relevance to the theme of essential oils and their effect on hypertension and credibility of the sources from the Google Schoolar Dataset. After conducting the selection process using the specific keywords “essential oils”, “gene expression regulation”, and “hypertension” as well as sorting the articles by publication year 2019-2024, we found 24 articles for further review. A search for previously published articles was conducted through the online resource Google Schoolar. The next process was data analysis, which involved collecting, reviewing and analyzing the selected publications. This analysis technique allowed the researcher to gain deeper insights into the topic under study and gain a rich understanding of the sustainability issues being studied.

The reporting of this study refers to the PRISMA scoping review protocol which consists of identifying, screening and inclusion of selected articles (Page et al., 2021). Then, researchers conducted a descriptive analysis of the selected articles or studies. The main objective was to organize the complex literature data and highlight important themes that emerged from the published research based on the following inclusion and exclusion criteria.

Inclusion Criteria:

1. The article is accessible in full-text.
2. Research addresses essential oils with high linalool content, or essential oils from plants such as rose, coriander, cinnamon, and lavender.
3. The study involves populations with hypertension or discusses the effects of essential oils on hypertensive conditions.
4. Articles must be published within 2019-2024.
5. Articles are related to the fields of Molecular Biology, Pharmacology and Therapeutics, or Cardiovascular Medicine.
6. Only articles with article research document type.
7. English language articles.

Exclusion Criteria:

1. Articles that only involve experimental animals or in-vitro cells, without involving humans or population samples with hypertension.
2. Articles that did not directly discuss essential oils with linalool content or essential oils from the plants mentioned.
3. Articles that only provide abstracts or cannot be accessed in full-text.
4. Studies that are not relevant to cardiovascular disease, hypertension, diabetes or inflammation. For example, studies that focus on non-cardiovascular diseases or have no relation to therapeutic effects.
5. Studies that do not involve essential oils, medicinal plants, or nutraceuticals. Example: studies on the effects of synthetic compounds or conventional pharmacology without natural components.

Result and Discussion Results

From the search results using Google Scholar with relevant keywords and the range of publication years 2019-2024, 114 articles were obtained. Article screening was conducted by examining all texts that met the inclusion criteria. 24 articles that fit the purpose of this study were obtained. The flowchart of article selection is presented in the following figure.

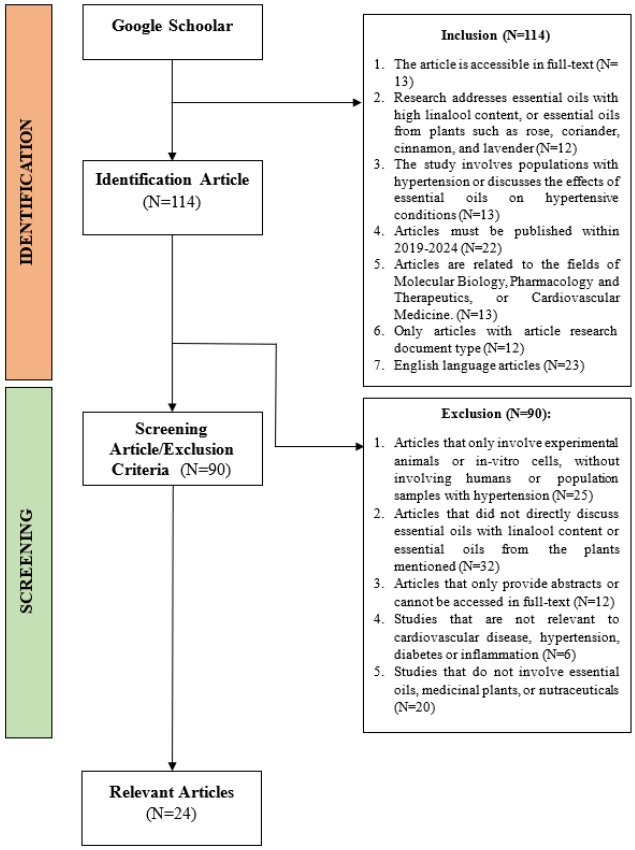

Figure 1 Flowchart of Research Article Selection

Table 1: Number of Articles Based on Year of Publication

Year of Publication	Frekuensi Artikel
2019	5
2020	9
2021	8
2022	3
2023	0
2024	0
Total	**24**

According to Table 1, the number of publications of research articles on the effect of essential oils on the expression of genes involved in blood pressure regulation showed fluctuations. The highest number of related research articles was published in 2020, but there were no new publications in 2023 and 2024. During the specified period of publication years, there was a downward trend in the publication of related articles since 2020. As for the results of previous studies can be presented as follows:

Table 2. Screenig Results of Article used in the Scooping Review

No	Researcher	Purpose	Research Methodology	Population	Type of Research	Relevant Findings
1	Younis & Mohammed (2021)	To examine the effects of Myrrh essential oil on cardiac function, oxidative status, apoptosis, and inflammation in myocardial infarction (MI).	Normal and Myrrh control animals were administered saline and Myrrh essential oil for thirty days. On the 29th and 30th day, animals were injected with saline and ISO. Myrrh treatment groups received Myrrh essential oil for 30 days before ISO injection.	Animal Study	Experimental Research	Myrrh essential oil showed effective cardio-protective actions in the MI model by improving oxidative conditions, reducing apoptosis, and inflammatory responses.
2	Ajebli & Eddouks (2020)	To critically analyze research studies on the blood pressure-lowering abilities of medicinal plant derivatives.	Reviewed experimental and clinical investigations from the last decade regarding antihypertensive effects of various plant derivatives, including their mechanisms of action.	Literature Review	Review Article	Several medicinal plants such as garlic and black cumin showed efficacy in lowering blood pressure; there is a need for more standardization in experimental methods.
3	Patrignani et al. (2021)	To discuss the cardioprotective effects of Lamiaceae and their active compounds against cardiovascular diseases.	Review of the use of Lamiaceae plants in traditional medicine and their mechanisms against cardiovascular diseases.	Literature Review	Review Article	Lamiaceae species can prevent cardiovascular diseases and show promise in developing new natural products for treatment.
4	Almatroodi et al. (2020)	To give an overview of the role of cinnamon and its active compounds in health management.	Analyzed epidemiological studies on cinnamon's effects on various diseases, including its antioxidant and anti-inflammatory properties.	Literature Review	Review Article	Cinnamon exhibits multiple therapeutic potentials, including antioxidant and anti-diabetic activities.
5	Bagheri et al. (2019)	To evaluate the effects of Pistacia atlantica oleoresin on oxidative stress	Adult male Wistar rats were divided into groups for treatment with PAO, glibenclamide, and	Animal Study	Experimental Research	PAO significantly decreased oxidative stress markers and improved antioxidant enzyme levels, suggesting

		markers in diabetic rats.	control; oxidative stress markers and antioxidant enzymes were measured.			protective effects against oxidative stress-related diseases.
6	Ji et al. (2019)	To examine the effects of essential oil extracted from Fructus Alpinia zerumbet on endothelial injury and inflammation.	In vitro and in vivo studies were conducted, using LPS-induced endothelial cell injury models.	Animal Study, Cell Culture	Experimental Research	EOFAZ prevented LPS-induced endothelial injury and inflammation, likely through inhibition of TLR4-dependent NF-κB signaling.
7	Ghaffari et al. (2020)	To summarize recent findings on nutraceuticals and their role in managing hypertension.	Review of clinical experiments assessing the impact of various nutraceuticals on blood pressure regulation and cardiovascular risks.	Literature Review	Review Article	Nutraceuticals, including various vitamins and spices, can help in preventing and treating hypertension through diverse mechanisms.
8	Guesmi et al. (2020)	To investigate the cardioprotective effects of terpenes extracted from Thymus algeriensis against cardiotoxicity.	Thirty rats were divided into groups; some received H2O2 to induce cardiotoxicity, while others received terpenes.	Animal Study	Experimental Research	Terpenes from T. algeriensis demonstrated antioxidant properties, reducing H2O2-induced cardiac damage and improving antioxidant defenses.
9	Aponso et al. (2020)	To identify physicochemical properties influencing essential oil volatility and brain uptake pathways.	Meta-analysis of animal studies assessing the effects of essential oils on anxiety and oxidative stress indicators.	Literature Review	Review Article	Essential oils can regulate anxiety and oxidative stress biomarkers in a dose-dependent manner, supporting their use in aromatherapy.
10	Zhang & Yao (2019)	To provide an overview of anxiolytic effects of essential oils in clinical and preclinical studies.	Review of various studies assessing the anxiolytic effects of essential oils through different administration methods (inhalation, massage, etc.).	Literature Review	Review Article	Many essential oils showed anxiolytic effects, with different mechanisms involving neurotransmitters and the HPA axis.
11	Farag et al. (2022)	To investigate the hepatotoxic	O. niloticus fish were exposed to	Animal Study	Experimental Research	Bifenthrin caused significant hepatic

		effects of bifenthrin and the protective role of parsley essential oil.	bifenthrin, and the protective effects of parsley essential oil were evaluated through biochemical and transcriptomic analyses.			damage, while parsley essential oil exhibited protective effects against these changes.
12	Chukwuma et al. (2019)	To review medicinal plants with both anti-diabetic and anti-hypertensive properties.	Literature search on studies reporting plants with both anti-diabetic and anti-hypertensive effects, calculating the potency ratio of each plant.	Literature Review	Review Article	Numerous medicinal plants showed dual effects against diabetes and hypertension, which could aid in developing combined therapies for these conditions.
13	Panda et al. (2020)	To review the chemical components, extraction methods, and applications of essential oils (EOs) in disease treatment.	Literature review of various studies regarding EOs and their use in pharmaceutical and health-related applications.	Various plants producing essential oils	Review	EOs are used as antimicrobial agents, with methods such as hydro-distillation and steam distillation for extraction. Their components inhibit human pathogens and show potential for disease treatment, particularly in antimicrobial and pharmaceutical applications.
14	Jugreet et al. (2020)	To explore the chemistry, pharmacology, and applications of essential oils in various industries and health sectors.	Literature review focusing on essential oil chemistry, their industrial applications, and new techniques to enhance their benefits.	Various industries using essential oils	Review	Essential oils show antimicrobial, antioxidant, and various health properties. Novel nano-technologies are enhancing their efficacy, especially in packaging, pharmaceuticals, and agriculture, where they extend shelf-life and act as eco-friendly pesticides.
15	Keykhasala r et al. (2021)	To evaluate the anti-cancer effects of Linum usitatissimum	Experimental study utilizing ultrasound-based techniques to	Human ovarian cancer cell lines	Experimenta l	LSEO nanoemulsions demonstrated selective

		seed essential oil (LSEO) on human ovarian cancer cells.	create nanoemulsions and test cytotoxicity, apoptosis, and anti-angiogenic effects.			cytotoxicity and apoptotic effects on cancer cells without affecting normal cells. The treatment reduced blood vessel growth, showing significant anti-angiogenic potential.
16	Li et al. (2021)	To investigate the role of gut microbiota in hypertension and its potential interventions.	Review of recent advances and bacterial genomic analysis linking gut dysbiosis to hypertension.	Hypertensive patients and animals	Review	Gut microbiome disruption contributes to hypertension development. Fecal microbiota transplantation and probiotic interventions may regulate blood pressure, but further studies are needed to confirm these findings and develop effective treatments.
17	Bal et al. (2022)	To compare the effects of resveratrol supplementation and exercise on hypertension-induced stress responses.	Experimental study on hypertensive rats, with some receiving resveratrol and others undergoing regular exercise, measuring cellular stress.	Hypertensive rats	Experimental	Both resveratrol and exercise improved heart function and reduced hypertension-induced stress. Resveratrol and exercise modulated oxidative stress and inflammation, showing potential as treatments to improve heart health in hypertensive patients.
18	Zhang et al. (2022)	To review the sources, properties, and applications of spearmint essential oil compounds.	Literature review of the biological properties and applications of aromatic molecules in spearmint essential oils in various industries.	Spearmint (Mentha sp.)	Review	Spearmint essential oil exhibits antimicrobial, antioxidant, insecticidal, and antitumor activities. It has potential in agriculture, food, medicine, and fragrance industries.

19	Perrone et al. (2019)	To assess the effects of phenol-rich extra virgin olive oil (EVOO) on cardiovascular health in healthy volunteers.	Randomized controlled trial examining the postprandial effects of phenol-rich EVOO on oxidative stress and inflammation biomarkers.	22 healthy volunteers	Clinical trial	Consumption of 25g of phenol-rich EVOO significantly reduced LDL oxidation, triglycerides, and inflammatory markers, improving the antioxidant profile and reducing the risk of cardiovascular disease.
20	Yang et al. (2020)	To examine the cardioprotective effects of fish oil supplementation on hypertensive patients in Inner Mongolia.	Randomized controlled trial comparing fish oil supplementation with corn oil in hypertensive patients, measuring inflammatory markers.	77 hypertensive patients	Clinical trial	Fish oil significantly reduced pro-inflammatory markers such as TNF-α and C-reactive protein, leading to improved cardiometabolic profiles. It showed potential as a treatment to reduce cardiovascular risks in hypertensive populations.
21	Kisa et al. (2021)	To investigate the effects of aromatic amino acids (AAAs) on gene expression and phenolic compounds in sweet basil.	Experimental study on sweet basil plants treated with AAAs to observe changes in phenolic content and gene expression related to biosynthesis.	Sweet basil (Ocimum basilicum)	Experimental	AAAs increased the content of certain phenolic compounds like chicoric acid, caffeic acid, and vanillic acid in sweet basil. Gene expression related to phenolic biosynthesis was significantly affected, suggesting AAAs can enhance the medicinal properties of the plant.
22	Tanveer et al. (2020)	To identify botanical interventions that protect the digestive system and improve upper gastrointestinal health.	Preclinical and early-phase human studies	Preclinical subjects and early-phase human studies	Experimental Research	Eight essential oils (fennel, rosemary, ginger, garlic, peppermint, bitter orange, cardamom, and dill) showed potential in preventing gastric ulcers, reducing

						gastric acid production, and promoting upper gastrointestinal healing. Limited human studies support these findings, requiring further clinical validation.
23	Wang et al. (2021)	To explore the effects of n-3 PUFAs and their mechanisms in hypertension control and suggest future directions.	Review of clinical trials and systematic discussion	Hypertensive and normotensive subjects	Systematic Review and Meta-analysis	Increasing intake of n-3 PUFAs is beneficial for reducing blood pressure in hypertensive individuals. The research highlighted how n-3 PUFAs reduce oxidative stress, alter membrane-related protein functions, and regulate vasodilator release. The study suggests combining n-3 PUFAs with agents targeting their metabolism to amplify effects.
24	Sharifi-Rad et al. (2021)	To assess the pharmacological potential and risks of Origanum species and their bioactive compounds.	Review of preclinical studies and pharmacological potential	Various preclinical studies across different regions	Systematic Review	Origanum essential oils have various bioactivities, including anticancer, antidiabetic, and cardioprotective effects. The study highlights its nanotechnological applications and the need for further clinical studies on its safety and efficacy. Reported adverse effects include angioedema, allergic reactions, and potential for causing abortion, necessitating

						detailed toxicity analysis.

Based on the research table provided (Table 2), several studies show how essential oils (EOs) play a role in hypertension-related gene expression through various mechanisms. For example, research by Tanveer et al. (2020) identified the potential of EOs from culinary and medicinal plants to protect the digestive system from harmful agents and immune hypersensitivity. The EOs exhibited anti-inflammatory, antioxidant, and antibacterial activities, potentially helping to address hypertension-related inflammation by modulating gut microbiota and gastric acid production.

Another study by Sharifi-Rad et al. (2021) evaluated the bioactivity of Origanum essential oils, which showed antihypertensive effects as well as other pharmacological activities such as antidiabetic and anticancer. These EOs were found to have the potential to lower blood pressure, but more clinical evidence is needed to ensure their safe use in pharmaceutical applications. In addition, toxicity analysis is also important to ensure the safety of long-term use of Origanum essential oil.

Discussions

Essential oils have significant potential benefits in influencing gene expression associated with hypertension from the results of 24 previous research findings, mainly through antioxidant and anti-inflammatory mechanisms. showed that *myrrh* essential oil was able to reduce cardiac damage in an animal model with *myocardial* infarction (IM) induced by isoproterenol. The results of this study showed that *myrrh* significantly reduced apoptotic markers, inflammation, as well as improved antioxidant status through regulation of Nrf2 and HO-1 pathways, which play an important role in protecting cells from oxidative stress and reducing abnormal blood pressure. This supports that essential oils have a potential role in reducing the impact of hypertension by suppressing damage mechanisms at the cellular level.

In line with this, highlighted the effectiveness of various plant extracts, including essential oils, in lowering blood pressure. They emphasized that compounds such as *allicin* from garlic and *apigenin* from celery have blood vessel relaxing effects and inhibit the renin-angiotensin *system* (RAS) which is a major regulator of blood pressure. By inhibiting the angiotensin *converting enzyme* (ACE), essential oils act directly on blood vessels to lower blood pressure. This study supports the view that essential oils and other phytochemicals may play an important role in hypertension therapy through their effects on the vascular system and genetic pathways involved in blood pressure regulation.

highlights that species from the *Lamiaceae* family, which include lavender and *rosemary*, have cardioprotective effects and can be used to manage various cardiovascular diseases including hypertension. The flavonoids and terpenoids in the essential oils of these plants contribute to antioxidant mechanisms that can protect heart cells from oxidative damage and inflammation, which often trigger hypertension. Thus, essential oils have great potential in regulating the expression of genes involved in inflammatory and oxidative stress which are the main causes of hypertension.

On the other hand, it was shown that *Pistacia atlantica oleoresin* (PAO) can modulate oxidative stress and increase the expression of antioxidant enzymes such as GPx, CAT, and SOD in diabetic rats. The results showed that PAO was able to reduce malondialdehyde (MDA) levels and increase the expression of antioxidant enzymes involved in blood pressure regulation. In the context of hypertension, this increased expression of antioxidant enzymes helps reduce oxidative stress, which is one of the contributing factors to hypertension.

Another study by focused on the effects of essential oil from Alpinia zerumbet (EOFAZ) in preventing inflammation-induced endothelial injury in human aortic cells. This study found that EOFAZ could inhibit the activation of hypertension-related endothelial adhesion molecules through the TLR4-dependent NF-κB signaling pathway. Inhibition of this pathway prevents inflammation and apoptosis of endothelial cells, which play an important role in the development of hypertension. Therefore, EOFAZ has potential in the management of hypertension by suppressing inflammatory mechanisms.

In addition, studies by show that various essential oils and nutraceutical components can affect blood pressure by regulating oxidative stress and the renin-angiotensin system. Essential oils such as thyme have also been shown to increase the expression of antioxidant enzymes and protect the heart from oxidative stress damage. concluded that essential oil inhalation can affect oxidative stress-related gene expression and neurological function, which in turn impacts blood pressure regulation.

Not only modulate gene expression, essential oils play an important role in influencing gene expression through biological pathways, essential oils also play a role in antioxidant, anti-inflammatory, and molecular

pathway regulatory mechanisms. Research by showed that essential oil from parsley (*Petroselinum crispum*) has the ability to reduce liver damage caused by exposure to bifenthrin insecticide in fish. This essential oil was able to reduce oxidative stress and the expression of apoptosis-related genes such as p53 and caspase-3, which are also associated with hypertension. This suggests that essential oils may protect vital organs through regulating gene expression under conditions of oxidative stress, which is also a cause of hypertension.

In addition, research by highlighted the use of essential oils in the concurrent management of hypertension and diabetes. Some active compounds in essential oils, such as chlorogenic acid and caffeic acid, exhibit anti-hypertensive effects through inhibition of angiotensin converting enzyme (ACE) and regulation of gene expression related to glucose metabolism and blood pressure. These mechanisms serve to maintain a balance of cardiovascular and metabolic homeostasis, which is crucial in the management of hypertension.

It is confirmed that essential oils have a wide range of pharmacological applications, including as cardioprotective agents. Essential oils have been shown to modulate oxidative stress, enhance antioxidant activity, and regulate gene expression pathways associated with inflammation and cellular responses to high blood pressure. Improved stability and bioavailability of essential oils through nanotechnology allows for a more optimal therapeutic effect on hypertension. This overall evidence strengthens the role of essential oils in the management of hypertension through influencing the expression of genes related to cardiovascular function. showed that Linum usitatissimum seed essential oil (LSEO) has specific cytotoxic effects on cancer cells by inducing apoptosis through increased expression of caspase genes. While the focus of this study was on cancer, these findings are relevant in the context of hypertension due to the interplay of apoptosis and oxidative stress that contribute to cardiovascular dysfunction. Similarly, it was identified that gut microbiome imbalance is closely linked to hypertension through inflammatory and metabolic pathways. This research opens up the possibility that essential oils, through their effect on the gut microbiome, may help regulate blood pressure.

We found that resveratrol, which is a component of essential oils, can reduce oxidative stress and regulate the expression of antioxidant genes such as NLRP3 inflammasome, caspase-3, bax, and bcl-2 in hypertensive rats. These results suggest that resveratrol is able to ameliorate cellular dysfunction caused by hypertension, by reducing inflammation and oxidative stress. This study highlights the potential role of essential oils in the modulation of cellular stress responses associated with hypertension. Meanwhile, it discusses spearmint (Mentha spicata) essential oil, which has antioxidant and anti-inflammatory effects. The main components of spearmint oil such as carvone and carveol show therapeutic activity that may support the management of hypertension through the regulation of oxidative stress. provides further evidence that extra virgin olive oil (EVOO), which is rich in hydroxytyrosol, can decrease inflammation and oxidative stress in humans. The study showed increased expression of antioxidant genes such as catalase and superoxide dismutase after olive oil consumption. Thus, antioxidant-rich essential oils may affect the expression of genes associated with hypertension through decreasing oxidative stress and inflammation, which are two major factors in the pathogenesis of hypertension.

Based on research, fish oil supplementation rich in eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) showed cardioprotective effects through reducing subclinical inflammation in hypertensive patients. These oils play a role in reducing C-reactive protein (CRP) and tumor necrosis factor-α (TNF-α) levels, both of which are associated with cardiometabolic risk. These mechanisms suggest that the regulation of proinflammatory genes involved in hypertension may be influenced by fish oil components, potentially improving the cardiac metabolic profile in populations exposed to hypertension risk.

In addition, essential oils from medicinal plants such as Ocimum basilicum studied by showed that essential oils can regulate the expression of genes involved in the biosynthesis of phenolic compounds and flavonoids. These compounds are known to have strong antioxidant activity and play a role in reducing oxidative stress which is one of the triggering factors for hypertension. Genes such as EOMT, FLS, and HPPR had significantly increased expression after treatment, suggesting that essential oils may modulate biochemical pathways that support cardiovascular health and lower the risk of hypertension. Another study by found that essential oils from Origanum species have cardioprotective effects through key ingredients such as carvacrol and thymol, which were shown to have anti-inflammatory and vasoprotective properties. These effects support blood pressure regulation by modulating genes involved in inflammation and vascular protection.

Conclusion

Based on the results of a scoping review of 24 selected research articles, essential oils have significant potential in influencing gene expression associated with hypertension through various biological mechanisms,

especially antioxidants and anti-inflammation. Some essential oils, such as myrrh, thyme, lavender, and rosemary oils, have been shown to reduce inflammation, oxidative stress, and regulate genetic pathways that play a role in managing hypertension. The study also revealed that active compounds in essential oils, such as allicin and apigenin, play a role in blood vessel relaxation and inhibition of the renin-angiotensin system (RAS), which is key in blood pressure regulation. The results of this study suggest that essential oils may be an important component in hypertension therapy, especially for reducing the risk of cardiovascular complications through genetic regulation related to oxidative stress and inflammation. Thus, essential oils offer potential use as a natural and safer adjunctive therapy in the management of hypertension. This study also encourages a phytotherapy-based pharmacological approach in managing hypertension, opening up opportunities for the development of essential oil-based pharmaceutical products. Further research is needed to explore the effect of essential oils on humans clinically, including the appropriate dosage, duration of use, and interaction with conventional antihypertensive drugs. In addition, in-depth research on the impact of essential oils on the regulation of the gut microbiome, which is also linked to hypertension, is worthy of further study. The combination of nanotechnology in improving the bioavailability of essential oils also needs to be investigated to ensure optimal therapeutic effectiveness in the management of high blood pressure.

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Conflicts of Interest

The authors declare no conflict of interest.

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